MAY 1961 / 50c

AIR FORCE

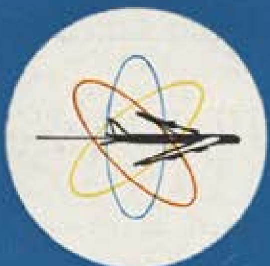
and SPACE DIGEST

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

A Special Report on USAF'S SAFETY PROGRAM

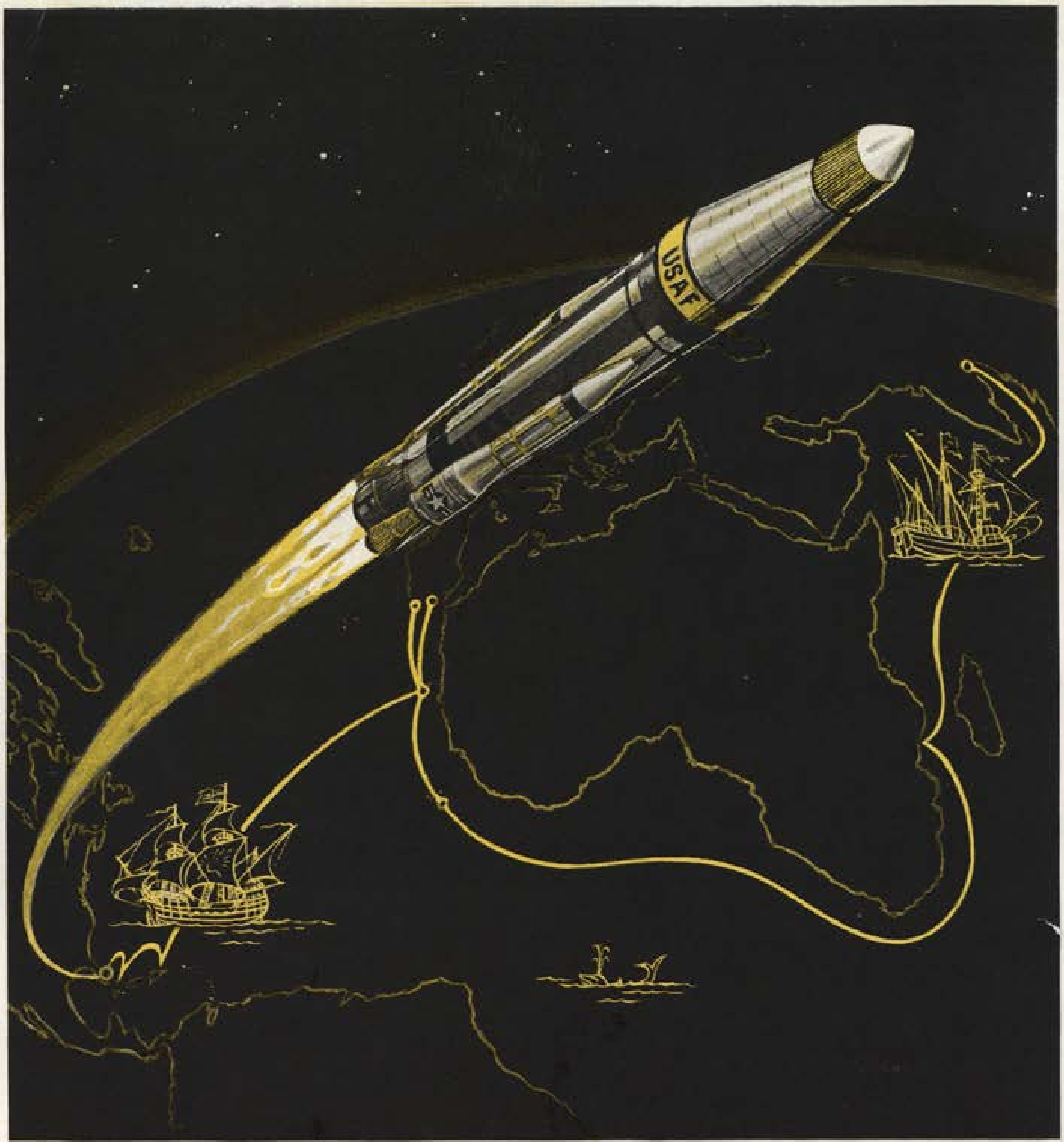
FLIGHT SAFETY

MISSILE SAFETY



NUCLEAR SAFETY

GROUND SAFETY



Arma navigates new routes

Navigating with cross-staff and primitive compass, Prince Henry's Portuguese pilots took more than 80 years to find a route around Africa and reach India. The Spaniards took another 20 years to cross the Atlantic and reach the shores of Florida.

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

AIR FORCE

and **SPACE DIGEST**

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Sovfoto

We were doubly involved with putting this May issue to bed and unpacking our effects in our new editorial quarters at 1901 Pennsylvania Avenue, N.W., in Washington, when the news came *(see "Aerospace World," page 26)* of Soviet Air Force Maj. Yuri Gagarin's epochal orbital flight. We trust you have heard and seen enough of the young Red astronaut to last you till again the snow flies. This is not said in denigration of a demonstrably brave man. We certainly join in the congratulations due him as a human being whose achievement, we must agree with the Soviet press agents, will go down in history as monumental. True, Gagarin's feat embarrasses our country. This is painful but endurable. How incalculably more important are the questions: Do enough people understand the meaning of the Soviet astronaut's flight? Can our leadership convey to the citizenry the fact that we are truly—fatefully—challenged? Can Americans understand that clichés on Capitol Hill will not serve freedom's cause in the rocket age, that an extraordinariness is required of this generation of Americans?

On the ground floor of the building in which our editorial offices are newly located, there is a glittering super-drugstore that supplies everything from pet toys to potato chips. On our morning's way through this vast fluorescent expanse, we wonder: Can this be the real world?

Once at our desk, the blunt *no* resounds in our mind. This is painful, until we think further and recall that there are still people like you, our readers, who *are* thinking seriously of the challenge of our age.

And with that thought, we get down to work again.—W.L.

DEPARTMENTS

VOLUME 44, NUMBER 5 • MAY 1961

MACE CAPABILITIES AND ACCURACY—A TOUGH INERTIAL GUIDANCE JOB ACHIEVED BY AC!

Try as they might, enemy radar eyes would have a tough time finding and tracking the Air Force Mace. Built to fly undetected by typical radar screens, the Mace twists and dodges its way to the target—unerringly! The reason: AChiever Inertial Guidance by AC . . . the most accurate and reliable means of delivering Mace to its target despite a constantly shifting flight path, low altitude winds or changing terrain. The Mace guidance package is the result of precise design and development, endless testing and careful production . . . another example of AC's way of doing business.

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Inertial Guidance for Mace, Titan and Thor. Bombing Navigation Systems for the B-52 and B-47.

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An Editorial

The Hard Choices Are Still to be Made

John F. Loosbrock
EDITOR, AIR FORCE/SPACE DIGEST

THERE is much to applaud in the defense management decisions made to date by the Kennedy Administration. In the hardware field, on the slim evidence provided by the "quick-fix" amendments to the fiscal 1962 budget, the trend is less encouraging. Conceptually, the really big decisions have not been made, undoubtedly because the evidence has not all been sifted.

But available signs and portents, plus old wounds that begin to ache at the approach of foul weather, cause us to postpone cosmolining our editorial typewriter. We find disturbing evidence that minimum deterrence, sometimes called finite deterrence and, more fashionably, "stable" deterrence, is still with us. We find preoccupation with invulnerability, with limited war, with conventional (meaning nonnuclear) weapons, with arms control and disarmament. We hasten to add that we find these matters all worthy of deep consideration. We ask only that they be considered under the cold, harsh light of the realities of the international power equation and not in the clinically sterile atmosphere of intellectual isolationism.

In the current defense budget, as amended by the Administration, the improvements in the nation's military posture are significant but they are mainly defensive and passive in nature. The survivability of the strategic deterrent is being improved by hiding missiles (the stepped-up Polaris program), by hardening missiles (Minuteman), by dispersing missiles (Skybolt), and by building a command and control system that can ride out an attack. But the flexibility of the mixed-force concept has been compromised by the cutback in the B-70 program and the cancellation of nuclear-propelled aircraft. The bulk of the eggs are going into the missile basket, with emphasis on the so-called "invulnerable" missiles. The trend clearly is toward the "stable" deterrent which, its proponents claim, need not be great enough to win a big war because it cannot be knocked out; therefore the big war won't begin.

At the moment, however, this is but a trend and working toward an invulnerable deterrent is not wrong in itself. Indeed, it is desirable. It is wrong only if the wrong conclusions are derived from it, which is being done often enough these days to warrant some ventilation of the issues involved.

The first fallacy of stable deterrence is implicit in its name—that stability is indeed possible in an age of exploding technology. The Polaris-carrying nuclear-powered submarine has been hailed as the ultimate in mobility, dispersal, and invulnerability. For the moment, and primarily because it is available at the moment, Polaris is a welcome addition to our arsenal. But it is not the perfect and ultimate deterrent that many have been led to believe. It is terribly expensive by any legitimate cost-effectiveness yardstick. The Polaris warhead, by today's standards, is relatively puny—about one-fifth that of an Atlas or a Titan warhead, about one-tenth that of the bomb load of a B-52. It is subject to technological breakthrough in antisubmarine warfare techniques with possible effects similar to those encountered by the Luftwaffe before the Germans found out how good the British radar was. It poses inherent command and control problems in mounting a coordinated response to aggression. It is subject to attrition in open, nonterritorial waters, whereby our submarines could quietly, mysteriously, and suddenly disappear, one at a time, leaving no evidence that a hostile act had been committed against them. It is not that these shortcomings are any great secret or cannot be determined just by thinking about the problem a bit. It is that they have not been acknowledged or included in the vast majority of public discussions of the weapon system.

The Minuteman, by its nature, is not the perfect weapon system either. Its warhead is analogous to that of Polaris. Its prime virtues, as against Polaris, are those of economy—it is cheaper by several times on a cost-effectiveness basis—and its credibility as a deterrent, due to being based in this country. To hurt our Minuteman capability the Soviets would have to hurt the United States, and this we cannot allow so the deterrent becomes believable. The reverse obviously is not true of a weapon system deployed throughout the open seas of the world.

The second fallacy of stable deterrence follows from the first. This is the assumption that if you can cheaply deter the big war with small, "invulnerable" missile forces, you can turn your attention—and your money—toward "lesser forms of aggression." The theory assumes that, because limited war is more likely than general war, it is therefore more dangerous, and it forgets that limited wars have remained limited primarily because of the efficacy of our general-war posture. As Lt. Gen. James Gavin, so often cited by the stable-deterrent advocates, put it in a conveniently overlooked statement in his book, "A limited-war concept is only valid within an impressive over-all framework to wage general war."

The third fallacy of the stable-deterrent school is that we must not fight limited wars with nuclear weapons. In discussing this point it is customary to say that "we must be able to respond to local aggression with something less than a nuclear holocaust," thus creating the impression that there is no level of nuclear response below that of raining hundreds of megatons simultaneously on the Soviet Union and the United States. This thesis ignores completely the vast range of sizes in which nuclear weapons now come. It also ignores the interesting question of whether either side would lose a "conventional" war rather than dip into its nuclear arsenal if it needed to do so to win.

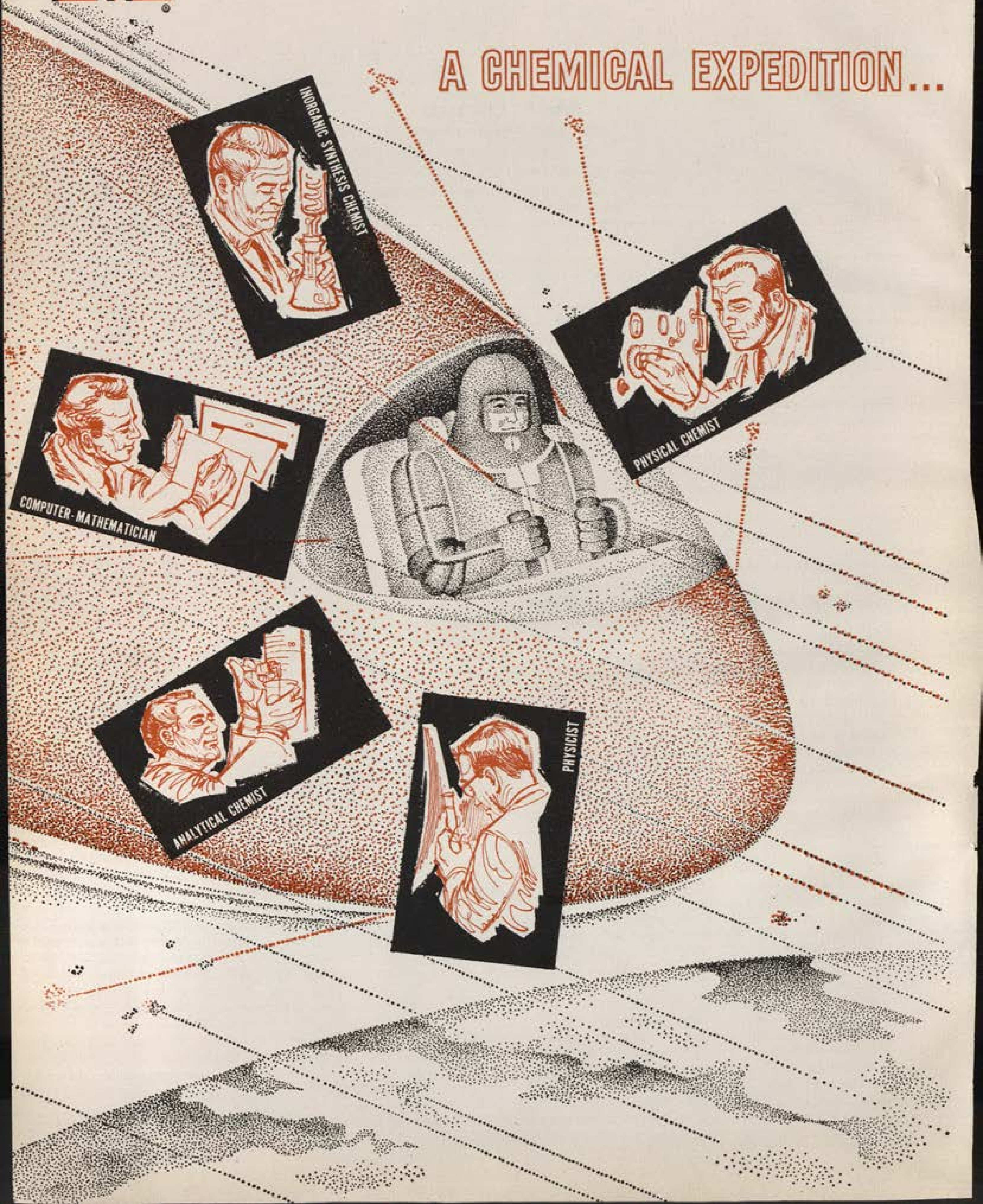
Thus the ivory-tower strategists see only what they wish to see—a world power equation reduced to the formality of a parlor game, with each side limited to a certain number of pieces and bound by fixed rules. If one side outmaneuvers the other, we suppose, the loser shakes hands with the winner and says, "Good show, old boy. We'll try again another day." This is good etiquette, but we are dealing with a fellow who pounds on his desk with his shoe.

It remains to be seen how deeply the Administration is influenced by the reasoning of the stable deterrent stable. It is our hope that the speciousness of their point of view will be exposed in the months to come, and we are sure it will be—if the facts are laid on the table.—END

Monsanto

Space-Age Project "POLYMER"

A CHEMICAL EXPEDITION...



deep in research on <u>inorganic</u> polymer structure... discovers promising clues to heat-resistant "plastics"

Recent Monsanto research work has uncovered new clues to a theory for predicting inorganic polymer bonds that have high resistance to rupture. Through use of inorganic chemical bonds with indicated polymer-structure capabilities, a number of make-and-see "pilot" polymers have been synthesized and have substantiated the theory. Conventional organic polymers have undergone tremendous commercial development. However, exploration into the new geometry of inorganic molecular structures has put Monsanto on the track of totally new and promising compositions of matter.

Is it possible to develop a "plastic" with rubber-like elasticity that will retain flexibility and a reasonable amount of strength without flowing at the temperature where ordinary glass melts—where iron glows red? What are the odds for discovery of a long-lived coating that would make clear plastic windows "scratchproof" . . . or a protective "heat-shield" wire coating that would permit electric motors to run efficiently up to 400°C.? These products and many more may well be found in inorganic polymers of carefully planned molecules.

Now, Monsanto chemists are exploring ways to catalog basic parameters that predict inorganic molecular structure. From application of this basic knowledge, inorganic chain structures may be tailored specifically to zero-in on promising inherent properties such as rigidity, elasticity, strength, stability and high resistance to heat. In general, organic polymers are limited to around 250°C., but more heat-stable inorganics might extend the polymer endurance range to 500°C. or beyond!

A NEW WORLD OF POSSIBILITIES

Actually, hundreds of inorganic polymers are already known, but few have the properties needed for space-age engineering applications. On the other hand, via atomic architecture, literally thousands of inorganic polymers are possible. Only a relatively small proportion of these have as yet been synthesized and examined.

To help predict the properties of inorganic polymers, Monsanto chemists have devised some new methods and adapted many recently developed techniques for characterizing chain structures. Applying elution fractionation to crystalline and amorphous polymers, they developed a new reliable procedure to establish molecular-weight distribution. To uncover other clues to inorganic polymer structure they have employed selective hydrolysis, solution chromatography, differential thermal analysis, and such techniques as nuclear magnetic resonance. Out of all this work on the riddle of molecular configuration have come some leads that may point the way to the "500°C. plastic."

At first inspection, the multiple deficiencies of existing materials are discouraging. But major goals are abundantly clear: chemically, the ideal inorganic polymer must not react with its environment; it must not decompose under heat and mechanical stress; it must resist molecular reorganization. Apparently, from the relatively slow progress that has been made toward these goals, something radically new and different is needed—totally new mechanisms rather than research modeled after organic polymer mechanisms.

IMAGINATION MAPS A RESEARCH ROUTE

A key to Monsanto's research approach is in *controlling* the structural reorganization of inorganic molecules. This chemical phenomenon has been well known in special cases, but its general importance to inorganic chemistry has only been recognized in recent Monsanto studies. Control of molecular reorganization may be the answer to designing useful, heat-stable inorganic polymers.

In order to create an inorganic material with elasticity, it is necessary to have straight-chain, only-occasionally-branched molecules able to assume various configurations . . . so the energy of deformation can be stored by reducing the configurational freedom. The elastic stretch comes from straightening molecules throughout the body of material. If molecular chains undergo simultaneous making and breaking with interchange of parts, there is no permanent elasticity, but rather, the properties of a viscous fluid.

In recent exploratory studies, molecules tailored for the purpose of controlling molecular reorganization have given clues both to patterns of stereospecific regulation and to "building blocks" that show promise. For example: "pilot" compounds of high molecular weight have been prepared based on phosphorus. The physical properties have been controlled to the point of turning out compositions in the form of elastomers or as rigid solids!

(Please turn page)

The rigidity is derived either by built-in cross-linking or by "sprinkling" ionic charges along the polymer chain.

Although the pilot compounds in themselves are not satisfactory, these polymers (and others) have revealed sufficient clues to prompt Monsanto research into a frontal attack on the problem of finding high-heat-resistant inorganic polymers in the jungle of chemical compounds that contain no carbon-to-carbon linkage.

INORGANIC CHEMICALS FOR CREATIVE SYNTHESES

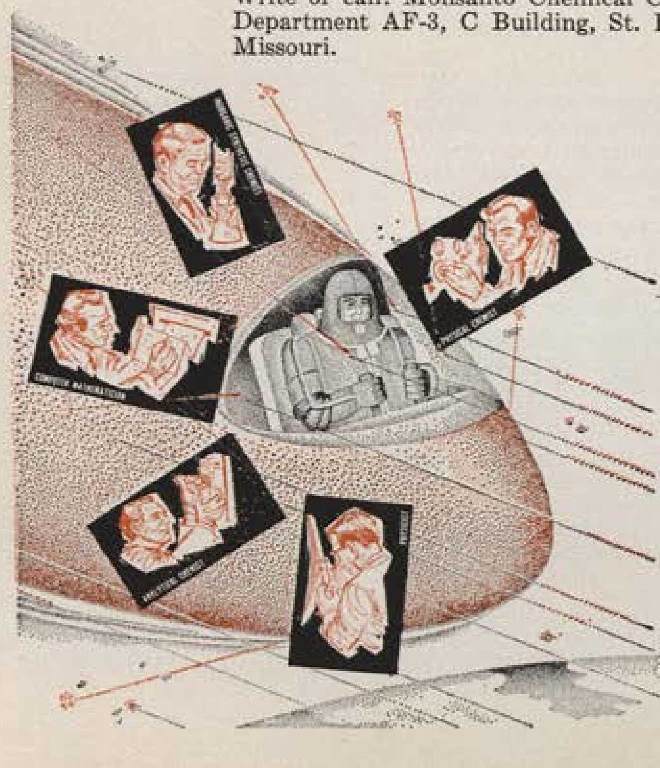
Several novel combinations of selected elements offer promise of high stability—and Monsanto research has started examining the more promising ones. The search is two-fold: first, synthesis of the predicted polymer and study of its properties; next, "creation of clean reactions" to make it.

A variety of structures is under study, among them . . . compounds having phosphorus-to-phosphorus and phosphorus-to-carbon bonds . . . cyanofluorocarbons, isocyanate and ketene analogs with bonds between boron, carbon, sulfur and nitrogen . . . conjugated fluorocarbons . . . polymers containing the -C=N-C=N- skeleton . . . polymers from metal-phosphorus linkages, and others.

HIGH-TEMPERATURE POLYMER RESEARCH . . . a chemical capability of Monsanto

Over a dozen Monsanto research projects are aimed at the development of heat-resistant materials for structural use, for imbedment of electronic parts, for coating purposes, and for high-temperature fluids. Hopefully, even high-temperature elastomers may be developed for such uses as O-rings, diaphragms and gaskets.

If you are working on a problem requiring a heat-stable compound for special service, you are invited to discuss your needs with Monsanto. Write or call: Monsanto Chemical Company, Department AF-3, C Building, St. Louis 66, Missouri.



Monsanto Space-Age Projects for Government and Industry

* High-Temperature Hydraulic Fluids
* Coolant-Dielectrics for Electronic Equipment
* High-Temperature Plastics
* Improved Nitrogen Oxidizers for Solid Propellants
* Fire-Resistant Structural Plastics
* Hydrocarbon Fuels for Jets and Missiles
* Fire-Resistant Hydraulic Fluids for Ground-Support and Missile-Launching Equipment
* Radiation-Resistant Heat-Transfer Fluids
* High-Temperature Lubricants and Additives
* Radiation-Resistant Reactor Coolant-Moderators
* Intermetallic Semiconductor Materials
* Pure Silicon for Transistors, Rectifiers, Diodes
* Ultra-Fine Metal Oxides
* Materials for Vibration Damping
* Heat-Resistant Resins for Laminating and Bonding
* Inorganic Polymers
* High-Energy Solid Propellants

Monsanto ®

You are invited to work with Monsanto on your materials needs in any of the above fields of technology.

AIRMAIL

Volcanic Exchange

Gentlemen: Reference the article "Three Theories on the Craters of the Moon," by John W. Macvey, in the March issue of SPACE DIGEST.

Although, like Mr. Macvey, we of Omni-Science, Inc., would be inclined to discount, as presented, the volcanic theory for creation of the craters on the moon in favor of some combination of forces, by no means can this theory be set aside on the basis of the information he presents.

It is respectfully suggested that the author might well return to the texts on volcanology and to volcanism as it has occurred not only in historic times, but throughout the geologic past. . . .

Mr. Macvey would appear to regard volcanoes as merely "mountains with holes in the top," or nice, neat shield volcanoes built up by the mild outwelling of highly viscous lava, or by a combination of lava and extrusives such as pumice, ash, and breccia blown out to no great distance. This is not the be all and end all to volcanism and the volcanic processes.

Mr. Macvey would seemingly be unaware that Vesuvius, for example, is a mere cinder cone in the crater of ancient Mt. Somma, and that Mt. Somma could have held eighty volcanic mountains the size of Vesuvius. . . .

Similarly, Mr. Macvey is not disposed to explain that Mount Tehama in our own West could have held 120 volcanoes the size of its relic, Mt. Lassen. He overlooks for size those volcanoes responsible for much larger craters, one of which comprises Hokkaido Bay, while other examples include those single volcanoes responsible for creation of the ports of Aden and Lisbon. Krakatoa, the explosive eruption of which in 1883 has been termed "the loudest noise ever heard on earth," sets on the lip of Sunda Straits, which themselves define the limits of what was once an immense volcanic crater. Equally important is the fact that when Krakatoa tore itself apart, at least fifteen other volcanoes in Java and Sumatra were in simultaneous eruption, just as last spring in Chile there were at least nine volcanoes in eruption, three of them brand new. What does Mr. Macvey think of a rift volcano in Sumatra 100 kilometers long, eighteen kilometers wide, and which is credited with throwing the Pahang Volcanic Group debris 400 miles into Malaya?

The author makes the fine distinction between "volcanic" and "plutonic," or the distinction once again between the nice, neat shield volcano and "volcanoes that didn't make good," didn't break the surface of the earth, and are represented by intrusive dikes and sills such as the Kimberly mines.

Much can be made of the cyclic nature of volcanism. But in any event, the residual activity of some 600 active volcanoes on the earth today is no yardstick by which to measure the craters of the moon. Beyond these 600 are the dormant and extinct volcanoes which account for many times that number. And beyond that, when ice, water, and the erosional forces of nature have removed the evidence of the volcanoes themselves, there is the residual debris, the ash, the lavas, the bentonite, montmorillonites, and all other evidences of extrusive volcanism so important to the study of our geologic past.

Phillips B. Franklin
St. Petersburg, Fla.

Gentlemen: The points Mr. Franklin raises are of considerable interest. On the whole I feel that essentially we are in agreement. . . .

I am bound to agree that the evidence of former large-scale activity on earth is very much more widespread than the present number of volcanoes (active, quiescent, and extinct) suggest. The form of such systems, both ancient and historic, even allowing for erosion, etc., bears little or no resemblance to the majority of lunar craters. This is borne out by such features as lunar ring walls of very appreciable height, the extensive area of many lunar formations, and the existence of central peaks of relatively little height with respect to ring walls and surrounding terrain.

I wholly agree that true volcanic activity (true in the strictly terrestrial sense, that is) must have taken place on the moon and in this respect I feel I cannot do better than quote from the original article, "there must almost inevitably have been a certain amount of true volcanic activity at one time in the moon's history."

Typical lunar features such as the ring walls, central peaks, terraces, lava-flooded craters, etc., can much more easily be explained in terms of the plutonic theory. . . .

I think it is important to remember that the latter theory, as first enunciated and since, visualized lunar volcanoes by and large on the general terrestrial pattern. I sought to show that in view of the evidence this is rather improbable and that a different *type* of "volcanic" activity is more likely to have been responsible. That this has been termed "plutonic" should not be allowed to cloud the essential fact that both have a common magmatic basis. It may well be that the crux of the matter lies in the use of those particular two terms. The over-all use of the word "volcanic" in place of the more narrowly defined "volcanic" *and* "plutonic" might not be without advantage—or perhaps better still the introduction of the term "igneous" in this respect, which would be completely and geologically correct for both.

Nevertheless, I feel the points that Mr. Franklin raises are very good ones and well worth inclusion in the over-all considerations of this quite fascinating question.

John W. Macvey
Saltcoats, Ayrshire, Scotland

New Worlds to Conquer

Gentlemen: It was with a tinge of regret that I read in your February issue of AIR FORCE/SPACE DIGEST about Martin Airplane Company's discontinuation of aircraft assembly and turning to a new phase of missile construction.

The Martin Company has built fine aircraft. The B-26 was one of the mainstays of the United States Air Force in the European Theater of World War II. The "China Clipper's" transpacific flights made aviation history, and other Martin aircraft have proved their worth many times over.

(Continued on following page)

I sincerely hope that Martin Airplane Company finds as much success in the missile field as it did in the construction of military aircraft.

John Manger
Tucson, Ariz.

• *The Martin Company, of course, was never officially known as the Martin "Airplane" Company, and up until April of 1957 the official title was The Glenn L. Martin Company. As it passes on to the missile, electronics, and nuclear age, its contributions should continue to make significant history.* —THE EDITORS

Astronautics Bibliography

Gentlemen: In recognition of ever-increasing interest in the field of astronautics, members of the Department of Astronautics of the Air Force Academy, assisted by the staff of the Academy Library, have compiled the third revision of our special bibliography on this subject.

While our supply lasts we would be willing to furnish single copies to interested persons and libraries.

Lt. Col. George V. Fagan
US Air Force Academy
Colorado

Even Better Record

Gentlemen: In your March '61 issue under "The Ready Room" feature devoted to Reserve Forces news, you complimented CONAC for improving its flying safety rate from 3.4 in 1959 to 2.4 in 1960. While this favorable mention is appreciated, the figures were actually better. When the final figures were available, the CONAC 1960 rate (Regular and Reserve) was computed to be 1.88, or rounded off to 1.9. Prior to 1960, we believe this to be an all-time low for a major command and exceeded in 1960 only by MATS with a 1.4.

. . . We are very proud of this showing and wish them to get full credit.

Col. M. A. Elkins, DCS/O
Mitchel AFB, N. Y.

Upon Request

Gentlemen: . . . The material that William Leavitt abstracted from our report to NASA, which begins on page 59 of your February issue, is very well done indeed. It is refreshing and deeply satisfying to find one's efforts effectively represented in as important a journal as AIR FORCE/SPACE DIGEST—and to find material presented without distortion.

Thank you for making some of the report available to your large and important readership. We look forward to requests for copies of the report.

Donald N. Michael, Senior Staff
The Brookings Institution
Washington, D.C.

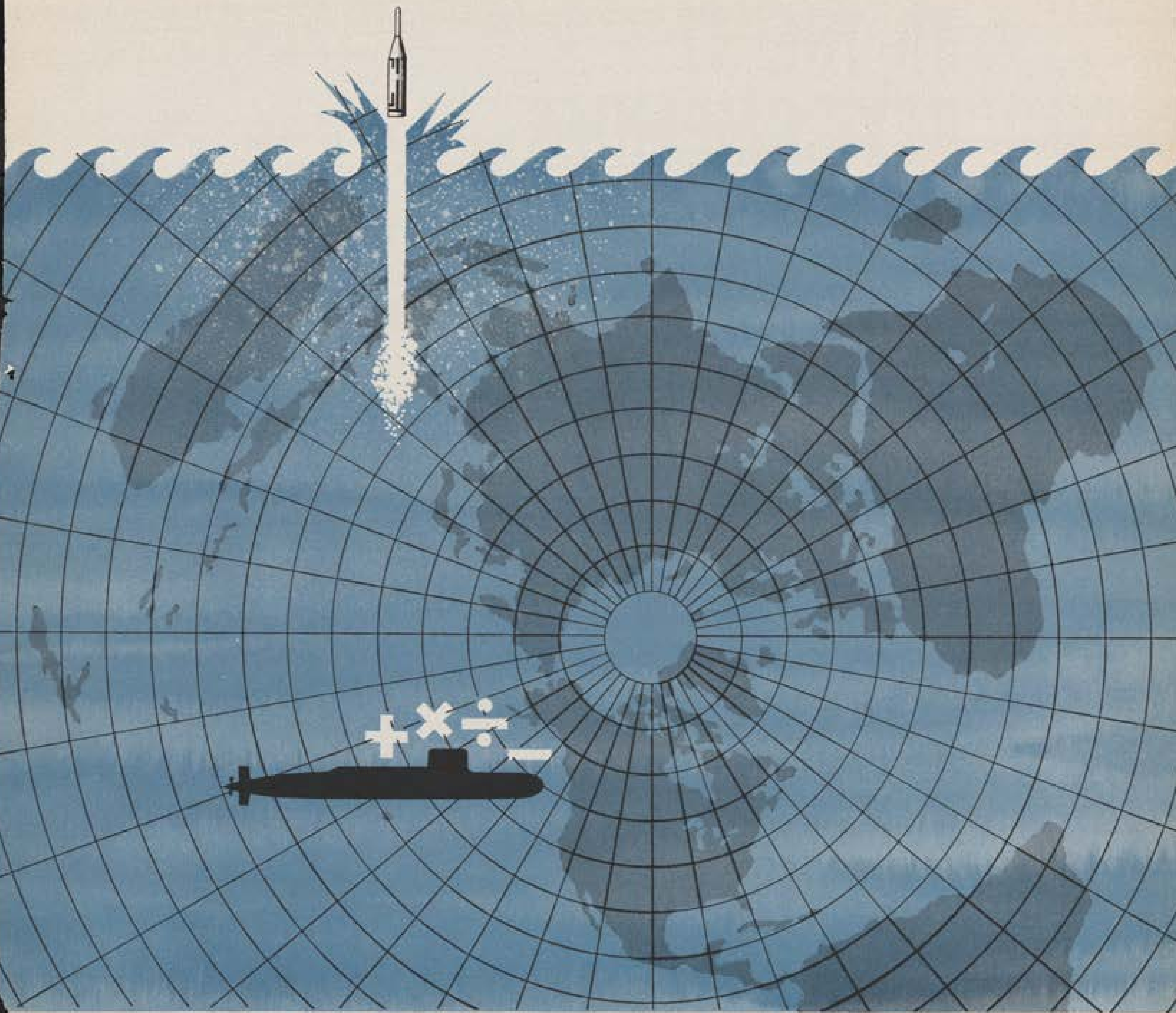
Time Dilatation

Gentlemen: Alexander Dorozynski's essay, "Clearing It Up About Relativity," in your October '60 issue, gave an excellent and, I believe, accurate account of the present conflict between a number of physicists, apart from Gamow and myself, regarding the time paradox. Clarification demands my pointing out that there are two different causes for time dilatation: one due to constant relative velocity, as predicted by the time-dilatation formula of Einstein's Special Theory; the other due to acceleration. Both of these cannot be manifested simultaneously in any particular situation. The former is the subject of disagreement with some physicists, including myself, who maintain that the effect exists during relative motion between two objects but that there is no permanent time difference between the two upon termination of the relative motion. Others, including Gamow and Bondi, believe the time dilatation is permanent with a "frozen-in" time lag between the two objects upon cessation of the relative velocity. Most physicists do agree that time dilatation due to acceleration or gravitation alone is permanent, however.

The difficulty in applying the time-dilation formulas arises because any actual test has to incorporate a combination of accelerations and velocities or, at best, accelerations only. It is claimed by some that an atomic clock in a satellite will test the effect predicted by the special theory; but this cannot be done since the complicating effect of accelerations must enter. The proposal to test the effect due to gravitation or acceleration alone, however, should be 100 percent successful and few physicists are disputing the predicted results.

Many people, including some eminent scientists, are claiming that space travel will be the "fountain of youth." This is based on the belief in a permanent time lag from velocity effects alone, with which I disagree. Based on acceleration alone, the time saving is extremely small and would amount to but several seconds for a total trip lasting 100 years, during which time the highest now-tolerable accelerations are experienced.

James A. Coleman
American International College
Springfield, Mass.



*COMP'UTENCE

at work in Polaris program

The mission: to develop and manufacture the electronic digital computer that provides stabilization for the submarine periscope or radio-metric sextant; resolves celestial information in bearing and elevation order signals; provides data for the correction of the inertial navigator; and compensates for the effects of roll, pitch, heading, and mast flexure. **The means:** Burroughs Compútence. **The results:** precise launchings for Polaris. **Other USN missions-accomplished:** Polaris Fire Control Switchboards, aircraft carrier landing systems (through Burroughs Control Instrument Co.), and advanced digital airborne computers. **The message:** Be it by land, sea, air or space, Burroughs Compútence—ranging from basic research through production to field service—takes its bearings, goes straight for the goal. Burroughs–TM

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*COMP'UTENCE / *total competence in computation*

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.

East Germany's state-owned aircraft industry has been taken completely out of the airplane business and converted to the production of a variety of machine tools and factory equipment needed to bolster the output of consumer goods.

Announcement of the change was made by Bruno Leuschner, chief of the state planning commission, in a speech before the East German Communist Party Central Committee's twelfth plenary session in Berlin. Dresden was the center of the East German aircraft effort with about 20,000 people employed in six plants. Primary production item has been the Ilyushin-14 transport. A gradual switch to the subcontracting of nonaviation equipment has been in progress for many months.

The Baade BB-152, medium-range, four-jet transport was one of the casualties of the switch. For the past three years, this home-designed aircraft has had a succession of technical and financial problems. The first prototype crashed. Its development program was stretched out. Now it is completely dead.

Official reasons for the aircraft industry reorientation and the lowering of East German economic goals for 1961 were: inadequate capacity to produce modern machinery, insufficient raw materials, shortage of skilled labor, and a failure of the building and consumer goods industries to meet their goals. Remedies for these acute problems and the generally poor showing of East German industry will be closer ties to the Soviet Union and other East European satellites, according to new state planning commission instructions.

Actually the East German crisis reflects two factors which are probably the strongest cards held by the Allies in the cold-war struggle in Germany and Berlin. One is that the stream of refugees from East Germany has averaged well over 100,000 persons per year since the border was stabilized after World War II. Professional people, engineers, and technically skilled workers have been a disproportionately large segment of this constant drain on the population. In the neighborhood of two million East Germans have left for the West. Second factor is East Germany's strong dependence on West German trade to obtain many types of finished goods and raw materials needed for a balanced economy. West Germany does not share this dependence because of the ease with which it may trade on the Western European and world markets.

• • •

Russia is claiming a world altitude record of 47,000 feet for the YAK-32, its first jet-powered training airplane in its class. Eventually the YAK-32 is intended to replace two piston-engined aircraft, the YAK-18, 150-mph primary trainer, and the YAK-11, 290-mph advanced trainer, which now are standard equipment at Soviet Air Force and civil flying schools.

The long-standing Soviet policy of being secretive and deceptive about their aircraft, especially during the development period, has not been relaxed in the case of the jet trainer. Published descriptions of the YAK-32 state that it has two seats and a midwing, but this is not borne out by the highly retouched photograph the Soviets have circulated purporting to show the trainer in flight over a forest area. The low-wing airplane in this photo still has ground run-up screens over its engine air intakes.

S. K. Tumanskiy is credited with being the powerplant designer on the YAK-32. Valentine Mukhin flew it to the record altitude.

• • •

The Antonov AN-10A Ukraine has flown straight and level with three engines shut down at 13,120 feet carrying dead weight equal to a full load of 100 passengers, according to the aircraft's deputy designer, A. Gratsianskiy. Only a small fuel load was aboard on this flight, however. The test aircraft's gross weight was slightly over 88,000 pounds. AN-10As normally take off at about 110,000 pounds on maximum range flights. Four Ivchenko 4,000 eshp turboprops power the AN-10A.

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Russia's large basic research program in the combustion of chemical fuels has been expanded in the last few years. The increased interest in the combustion fundamentals of chemically fueled rocket and air-breathing engines possibly indicates the direction of the main Soviet engine development program for the next five or ten years.

Combustion studies are one of a group of high-priority research programs closely directed from Moscow. Central direction of high-priority research is handled by a committee composed of men from the USSR Academy of Sciences, the Ministry of Higher Education, and the Scientific-Technical Committee of the USSR Council of Ministers industry representatives. Subcommittees, reporting to the main group, have been established to control activity in each major area. These major research fields include: controlled fusion, high-temperature fission reactors, high-temperature metallurgy, advanced computer work, and several specialized areas in chemistry as well as the combustion work.

Membership of the subcommittees includes the most prominent technical authorities in each field. The power of the subcommittees is great. They can play a prominent part in directing the activity and controlling the resources of anyone in the Soviet Union who is doing work of interest to them.

Fear of central control stifling scientific progress has been voiced by many Russian scientists, including some who are highly placed in the Science Division of the Communist Party. This point of view has prevailed to the extent that all activity outside the high-priority areas has been decentralized. Scientific institutes and laboratories have almost complete control over selecting and administering their low-priority projects.

Western observers report that Soviet central authorities have conducted an effective and well organized combustion research program. These authorities have shown a continuing determination to be realistic about deficiencies in program planning as well as execution. A major aspect of their policy has been to prevent duplication of effort as much as possible.—END

AIRPOWER in the news

Claude Witze
SENIOR EDITOR, AIR FORCE MAGAZINE

We Need a Force to WIN

WASHINGTON, D. C.

Maj. Yuri Alekseyevich Gagarin, a Russian Air Force pilot, now has played a role as a human Sputnik to demonstrate the fatuousness of the US contention of recent years that Soviet rocket superiority is not important. Up to now, spokesmen for both the Defense Department and the National Aeronautics and Space Administration have consistently discounted the "booster gap" and argued that there was no requirement for us to give the effort a high priority. The crude Russians, this school held, were forced to perfect their big rockets because of their inferior talents in the fields of miniaturization and warhead technology.

It is appropriate that Major Gagarin's fast trip around the world came so soon after our first peek at the Kennedy Administration's approach to the fiscal 1962 Defense Department budget. Again, there is a deliberate bypassing of a portion of the technological spectrum. The case against continued development of improved manned bombers sounds distressingly like the one we heard in 1959 and 1960 against a better booster effort.

Explaining his proposed cutback in the B-70 Mach 3 bomber program, President Kennedy told Congress its development as a complete weapon system is "unnecessary and economically unjustifiable" in view of the increased effort with Polaris, Minuteman, and Skybolt.

"The B-70 would not become available in operational numbers until well beyond 1965," the White House declared. "By that time we expect to have a large number of intercontinental ballistic missiles, fully tested and in place, as well as a substantial manned bomber force mostly equipped with air-to-ground missiles."

The reduction of the B-70 effort is accompanied by abandonment of the Defense Department's interest in a nuclear-powered airplane. It is true, as Mr. Kennedy said, that fifteen years and a lot of money—about a billion dollars—have been spent. But he has turned the project over entirely to the Atomic Energy Commission, where it cannot be expected to win warm support as an advance in the aeronautical arts. A Russian achievement in this area would not be quite as glamorous as a Sputnik or a man in orbit, but it would be a technological first of major importance.

A review of the details in Mr. Kennedy's application of the New Frontier to the defense budget must start with a press conference held in the Indian Treaty Room of the Executive Office Building next to the White House. It was the evening before delivery of the message to Congress. The principals were Robert S. McNamara, Secretary of Defense, and his Comptroller, Charles J. Hitch. It was long, as press conferences go, and there was much detailed discussion about the decisions. Not once was there a mention of the word *counterforce*. There was no suggestion that some day we might have to *win*, or even fight, a war, except for those in the brush-fire category.

The Administration program, a summary of which appears on page 24 of this issue of AIR FORCE/SPACE DIGEST, was clearly developed with major reliance on the scientific-budgetary management élite of the New Frontier. Mr. McNamara later told the Senate Committee on Armed Services, in support of the President's message, that the changes in the Eisenhower budget were based on a "preliminary reappraisal" in the "most urgent and important problem areas." This was accepted in Washington to mean that changes in the Pentagon and its approaches to the national security problem have barely begun.

"The final changes recommended by President Kennedy do not provide everything that everyone would like to have," Mr. McNamara said. "But I do believe it is fair to say that the President's recommendations reflect a consensus of the principal military and civilian officials of the Department of Defense. No doubt there is room for differences among reasonable men as to what constitutes the optimum combination of programs for the nation's defense. All I can say is that we have carefully examined all of the principal alternatives and have selected that combination of programs which we believe will give the nation a fully adequate defense at the least cost, in the light of the threat as we view it today."

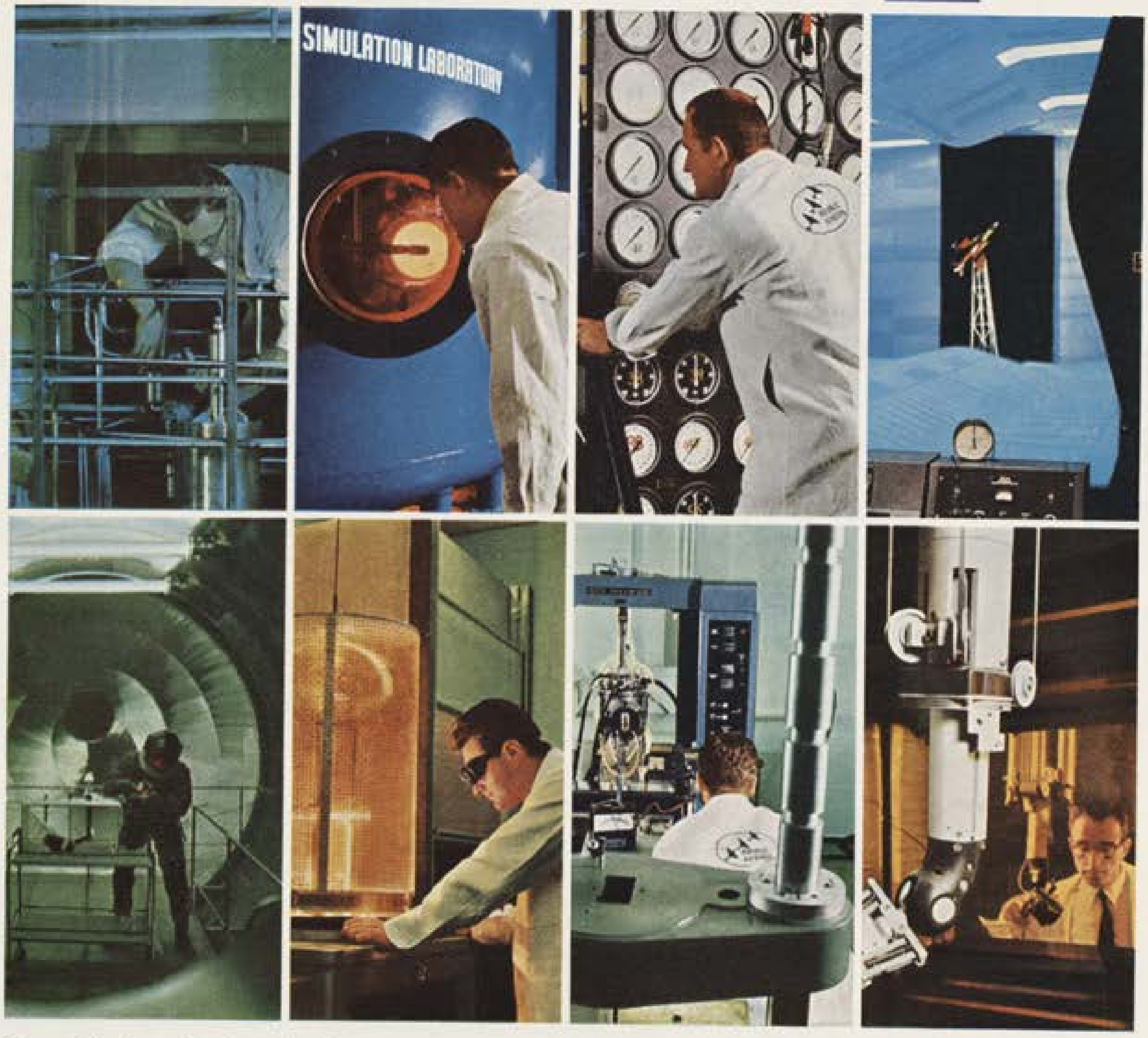
For all the early talk about new emphasis on limited-war capabilities, the bulk of the new fund-obligational authority is sought to close the much-debated missile gap. The emphasis here is on the Polaris system, with funds provided for ten more submarines, making a total of twenty-nine. The rate of delivery would be accelerated to get the entire fleet in action by 1965. The Administration holds that Polaris "has the highest degree of survivability under a ballistic missile attack." Second place is given to Minuteman, widely dispersed in underground sites, and production capacity for this weapon will be doubled. In the January budget drafted by the Eisenhower Administration there was provision for three mobile Minuteman squadrons, with the missiles mounted on railroad cars. These would be deferred in favor of three more fixed-base squadrons. The mobile version, on the job, costs fifty percent more than the missile in a silo and the squadrons are smaller—thirty weapons as against fifty. Extra funds are also requested for the Skybolt, the air-to-ground ballistic missile. Skybolt, with a range of 1,000 miles, would help extend the life of the B-52 bomber. The missile is also promised to the British, who are depending on the weapon to fit their own airplanes.

Until we get these missiles, under the sea, on the ground, and in the air, Mr. Kennedy knows he must put his faith in existing bomber forces to deter attack. He also appreciates that bombers on airborne alert are the least vulnerable, and he seeks funds to continue preparation for keeping at least an eighth of the B-52 force off the ground. He also would keep half of the B-52 and B-47 force on constant ground alert, ready to go with a fifteen-minute warning.

To provide this warning, and more of it as soon as pos-

(Continued on page 21)

IN THIS NEW HOME
REPUBLIC LIVES EVERY DAY IN THE FUTURE—YOUR FUTURE



Republic has just dedicated its newest contribution to the space age, the Paul Moore Research and Development Center. ➤➤➤ This is the only fully integrated research complex engaged in every vital area of space investigation.

Eight laboratories comprise the Center: Space Environment and Life Sciences, Re-Entry Simulation, Fluid Systems, Guidance and Control Systems, Materials Development, Nuclear Radiation, Electronics, and Wind Tunnels.

Man is now ready to probe further into the larger, unknown vastness of space. We believe that he must search for ways, not to conquer space, but to use it. ➤➤➤ The biggest job of Republic's new R&D Center is to help him in this search.

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An ICONORAMA system is now operational at NORAD (North American Air Defense Command) headquarters in Colorado Springs, Colorado. This system provides NORAD's Commander-in-Chief and his staff with the total visual information available on which to base decisions for the aerospace defense of Canada and the United States against enemy air or spatial attack. ICONORAMA, designed and developed by FF&M Electronics, Inc., a subsidiary of Ling-Temco Electronics, Inc., is a data processing and display system which records the movements of multiple airborne objects and projects their paths on a graphic display to help in vital judgments.

From NORAD, the information ICONORAMA displays, and interpretation of its meaning by NORAD's Commander-in-Chief, provides the second-to-second situation in our continent's security for the U. S. President and Canada's Prime Minister; the U. S. Joint Chiefs of Staff and Canada's Chiefs of Staff Committee.

Recent decisions have given operational control of all detecting and tracking equipment to NORAD, including the already operational BMEWS (Ballistic Missile Early Warning System) and Space Track, as well as upcoming Satellite Surveillance Devices . . all USAF systems; SPASUR (Space Surveillance Detection net) of the U. S. Navy.

NORAD ..KEY to Continental Aerospace Defense

ICONORAMA ..part of NORAD

ICONORAMA'S display keeps the Canadian Chiefs of Staff Committee and U. S. Joint Chiefs of Staff posted minute to minute on the situation; NORAD's Commander-in-Chief, in conduct of the aerospace battle, gives orders and instructions which cause .. ■ the U. S. Office of Civil and Defense Mobilization (OCDM) to signal the civilian populace of impending enemy strike; ■ Canada's Department of Transport and U. S. Federal Aviation Agency (FAA) to ground all civilian and nonessential flying to clear the air for combat; ■ all U. S. Air Force, Army, Navy and Royal Canadian Air Force air defense elements — such as jet fighter interceptors with atomic rockets and all guided missiles with nuclear warheads — to prepare for battle to protect Canadian-U. S. bases, people, resources, seats of government, and our will to resist; ■ permit SAC (Strategic Air Command) to get its planes aloft, its missiles ready for retaliation.

Eventually, the whole of NORAD's Combat Operations Center, together with ICONORAMA, and all the supporting communications and data processing will be placed underground in Cheyenne Mountain in Colorado. This single location, where all correlating and evaluation of the enemy threat takes place, will thus be much more safe and secure. ICONORAMA, as a part of NORAD, is an important contribution to the deterrent forces which — as long as they keep the peace — give North America and the free world a 100% effective defense. Should the deterrent fail, NORAD's forces constitute the main chance for major population and military survival to wage that war to a conclusion most favorable to our interests.

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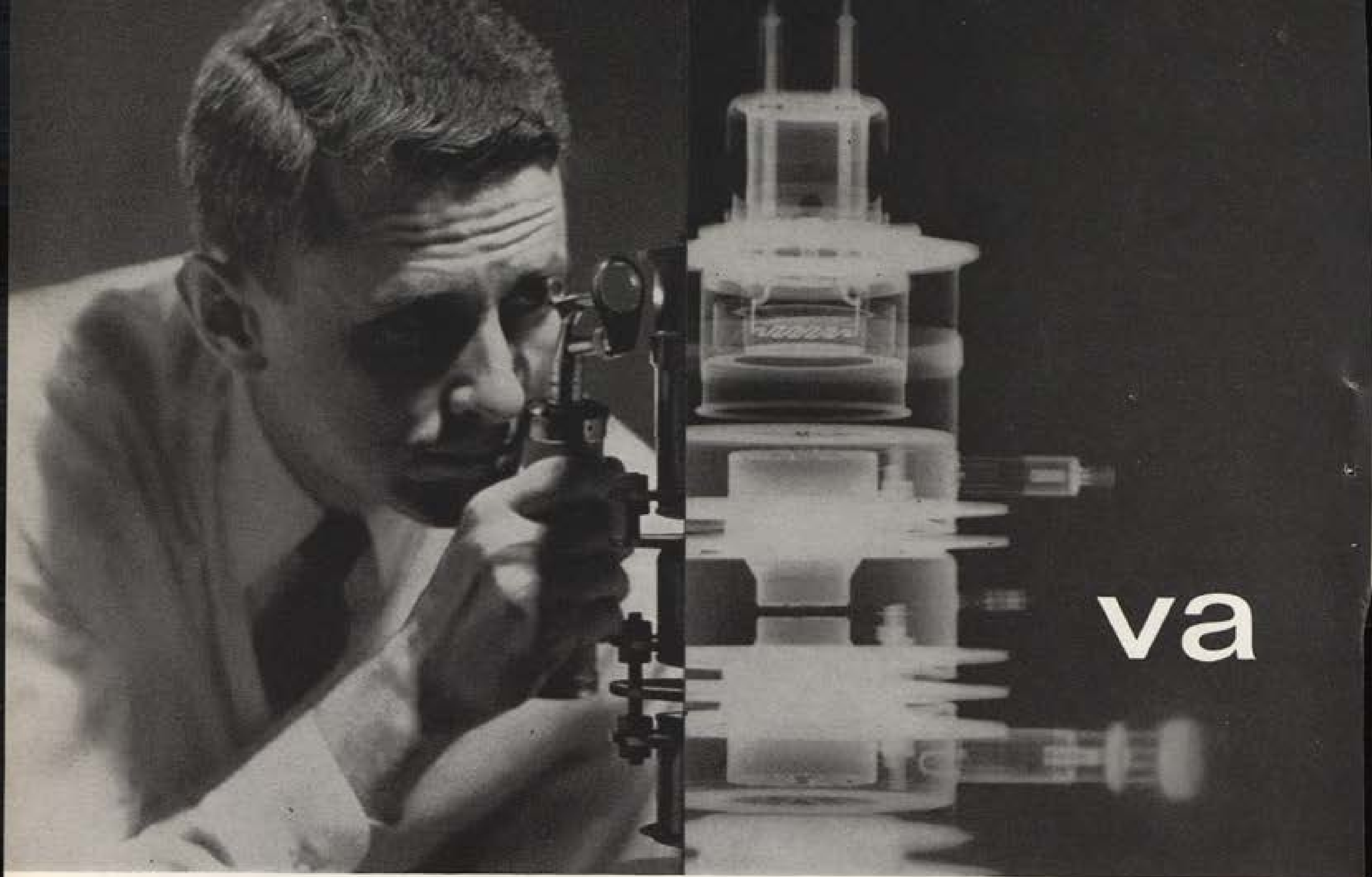
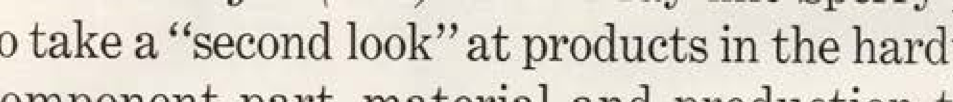


Value Analysis (VA) is an X-ray-like Sperry program designed to take a "second look" at products in the hardware stage. Every component part, material and production technique is challenged. The objective: lowest product cost at no sacrifice to essential quality and performance.

Sperry VA teams–specialists in engineering, product methods, purchasing and quality control–are attaining dramatic reductions in costs in a wide range of products and systems.

By introducing value analysis in the design stage as well, additional millions of dollars will be saved for the customer and the taxpayer. General offices: Great Neck, N. Y.



Some typical Sperry programs benefiting from Value Analysis: (left to right) SP-3 Automatic Pilot for light aircraft; Army's SERGEANT missile system; Navy's Mark 19 Gyro-Compass; USAF's APN-59 Airborne Radar System; Klystron tubes for long range radar systems (main illustration).

SPERRY

sible, the Administration proposes to press on with the Ballistic Missile Early Warning System (BMEWS) and try to supplement it as soon as possible with Midas, the warning system that is based in a satellite. Money also is requested for a beefed-up bomb alarm system at about 130 sites with display facilities at six control centers in the United States. BMEWS also would be equipped with bomb-alarm detectors, to provide a positive report if one of the three BMEWS sites were destroyed in a nuclear attack.

The Administration feels, Mr. Kennedy said, that there must be new emphasis on improved command and control —"more flexible, more selective, more deliberate, better protected, and under ultimate civilian authority at all times." To achieve this calls for renewed effort all the way from development of the basic equipment to improvement of the "organizational and procedural arrangements for the President and others."

The Administration argues that its decision to drop the nuclear-propelled airplane and curtail the B-70 is no proof that it has lost interest in manned flight. At one point, after discounting the B-70 for what he believes to be "its lesser survivability as a ground-based system and its greater vulnerability in the air compared to missiles," he speaks of it as not greatly superior to "a B-52 or successor bomber." The latter was not defined. However, Mr. McNamara said there is $30 million in additional money being requested for Dyna-Soar, USAF's research vehicle that aims to study suborbital flight and recovery at a predetermined landing spot. So far, this project is too young a technological program to be spotted as a military system. In addition to Dyna-Soar, other space and research programs that are considered worthy of more attention are Defender, Advent, Discoverer, and Saint. These are studies concerned with missile defense, communications, reconnaissance, and the inspection of hostile satellites. All would operate in space.

A substantial portion of the funds sought to bolster limited-war capabilities would be spent for airpower. There is a step-up in the procurement of Lockheed C-130Es —the extended-range turboprop transport. There is a purchase of thirty Boeing C-135 jet transports, deliveries to begin next month. Thus the plan of the Eisenhower Administration to add fifty modern transports has been upped to 129.

There also would be expanded research on conventional weapons and equipment. The reason for this, according to Mr. McNamara, is that " the decision to employ tactical nuclear weapons in limited conflicts should not be forced upon us simply because we have no other means to cope with them." On this issue he appears at variance with Gen. Lauris Norstad, among others. General Norstad is boss of Supreme Headquarters, Allied Powers, Europe. The General says it is true that he is determined to stop any penetration of land frontiers in Europe and will use nuclear weapons at once if they are needed. He says both weapons and posture of forces in Europe must be improved and "substantial dependence must be placed on nuclear weapons under almost any circumstances." Mr. McNamara, who may be thinking of some places outside Europe, says, "There are many possible situations in which it would not be advisable or feasible to use such weapons."

On top of this the Army is expected to upgrade its helicopter fleet. The Navy would step up its rehabilitation and modernization of ships. The amphibious task forces, which may or may not see another Korea, would get new equipment. The Republic F-105, in earlier models, would be modified to carry conventional ordnance and do it with added thrust from shorter runways. Finally, there is a $45 million proposal for development of a tactical fighter that can meet the requirements of the Army, Navy, Air Force, and Marines. "In general," Mr. McNamara said, "what we are striving for is one fighter to fill the needs of all the services—a fighter which could operate from the large number of existing smaller airfields all over the world and yet fly without refueling across the ocean, thus greatly increasing its value for limited-war purposes." This is a big order, but NASA has been working on the problem. There are engine improvements and new concepts of wings with variable geometry that may make it possible.

On the side of economy, two squadrons of Titan II ICBMs have been canceled on the grounds that the Polaris and Minuteman systems are cheaper and more efficient. Snark, the subsonic missile, will be phased out. The Navy's expensive Eagle-Missileer system, a costly system of trying to defend the fleet against enemy attack, will be canceled. The phase-out of B-47 medium-bomber wings will be accelerated. Proposed installation of Polaris missiles on a Navy cruiser will be abandoned.

Biggest single item under "Savings Made Possible by Progress" in the revised budget is a deduction of $138 million for a cutback in the B-70 Mach 3 bomber program. It is unfortunate that a substantial amount of the comment on this action is concerned with what the proposal does to Congress instead of what it does to the Russians and the general stature of our country in the technological race.

At this writing there has been some material in the *Congressional Record* about the B-70's capabilities, what it represents as an advance in aeronautical science, and how the program has gone up and down on the yo-yo string of Budget Bureau and congressional whim. There has been almost no discussion of what the airplane might mean as part of the *counterforce* we will need to *win* a war. There has been a lot of comment about the fact that Congress once restored the B-70 to the status of a full weapon system after the Eisenhower Administration had gutted the airframe. The new Kennedy approach now is unfortunately labeled as an affront to Congress, thus putting the B-70 in the pork-barrel class as if it were part of the peanut crop or an item in the rivers and harbors bill. It is neither of these. It is a sound approach to a new frontier in aviation. It would cost the Russians $40 billion to prepare a defense against it, if they wanted to tackle the job.

On this score, of the B-70's ability to penetrate, the airplane's Mach 3 speed is not the only thing that will complicate an enemy's air defense problem. Going at 2,000 miles an hour and above 70,000 feet, its probability of penetration is nine times that of the B-52 and about twice that of the Mach 2 B-58. On top of this, the bomber would be equipped with the most advanced and sophisticated defensive systems. These will permit it to select the least-defended corridors in enemy territory, while enjoying accurate navigation and guidance to targets.

If the B-70 is a victim of over-reliance on the ICBM, and Mr. Kennedy proposes that it be carried forward only "to explore the problems of flying at three times the speed of sound with an airframe *potentially useful as a bomber*," the aircraft's other wide capabilities will be sacrificed. And this will happen even before military experts can fully explore their potentiality. The B-70, which could provide a show of force anywhere in the world in less than five hours, is possibly the most flexible weapon system ever designed. With a man at the controls, it could destroy mobile targets, hunt for unknown targets, and dump an

(Continued on following page)

explosive load far greater than that carried by a missile. It could scatter the load over several targets. The load could be nuclear or conventional. The B-70 can do reconnaissance, assess damage, and carry out strikes against small targets in local wars. It can be recalled and maintain an air alert under positive control. It has, perhaps most importantly, both flexibility and capabilities as a *counterforce*. It can deter because it can be used to *win*.

There is a strange irony in the fact that the same kind of decisiveness that has produced forward steps in management of the military establishment runs into rough territory when it examines military strategy. There are many unknowns that can't be put on the punched tape that is fed into the mechanical brain. Take, for example, the wide area that exists between a limited war and a general nuclear war. There are Laos, the Congo, Cuba, South America, Berlin, Western Europe, the Middle East, and other hot spots around the world. Whether one of them is ablaze, a half-dozen are in flames, or a conflagration spreads over a continent, no military force can stop to weigh its weapons. Were they designed for limited or general war? They must be able to fight across the entire spectrum and, with highest priority, do it fast. If there is a limitation on speed, flexibility, or firepower, the handicap could be fatal.

The Kennedy budget message puts this problem up to Congress. There are sound indications that the issues will be aired, and USAF witnesses, under examination, will state the case for the B-70 as they did a year ago. If it is not completed as a weapon system, we have abandoned the manned bomber, despite Mr. Kennedy's conviction that such aircraft have "certain advantages." The B-52s will be obsolete, according to the Strategic Air Command, in the mid-1960s. When the Chairman of the Joint Chiefs of Staff was asked in February of 1960 what was planned or under development to take the place of the B-52, he said: "The B-70 is the only one."

There Are More Changes Ahead

A great deal of the initial excitement over selection of USAF as the single manager for development of space systems has abated. Both the press and the House Committee on Science and Astronautics seem to have run out of scare approaches, and the Defense Department has been allowed to go on making decisions that will improve the management of military affairs. With barely a ripple, Secretary of Defense Robert S. McNamara has given USAF responsibility for research, development, *and operation* of all Defense Department reconnaissance satellite systems. Also to USAF is assigned responsibility for research and development of all instrumentation and equipment for processing reconnaissance data received from the satellite systems. This marks the first choice of a service for a specific *mission* in space. The McNamara directive gives to the Army the job of establishing and managing a single geodetic and mapping program. This means that the Army, using information from USAF-operated satellite systems, will fill the geodetic and map requirements of all the armed forces "under broad priorities established by the Joint Chiefs of Staff."

This is another one of the decisions that can be made under the existing Pentagon organization. One commentator, looking at three months of the New Frontier, has written that Mr. McNamara is the first Secretary of Defense to use his powers "to cut through the objections of special service interests and their allies in Congress." At the same time, the new Secretary is careful not to trespass in areas clearly staked out by the vagaries of geography. The mapping directive, for example, orders the Air Force to use manned airplanes in accordance with a schedule provided by the Army when that is necessary. It also says that the Army, and the Army alone, will be in charge of ground-based systems for geodetic work. And it picks the Navy for research, development, and operation of all oceanographic and geophysical equipment required for the survey of ocean areas.

Like the earlier space directive, the realignment of mapping responsibilities can be expected to bring about changes in the Army, Navy, and Air Force. How USAF will handle the operational job has not been made clear, but out at Andrews Air Force Base, headquarters of the new Systems Command, there is hard work under way. The goal is to have the working operation for development and procurement of all kinds of systems as perfect as possible by the first of July. There still is a little note of incredulity in some circles over the idea that procurement and production responsibilities no longer are vested in the complex at Wright-Patterson Air Force Base. As the chart in last month's AIR FORCE/SPACE DIGEST showed, the new Systems Command has a Deputy Chief of Staff for Materiel. He is a man with sound experience in the old Air Materiel Command, Maj. Gen. Clyde H. Mitchell.

At the same time there has been discussion for a month about the necessity for reorganizing the Air Staff. At this writing a final decision still is awaited, but conversation over the past few weeks has centered around the idea of realigning responsibilities so that offices in the Pentagon are kept in step with those in the field. It is expected that Lt. Gen. Roscoe C. Wilson, Deputy Chief of Staff for Development, will have his field confined to Research and Technology, which will include supervision of the new Office of Aerospace Research. To Lt. Gen. Mark E. Bradley, Deputy Chief of Staff for Materiel, will go a new jurisdiction of Systems and Logistics.

There are, perhaps, other management decisions ahead. In fact, there are people who predict a literal wave of them, once Secretary McNamara has completed his studies and received answers to the well publicized 103 questions he wants answered. Prominent among the possibilities is the proposed merger of Army's Strategic Army Corps with the Air Force Tactical Air Command. At first blush this was interpreted as an Army effort to swallow TAC, largely because the program suggests that an Army officer be placed in command. Actually, like the new mapping activities, the Strategic Air Command itself, and each of the unified commands around the world, the combined TAC-STRAC would be under direct control of the Joint Chiefs. Managementwise, the idea makes sense.

As each of these steps is taken there will be new outbursts of alarm, and hasty hearings will be called on Capitol Hill. Generals and secretaries will have to say again that this kind of progress is legal and inevitable and essential to national security. From the standpoint of executive efficiency perhaps somebody should propose that the Defense Department should use the British White Paper approach. Under this system action is taken and once a year the minister in charge presents Commons with a long dissertation on what he has done and why. Then there is one long debate, one grilling, and one opportunity for him to change his mind, which comes later. But there is a saddling of executive responsibility at a point where it is true responsibility, where the executive conduct is not monitored by kibitzers who can foul one nest before another is built.

(PROPOSED BUDGET ADJUSTMENTS ON PAGE 24)

SUMMARY BY PROGRAM OF PROPOSED ADJUSTMENTS IN NEW OBLIGATIONAL AUTHORITY IN FY 1962 BUDGET

Program	*Proposed Adjustments* Additional Millions of Dollars	Fewer Millions of Dollars
I. STRENGTHENING AND PROTECTING OUR STRATEGIC DETERRENT AND DEFENSES		
A. Improving our missile deterrent		
1. Polaris	$1,340.8	
Accelerate production schedule		
Accelerate A-3 development		
Increase personnel		
2. Minuteman	96.0	
Substitute three fixed for three mobile squadrons		
Expand production capacity		
Improve missile		
3. Skybolt	50.0	
B. Protecting our bomber deterrent		
1. Increased ground alert force and bomb alarms	44.6	
C. Improving our continental defense and warning systems		
1. Midas	60.0	
2. Backup control of air defense interceptors	23.0	
D. Improving the command and control of our strategic deterrent	16.4	
E. Other research programs related to strategic and continental air defense forces	226.0	
Penetration aids, Dyna-Soar, Advent, Defender, Discoverer, and others		
II. STRENGTHENING OUR ABILITY TO DETER OR CONFINE LIMITED WAR		
A. Expanded research on nonnuclear weapons	122.0	
B. Increased flexibility of conventional forces		
1. Additional transport aircraft	172.2	
2. Additional amphibious transport, new type	39.7	
3. Navy ship rehabilitation and modernization program	84.4	
4. Procurement of new weapons, ammunition, etc.	230.0	
C. Increased nonnuclear capabilities of fighter aircraft		
1. Development of advanced tactical fighter	45.0	
2. Modification of F-105 tactical fighter	24.6	
D. Increased personnel, training, and readiness for conventional forces		
1. Increase in Army and Marine Corps personnel strengths	39.0	
2. Increase in retired pay	25.0	
3. Increased readiness training of Army and Air Force units	65.3	
TOTAL ADDITIONAL MILLIONS	**$2,704.0**	
III. SAVINGS MADE POSSIBLE BY PROGRESS		
A. Titan II: Cancellation of two squadrons		$100.0
B. Phase-down of B-47 medium-bomber wings		34.7
C. Phase-out of Snark		6.9
D. B-70		138.0
E. ANP (Nuclear aircraft)		35.0
F. Eagle-Missileer		57.7
G. Cancel installation of Polaris on cruiser *Long Beach*		57.7
IV. TRANSFER FROM WORKING CAPITAL FUNDS		**320.0**
TOTAL FEWER MILLIONS		**$ 750.0**
NET TOTAL NEW OBLIGATIONAL AUTHORITY	**$1,954.0**	

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AEROSPACE WORLD

Frederic M. Philips
ASSOCIATE EDITOR, AIR FORCE MAGAZINE

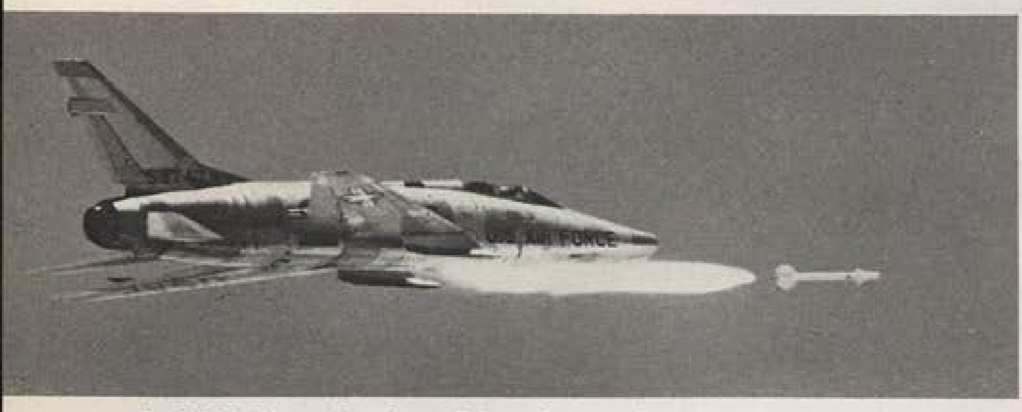
Soviet Air Force Maj. Yuri Alekseyevich Gagarin this month became history's first man in space. Russian rocketeers blasted him into orbit shortly after nine in the morning on April 12. Before eleven, having completed one orbital circuit of the globe, he landed safely and happily back on Soviet soil.

With numerous details of the dramatic flight yet to be disclosed, two facts stood in bold relief. Major Gagarin had earned himself a niche in the history of mankind—in the schoolbooks and scientific volumes of unborn generations. And the Russians had scored again, beating the US into manned spaceflight by a long shot. It had, of course, been widely predicted that the Reds would win the manned race into space just as they had put up the first artificial earth satellite three and a half years earlier.

The Soviets proudly declared in an official statement that "the land of triumphant socialism" had "opened the new era in the development of mankind." President Kennedy sent off a congratulatory message to Moscow, observing that the shot was "an important step" toward "the exploration of our solar system." Such exploration, he said, is also the object of "our own Mercury man-in-space program." Unarticulated, but there for all the world to see, was the fact that our Mercury program is far behind the Russians. The US planned to send a Mercury Astronaut on a nonorbital ballistic hop over the Atlantic in a matter of weeks. The first Mercury orbit shot was, hopefully, set for the end of this year.

Details of the Russian flight immediately available were these: Major Gagarin's vehicle, named *Vostok* or "East," weighed five tons. Orbiting time, at a speed of 17,000 mph, was about ninety minutes. Angle of inclination of the orbital plane to the equator was a little over sixty-five degrees, minimum orbital distance from the earth 110 miles and maximum distance 188 miles. Ground contact with Major Gagarin was maintained on two radio frequencies; he was also observed on television. Locations of blastoff and recovery sites were not revealed, nor were descriptions and specifications of the vehicle and booster.

Another unanswered question was this. Had the Russians tried and failed previously at launch and recovery of an astronaut? Brig. Gen. Don Flickinger, one of USAF's top aerospace medical authorities, told newsmen at the Air Force Association's National Convention at San Francisco last year that he believed they had—and that at least one Russian astronaut had perished in such an effort. Rumors of abortive Russian flights have circulated for the past couple of years, the most recent ones in the days preceding the historic Gagarin round trip into space.



An F-100 Supersabre firing Sidewinder missile. Air National Guard F-100 shot down SAC B-52 with accidentally-fired Sidewinder in USAF tragedy this month.

Wide World Photos, Inc.

Left, Maj. Robert Fitzgerald, leader of Thunderbirds killed in crash day before B-52 mishap. Right, NASA test pilot Joe Walker, X-15 record-setter.

Two deadly aerial mishaps hit the Air Force in one-two order in early April. On April 6 two of the Thunderbirds, the Air Force's famed aerobatic team, crashed and were killed in a practice session over the Nevada desert. One of them was the team leader, Maj. Robert S. Fitzgerald. Next day, an Air National Guard interceptor loosed a Sidewinder missile while making a mock pass on a SAC B-52 over the mountains of New Mexico. The heat-seeking missile blasted into one of the plane's engines, and sent the B-52 crashing into a barren hillside. Three crewmembers perished, for a total of five fatalities in the two accidents.

With Major Fitzgerald in his ill-fated F-100F Supersabre was Capt. George A. Nial, a newcomer to the group who was scheduled to become ground narrator during shows. Major

Fitzgerald, air veteran of World War II and Korean War fighting, had headed the team since early 1959. The Thunderbirds were running through their paces some sixty miles north of Las Vegas when the crash occurred.

The B-52 incident brought a routine intercept by combat-ready Guard planes to a sudden, shocking end. First Lt. James Van Scyoc and Capt. Dale Dodd of the 188th Interceptor Wing, New Mexico ANG, had made five practice passes on the eight-jet bomber from Biggs AFB, Tex. On the sixth pass, one of Lieutenant Van Scyoc's Sidewinders rocketed off. In less than two seconds, it struck its target. The big plane burst into flames, plummeted to the rocky terrain half a dozen miles below. Five of the crew, including aircraft commander Capt. Donald D. Blodgett and copilot Capt. Ray C. Obel, bailed out and survived despite blizzard conditions on the ground that also gave rescuers a tough time. Pending completion of USAF's accident investigation, the tentative verdict on cause appeared to be mechanical malfunction that fired the Sidewinder despite multiple safety devices and an experienced, careful pilot.

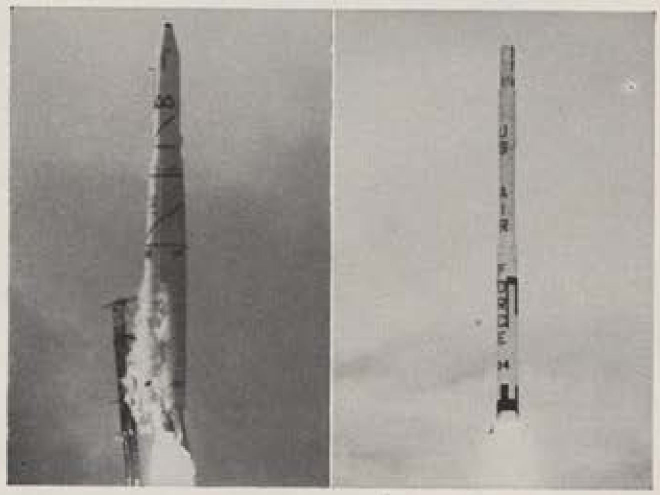
☆

This was Joe Walker's month to set an X-15 record. The NASA test pilot took the experimental rocket plane to 169,000 feet, about thirty-two miles, on March 30. This topped the 136,500-foot world mark attained by USAF Maj. Robert M. White last August. Pilot Walker was turning the record tables on his X-15 partner. Three weeks earlier, on March 7, Major White flew at 2,905 mph to break the speed record set by Walker in the X-15 in August. Aim in this game of aerospace leapfrog: 4,000 mph, an altitude of 100 miles. Russian spaceman Gagarin's orbit was 110 miles up at its closest point.

In other major hardware news:

★ Two more trial shots of the McDonnell **Mercury** man-in-space capsule were conducted, on March 18 at Wallops Island, Va., and on March 24 at Cape Canaveral, presumably the final rehearsals for the upcoming manned ballistic shot over the Atlantic.

★ Disappointment dogged the broadly successful USAF **Discoverer** program. Discoverer XXII failed to achieve orbit on March 30. Discoverer XXIII's capsule, slated to be recovered, did not reenter the atmosphere; the satellite did, however, yield data to ground stations. Date was April 8.



Far left, February launch of USAF's Discoverer XXI. Next two in series went up this month. Left, Blue Scout II research rocket blasts off. Solid-fuel Blue Scouts are comparatively inexpensive and designed for wide use as booster.

★ **Titan** went all the way in a 5,000-mile test shot from the Cape March 28, flopped in its next outing April 5. New operational Atlas sites were announced at Offutt AFB, Neb., and Warren AFB, Wyo.

★ USAF's new jet trainer, the T-38 **Talon**, was formally introduced into ATC in ceremonies at Randolph AFB, Tex.

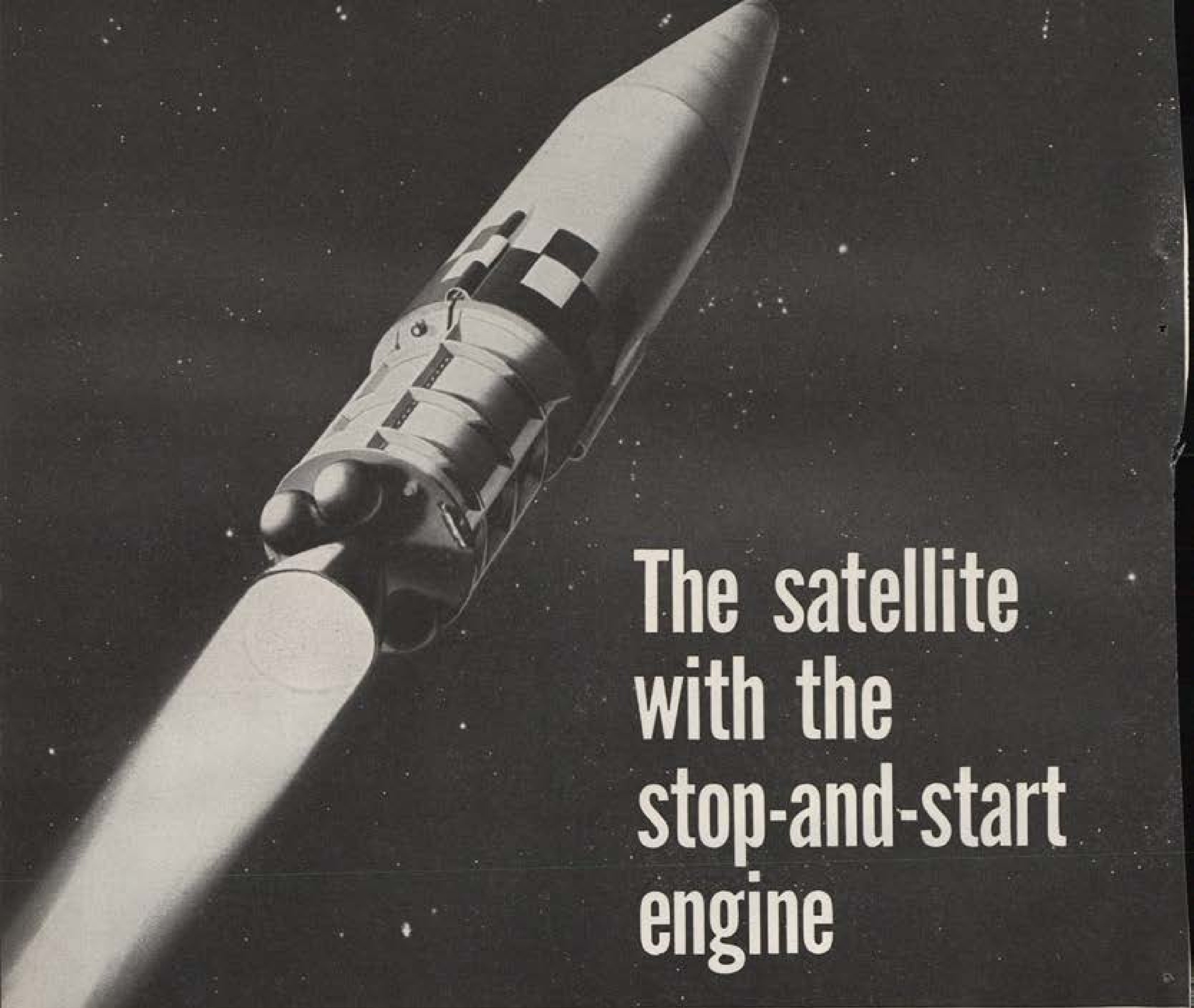
★ USAF launched a **Blue Scout II** up from the Cape April 12 in another of a major space research series.

★ NASA sent its **Explorer X** satellite up April 10 for space magnetism research.

☆

In Washington, the Administration made some tough budgetary-military

(Continued on page 29)



The Agena B's own engine ignites and drives it on to orbital velocity after first-stage booster burns out and drops away.

Radio signals from earth start and stop Agena B's engine to turn the original orbit into new around-the-equator orbit.

Why the Agena B gives America more orbits for the money

The Agena B's powerful rocket engine can be started and stopped at will by radio signals from earth. This new capability means 1) much greater certainty of reaching the desired orbit; 2) a heavier payload or a higher orbit from a given first-stage booster; 3) converting original orbits to around-the-equator orbits which hold great promise for communication and navigation satellites; 4) maintaining a satellite's precise position on orbit for long periods. Lockheed-built Agena Bs are now being used in the Discoverer, Midas, and Hawkeye programs of the U.S. Air Force, the Advent program of the U.S. Army, and the Ranger, Ogo, Oao, and Nimbus programs of the National Aeronautics and Space Administration. Major subcontractors: General Electric, Bell Aerospace, Philco.

LOCKHEED

MISSILES & SPACE DIVISION, SUNNYVALE, CALIFORNIA decisions. They were contained in a March 28 presidential message to Congress recommending changes in the Eisenhower Administration defense budget. Mr. Kennedy asked for an increase of about $2 billion in defense funds, $650 million of which would be spent in the fiscal year starting July 1. These were among the major recommendations:

- Sharp curtailment of the controversial **B-70** bomber program, cut by the previous Administration and then restored last year.
- Cancellation of USAF's **nuclear-powered aircraft** program.
- Immediate phase-out of the **Snark** intercontinental cruise missile.
- Cancellation of the last two of fourteen planned **Titan** squadrons.
- Step-up of the **Polaris** program, with installation of this missile on the nuclear-powered cruiser *Long Beach* canceled.
- Acceleration and beef-up of the **Minuteman** program, the first three railroad-mounted missile squadrons to be supplanted by fixed-base squadrons.
- Increase in the **Skybolt** ALBM program.
- Accelerated phase-out of **B-47** bomber wings.
- Inactivation or reduction of operations at seventy-three domestic military installations. Discontinued were to be **Presque Isle AFB, Me., and Laughlin and Harlingen AFBs, Tex. Kirtland AFB, N. M.,** was to be turned over to the city of Albuquerque, with USAF remaining as a tenant.

Funds were also recommended for development of an advanced tactical fighter emphasizing nonnuclear capabilities, SAC alert forces, airlift, and a number of space programs including Midas, Dyna-Soar, and Discoverer. Strictly limited-war hardware would receive slightly increased funding, and the services would be allowed to increase their manpower by a few thousand men each.

In other important Washington action, Defense Secretary McNamara assigned USAF responsibility for research, development, and operation of all reconnaissance satellite systems for the armed forces.

☆

ELSEWHERE IN THE AEROSPACE WORLD:

Saudi Arabia decided not to renew the agreement whereby MATS and an air-sea rescue unit are based at strategically located Dhahran. Present agreement terminates in April 1962. The US will complete work on a $5 million air terminal there and furnish $20 million for improvement of the port of Damman.

Russia in late March protested that another US RB-47 violated Red airspace. The US denied the charge.

Soviet, US airlifts continued to troubled Laos. US helicopters joined the lightplanes already supplied to the Laotian government for use against the Red rebels. There were scattered reports of US airmen being fired on or downed by the rebels.

At the same time, the US proposed reopening of US-USSR talks on institution of reciprocal New York-Moscow air service.

USAF's Mackay Trophy for meritorious flight went this year to the 6593d Test Squadron, Hickam AFB, Hawaii, for its aerial recoveries of Discoverer capsules from orbit. The Cheney Award for valor went to SAC's Capt. Alfred S. Despres, Jr.; last January, when the B-47 he copiloted crashed on takeoff at Eielson AFB, Alaska, he reentered the flaming wreckage after getting clear to rescue the plane commander. The Daedalian Trophy for flight safety went to the Pacific Air Forces for their safety program and the Daedalian Maintenance Trophy to ATC's 3500th Maintenance and Supply Group, Reese AFB, Tex.

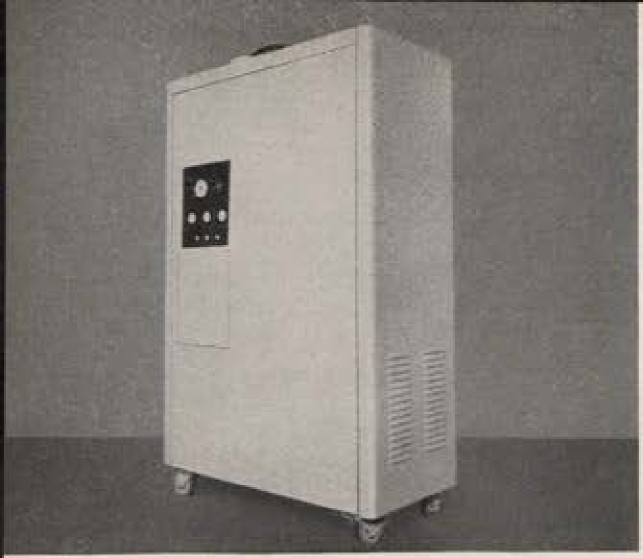
Work on NORAD's underground combat operations center in the Colorado Rockies was scheduled to begin shortly.

USAF in late March brought charges of dereliction against three officers in connection with the Texas Tower collapse that cost twenty-eight lives in January. They were Col. William M. Banks, acting Commander of the Boston air defense sector at the time, and Majs. William R. Shepard and Reginald L. Stark, successive Commanders of the 4604th Support Squadron, Otis AFB, Mass.

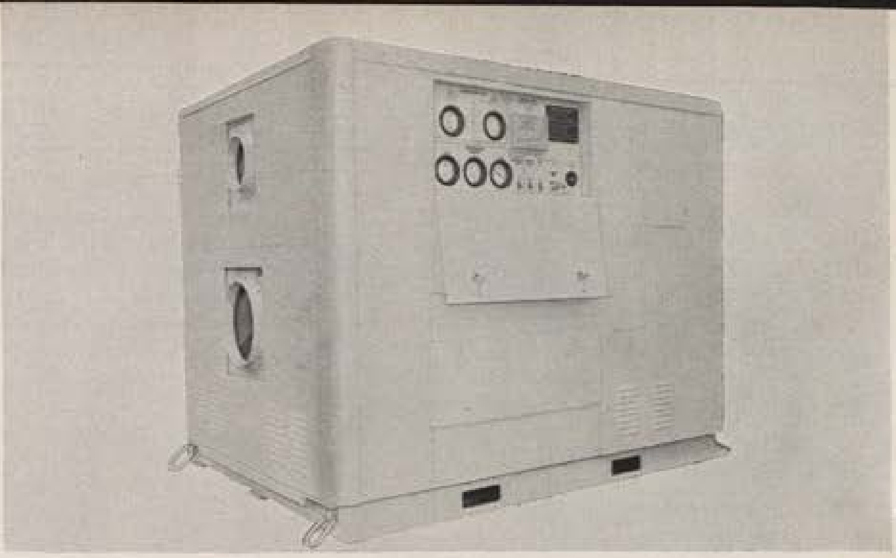
John F. Loosbrock, Editor and Assistant Publisher of AIR FORCE/SPACE DIGEST, was named to the Administration's top-level Project Horizon task force, which is charged with developing national aviation goals for the next ten years. The group has eight members.

A familiar face left the Washington scene with the retirement of Reserve Col. Moncel A. Monts, in the AF News Branch at the Pentagon for

(Continued on page 33)



FOR THE MINUTEMAN PROGRAM—An instrument cooling pack. Delivers 25 lbs/min of air at 37°F, and 2.5 psig. for R & D testing.

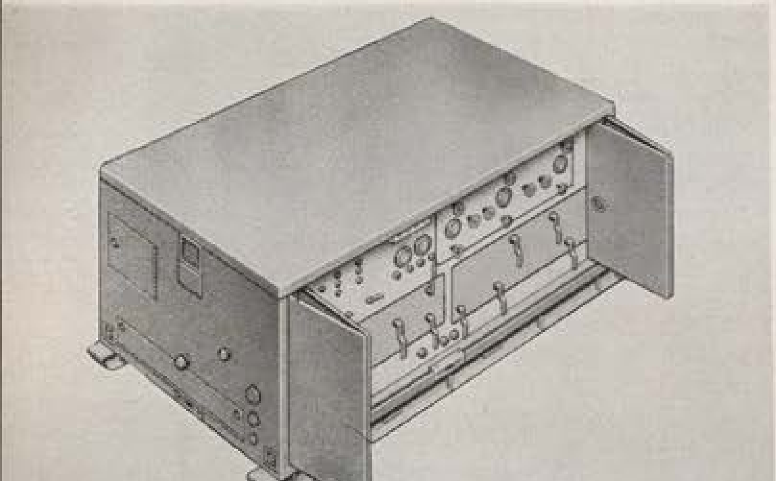


FOR THE TITAN I PROGRAM—An air-conditioner which simultaneously heats and cools guidance control gear in nose cone and lox sections of the missile, while in the silo.

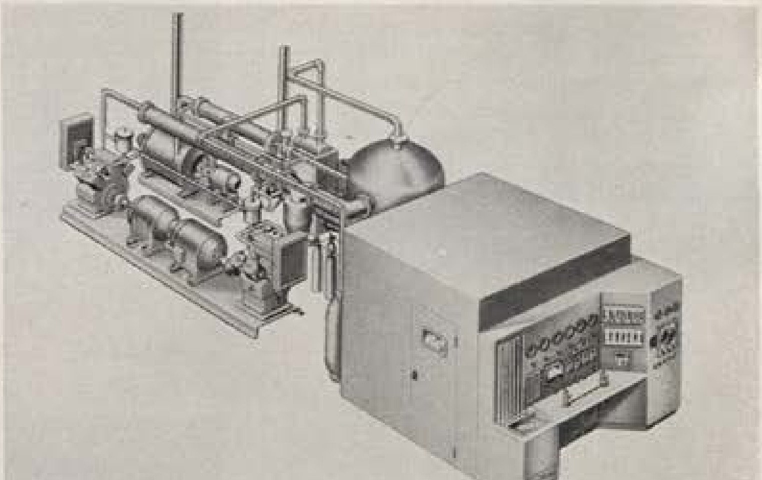
FOR THE NAVY T-56 & T-58 ENGINES—A complete jet fuel control test stand. Supplies fuel flows up to 6,500 lbs/hr at 1,500 psig. Has controllable air-flow temperature range from −65 to +300°F, accurate to ±1°F.

FOR THE C-130-B AIRCRAFT—A simulator which can make 100 electrical circuit checks in minutes.

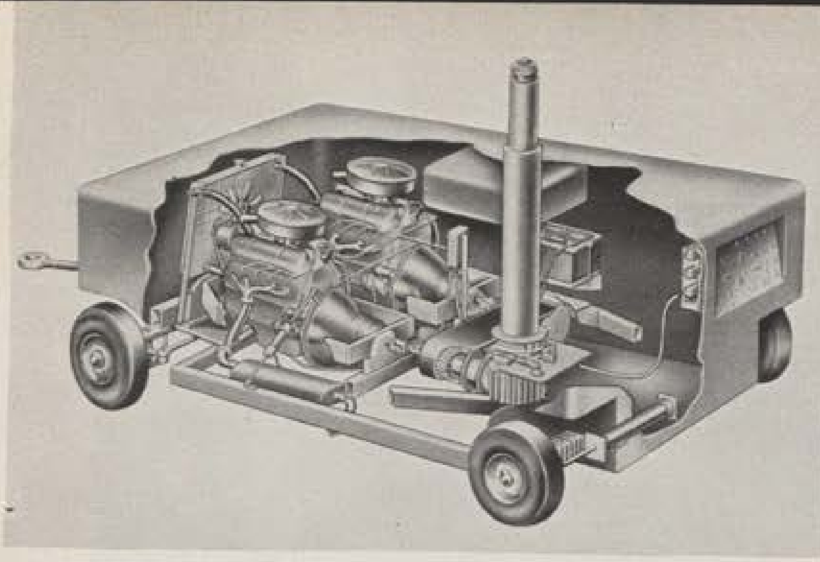
Two facts you should



FOR THE TITAN II PROGRAM—A pumping and metering unit for transfer of propellant fuel and oxidizer.

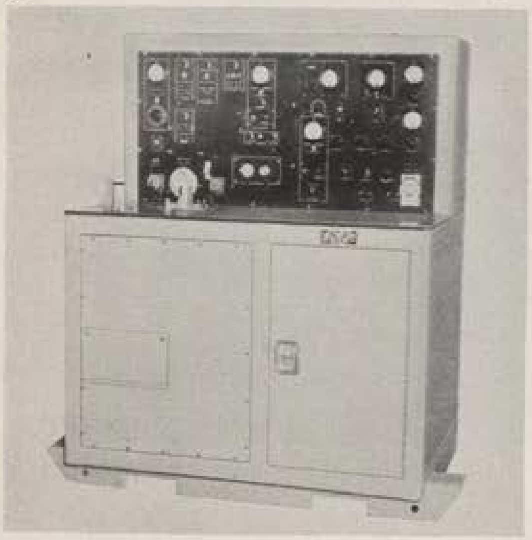


FOR THE F-104—A pneumatic test stand. Simulates flight conditions to functionally check the plane's air-conditioning system during overhaul.

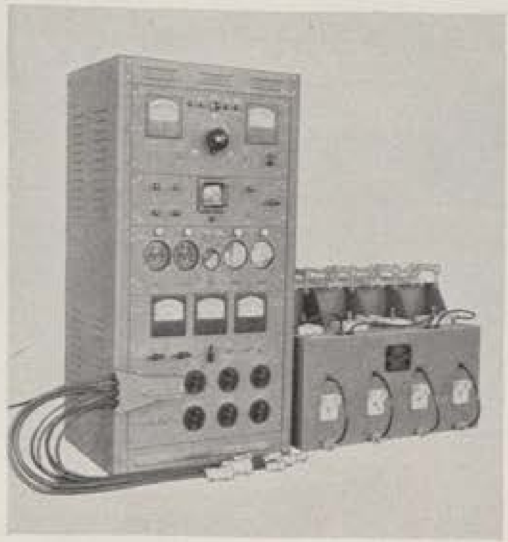


FOR AN ADVANCED TURBOJET ENGINE—A new mobile starter system. Engages directly with engine's gearbox. Offers a wide range of starting torques and speeds.

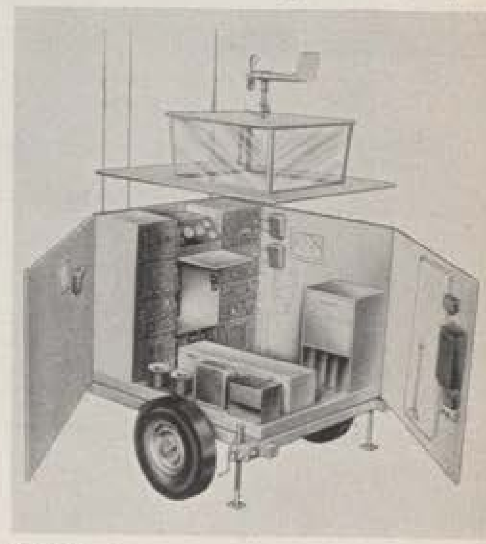
FOR AN ADVANCED FALCON MISSILE—An automatic liquid conditioner. Cools or heats electronic components, during ground checkout.



FOR THE B-58—A test stand for functional check out of the plane's temperature-control components.



FOR THE AIR FORCE AND NAVY—A propeller synchronizer test stand for 2- and 4-engine aircraft.



FOR TAC—A portable air-traffic control "tower". Houses operator, radio and weather equipment.

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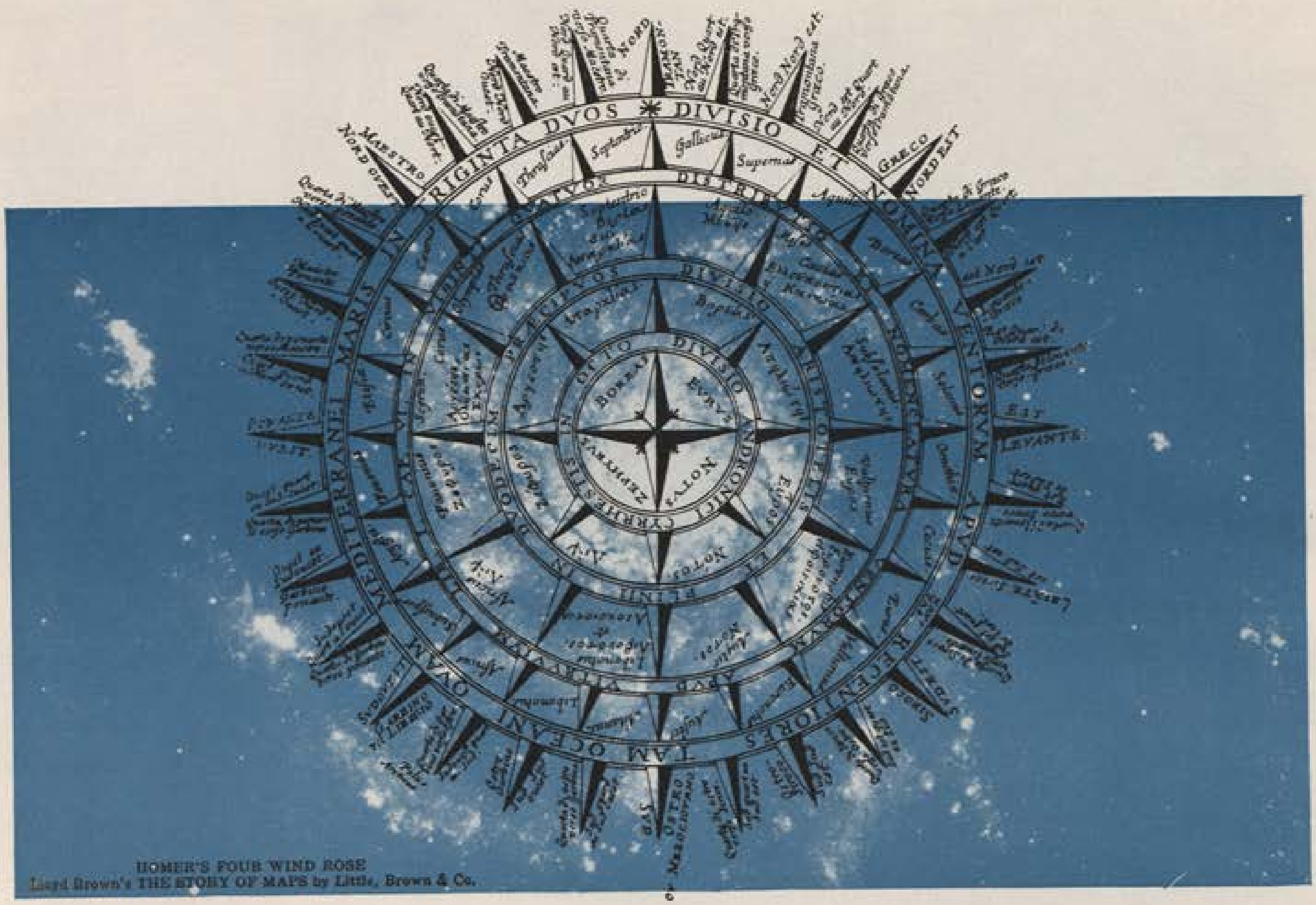


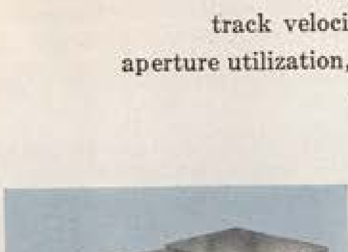
HOMER'S FOUR WIND ROSE
Lloyd Brown's THE STORY OF MAPS by Little, Brown & Co.

When Homer Found Home

The Odyssey of Homer developed the true concept of direction. His naming of the four winds divided the horizon into quadrants, giving rise to the wind rose as an aid in dead-reckoning. But, variable wind was still the major uncertainty that he encountered.

To modern jet pilots, wind is still the greatest variable in air navigation. Out of contact with visual references and often over unfamiliar territory, the jet pilot finds wind a most important determinant for mission success. By navigating with ground track velocity instead of air track velocity and meteorological wind, mission success is enormously improved.

The self-contained doppler navigators made by LFE measure ground track velocity with an accuracy better than 0.1%. They are small in cubage, efficient in aperture utilization, low in power consumption, almost impossible to detect, and operable over extremes of altitude, temperature and meteorological conditions.



LFE Self-Contained Doppler Systems provide all-weather navigation for fixed-wing, rotary-wing and V/STOL aircraft. Features are: • Altitude-controlled ICW modulation • Complete weapons system integration with bomb navigation systems, autopilots, map displays, terrain clearance indicators and plotting boards • Single antenna aperture for all beams • Dielectric lens or planar array antennas • X-Band or K_u-Band frequency • Analog outputs for pilotage displays. Write to Department PI-24 for further details on the outstanding characteristics of LFE Airborne Doppler Systems.

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ELECTRONIC DATA PROCESSING • MICROWAVE INSTRUMENTATION • AUTOMATIC CONTROLS • AIR TRAFFIC CONTROL

the past twelve years and its head for the past seven *(see cut, page 35)*.

President Kennedy named Joseph S. Imirie, former Deputy Assistant Secretary of the Air Force, to be Assistant Secretary of the Air Force.

Aviation pioneer George F. Myers, H. Rowan Gaither, Jr., author of the controversial Gaither Report on the nation's defenses, and Robert McArthur Crawford, composer of "The Army Air Corps" song, died this month.

☆

Air Secretary Zuckert, Chief of Staff General White present set of now-authorized AF battle streamers to House Armed Services Committee. Congressmen are Rivers (S. C.), Kilday (Tex.), long-time chairman Vinson (Ga.), Arends (Ill.), Gavin (Pa.), Becker (N. Y.), Pirnie (N. Y.)

STAFF CHANGES. . . . **Gen. Samuel E. Anderson,** from Commander, Hq. AMC, to Commander, Hq. AF Logistics Command, Wright-Patterson AFB, Ohio. . . . **Brig. Gen. Wilbur W. Aring,** from DCS/P, Hq. AFMTC, ARDC, Patrick AFB, Fla., to Commander, Hq. 3d AF Reserve Region, CONAC, Dobbins AFB, Ga. . . . **Brig. Gen. Fred J. Ascani,** from Director of Systems Engineering, WADD, ARDC, to Deputy for Systems Engineering, Div. of AF Systems Command, Wright-Patterson AFB, Ohio. . . . **Maj. Gen. T. Alan Bennett,** from Director of Maintenance Engineering, DCS/M, Hq. USAF, Washington, D. C. to Director, Maintenance Engineering, Hq. AFLC, Wright-Patterson AFB, Ohio.

Maj. Gen. Kenneth P. Bergquist, from Commander, AF Command & Control Development Div., ARDC, to Commander, Electronic Systems Div., AFSC, Laurence G. Hanscom Field, Mass. . . . **Maj. Gen. Frank A. Bogart,** from Director of Supply, Hq. AMC, Wright-Patterson AFB, Ohio, to Acting Comptroller, Office of AF Comptroller, Hq. USAF, Washington, D. C. . . . **Maj. Gen. Richard L. Bohannon,** from Command Surgeon, PACAF, APO 953, San Francisco, Calif., to Deputy Surgeon General, Hq. USAF, Washington, D. C. . . . **Brig. Gen. Robert F. Burnham,** from Provost Marshal, The Inspector General USAF, to Director of Security and Law Enforcement, Hq. USAF, Washington, D. C. . . . **Brig. Gen. Murray A. Bywater,** from Commander, SATAF, Hq. AMC-BMC, Air Materiel Command, to Commander, SATAF, Hq. Ballistic Systems Div., AF Systems Command, Inglewood, Calif. . . . **Brig. Gen. Frank P. Corbin, Jr.,** from Staff Judge Advocate, Hq. PACAF, APO 953, San Francisco, Calif., to Judge Advocate, Hq. ATC, Randolph AFB, Tex. . . . **Brig. Gen. Don Coupland,** from Deputy Commander, AMC-BMC, to Vice Commander, Ballistic System Div., AFSC, Inglewood, Calif. . . . **Maj. Gen. Allman T. Culbertson,** from Director of System Management, WADD, ARDC, to Deputy for Systems Management, Aeronautical Systems Div., AFSC, Wright-Patterson AFB, Ohio. . . . **Maj. Gen. John K. Cullen,** from Deputy Surgeon General, Hq. USAF, Washington, D. C., to Surgeon, Hq. USAFE, APO 633, N. Y., N. Y. . . . **Maj. Gen. Benjamin O. Davis, Jr.,** from DCS/O, Hq. USAFE, APO 633, N. Y., N. Y., to Director of Manpower and Organization, DCS/O, Hq. USAF, Washington, D. C.

Maj. Gen. Waymond A. Davis, from Commander, Aeronautical Systems Center, AMC, to Commander, Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. . . . **Brig. Gen. Jack N. Donohew,** from Director for Programs, The Joint Staff (Central Control Group) Hq. USAF, Washington, D. C., to Commandant, Squadron Officers' School, Air University, Maxwell AFB, Ala. . . . **Maj. Gen. Howell M. Estes, Jr.,** from Asst. DCS/O, Hq. USAF, to Deputy Commander, AFSC for Aerospace Systems, AFSC, Andrews AFB, Washington, D. C.

Brig. Gen. Richard W. Fellows, from Deputy Director, Programs, DCS/P-P, Hq. USAF, Washington, D. C., to Deputy Director, Maintenance Engineering, Hq. AFLC, Wright-Patterson AFB, Ohio. . . . **Maj. Gen. Robert J. Friedman,** from Director of Budget, Office of AF Comptroller, Hq. USAF, to DCS/Comptroller, Hq. AFSC, Andrews AFB, Washington, D. C.

Maj. Gen. Thomas P. Gerrity, from Commander, AMC-BMC, to Commander, Ballistic Systems Div., AFSC, Inglewood, Calif. . . . **Brig. Gen. Jack A. Gibbs,** from Commander, Hq. 5040 AB Wing, AAC, to Deputy Commander, AAC, APO 942, Seattle, Wash. . . . **Maj. Gen. Joseph E. Gill,** from Director of Site Activations, AMC-BMC, Norton AFB, Calif., to Asst. to Commander, Hq. Ballistic System Div., AFSC, Inglewood, Calif. (duty station Norton AFB, Calif.) . . . **Brig. Gen. Frank**

(Continued on page 35)

The free world, three distinguished authors declare in an important new book, has "steadily lost ground in the international struggle with communism." The answer, they say, is an across-the-board "strategy of active pressures against the Communist bloc" . . .

'A Forward Strategy for America'

A BOOK ANALYSIS

FOR several years the United States and the free world have steadily lost ground in the international struggle with communism. If this process continues it may, within the foreseeable future, become irreversible . . .

"As we see it, the most prudent policy—and indeed the only safe policy—for the next decade will be to be prepared for continued conflict along a wide spectrum. . . . If our analysis has any validity, then it should be profitable for us to examine the emerging world picture from that unified viewpoint and suggest the outline of a forward United States strategy to counter the Communist conflict pattern."

This, in the words of its three distinguished authors, is the theme of an important new book, *A Forward Strategy for America* (Harper & Brothers, N. Y. $5.95). It deals with military, economic, psychological, political, and technological aspects of today's international power struggle. The authors are Dr. Robert Strausz-Hupé, Col. William R. Kintner, USA and Dr. Stefan Possony. All are associated with the Foreign Policy Research Institute of the University of Pennsylvania; Dr. Possony is also a professor at Georgetown University and a consultant to the Air Force. Dr. Strausz-Hupé and Colonel Kintner, a Pentagon staff officer, were among the four coauthors of *Protracted Conflict*, a studious analysis of the global Communist threat published in 1959. *A Forward Strategy for America* is a follow-on to the earlier volume.

The US, the authors say, has failed to date to pursue a positive, energetic, "forward" cold-war strategy for several reasons:

- "The *defensive* psychology of the West and the moral aversion of the free nations to employ force for purposes other than defense against physical aggression."
- "The strange reluctance of the West to face the plain fact that the goals of the enemy are as fixed as his methods are flexible."
- "Residual complacency" regarding armed strength "nurtured by the belief that a nuclear stalemate has made war unthinkable."
- Failure to calculate correctly military power and the extent to which the Red rulers are prepared to assume the risks of a showdown."
- Western European military weakness and related fear that a bold American policy would invite a Soviet invasion of the area.
- Western underestimation of Communist sentiment behind the Iron and Bamboo Curtains.
- The "erroneous notion" that the world's noncommitted areas hold the balance of power and, therefore, must claim the highest priority in Western policy. This concept, the authors feel, has diverted our attention from the true jobs at hand.

In place of the policies that we have pursued, *A Forward Strategy for America* calls for a fresh approach, "a strategy of active pressures directed against the communistic bloc . . . designed not only to contain communism but to emasculate its disruptive power." The first and most urgent requirement of this strategy would be "to reduce Communist power by restoring and then maintaining our military advantage over the Sino-Soviet bloc."

"The immediate requirements for stopgap measures which will block the Communist bid for a clear military superiority call for expenditures of several billions of dollars over and above the defense budget of 1961," the book continues. Specific short-term programs include an airborne alert; improved US air defense; accelerated development of antimissile systems and production of Nike Zeus; stepped-up ICBM development, production, and deployment; the construction of fallout shelters by federal and state governments; intensified antisubmarine programs; strengthening and hardening of US and overseas bases; modernization of surface-battle weapon systems; establishment of a rational 'mobilization' base capable of functioning after a nuclear strike; development and production of supersonic aircraft like the B-70; accelerated research and development for nuclear-propelled aircraft, nuclear ramjet engines, and short-range space systems; a genuine sharing of nuclear weapons with our allies; and the incorporation of some chemical weapons into the military arsenal for tactical purposes.

"Only immediate action will tide the US over the incipient period of extreme danger in the early '60s. Half measures will not solve all the military problems of an

(*Continued on page 36*)

W. Gillespie, from Commander, Hq. SEADS, ADC, McChord AFB, Wash., to Commander, 86th Air Div. (Def) USAFE, APO 12, New York, N. Y. . . . **Brig. Gen. George M. Higginson,** from DCS/O, Hq. USAFSS, San Antonio, Tex., to Asst. Director, National Security Agency, Ft. George G. Meade, Md. . . . **Brig. Gen. Perry M. Hoisington, II,** from Commander, 820 Air Div., SAC, Plattsburgh AFB, N. Y., to Commander, Hq. 6th Air Div., SAC, Dow AFB, Me. . . . **Maj. Gen. Joseph R. Holzapple,** from Commander, WADD, ARDC, to Asst. to Commander, AFSC (duty station Wright-Patterson AFB, Ohio). . . . **Maj. Gen. Robert E. Greer,** from Vice Commander for Satellite Systems, AFBMD, ARDC, to Deputy Commander, Space Systems Division, AFSC, Inglewood, Calif. . . . **Maj. Gen. Daniel E. Hooks,** from Commander, AF Research Div., ARDC, to Commander, Office of Aerospace Research, Washington, D. C. . . . **Maj. Gen. John H. Ives,** Deputy Commander, 3d AF USAFE, APO 125, N. Y., assigned additional duty as Chief, MAAG, United Kingdom. . . . **Brig. Gen. David M. Jones,** from Vice Commander, WADD, ARDC, to Vice Commander, Aeronautical Systems Center, AFSC, Wright-Patterson AFB, Ohio. . . . **Maj. Gen. Alfred F. Kalberer,** from Asst. to the Commander, CONAC, Mitchel AFB, N. Y., to Chief of Staff, Allied AF Southern Europe, FPO 510, N. Y., N. Y.

Brig. Gen. Baskin R. Lawrence, Jr., from Director of Technology, AFCCDD ARDC, to Asst. to Commander, Electronic Systems Div., AFSC, Laurence G. Hanscom Field, Mass. . . . **Brig. Gen. William E. Leonhard,** from Deputy Commander for Civil Engineering, AFBMD, ARDC, Inglewood, Calif., to Director of Budget, Office of AF Comptroller, Hq. USAF, Washington, D. C. . . . **Lt. Gen. William F. McKee,** from Vice Commander, Hq. AMC, to Vice Commander, AFLC, Wright-Patterson AFB, Ohio. . . . **Maj. Gen. Marvin L. McNickle,** from Director of Materiel, Hq. TAC, Langley AFB, Va., to Director of Supply, Hq. AFLC, Wright-Patterson AFB, Ohio. . . . **Maj. Gen. Clyde H. Mitchell,** from Commander, AMC Electronic Systems Center, Laurence G. Hanscom Field, Mass., to DCS/M, Hq. AFSC, Andrews AFB, Washington, D. C. . . . **Maj. Gen. Thomas S. Moorman, Jr.,** from Commander, Hq. 13th AF, PACAF, APO 74, San Francisco, Calif., to Commandant, War College, Air University, Maxwell AFB, Ala. . . . **Brig. Gen. J. W. O'Neil,** from DCS/Plans & Operations, AFBMC, ARDC, to Asst. to Commander, Ballistic Systems Div., AFSC, Inglewood, Calif. . . . **Brig. Gen. Harvard W. Powell,** from Vice Commander, AFBMD, ARDC, to Asst. to Deputy Commander, AFSC for Aerospace Systems, AFSC, Inglewood, Calif. . . . **Brig. Gen. Kyle L. Riddle,** from Commander, 66th Tactical Reconnaissance Wing, USAFE, APO 17, N. Y., N. Y., to Chief of Staff, Hq. 17th AF, USAFE, APO 12, N. Y., N. Y. . . . **Maj. Gen. Osmond J. Ritland,** from Commander, AFBMD, ARDC, to Commander, Space Systems Division, AFSC, Inglewood, Calif. . . . **Brig. Gen. John A. Rouse,** from DCS/Plans, Programs & Operations Services, Hq. ATC, Randolph AFB, Tex., to ACS Operations, A-3 PACAF, APO 953, Calif. . . . **Lt. Gen. Bernard A. Schriever,** from Commander, Hq. ARDC, to Commander, AFSC, Andrews AFB, Washington, D. C. . . . **Maj. Gen. Sory Smith,** from Chief of Staff, TAC, Langley AFB, Va., to Deputy Commander, Joint Task Force Four, Ft. Monroe, Va. . . . **Brig. Gen. Charles H. Terhune, Jr.,** from Vice Commander, AFCCDD, ARDC, to Vice Commander, Electronic Systems Div., AFSC, Laurence G. Hanscom Field, Mass.

Maj. Gen. Harold Twitchell, from Surgeon, Hq. USAFE, APO 633, N. Y., N. Y., to Asst. to Commander, Hq. Lowry Tech. Training Center, ATC, Lowry AFB, Colo. . . . **Brig. Gen. Neil D. Van Sickle,** from ACS/Operations, A-3, Hq. PACAF, APO 953, San Francisco, Calif., to Commander, Hq. 3535 Nav. Training Wing, ATC, Mather AFB, Calif. . . . **Brig. Gen. Thomas B. Whitehouse,** from Executive to the Vice Chief of Staff, Hq. USAF, Washington, D. C., to DCS/Plans, Programs & Operations Service, Hq. ATC, Randolph AFB, Tex. . . . **Maj. Gen. Albert T. Wilson, Jr.,** Asst. Comptroller of the AF, Hq. USAF, Washington, D. C., relieved of duty as Acting Comptroller of the AF. . . . **RETIRED:** Brig. Gen. Sheldon S. **Brownton,** Lt. Gen. William D. **Eckert,** Brig. Gen. Bertrand E. **Johnson,** Lt. Gen. Donald N. **Yates.**—END

Arthur Sylvester, Assistant Secretary of Defense for Public Affairs, pins Meritorious Civilian Service Award on Reserve Col. Moncel A. Monts, Chief of Air Force News Branch in Pentagon, on latter's recent retirement from capital scene.

effective forward strategy; but they will redress at least the power balance and rescue the US from its present predicament. Such measures will also help to change the psychological mood of the free world. The belief that the world military balance is tipping against the US is at the root of many of our external problems."

It is apparent that the authors' views are not in total consonance with those of President Kennedy. The President's military budget message to Congress on March 28 did increase the *rate* at which we would acquire ICBMs and Polaris submarines and accelerated the Army's modernization of its conventional arms.

Yet the President's message cut off the Aircraft Nuclear Propulsion Program from the military establishment and gave the eviscerated remains to AEC. The B-70 was reduced to a purely development effort. Three squadrons of mobile missiles were diverted to hardened configurations. The three latter decisions differ from the authors' thesis.

Here, in subject-by-subject breakdown, are some of the book's further conclusions—with some thoughts on them along the way:

Military weaponry: Technological advances have vast implications for our military power. But we have not made full use of technology. One fertile field for development has been that of nuclear weapons; there is still, at this point, much room for further development, although this in some cases would hinge on renewed nuclear testing. Important developmental goals would be "clean" nuclear bombs, radiation weapons, a variety of warheads suited for diverse targets. We might also seek reduced costs of nuclear weapon production. Nuclear propulsion systems for subsurface, surface, atmospheric, and space vehicles are a must.

Further, modern technology could provide us with improvements in "conventional" weapons but it is "stymied" by "lethargy." It is "perplexing" that in the nuclear age the US has such little regard for chemical and biological weapons. In addition, we must press forward with increased energy to produce a defense against ballistic missiles, antisubmarine weapons, up-to-date amphibious and ocean-going transports, increased air defense capabilities, modern strategic and tactical airlift.

General-war strategies: Before the nation are five possible wartime strategies; finite deterrence, balanced deterrence, preemptive counterforce deterrence, counterforce preventive, and counterforce.

• Finite deterrence envisions a "no-win" situation. It is in effect, a mutual suicide pact. "Its tool is an invulnerable second-strike force that can smash the attacker's cities." It can be used only if the US is directly attacked.

• Within the strategy of balanced deterrence, we must accept the first blow and then go on to level the enemy's cities. Emphasis is placed also on continental defenses, civil defense, and limited-war capabilities.

• Preemptive counterforce deterrence evolves from balanced deterrence, adding a "first-strike" capability which could be used in a state of extreme provocation—for example, a major Soviet attack on a NATO ally. We would threaten to strike Soviet cities, but we would spare them, holding them hostage instead. Simultaneously, we would defend our military force, our cities, and our population against the Soviet second strike. Although the requirements of this strategy are demanding of national resources, if we had the national "will" essential to make such a strategy work, we could chance a reduction in our limited war forces.

• Counterforce preventive or "Win on First Strike" has lost most of its supporters. The main attraction in this strategy is that, theoretically, it would relieve us of maintaining large limited-war forces. "A policy of preventive war, however, is anathema to our sense of values. . . . The open rejection of this option limits the versatility of our political action and hands the initiative to the adversary."

• Counterforce or "Win Strike Second" is our current official position. We allow the Soviets to strike the first blow and then we go on to win. We "hold Communist bloc cities hostage . . . and seize and occupy the Soviet Union and Red China. This is the American ideal strategy. It is sound morally—and it may be sound militarily, as we approach the late '60s and a higher degree of invulnerability in our strategic forces." We do not now have the capability to fight such a war even though this strategy is the most desirable.

"Despite some discussion of the above alternative strategies, we as a nation, in fact, have in recent years adopted a 'mutual suicide pact' posture by default. We lack the forces needed to replace the so-called 'massive retaliation' policy."

Nuclear stalemate: The authors caution against assuming that a "balance of terror" automatically produces a stable nuclear stalemate. They feel such a view is dangerous because it fails to recognize that persistent scientists will come up with "breakthroughs" and "most disconcerting military surprises." In this regard, they propose that the United States consider a "comprehensive system of academies for the sciences and technologies as a means of invigorating the national effort."

Limited war: The authors propose to fight limited wars with conventional weapons. They are critical of public opinion which they feel has eliminated all forms of war other than general nuclear. The atom bomb was so powerful that "older instruments of military power" appeared to have lost their usefulness. "Events since then have taught us otherwise. They have discredited the notion that all the weapons of the preatomic age are outmoded."

There is a question, they say, whether we possess the "psychological resolve" to use nuclear weapons if they are not first used by the enemy. The authors view nuclear weapons as "massive" and not easily restricted to the battlefield. They are deeply concerned about unintentional damage to centers of population located near military installations or troop concentrations. "It follows that the United States and its allies require 'multicapability' forces for land operations. Yet nuclear weapons must be a part of this arsenal."

The authors state, "By maintaining a sizable nonnuclear military capability we can force the Soviets to use *their* nuclear weapons *first* if they choose to achieve their objectives" *(their italics)*. They continue: "Even considering world opinion, the United States must calculate the disastrous harm to its international prestige if it were defeated in a limited war with the Communists because it feared to resort to nuclear weapons. Although we hope that the onus for initiating nuclear war will fall upon the Kremlin, the Communist strategists must be under no misapprehension that we will not use, if necessary, nuclear arms."

Here the authors have discovered a basic dilemma. They say that an effective nonnuclear capability could *force* the Soviets to use nuclear weapons. Otherwise the Soviets could force *us* to use nuclear weapons. Then we would not use nuclear weapons first—if we were winning! If we were losing we *would* use them first! It appears reasonable that the Kremlin could use the same logic, *i.e.*, if they were winning we would be forced to use nuclear

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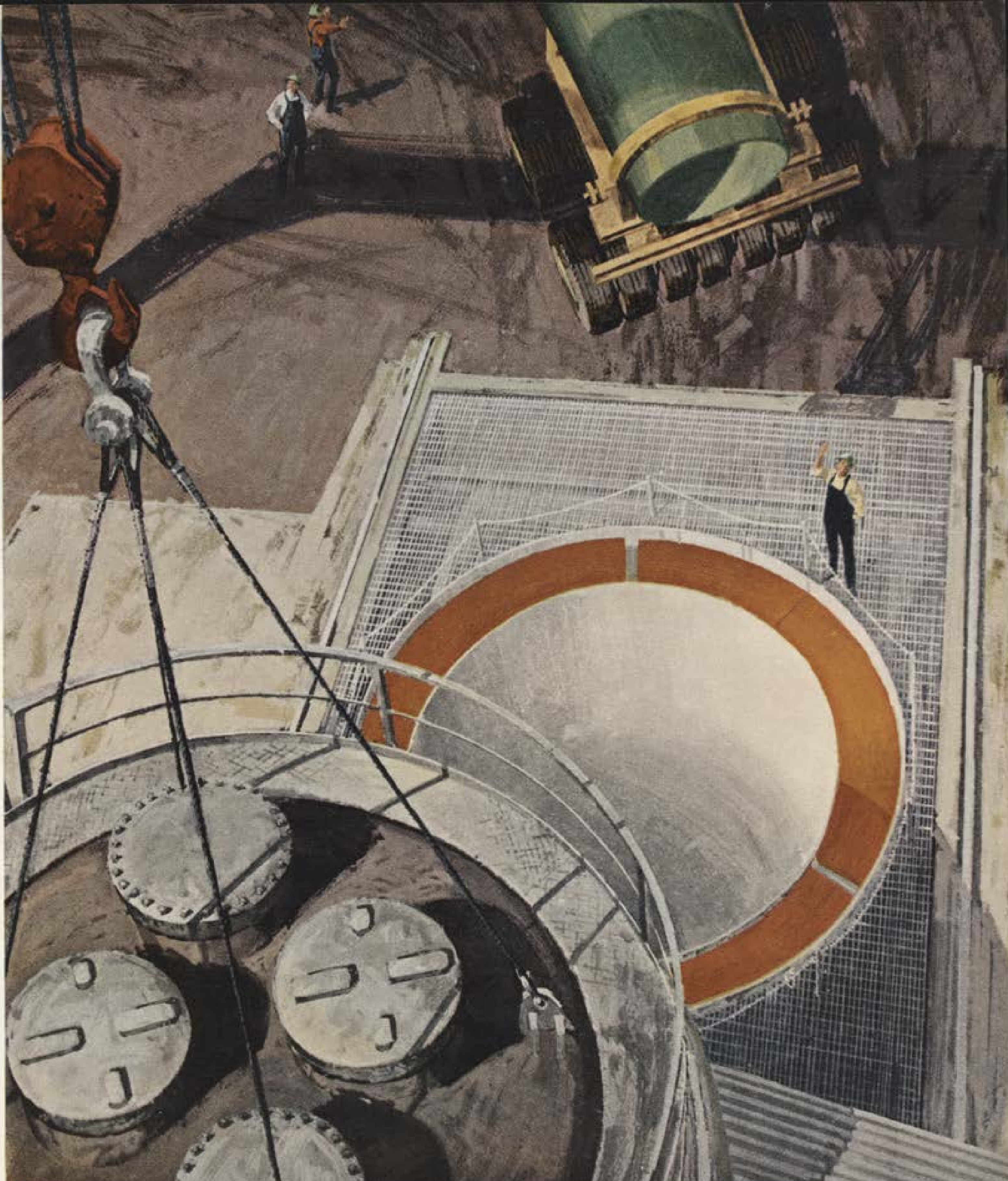


UNITED TECHNOLOGY CORPORATION DEDICATES NEW ROCKET PROPULSION COMPLEX NEAR SAN FRANCISCO

HUGE LID is lifted from an in-ground curing oven for solid propellant rockets at UTC Development Center. This particular oven is the largest in the free world.

AERIAL VIEW of UTC Research and Engineering Center in Sunnyvale, California, shows Administration and Engineering Buildings and Research and Testing Laboratories.

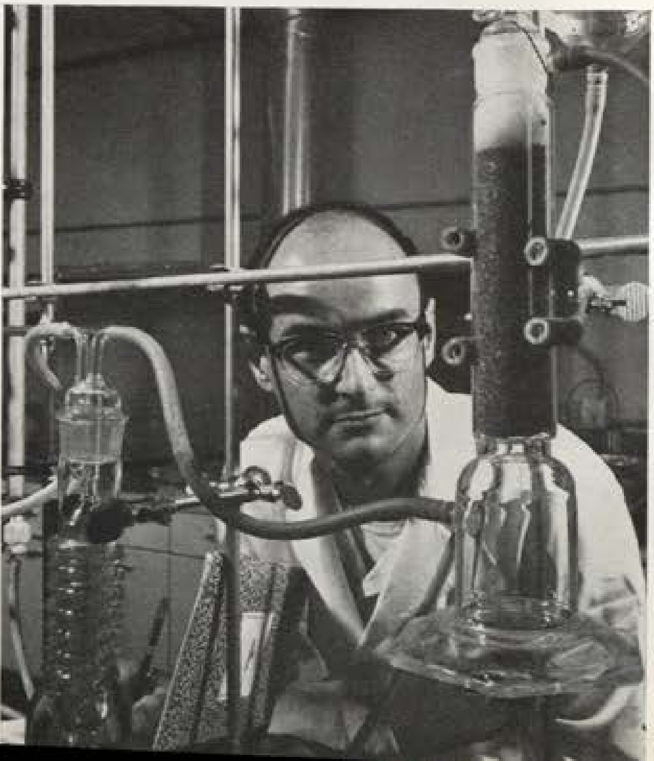
UNITED TECHNOLOGY CORPORATION FACILITY PROVIDES CAPACITY FOR DEVELOPMENT AND TEST OF BIGGEST U.S. SOLID PROPELLANT ROCKETS

Dedication of privately-financed installation is significant milestone in 41-year history of pioneer propulsion organization

With work well underway on a broad range of propulsion research and development activities, United Technology Corporation has officially dedicated its new facility in the San Francisco Bay Area.

Here all the necessary equipment and facilities for basic research, prototype evaluation, final development, and processing of solid and liquid rockets have been integrated into a modern, functional complex.

The photos here give some indications of the capacity of these facilities.

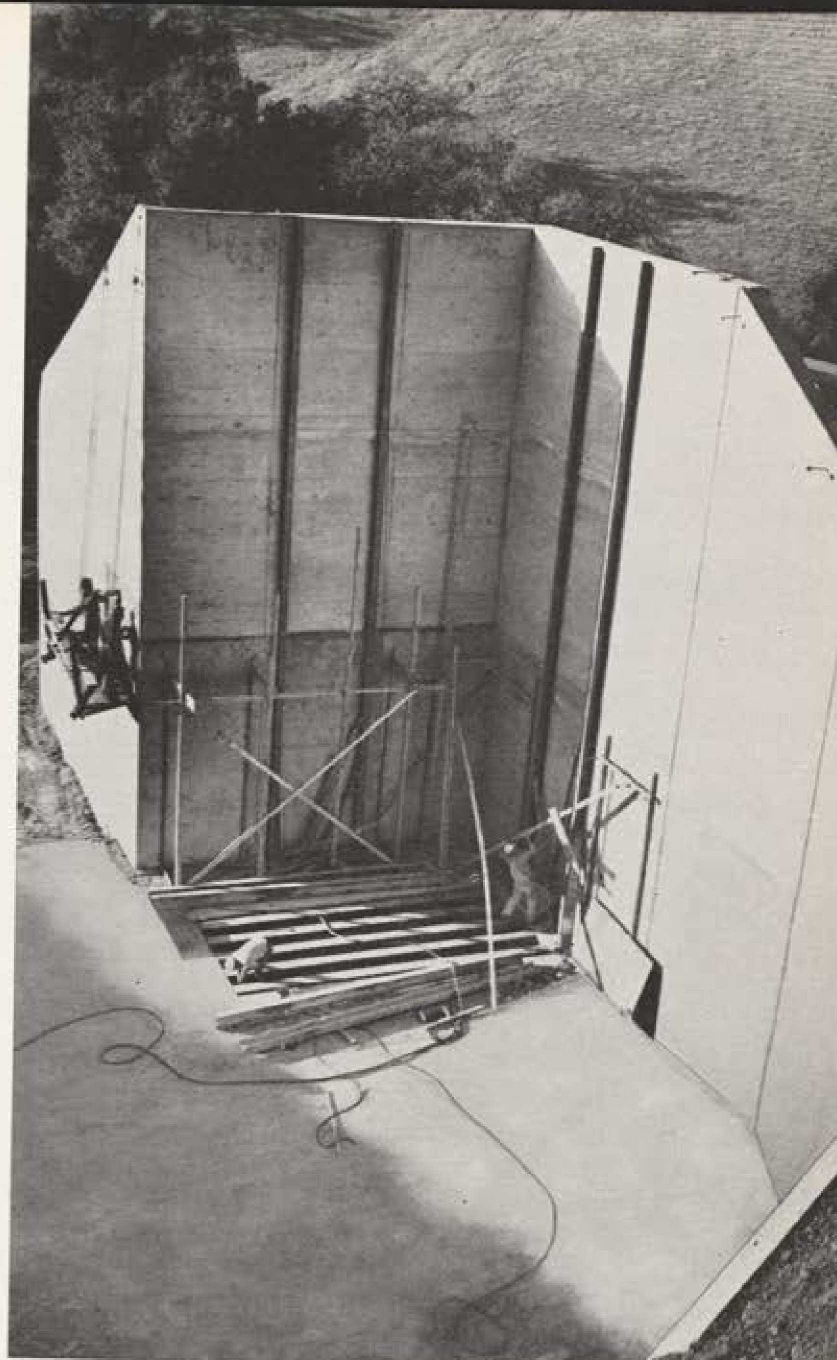


HIGHLY SKILLED and experienced scientists and engineers are conducting a full range of propulsion research and development activities at UTC's new installation.

VIEW OF ENTRANCE to the 3200 acre Development Center, located in foothills a short distance from Sunnyvale, which includes the world's most modern propellant processing plant and test facilities for both solid and liquid rockets.

UTC's SOLID-PROPELLANT MANUFACTURING PLANT has capacity to produce in excess of a million pounds of propellant per month.

HUGE PROPELLANT MIXER is one of four included in UTC processing line.



TOWERING TEST STAND at the Development Center will accommodate very large solid rockets. In addition, four medium sized solid rocket test cells and two liquid propellant test stands are available for developmental work. Each is connected to a remote control center which houses equipment for test control and data acquisition.


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

weapons first; if losing, they would use nuclear weapons first. This leaves no justification for "sizable conventional forces, since nuclear weapons are bound to be used anyway."

Thus, the authors have exposed unintentionally the principal fallacy of advocating "sizable" conventional limited-war capability. Since nuclear weapons would be employed by the losing side to prevent defeat, what is the purpose of creating "sizable" conventional forces in the first place? One of the few major criticisms of this book is that it reflects some of the current confusion on "limited" war.

Soviet strategy: The authors assess the main lines of current Soviet strategic thinking as follows:

1. The Soviets do not accept the finality of mutual thermonuclear deterrence.
2. The Soviets do not rule out a surprise thermonuclear attack.
3. The Soviets seek to deceive us and enfeeble our efforts, saying limited war is no longer possible.
4. The Soviets are aware that a nuclear attack on Russia would cause heavy damage to their country. After the initial exchange, the survivors must slug it out. "No matter how else one might rationalize the Communist intention, it is difficult to shrug off their preparation for a bitter-end fight with the United States."

Arms control: Disarmament, arms control, and arms reduction are discussed in some detail. The authors list five fallacies regarding the cessation of atomic testing:

• Fallacy 1. *"Since we and the Soviets have arrived at a nuclear 'stalemate,' we need not push the development of nuclear weapons any farther."*

Such an assumption is "intrinsically absurd." We need testing to increase the efficiency and discrimination of our warheads; we need new multimegaton warheads for attacking hardened missile sites; we need improvements in yield-to-weight and yield-to-diameter ratios; we have never tested a fully armed ICBM; we need to perfect small atomic weapons; we must continue experimentation to reduce radioactive contamination and develop neutron weapons; we need to test in order to perfect antimissile defenses; and we must learn more of the "Christofolos effect." All these can be accomplished underground or in space—*testing need not contaminate the atmosphere.*

• Fallacy 2. *"Our technical detection capabilities had progressed to a point where the policing of an all-inclusive test ban was feasible. Moreover, our unilateral moratorium was perfectly safe from the standpoint of national security because our scientists could certainly tell us whether the Soviets were testing."*

Damped or decoupled underground tests in the small-to-medium kiloton range cannot be reliably detected. Tests could also be made behind the moon.

• Fallacy 3. *"All nuclear tests contaminate man's physical environment and jeopardize the health of mankind."*

We could have, and perhaps should have, unilaterally renounced atmospheric testing. Yet we let the Russians maneuver the Geneva meeting into a discussion aimed at the elimination of *all* testing—harmful or otherwise.

• Fallacy 4. *"A test ban treaty among the 'Big Three' nuclear powers would resolve the so-called nth-Country Problem by limiting the membership in the 'Nuclear Club.'"*

The authors' argument is summed up in this sentence: "No one has yet come forth with a politically satisfactory explanation of just how the 'Big Three' solution is to be imposed upon all the other nations of the world, especially those like France and Red China who entertain serious nuclear-power ambitions but have not been parties to the Geneva negotiations."

• Fallacy 5. *The nuclear test ban will provide a significant precedent in international arms control administration and will serve to "open up" the Soviets' closed society.*

"Setting up a handful of stations in isolated areas of the USSR (where conditions of travel by motor vehicle, rail, or aircraft would not be available) will contribute little to the 'opening up' of six million square miles of totalitarian society. The Soviets obviously have no intention of permitting the international staffs of scientists and technicians to engage in either casual movement or unsupervised contacts. If the cultural exchange programs which involve much larger numbers of persons have not succeeded in opening 'Western windows' into the USSR, certainly a test ban treaty cannot."

A too-often neglected problem of arms control is what to do if one nation is caught cheating! The authors deserve a pat on the back for their note of caution:

"Arms control systems cannot be policed. The only sanction, once we have discovered a violation by the other side, is to scrap the agreement and resume the arms race. But once a violation has been reported, a Western democratic nation will be reluctant to take the required counteraction. . . ."

Manned aircraft: The authors point out that at least until the mid '60s the bulk of the free world's strategic power will reside in aircraft.

". . . The race for missile superiority holds public attention. Both sides, however, will experience a recurring, indeed a permanent, need for aircraft delivery in order to strike at *mobile* launching systems and other mobile targets, and, last but not least, to deal with unforeseeable circumstances. To put it differently, the more the United States relies on the mobile Polaris and Minuteman, the more necessary it is for the Soviet Union to retain effective bomber forces as part of its own striking power. Both sides will have to rely on aircraft for poststrike reconnaissance missions to determine the damage done to targets, for air surveillance may be a vital factor in determining the residual capabilities of the enemy following a strategic nuclear exchange. Such craft will have to pit themselves against increasingly sophisticated and effective defense systems."

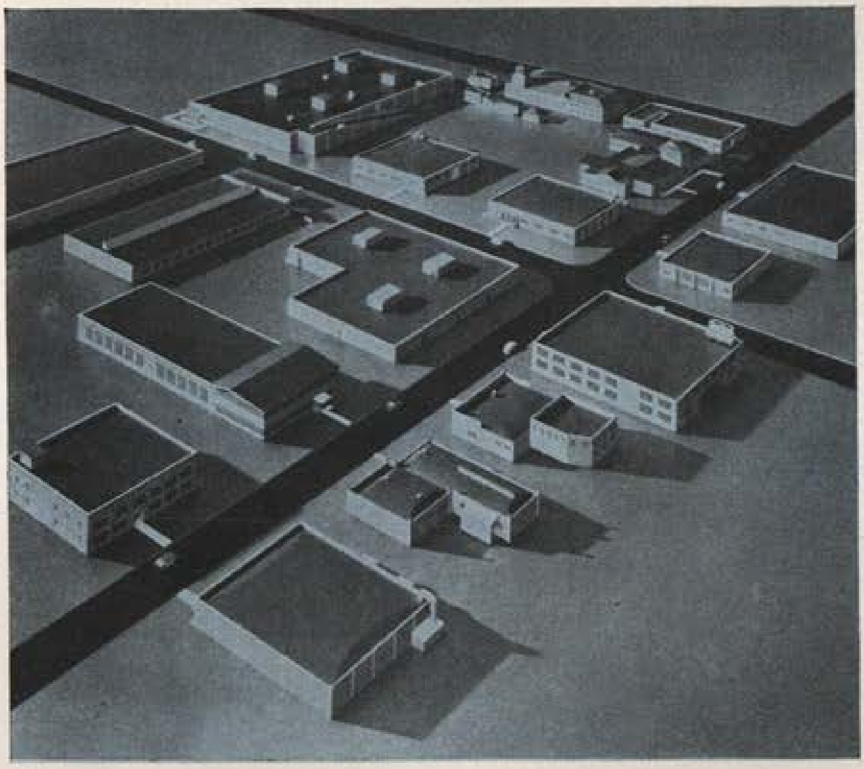
Money: Substantial augmentation of US strategic efforts within the next few years, efforts well above the Soviet level, would not involve undue sacrifice or unmanageable inflation, much less "economic ruin . . ." America can "afford to survive" and *must* make almost herculean efforts to do so within the next few years.

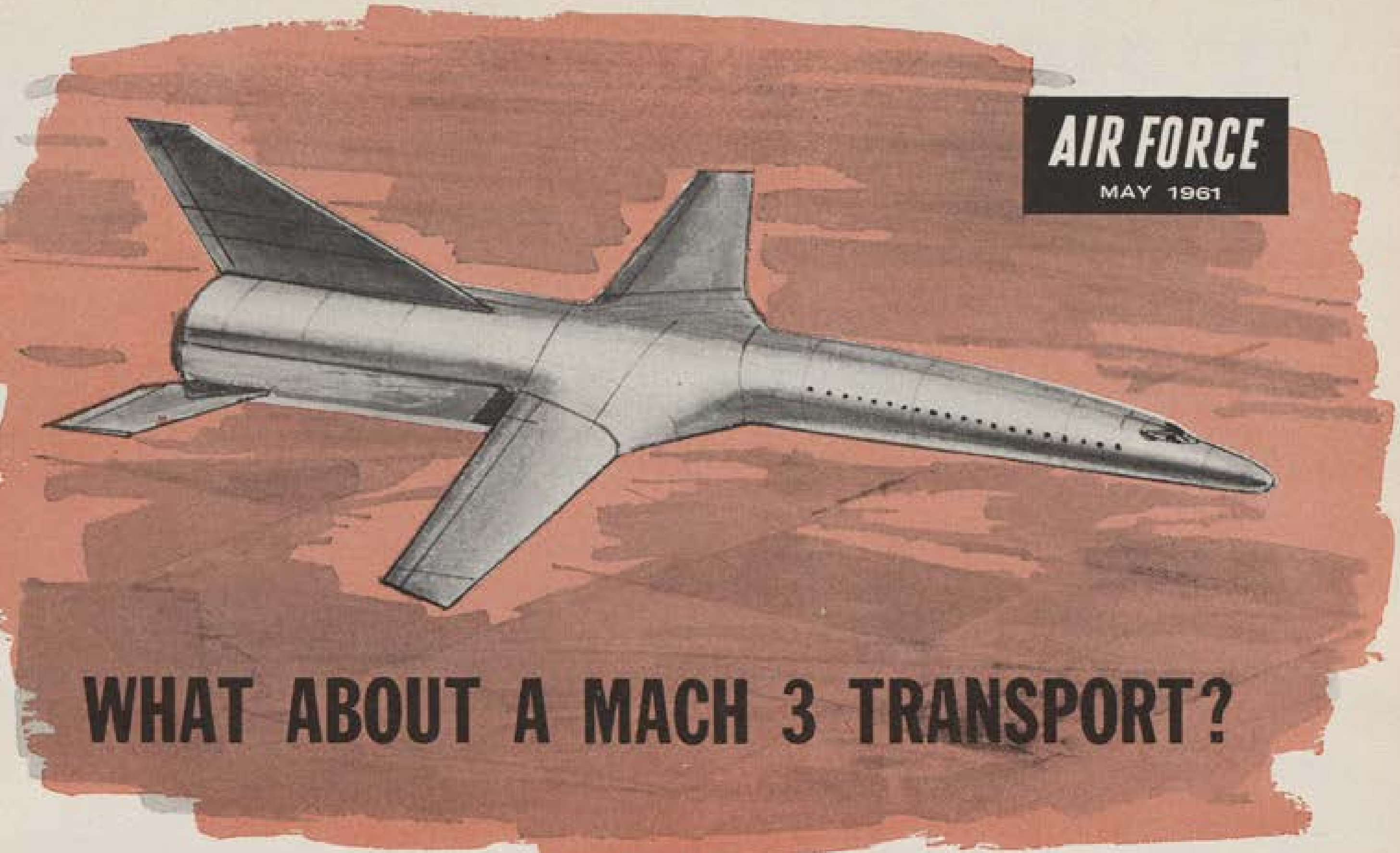
Economic cold war: "A fully employed, purposive Soviet economy, bent on overtaking the US, appears, at present, to be gaining in the race. An underemployed United States, lacking a positive strategy, is lagging.

"But the underemployment of the resources of the US economy can be a source of strength. Our economy possesses the flexibility and reserves to support any and all strategies which lie in the national interest."

Summation: "Central to any forward strategy must be the thesis that there is no substitute for victory. The growing tendency within certain elements of the US public to accept conditions short of victory must be reversed. This can be done only through strong and courageous leadership by the Administration. The public cannot be continually fed statements which convey too often the impression that all is well."

Comment: This book is the best to come from the "armchair strategists" to date.—END





WHAT ABOUT A MACH 3 TRANSPORT?

Artist's conception above resembles the Mach 3 airliner design favored by NASA's Langley Research Center and at least one major transport manufacturer. Its variable-sweep wings are extended above for efficient subsonic approach and landing.

J. S. Butz, Jr.

TECHNICAL EDITOR, AIR FORCE MAGAZINE

IN ITS early aviation judgments the Kennedy Administration decided the Air Force should not build the B-70 Mach 3 bomber in quantity. At the same time, the Administration started the ball rolling on a Mach 3 transport for commercial airlines to use around 1970.

Paradoxical as these decisions might appear, they imply much more than just an opinion that the Air Force does not need a 2,000-mph bomber to fulfill its responsibilities in the last half of this decade.

The Administration also has strongly implied that a Mach 3 bomber cannot be easily modified into a Mach 3 commercially attractive transport. While there are some competent people in industry who dispute this idea, it obviously is the judgment of Mr. Kennedy's advisers.

The basis for this judgment can be summed up in one sentence: The supersonic transport mission is technically more difficult than the supersonic bomber requirement that the B-70 satisfies.

The fact is, the B-70 project has pioneered Mach 3 technology in the US. With a redesigned fuselage, the airplane could serve as a military transport for the rapid movement of troops or high-priority cargo. If a tight development cycle was considered a key factor in choosing a supersonic transport for civil use, the B-70 would be the logical choice because the airframe design is essentially complete. This B-70-type transport could be ready for service three or four years ahead of any new design.

However, no design exists today, either a modified B-70 transport or a paper preliminary design, which would satisfy all of the basic requirements for a money-making 100-120 passenger, transoceanic, Mach 3 transport.

Some of the unique commercial requirements for this airplane are:

- The airframe must last for 30,000 to 40,000 hours as against about 4,000 hours normally figured for a military aircraft. In addition, the structure must survive heating to around 500 degrees F. and then cooling down on the average of twice a day.
- New-type, low-noise turbofan engines will be required. Large afterburning turbojets, such as the J93 in the B-70's six-engine, 150,000-lb.-thrust-plus installation, are too noisy for present civil airport regulations. Public complaints have united airport operators in resisting further increases in noise. A new type of large-airflow turbofan engine under study shows promise of doing just this. It could make a Mach 3 transport a little quieter than current jet airliners. This engine also appears to satisfy the stringent demands made on a long-life transport powerplant. Its unusual cycle is

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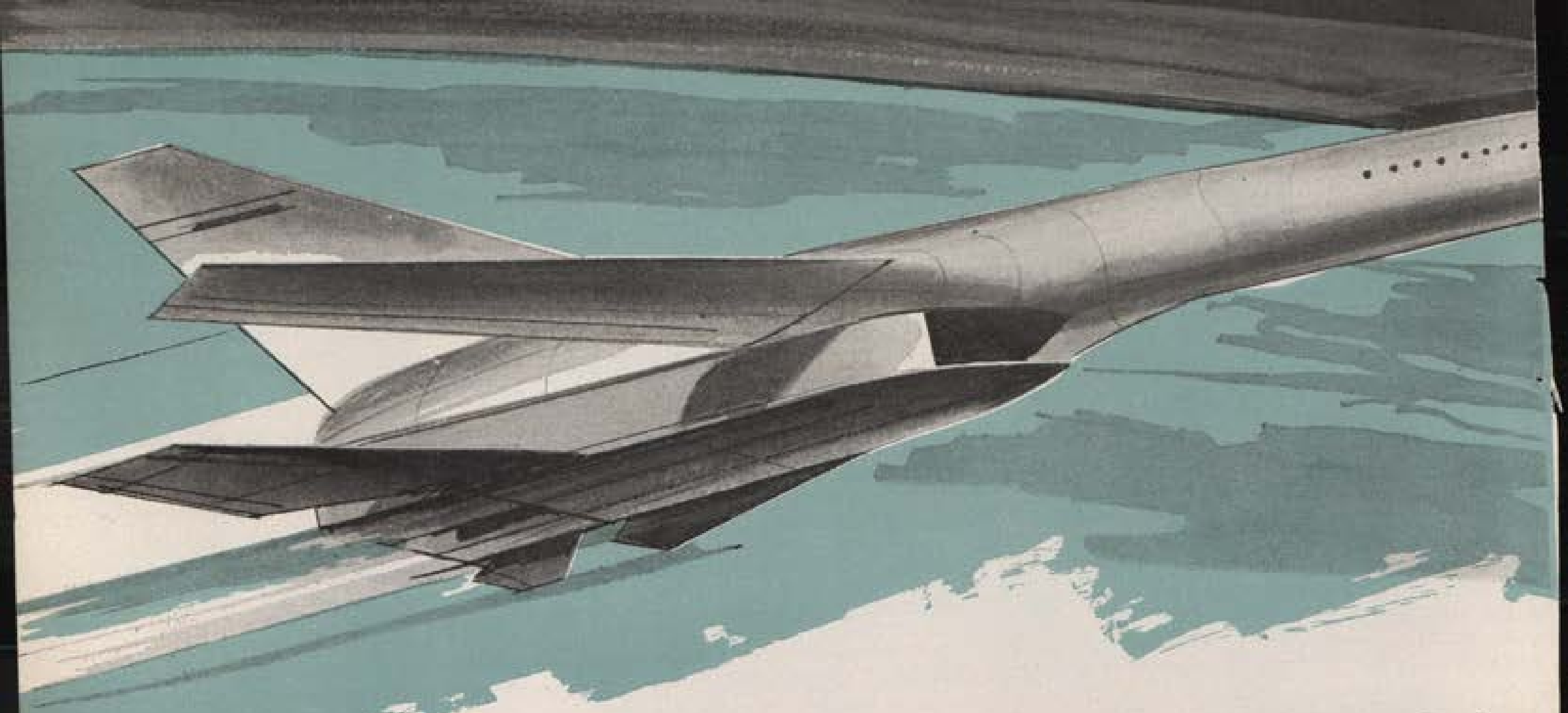

Wing sweep would be increased to slightly more than 70 degrees during Mach 3 cruise at 65,000- to 75,000-ft. altitude climb and acceleration would consume almost one-third of fuel. Variable-sweep wings and turbofan-ramjet engines possibly will eliminate strong sonic boom on ground by allowing the aircraft to climb to 45,000 ft. before exceeding Mach 1. Magnifying optical windows requiring small fuselage hole probably will be used to give passengers large view.

probably best described as a supercharged ramjet (*see illustration, page 47*).

• Large fuel reserves, for "stacking" or diversion to an alternate landing field in case of bad weather, are much more pressing in terms of the Mach 3 transport than in the case of a military aircraft. Weight of the necessary fuel reserves on a 2,000-mph transport would almost equal the airplane's entire payload. Studies are under way now to relax the civil rules to reflect the rapidly improving capabilities of the air traffic control system and all-weather landing equipment. By the time the supersonic transport is available, it should be possible to land at all major airports with almost complete disregard of weather conditions. If this proves to be true, the need for fuel reserves will be greatly reduced. But, as of now, the need is there.

• Landing and takeoff speeds for most Mach 3 airplane designs will be higher than those of present airline jets. Highly swept, short-span wings are needed for efficient cruise at Mach 3. But these wings give poor performance at subsonic speeds and during landing and takeoff. Most airport operators oppose the lengthening of runways to accommodate higher speeds. Few airlines want to take off passenger aircraft faster than the present high of 185 mph. The present-day 140-mph touchdown speed also is about the maximum that most airlines want to handle.

In contrast, the short-span, deltawing airplane with a canard horizontal control surface on its nose (a very efficient Mach 3 cruise configuration) would have to land at 165 to 175 and take off at more than 220 mph.

Low-speed performance depends basically on the wingspan. To realize a significant improvement, the span must be increased. Additional power, slats, flaps, and other high-lift devices help, but the wing must be lengthened if major reductions are to be made in landing and takeoff speeds.

Two methods are available today to increase the span on a Mach 3 airplane. Actually it is the aspect ratio which must be increased. This is equal to the span divided by the wing chord.

The first method is simply to increase the aspect ratio by making the wing longer and slimmer. A weight penalty and an increase in drag at cruise speed work against this system.

The second method is to use variable-sweep wings. During subsonic flight, the outer portions of the wing would be moved forward so that their leading edge had thirty degrees sweep or less (*see illustration, page 43*). Landing performance then would be close to that of current subsonic jets.

In flight, as the aircraft accelerated to its cruise speed the wings would be swept back until the angle reached seventy degrees or a little more (*as shown in the illustration above*). There would then be no penalty in cruise drag because the leading edges would be behind the strong shock wave created by the nose of the aircraft. Disadvantages of the variable-sweep approach are increased structural weight and mechanical complexity.

The variable-sweep wing had a disappointing development history in the early and middle '50s. Recently, however, the situation has changed radically. Manu-

facturers who wouldn't have considered a variable-sweep wing under any circumstances two years ago are now creating bomber, transport, fighter, and reconnaissance aircraft designs around this wing principle.

The change of attitude stems from research studies performed at the Langley Research Center of the National Aeronautics and Space Administration. These have spurred US variable-sweep research. The NASA researchers kept after the idea even though their early designs lacked appeal for both industry and the military because of control problems and excessive weight.

Once the Langley group began to report solutions to their former troubles, industry started its own investigations. Some manufacturers now have more hours of wind-tunnel time on variable-sweep wing studies than does NASA. The results have been extremely encouraging. Today it is safe to predict that a portion of the next generation of US aircraft will have variable-sweep wings.

Variable sweep is figuring prominently in the competition for a new Tactical Air Command short-take-off-and-landing airplane. Theoretically, variable-wing sweep offers great performance benefits for any high-speed airplane. These are being investigated by many preliminary design teams.

In the case of large aircraft, such as a Mach 3 transport, some companies believe that the aerodynamic benefits of variable sweep can be enjoyed at only a slight cost in increased structural weight. Several simple mechanical schemes have been devised to move the wing forward and back and carry the loads on the outer panels into the wing roots.

Najeeb E. Halaby, the new Administrator of the Federal Aviation Agency who is coordinating the Administration's effort on development of the Mach 3 transport, has given four compelling reasons why the United States should proceed at once with the project.

First, Mr. Halaby believes that it is important to advance the technology of manned flight.

Secondly, he regards the supersonic transport as a valuable tool for our armed services. In special situations, it would allow troops to be moved to almost any of our outposts in three or four hours.

His third reason concerns national prestige. He believes that the US is close to losing the undisputed lead it has held in aviation for the last two decades. Certainly a supersonic transport will be built by someone. If we don't, someone else will.

Fourth, Mr. Halaby's studies show that a fleet of supersonic transports will add to the gross national product by generating new air traffic, allowing goods to be moved more quickly, and saving travel time of executives.

Halaby hasn't openly said that he favors a Mach 3 transport over one that cruises at Mach 2, probably out of deference to the British government, which is still interested in a joint US-British Mach 2 development venture. Under this plan, maximum use would be made of the existing state of the art. Both nations would be able to contribute substantially on the basis of their recent military aviation experience.

A major arguing point for this plan is that a Mach 2 airliner could be ready two or three years ahead of the Mach 3 airplane. This could make the difference between being first or second in development of the supersonic transport—with a consequent effect on Western prestige.

The vast majority of US experts have been opposed to the Mach 2 airplane. They would rather take a chance on being second with a solid Mach 3 money-maker. It is reasoned that the airlines would not be

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able to buy both a Mach 2 and a Mach 3 transport. Probably no nation would want to subsidize the development of both airliners. Therefore, if the US and Britain went ahead with the Mach 2 airplane, they would be forced to live with it no matter what happened elsewhere in the world. Any nation that went ahead with the Mach 3 airplane would be in a commanding position over the US-British combine.

Several technical factors have been cited to show just how commanding that lead would be. First recent tests have shown that aluminum structure does not have a long fatigue life at Mach 2 temperatures of 200 degree F. or so. Heating and reheating through a few hundred cycles quickly lowers the strength of aluminum, so a supersonic airliner constructed of aluminum probably would have to cruise around Mach 1.5 or a little better.

In turn, the Mach 1.5-plus airliner would have to have an arrow-wing configuration to cruise efficiently. Unfortunately, the arrow wing performs poorly from Mach 2.5 on up. For Mach 3 or 4, therefore, a whole new aerodynamic configuration and wing shape would be needed as well as a complete change of structural material from aluminum to steel.

A big advantage of starting with the Mach 3 configuration is that its cruise efficiency does not fall off as the speed is increased to Mach 4 and better. The only necessary major change would be to strengthen the steel Mach 3 airframe and probably add new engines.

Another selling point for Mach 3 cruise is recent research which indicates that the sonic boom heard on the ground will be greater from a Mach 2 than from a Mach 3 airliner. The reason is that the slower airplane must cruise 10,000 feet below the faster one. And altitude is a great attenuator of pressure waves.

There is one important question that can be approached with a little information, a lot of intuition, and possibly a touch of the soothsayer. This is the puzzle of what the Russians intend to do. What kind of national prestige and economic competition do they intend to create in the supersonic transport field?

In the past the statements of Soviet political leaders and prominent technical figures in the Soviet aircraft industry have been the best indicators of what they plan to do and are doing. Such statements gave ample advance notice of the sizable group of Russian turbojet and turboprop transports currently in service. This notice of forthcoming projects included the Tupelov TU-104 which beat US turbojet transports into service by a couple of years and gave the Russians a temporary leg up prestigewise.

Recently the same kind of statements have indicated that the Soviets have a supersonic transport program. The political leaders have talked at cocktail parties. Propaganda outlets have made typically convoluted references to the program. More important, leaders of the Soviet aviation industry have said they are working on a supersonic airliner.

There has been no clear indication, however, of "how supersonic" the plane would be. They could take the easy road and develop the Mach 1.5 to 2 transport. They would want us to know it, counting on us to settle on the "easier" plane, also, if they did. They might, on the other hand, deceive us into believing they were at work on a Mach 2 plane—when actually they had set their sights higher.

Since the Russians operate as they do, most informed parties in the US believe the Mach 3 transport is our most sensible investment, especially if we want to ensure against being outflanked by a vastly superior airplane. The new Administration has accepted this view and decided to make full use of the currently strong technical position of the US aircraft industry. Its reserve of unused technology is higher today than it ever has been. A firm base for Mach 3 development has been built through extensive research and the abortive F-108 and B-70 programs.

A new method of putting this knowledge to use must be formulated, however. Developing large supersonic airplanes for commercial use is too big a job for private industry to handle alone on a timely basis.

Development costs on the Mach 3 transport will run somewhere between half a billion and a billion dollars. What airframe manufacturer can carry that kind of a financial burden alone for several years in the hopes that someone will buy his airplane?

US airlines are just beginning to pay for their fleets of subsonic jets. Few like to think about putting any money into a supersonic airliner until 1968 and 1970. By that time some other nation is bound to have taken an overwhelming lead in this field if the US has not acted. It should take about ten years to design, develop, and flight test a Mach 3 transport before it is ready for scheduled service.

The new Administration has recognized these fiscal facts of life. A request for $12 million is included in the new Federal Aviation Agency budget for the studies and experimental work necessary before a sensible supersonic-transport development program could be planned. These studies will provide specific answers on a number of aerodynamic configurations, engine cycles, and the performance of various sheet-metal structures which operate at high temperatures most of their life. Enough basic work has been done in the past to point out what problems should be attacked. Most supporters of the project feel that this money plus the $2 million NASA has allocated for the same purpose will provide the information necessary to pick the best engine and airframe design approaches by the summer of 1962. The major portion of the studies will be handled by two airframe and two engine manufacturers on a competitive basis. NASA's Langley Research Center will also participate in the program.

Original impetus for a government-sponsored supersonic transport program was provided by Elwood R. Quesada, Halaby's predecessor as FAA Administrator. Quesada had drawn up an organizational plan and set a tentative development schedule, but his request for $17.5 million to start work on the project was turned down flatly by the Eisenhower Administration.

Mr. Halaby likes his predecessor's plan and apparently will fight for it with only minor changes. Under this plan the FAA will have over-all authority over the supersonic transport development effort. A board of airline advisers will help in getting an airplane that will please all of the carriers. The Air Force will be the contract manager. NASA will provide technical counsel for the FAA.

It is estimated that about $750 million will be needed to take a Mach 3 transport through its development and get it certificated. First flight would be around 1966. Certification would take three or four more years if no serious trouble occurred. The government's aim probably would be simply to see that a certificated airframe and engine are available for a manufacturer to produce if he can get enough orders to make it worthwhile. Most predictions of the sales market for these airplanes run from 200 to 250 airplanes. On the basis of present information, they would cost about $15 million each so that the gross business would be worth between $3 and $4 billion.

Most of the economists who have reviewed the problem believe that the airlines can pay for the Mach 3 transports in less than ten years if they do not cost much more than $15 million each. The tremendous earning power of these aircraft can more than make up for the high purchase and maintenance costs. If the airlines get eight-hour-per-day utilization out of each Mach 3 120-passenger airliner, it would be possible to log over 1.5 million passenger miles per day from each airplane with a load factor of less than eighty-five percent.

Final cost of a Mach 3 airliner will depend on its construction style. Under the present state of the art, steel-sandwich is lighter than steel-skin-stringer structure, especially for thin sections. However, skin-stringer design costs less than one-fifth as much in some cases. Energetic efforts will be made to reduce skin-stringer design weight.

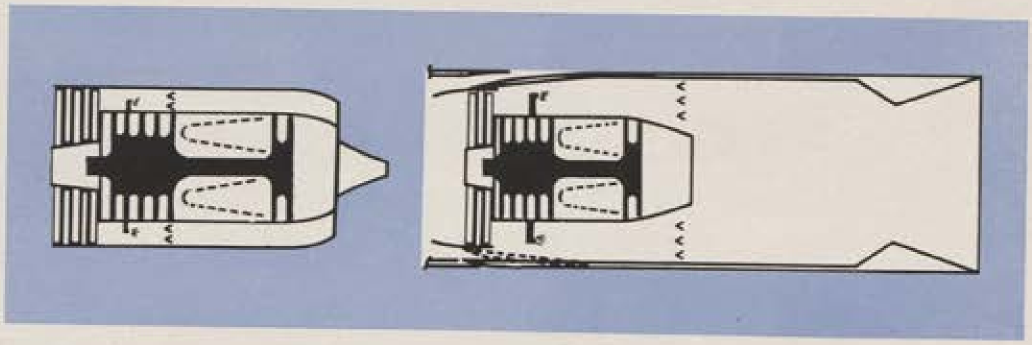
The outer surface of the Mach 3 transport will have to be several times smoother than the skin of any production aircraft built to date. If skin mismatches are not eliminated, the skin friction drag can go up high enough to endanger the aircraft's range.

Detailed design of the Mach 3 airliner will require more new data than that to be provided by high-temperature structures tests. There is still considerable uncertainty regarding the air loads the aircraft will experience. Big questions exist on the loadings due to gusts, maneuvers, high-speed ground runs, flutter, and buffet. Complete data is still not available on air turbulence at 50,000 to 100,000 feet.

The amount of new knowledge that must be gathered for the Mach 3 transport is so long that even the most ardent aviation enthusiast cannot escape the conclusion that its development will be one of the most difficult steps forward ever taken in the history of flight.

In even the most cursory discussion of the promise and problems of the Mach 3 civil transport, it is impossible to ignore the airplane's military potential. Two of its characteristics would make it attractive to the Air Force as a bomber.

First, the airliner airframe with a 30,000- to 40,000-hour life would make an airborne alert possible without the structural fatigue problems facing strategic bombers today.



New-type engine will be needed on Mach 3 airliner. Fanburner engine (left) was studied last year. Engine companies now favor a supercharged ramjet or turbofanjet (right). Engine has low noise and high thrust during take off and cruise with no tailpipe burning. High thrust increase for acceleration is given by tailpipe burning in this model.

Second, the variable-sweep wings that would give the transport good subsonic and supersonic performance would also allow a bomber to attack over long ranges using any combination of high and low altitude and supersonic and subsonic speeds.

By many interpretations, the Administration's interest in Mach 3-class aircraft died with the B-70 weapon system. It has been predicted that Dyna-Soar-type boost-glide weapons would be given increased emphasis as a result.

But, in reality, we may still have a Mach 3 bomber in our future.

President Kennedy mentioned a "successor bomber" to the B-52 in his budget message. He also told Congress that, "We should explore the possibility of developing a manned-bomber system specifically designed to operate in an environment in which both sides have large ICBM forces."

This statement seems to indicate that the President agrees with the fundamental Air Force doctrine that manned aircraft able to penetrate over all targets would be necessary in any war in the years immediately ahead.

And, in the view of many officers, single-pass, very-high-speed aircraft like the Dyna-Soar cannot be the sole answer to the manned-penetration requirement for quite some time.

Therefore, it seems highly likely in view of the performance predictions for large, Mach 3, variable-sweep aircraft, that they would receive strong consideration for the penetration mission.—END

Amrom H. Katz

This paper, which appears in slightly different form in the April 1961 issue of The Bulletin of the Atomic Scientists, is adapted and condensed from Mr. Katz's portion of a public debate on Disarmament and Security held in Santa Barbara, Calif., in April 1960.

We need "serious, hard, inventive, imaginative, massive, expensive work" on the subject of disarmament and arms control, writes a RAND Corporation expert in the area. The issues involved are manifold and complex, not given to speedy or simple solutions . . .

Arms Control and World Peace

- A new concept has been introduced in recent years by serious students of world problems. They have substituted the aim of "arms control" for "disarmament" in the interests of world stability and peace.

- This realistic school of thought recognizes that suitable schemes and systems may be devised for reduction of the fear of surprise attack, for lessening dangers of war, and achievement of these goals may or may not involve large-scale disarmament. Disarmament might, in fact, have the opposite effect.

- Arms control is bigger than disarmament alone, permitting contemplation of useful agreements, measures, and systems that might be ruled out if we sought disarmament literally and exactly.

- The first step toward effective arms control may well be the development of a high level of balanced military strength that would itself act to prevent the outbreak of sudden, surprise, cataclysmic war.

- Then we must work hard—technically, imaginatively, morally, purposefully—toward arriving at a technically feasible international agreement for arms control and a rational, stable world.

"If we could first see where we are and whither we are tending, we could better judge what to do and how to do it."

—ABRAHAM LINCOLN
SPRINGFIELD, ILLINOIS
JUNE 16, 1858

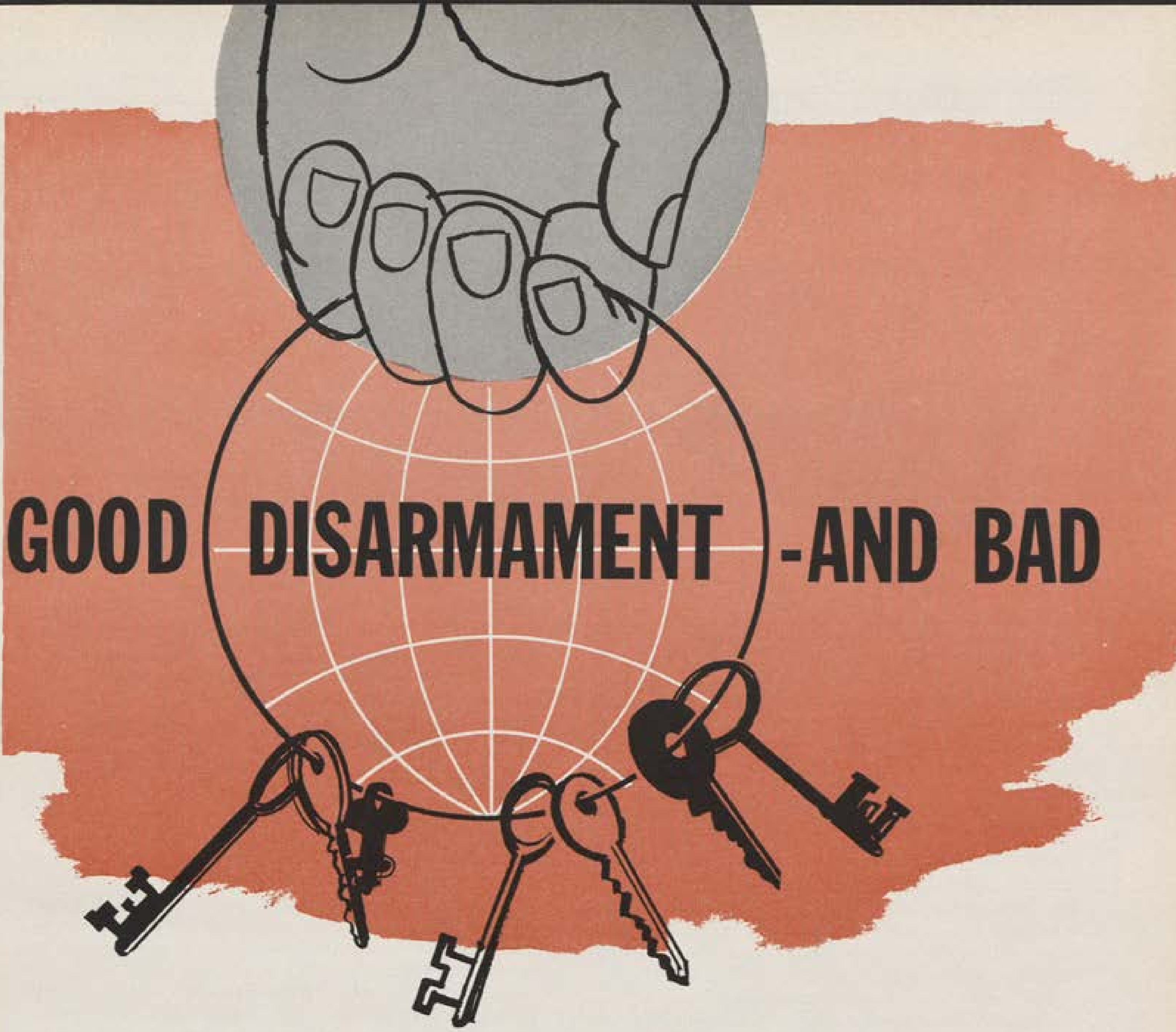
I WILL attempt to discuss and illuminate some of the main ideas, words, and problems associated with current talk and proposals about disarmament. There are things to talk about and think through, with both heart and mind, before we can know what to do. Because brevity and superficiality are often concomitants (the Gettysburg Address being an outstanding exception), I urge the reader to consider this a night-letter version of a much longer and detailed discussion.

From the common assumption, sometimes made implicitly, sometimes explicitly, that war or preparation for war doesn't yield security, it seems to follow that disarmament is a way to get security. Although more or less predisposed toward this general viewpoint, I urge careful examination and analysis of this route to security.

I argue that there are several roads to, and several kinds of, disarmament. Presumably, if we had the kind of disarmament that yields more security than we'd have without it, we'd be better off.

The contrary statement must also be made: Disarmament that doesn't give us security is no good. I am now implying that there may be some forms of disarmament which won't give us security and are therefore no good by the criterion which we have picked.

Mixed in with, and part of most discussions of disarmament and security, are numerous goals and ideas involving the saving of money and the lowering of taxes and budgets, etc. I think these issues are entirely



GOOD DISARMAMENT—AND BAD

extraneous and diversionary. If it turns out that disarmament costs more—by whatever method of costs we are thinking of, for example, dollar costs—and it gives us more security, that is fine. If we want security we should be prepared to pay for it. We should be prepared to realize that it might turn out to cost more than we are now spending on security.

What Do We Mean by Security?

The attempt to define what we mean by security is worthwhile, not because a standard definition is required, but because the attempt to do so will provoke arguments and may produce insights. I suggest that what we mean by security is freedom from both the fear and danger of violent war. I must point out that these are quite different—the fear and the danger—and not at all redundant. We might well be confronted with the danger of violent war and for whatever reason—stupidity, blindness, bravado, or a large national dose of tranquilizers—we might have no fear. Similarly, we might have fear and not be in any real danger. And, of course, we might well have real fear in the presence of real danger.

Somehow we imply by security not only the absence of war, but the presence of some kind of freedom, and not only anarchic freedom but freedom and opportunity to pursue the peaceful activities of society. Some people, recognizing the multidimensional nature of conflict in the world, might well define security as a situation in which bleeding conflict is suppressed, permitting the freedom and exercise thereof to pursue forms of nonviolent conflict.

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Of course, there is what I call the relativity theory of security. We can't be perfectly secure. We can't be confronted with 100 percent danger on the one hand and suggest that if we just do this, or take some simple nostrum, we can be 100 percent secure. It is far more likely that we are never in 100 percent danger nor can we ever achieve 100 percent security.

Different Kinds of Disarmament

I will give two examples of "good" or "peaceful" disarmament and two examples of "bad" or "violent" disarmament, meaning that these are some people's subjective votes on the applicable adjectives. Clearly more and varied examples could be invented. I leave this exercise to the reader.

One "good" kind is unilateral disarmament. It goes like this. Without paying much attention to the other members of the world and what they are doing we just run everything off the end of the runway (or off the edge of the cliff), smash and destroy our arms, and that's it. We disarm. We don't have bombs; we don't have missiles, tanks, guns. This is easy to understand, requires no negotiation or analysis, is definitive—but has some disadvantages, about which more later.

There is also the much harder to discuss and explain (but still "good") kind of disarmament—and that is the agreed-on form of disarmament which both government and private study groups have been working on and discussing.

Let me cite two examples of "bad" disarmament—which could result from use or threat of use of force. There is the kind of disarmament which could result when you have a really big war, in which you use up all your ammunition, missiles, people, and resources—you are disarmed. Whether or not it results in slavery, whether or not it results in loss of freedom is irrelevant to the point: *This is a form of disarmament.* Still another form of disarmament is some kind of an enforced disarmament. I neither have to nor intend to spell out any of the possible scenarios here.

If security is tied in with disarmament, it seems fairly obvious and logical that the kind of security we would get is related to the method by which we happened to get disarmament, and what form disarmament took when we got it. In summary, having demonstrated that there are "bad" kinds of disarmament it should not be regarded as obvious that all kinds of disarmament are good, that all kinds of disarmament give us security, and that the security we get is identical in all these cases.

How Big Are Megaton Weapons?

A discussion of some of the more important new factors present in today's world which are relevant to problems of disarmament will enable examination of their implications for successful disarmament or arms control. We start with the emergence of the big weapons—the megaton weapons.

The expression "twenty-megaton bomb" means that this weapon has the explosive energy of twenty million tons of TNT. There is a strong and justifiable suspicion entertained by many laymen that when technical people use an expression like twenty megatons (which means twenty million tons) they have a desire to use a small number like five, ten, twenty, and then need to invent a handle or unit sufficiently big to take account of the size of the thing they are talking about, after which they can deal comfortably and familiarly with small numbers. Let's see how really big twenty megatons is.

Had we detonated TNT at the rate of twenty-five pounds a minute starting at that moment when Moses received the Ten Commandments on Mount Sinai (about 3,500 years ago) and continued without interruption till now, this would add up to approximately twenty megatons of TNT.

Not everyone has a sense of time or history, but everyone has an idea of size. Suppose we convert this twenty megatons to TNT and put it into a pile. How big would this pile be? How big would it be compared with the great pyramid in Giza, for example? It turns out that the great pyramid in Giza would be about a fifth the size of this pile—all TNT. Bringing this example up to date, compare this pile with what used to be the largest man-made structure on earth—the Grand Coulee Dam. Twenty megatons of TNT would have made a structure half again larger than Grand Coulee!

It is clear that we could go on inventing and constructing these examples. One more will suffice—if you had a contract to haul twenty megatons of TNT from Los Angeles to New York you would need a line of freight cars that extended from Los Angeles to New York. In fact, that wouldn't be enough—they would have to double back to Chicago. This is 4,000 miles of freight cars!

One more statistic will pin this down. In the European part of World War II less than three megatons of bombs were dropped altogether—and this took six years, and almost two million individual bomber sorties! We should still remember the damage done in Europe; the people in Europe certainly do.

The Nth Country Problem

Another important new factor to consider results from the likely forthcoming wide diffusion of nuclear weapons to many countries—now called the *n*th country problem. There are several routes to membership in the nuclear club—autonomous manufacture, diversion of materials, gift, or purchase of weapons. We like to believe and hope that we're pretty responsible. We won't get into a big-weapon war by accident, by miscalculation, or by irrationality. We may even believe that the Soviets would behave this same way, but we may also believe that there may be some people in the world who are not so responsible, not so serious, who may not suffer the consequences to the same extent.

This situation started being called the *n*th-country problem only fairly recently. In 1949 the second-country problem arrived when Russia got the bomb, in 1952 the third-country problem when Britain had the bomb, and in 1960 France got into the nuclear club, making the fourth country. It is interesting to note that in France the fourth-country problem was never discussed. They always discussed the fifth-country problem. I am not exactly sure just where the sixth-country problem is now being discussed.

Now, what is so bad about lots of bombs and bomb owners around the world? After all if the US, big and strong as it is, thinks it needs lots of bombs and has to have them, why shouldn't every smaller nation feel the same way? There is some superficial merit to this kind of argument. However, the dangers that the "responsible" powers envision stem from the probability or the possibility (once there is a possibility, there is a probability associated with it) of accidents, or erosion into nuclear war, of limited nonnuclear wars.

The world has had a dozen or two dozen small wars since World War II, and civilization, though wounded and bruised, is intact. This is not callous tolerance of wars which are elsewhere but is instead simple fact. However, the widespread diffusion of nuclear weapons, among other factors, might make possible the erosion or spread of these limited wars into much larger, more violent, and less controllable wars—into very widespread unpleasantries, and into wholesale mass destruction.

The Possibility of Catalytic War

I invented the term *catalytic war* a dozen or so years ago to describe and symbolize a process, an extreme but not the only form of which, is country C starting a war between countries A and B either by malevolence, miscalculation—or other means. Ways of doing this with today's weapons are, on the face of it, rather straightforward. *Whether or not we respond by getting into a big war depends on whether or not we have anticipated and thought about this possibility ahead of time.*

A third country, or its leaders, might, in a fit of miscalculation or ignorance or stupidity or for other reasons, consider it useful or desirable to bring both the United States and the Soviet Union to their knees, thus elevating the relative position of the third country.

One way for a third country to do this would be to put a bomb in a ship and set it off in New York harbor, with the hope that the US, thinking the Soviets did it, would immediately launch a "retaliatory" attack on the Soviet Union. Neither sophisticated weapons nor sophisticated delivery systems are needed (by sophisticated I mean complicated or expensive in the sense in which warheads, cleverly packaged bombs, ICBMs, and B-52s are so regarded). Everybody has ships, and soon many people may have weapons.

What would we do if such an event happened? This process does not lend itself to standard police investigative procedures, like taking fingerprints and interrogating witnesses. It is not that kind of an affair. Unless we had thought about this possibility (which we are now doing) there is some kind of chance that we might go to war. But, because we have thought about this, and because the consequences of war are even more serious, we would now pause and ask the question, "Where did it come from, and whose was it?" This suggests an interesting task, purpose, and value for mutual inspection systems.

In some bitter and facetious moments some years ago, I suggested that international standardization and assignment of the colors of the bomb cloud would answer the question, "Whose cloud is that?" However (apart from obvious administrative problems), unless we stop the increase in the nuclear-club members, in a few years there will likely be more owners than clear unambiguous colors possible to detect in the mushroom, so this "solution" had to be ruled out.

Another factor, in addition to the big weapons, the *n*th-country problem, and catalytic war, stems from the emergence of rapid-delivery systems. We used to go to war in a fairly leisurely fashion. One started by getting on a train, going a couple of thousand miles, and reporting to camp. It is now possible to get high-speed space mail from the Soviet Union (and vice versa) in about thirty minutes via ICBM. This compresses the decision time and the response time and multiplies the dangers. Consider also the distinct and real possibility (whether or not anyone wants to do it is another matter) of storing bombs in orbit and calling them down at one's leisure or convenience. After all, we intend to get one or more of our seven Astronauts out of orbit; though sturdy characters, they are likely more fragile and less storable than a bomb.

Increasing Difficulties of Inspection

There are more new factors. One concerns the difficulty of inspection. It used to be that things were quite easy—or so we now think. We're always fond of looking at the good old days—at some period a few years back.

The "good old days" for instituting some form of atomic-energy control were the 1946-1950 period. The Baruch proposals of 1946 had value in that era. The determination of the exact point at which we passed the practical feasibility of employing that kind of retro-

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active bookkeeping system is now a matter for historians. Many of us are convinced that the point has been passed. That particular kind of proposal—international ownership and picking up the amount of material that has been made—is no longer available; not because we don't want it, but for technical reasons. Too much material has been made. When there was little fissionable material, a small error was not significant. However, a small percentage error in accounting for a very large quantity could leave a large and significant quantity unaccounted for. This illustrates the relation between technical arguments and feasibility, and political bases, proposals, and activities.

If we wait a few years there may come a point when too many missiles will have been hidden and too many bombs will have been produced to enable instituting good retroactive bookkeeping systems. This means doing the bookkeeping well enough so that we could sleep at night with some confidence or assurance that yes, indeed, 99.3 or 99.4 percent of the missiles have been found and are being monitored, and that we don't have to worry about a surprise attack. We cannot be sure how much time we have—it might be five years to this point of no return. Or we may have already passed this point, for it depends to a considerable degree upon what the Soviets have been and are doing.

Another difficulty arises from the constantly increasing areas that must be subject to inspection. A few years ago some of us thought inspection of twenty-five million square miles, half the land area of the world, would cover the problem. In a few years, we would need to inspect not only fifty million square miles, the total land area of the world (of which the Soviet bloc and China occupy about a fourth) but the total surface area of the world, about two hundred million square miles. At this point, it should be clear that area is not quite the right term. Indeed, when we get into the era when bombs may be in orbit, it will be even more clear that cubic miles is the correct term.

Obviously this discussion of the problem is not a solution. Problems are getting more difficult faster than we are getting smarter. I like to think that we are getting smarter, but it usually turns out to be about obsolete problems.

A Metastable Strategy

There is serious thought about removing or desensitizing the retaliatory hair trigger, the instant response strategy that we seem to prefer. One way that has been suggested is to slow down the required response time of our retaliation, to back off from the kind of instant response or preemptive strategy that used to be fashionable—to convert our strategy into what I have been calling a *metastable strategy*. This concept implies not perfect but relative stability. The idea I'm suggesting is simple. A successful strategy of this type would take us from an unstable situation to a relatively stable one. It would enable us to respond in some measure but without ultimate disaster and ultimate commitment—it would be a strategic boat that can stand a little rocking without being swamped.

What are the elements of such a strategy? It seems easier to describe than to attain. This strategy may take more money, for example. The elements that would enter into a stabilized deterrent strategy are those things which involve ensuring that we don't have to strike first or preempt ("anticipatory retaliation"), building a capability of being quiet while we are being hit, or absorbing a first blow, not having to respond instantaneously, not having to get our airplanes and missiles off at once. This strategy might involve, for example, building missile sites that are hardened, numerous, dispersed, or perhaps mobile—that are able to absorb the first hit. This is expensive.

Such a strategy would require having adequate mutual inspection—adequate information exchange with all possible opponents to convince each other that it neither pays nor is there occasion to strike first. I'm assuming we're in an era when we haven't got perfect disarmament, and that there are still some things to worry about. In the event of an accident, or a third-party attempt to catalyze a war, an adequate mutual-inspection system would enable the Russians to tell us and us to tell the Russians, "Now, look, that bomb didn't come from us, and we can prove it. It came from somewhere else. Don't start a war." There are many more complicated elements than those few examples, but this is not an essay on strategy, so we'll move on.

What's Wrong with Deterrence?

What is wrong with deterrence as we have come to talk about it is not deterrence itself but an overwhelming preoccupation with deterrence alone, to the exclusion of complementary and concurrent efforts. A main purpose of deterrence has been to buy time. The purpose of buying time was to evolve a constructive program, one that hopefully could be sold to the Soviets and the world and could be implemented. Well, it didn't work that way.

The kind of a program I see as necessary is one which would involve successful arms-reduction negotiations, arms reduction, arms stabilization agreements, and a climbing down from the precipice—the getting off, without jumping off. The situation we are in today resembles that of a hiker who has climbed a sheer rock cliff; while he is climbing it and everything is going well, he gives little thought to his situation. When he turns around and sees where he is, he realizes that he had better hang on. If he falls off he'll be killed. Let us imagine he cries for help; while he is being helped, he's happy, but he fails to notice that the kind of help he gets only shoves him farther up the cliff. Somehow we have to be able to get off this cliff without jumping off. That's one way of doing it, but it doesn't meet the requirements.

Gandhi and Unilateral Disarmament

There are many serious people who don't believe in negotiated disarmament or arms control, in stable deterrence as an interim measure, or in military methods of any sort. They belong to the new group of *unilateral disarmers*—loosely confederated under the *Committee of Correspondence.*

I think any analogies to Gandhi or to any pacific "passive" resistance now being offered in our own South are fruitless, unrelated, and irrelevant. Gandhi would not have lasted against Hitler, nor against Stalin or Khrushchev, long enough to have become famous. And fame is usually a prerequisite to martyrdom. He couldn't have made it. His followers were able to lie down on streetcar tracks only because they were confident of the identity and scruples of the motormen. Gandhi's techniques worked fine against the British.

This is related to the confidence most California pedestrians have when crossing the street. They know that California drivers know the rules: Drivers are supposed to stop for you when you are in the crosswalk. Of course, I always look down the street and make sure that it's a California car coming whose driver presumably knows the rules. Again, like unilateral disarmament, this technique is fine if one picks his opponent correctly.

The unilateral disarmament movement has the ostensible and attractive look of principle, morality, nobility, and purpose. On the other hand, I don't believe we came across the ocean of history these thousand of years fighting tyranny, fighting Nazism the last few years, fighting concentration camps in order to drop onto the beach and say, "Well, we're not going to do anything now, we're just going to lie down and quit." This quote from an early statement by the Committee of Correspondence will illustrate this point:

"We know perfectly well that the consequences of such radical action—unilateral disarmament—includes invasion, conquest, and tyranny. Yet they are within the limits of human experience."

The Sidney Hook-Bertrand Russell debates, which appeared in the *New Leader* several years ago, are directly relevant, and I commend them to the reader.

How to Get There from Here

The real problem is, "How do you get there from here?" How do we get off the precipice without jumping off? What do we really mean by some kind of disarmament? We really don't know the answer. *There are no real experts on disarmament; there are only experts in talking about it.*

Therefore, serious, hard, inventive, imaginative, massive, expensive work is indicated to find out not only how to get disarmament, but how to get it and achieve and maintain security as well. The problem is to have and to hold. If we don't want security we could get disarmament very easily. The pitiful little full-time professional work in this area that's been done to date is, hopefully, going to be vastly increased under the Kennedy Administration.

On the other hand, there are certain technical reasons (posed by the problems of points of no return) that may prevent the achievement of complete disarmament—if by this we mean the smashing of all weapons, the reducing of all arms down to those necessary for internal policing. A new concept has been introduced in the last few years by many serious students of the subject. The notion is that of "arms control" instead of "disarmament."

The notion of arms control recognizes that suitable schemes and systems may be devised for reduction of fear of surprise attack, for achievement of greater stability, for lessening dangers of cataclysmic war, and that achievement of these goals may or may not involve large-scale disarmament either at first or at all.

The point is, I think, that the notion of arms control is larger than that of disarmament alone, and permits contemplation of useful agreements, measures, and systems which might be ruled out if we apply the word "disarmament" literally and exactly.

This line of argument is additive to the suggestion that safe "disarmament" might turn out to be technically impossible. Further, "disarming," in the sense used by World War II bomb-disposal squads who rendered bombs harmless, yields a new cogency and relevancy to the interchangeable usage of "disarmament" and "arms control." "Disarming" may not require abolition of weapons.

The first few halting steps may involve the stopping of testing, which may or may not have anything to do with arms control. A successfully negotiated test ban would certainly give us some useful and constructive practice in talking and negotiating with the Russians. And we really need that practice—not so much the talking, but the practice of serious negotiations. Next, if we can evolve a scheme that would significantly and confidently reduce the mutual fear of a surprise attack, this tranquilizing move will be all to the good and will enable proceeding to more steps.

Now how do we go about getting this? Well, I think first we must work hard at understanding the problems: technically, imaginatively, morally, and with purpose. And then we must construct and test proposals that are sound, of mutual advantage (or lack of disadvantage), technically feasible, useful, significant, and saleable. This is a difficult prescription, but it contains the essential ingredients.

The Soviet Rock of Secrecy

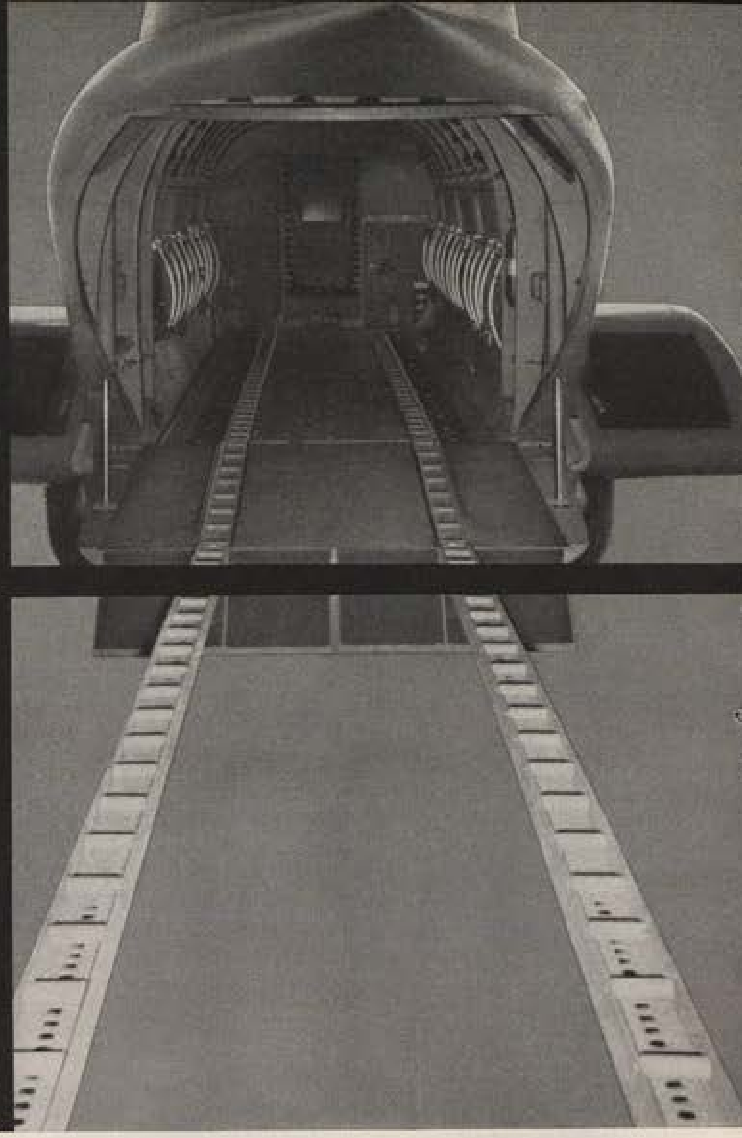
The major obstacle standing smack in the road of progress is the Soviet Union's premium on and obsession with secrecy, which has conditioned their entire behavior during the last fifteen years. As long as the Soviet Union stands firm on this rock of secrecy, we aren't going to have any disarmament. For if they insist on their form of secrecy, we aren't going to have any effective inspection, and if we aren't going to have inspection we aren't going to have any arms control, and if we aren't going to have any arms control we never are going to have any disarmament—unless it's a nonpreferred variety, yielding not security, but insecurity.

The Soviets have written an equation on a gigantic national blackboard which says that the strength of the United States and and the strength of the Soviet Union are functions not only of nuclear weapons,

(Continued on page 55)

BOEING-VERTOL 107...

THE WORLD'S ONLY "MISSION MODULE" HELICOPTER



BUILT-IN CARGO LOADER PERMITS IMMEDIATE CONVERSION FOR OTHER MISSIONS

"Mission module" design of the new, twin turbine-powered, Boeing-Vertol 107 means this truly versatile helicopter can perform a wide range of military assignments—without costly or time-consuming conversion. A change from cargo mission to minesweeping can be made readily because of basic aircraft design.

In addition, an integrated loading system can be built into this *first* all-mission, all-service helicopter. With the new system one man working alone can unload up to two tons of military cargo in three minutes or less. Even under demanding field conditions, loading can be completed in as little as eight minutes. The fully integrated system makes use of the Boeing Vertol 107's straight-in rear loading ramp. It includes recessed rollers and cargo beams which, when stowed inside the 107, serve as guides for vehicle wheels. A built-in hydraulic winch speeds loading, while the nose-up ground attitude permits fast gravity or taxi unloading. The loading system does not interfere with use of the Boeing Vertol 107 as troop transport, and troop seats can be quickly stowed along the fuselage sides to permit other "mission module" use—for ASW, land or sea rescue, medical air evacuation, missile site support.

The Boeing Vertol 107's capability to perform many missions such as these makes it the logical choice for today's flexible and alert Armed Forces.

VERTOL DIVISION BOEING

MORTON PENNSYLVANIA

*TOP PHOTO: FULL SCALE DEVELOPMENT MOCKUP atomic and thermonuclear, not only of the delivery systems, missiles, aircraft, and submarines, but also of the relative intelligence available to each side.

No matter how we try to score these two nations, vis-à-vis each other, they seem to be roughly equal in weapons and delivery systems. The Soviet Union has a lot of bombs. So have we. They have a lot of bomb carriers. So have we. We may have more airplanes than they have. They may have more missiles than we have, although we aren't really sure. But when it comes to the third term in the equation, intelligence based on relative secrecy in the two nations, the balance is upset. There is a tremendous asymmetry to the entire equation when the situation is dominated by this factor of secrecy.

The Russians are continually asking us to trust them. To me this situation is like having a neighbor in the community who decided to build not the standard six-foot fence, but a fence about 400 feet high. This should arouse some suspicion. And then when you hear odd noises going on behind this high fence and strange odors coming out and you see flashes of light and hear occasional loud arguments and curses, in which your name is featured, I'm not saying you have anything definite to go on but you should get a clue that maybe something unpleasant and potentially dangerous is going on in there. Now, when you get curious and worried, and drill a small peep hole in the fence, and he attempts to knock your head off for this, you are liable to treat his requests for trust with some suspicion. *The Soviet rock of secrecy must go. If this rock isn't removed I submit that there will be no progress toward disarmament.*

The Greenhouse Society

We talk open-skies policy, but we have been practicing an open-mouth policy. Because we are indeed a greenhouse society, a really open society—because anyone can get open government hearings which cover almost all of our secrets, our plans, our ideas and information about missiles, our space projects, our military defenses, our strategy, and our budget—because of this, I believe we have advanced our own thinking about and appreciation of our problems.

Well, if this process is a good one for us, what about the corresponding Soviet discourse? There is very little public discussion in the Soviet Union of the kind noted above. Though they can obtain all of our open material, they are not participating in this public discourse, in this great continuous debate. This leads me to the conjecture that they must lag behind our thinking, our evaluation of the dangers, and understanding of the problems by some several years. Such a lag is bad and could be dangerous.

We must invent ways of educating the Soviets, of cutting down this particular cultural lag. We are in need of fast positive, nonliterary methods of educating the Soviets to the dangers of the *n*th-country problem, of educating them to the genuine requirements and problems of disarmament, to the need for some form of arms control, to the problems of erosion of limited wars, to the requirements for achieving increased stability and tranquility, and to those arrangements which are of mutual advantage.

A Need for National Purpose and Thrust

We cannot take a defensive position and say what we want is everyone else to leave us alone. Nor are statements of national purpose much besides compass directions. We need purposeful thrust, equal in its domain to the thrust of our giant rockets, with consistent long-term national and international goals. The problem of achieving and maintaining security via arms control and disarmament is not only how to get it, but how to keep it—a problem at least as hard as getting it.

If, intellectually speaking, we get fat and foolish, or on the other hand fanatic and frenetic, we might well lose our security after achieving it (as I recall, it was Santayana who described a fanatic as someone who, when he loses sight of his goal, just redoubles his efforts). We require guided efforts as well as guided missiles.

Though waging war is deadly, it is intensely simple and direct, consisting principally of many people getting positive orders. Unfortunately, there isn't any corresponding set of positive orders, any prescription, that can be written for peace.

We need some kind of gigantic moral equivalent of war, some activity on which we can focus and spend our energies and resources—the conquest of space, disease, hunger, the problem of world education, the development of resources, the problems of population. Clearly we don't have to invent problems.

But we're not going to get to those important and long-range problems until the particular short-range and urgent problem of war gets out of our way. When one is faced with the twin problem of a fire raging in the living room and a faucet dripping in the kitchen, it is very unlikely that he'll work on the faucet first. The proper ordering of these problems is obvious. And if the first problem is not solved, there will be no house within which to work on the second, nor second problem either.

We need this moral and national thrust and program, to surpass that which the Soviets are claiming and selling around the world. I certainly hope we make it, and I think it possible to do so.—END

The author, Amrom Katz, has been a RAND Corporation physicist at Santa Monica, Calif., for the past seven years. He was an Air Force physicist from 1940 to 1954, the last six years as chief physicist of the Aerial Reconnaissance Laboratory, Wright Air Development Center, Wright-Patterson AFB, Ohio. Mr. Katz also served as Chief Photographic Technical Adviser at the Bikini thermonuclear tests after World War II. A forty-five-year-old native of Chicago, educated at the University of Wisconsin and Massachusetts Institute of Technology, Mr. Katz is an articulate and widely recognized expert on the subject of arms control. He has been engaged in various studies of the subject for the past several years.


A REVOLUTIONARY CONCEPT IN HEAT TRANSFER DESIGN
multicontoured
heat
exchangers
reduce size,
weight and drag...
Multicontoured oil cooler is section of fan exhaust duct
A
B
C
D
Conventional oil cooling system includes: A. Duct B. Heat exchanger C. Door D. Actuator

THE SPACE AGE IN PERSPECTIVE

SPACE DIGEST

VOLUME 4, NUMBER 5 • *MAY 1961*

Deterrent Strength for the Free World

THE ARMS OF A PHANTOM

The arms of a Phantom are unique—they are varied, they are sure, they are powerful. The Phantom II delivers a variety of air-to-air and air-to-ground weapons at double-sonic speeds over long distances. It returns to approach at transport-slow speeds and parabrakes swiftly to a stop on existing mile-long runways. Single point refueling and external weapon storage facilitate fast turn-around. Air-to-air refueling adds extended range for intercontinental missions.

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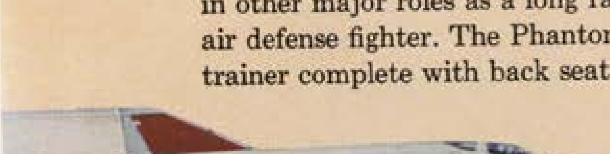

MCDONNELL

Phantom II and F-101 Fighter and Attack Aircraft • Project Mercury Space Capsules • Talos Airframes and Propulsion Systems • Quail Decoy Missiles • Rotorcraft • Electronics Systems • Automation

MCDONNELL AIRCRAFT ST. LOUIS

Has modern science canceled out the ancient dream of a living cosmos of which man can feel a part?

THE UNIVERSE REVALUED

D. E. HARDING

A review of The Universe Revalued, *by D. E. Harding, from the "Adventures of the Mind." Reprinted by special permission of* The Saturday Evening Post. *© 1961 by The Curtis Publishing Company.*

EVERY age has its world-picture, its taken-for-granted view of the universe and man's place in it. Ours is *supposed* to be based on science, and no longer on religion or superstition. But is it really the growth of science which has made a cosmology like Plato's or Shakespeare's incredible, and our own the only possible one? Is our modern, educated layman's estimate of the universe really founded on facts, or is it founded on prejudice?

It is certainly unlike the old estimate. Men once used to think of the universe as full of life, of the sun and stars and even the earth as visible deities, and of the blue sky as the country of the blessed. Priests and astronomers pointed up to the same encircling heavens, to realms whose divinity was proportional to their distance from man at their center. Physical height matched spiritual status.

All of this has now, we imagine, been finally disproved. Instead of a universe of concentric spheres, we have a centerless one, a cosmic potato instead of a cosmic onion. Instead of an aristocratic universe, we have a leveled-down one, whose principalities and powers have long ago lost all their influence. Instead of awesome star gods looking down on us, we have so many celestial firecrackers or blast furnaces blazing away in the night sky.

Instead of a tremendously alive universe, we have an inanimate one in which sentient beings, lost like the finest of needles in the vastest of haystacks, manage to scrape a brief living. Instead of a meaningful creation—a proper place for man—we have a vast expanse of mindless space in which living things are the rarest accidents, or anomalies. And, in the last resort, even they are accidental collocations of particles.

Such, more or less, is the new world-myth. Roughly speaking, this is how most of us educated nonscientists regard the universe. And we are under the impression that science makes any other view impossible. Does it, in fact?

First let us note that, truly speaking, there is nothing about the universe which forbids our taking this earth—or the sun, or any other convenient spot—as its center. On the contrary, we have only to use our eyes to see that the universe is always arranged as a nest of concentric regions—occupied by such things as pipe bowls and spectacle rims, hands and feet, men and animals, clouds and aircraft, moon and sun and stars—around the ever-central observer. To discount altogether this eminently verifiable fact, in favor of some theory—however useful—of uniform space, is unrealistic. In practice, the dead and centerless cosmic potato is found to be a cosmic onion, whose observer core is the very focus of life and mind.

Nor are the outer layers of this onionlike universe necessarily without life. True, we have direct evidence of only one inhabited heavenly body—our own. Nevertheless, according to recent scientific theories, a significant proportion of these systems are likely to contain planets which are suitable homes for the living. And where the right conditions arise—the right ingredients and temperatures—there, scientists assure us, life will follow.

Consequently, the number and variety of inhabited worlds may well beggar the imagination.

At any rate, then, we have better reason than Shakespeare for feeling, on starlit nights, that we are looking up into heavens well sprinkled with life, some of it far surpassing our own. And the chances are that, to find the more superhuman of these inhabited worlds, we should need to probe farther and farther afield from our earth center. For the realm of the nine planets plainly holds less promise than the remoter realm of the stars—the hundreds of millions of stars of our own galaxy—containing who knows how many earth-encircled suns. Nor is this realm a millionth part so rich in celestial possibilities as the still remoter realm of the galaxies, with its unthinkably great star population.

Thus science itself not only hints at the existence of the superhuman but links it with distance from ourselves. We are even warned that the more exalted of the worlds above could be influencing us all the while in unsuspected ways—say by telepathy: The laboratory evidence for this faculty is impressive and, apparently, distance is no bar to its operation. In short, we are already back to something like the ancient world-picture, which science was supposed to have destroyed once and for all!

Clearly, then, we laymen can hardly claim the support of science for our pseudoscientific world-picture.

To say the least, then, the ancient notion of a living cosmos is neither ridiculous nor inconsistent with science. But whatever we think of the universe as a whole, we feel quite sure that its bigger parts are not alive. The bulkiest organisms we

From Aerojet's
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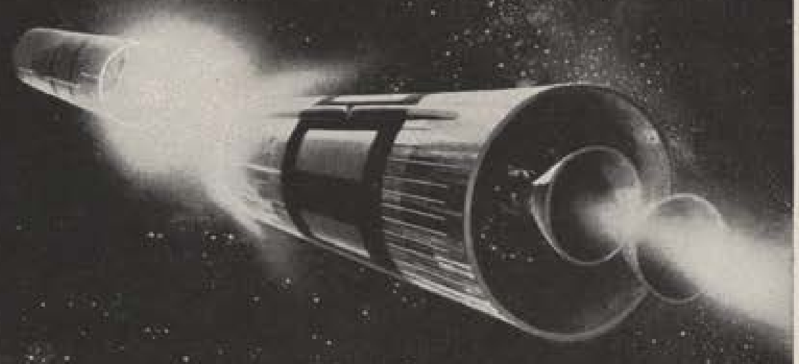
TITAN, DYNA-SOAR,
ADVANCED PROJECTS

The missile: TITAN I, shown here in its first stage-separation flight. The power plants: liquid-propellant rocket engines—designed, developed, and manufactured by Aerojet-General's Liquid Rocket Plant.



Supplier of engines for TITAN I and II, DYNA-SOAR, and BOMARC, the Liquid Rocket Plant is the nation's largest fully integrated facility for the research, development, and production of liquid rocket engines.

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recognize are the big trees of California and Oregon and the blue whale.

This is rather odd. For we have, extending from ultimate particles through atoms and molecules and cells up to man who includes them all, a well filled scale or hierarchy of unitary beings; and then, immeasurably above man, the living whole. Why this cosmic gap? If the vast interval between man and his minutest particles is filled by a series of increasingly subhuman parts, surely the principle of nature's continuity suggests that the equally vast interval between man and the totality may be filled by a series of increasingly superhuman wholes. If these have so far escaped our notice, could that be because we have eyes only for our equals in the cosmic hierarchy?

Have we ever looked for our superiors? Would we recognize them if we saw them? It is notoriously difficult to find a thing one has no idea of. Therefore let us assume that this gap in the natural order is not empty. Let us posit a creature who outbulks a man as a man outbulks a cell, and ask how such a giant would have to differ from ourselves in order to live at all.

Apparently there are limits to the size of a terrestrial organism. If it is too big it is unlikely to survive. In that case, we can only assume that our giant takes flight from his parent heavenly body and sets up as a heavenly body on his own account. Then he not only can be very massive, but *needs* to be; otherwise, he can neither incorporate his own atmosphere and water supply, nor keep a firm gravitational hold on them; and without water and oxygen and atmosphere shells to shield him from meteorites and dangerous radiation and extreme temperatures, he cannot make the heavens his home. And once there, he cannot just wander at will, but must attach himself to some star for warmth and energy, keeping a safe distance and turning continually to avoid freezing behind and roasting in front. And he is certainly a lucky giant. As soon as he starts spinning and circling round his star, the laws of gravity and inertia see that he goes on doing so without effort or deviation.

As for his physique, what would he want with legs or arms, hands or feet, or even wings? Nose and tongue and ears, a mouth and rows of teeth, a stomach and bowels and an anus—anything like these would surely be an encumbrance and a laughingstock in the heavens. We are left, apparently, with some vast rounded body, its whole surface drinking in solar energy.

And supposing there were no convenient star to feed on? Well, if he cannot *find* what he needs, he must *be* it. Our starless sky dweller must himself incorporate a starlike source of energy—a great blazing heart to sustain the smaller and cooler peripheral body we have just described.

To sum up: If we greatly enlarge the creatures we know, adjusting their physique and behavior to suit their size, we get creatures that are indistinguishable from planets and stars. If they exist, they are probably a familiar sight. Many a star shining in the sky could in fact be a living thing, a fit inhabitant of heaven. And so the scale of creatures does not necessarily end with us. The seeming gap could arise from a defect of vision instead of a defect in the universe.

A celestial detective story with no solution! Perhaps it is time we came down to earth again, to the life we know.

But *do* we know it? A living thing (scientists tell us) is an organization of nonliving ones. The salts of our blood, the acid of our stomachs, and the calcium phosphate of our bones are clearly not alive; but neither are the atoms comprising all our living cells. What is physics or chemistry at one observational level is a man at another, and at once alive and not alive. All depends on whether this thing is taken to pieces or not.

But if the pieces (as pieces) are lifeless, where shall we set the boundaries of the living whole? If by the whole man we mean one who is independent and self-contained, we can hardly leave out the air in his lungs and the saliva in his mouth and the chyme in his guts—at least, nobody has pointed out where these cease to be environment and become organism. And if *they* are caught up in the living whole of him, why not the tools without which he would starve to death and the clothes without which he would freeze to death? After all he is far more dependent upon his shoes than his toenails, and upon his good false teeth than his bad real ones. They have become part of his life.

That is how he describes them and that is what they feel like. He identifies himself with his possessions and is not himself without them. He may be more vain of his façade than his face, and more hurt by the loss of a few tiles than many hairs. Until he feels so all-of-a-piece with the clothes he wears, and the horse he rides, and the financial or political power he wields, that they no longer seem outside him, he has still to learn their use. The expert is one who, having incorporated his tools, is unaware of them. They have temporarily vanished into his physique. He doesn't sit on the seat of his pants, or even on a seat in a boat that sails on the sea. *He* sails, *he* is at sea. He doesn't grasp a handle that holds a blade that cuts bread. *He* cuts bread. That is how a man speaks because that is what he is—an endlessly elastic organization of "dead" parts, mostly outside his skin. Thanks to them, he can drink at the lake and browse in the field while attending a concert on the far side of the world—all without setting foot outside his own porch. Instead of going out to these places, he grows out to them.

Nor do these artificial but vital extensions complete his physique. To cut man off from the other creatures is homicidal, for species neither occur nor survive nor develop as things apart, but in great interlocking patterns of mutual dependence. Just as our muscle cells make no sense without our blood cells, so the bee's tongue makes no sense without the flower's nectary; and so on indefinitely—the more you study one bit of life the more you must take the others into account, so that really to know one would be to know the lot. If, then, we seek the living whole—and life, we have seen, is a question of wholeness—nothing short of the entire network of terrestrial organisms, growing up as one living thing from the start, really deserves such a title. And even this vast spherical organization is not yet a complete organism. This living earth-skin is still far from being self-contained—without rock and water, topsoil and air it is as dead as the least of its parts.

In short, nothing less than the whole earth is genuinely alive! Here indeed is a visible god or goddess. The giant we were seeking in the heavens was down here all the while!

Whose life is in doubt? Hers, or ours which is hers or nothing? The only *complete* living thing of which we have inside knowledge turns out to be a heavenly body—our earth. And the *only* heavenly body of which we have inside knowledge turns out to be a living thing—again, our earth. In fact, it is not *living* heavenly bodies which call for proof, so much as *dead* ones!

The behavior and build of such a creature are so odd that we need a new word for this high-level vitality, this superlife which is at least planetary. Oddity, however, must be expected here. The living cell is a very different story from one of its molecules, and man from one of his cells. It would be strange if the living earth were not, in turn, unlike her animal and subanimal parts.

All the same, the earth is no foreign body, living some mysterious life apart from ours. Admittedly her life-preserving maneuvers in the sky are less varied than ours in her; but if to act deliberately is to know with scientific precision what you do and why (its causes and effects in the past, present, and future) then her behavior is much more deliberate than any man's. Admittedly her beginnings were unconscious and unpromising, but so were ours; and now who can match her adult complexity—all her own unfolding and no invasion? For parent, she has the sun; for anxiously awaited offspring, manned spaceships and satellites; for eyes, observatories whose binocular vision (like the merely human) enables her to place her nearer neighbors; for special sense organs, receptors tuned in to cosmic influences; for intellectual exercise, our science of the heavens. We hang her portrait on our walls, and the close-up of her face is familiar to every radio-equipped aviator as a luminous and noisy and ever-changing network and patchwork.

This is indeed no alien godling. She is the full extent, the filled-out body-mind of each of her creatures. For there is nowhere to live but heaven and no way to live there but hers.

But, of course, even she is not really suited to the hard climate of the skies. The smallest complete creature fit for this universe is no sunless planet, but a star—a fully developed sun, a solar system whose "living" planet is a mere organ. And even such a star is not independent of its fellows in our galaxy, and of the universe of the galaxies itself. Only the whole is a genuine whole, and therefore altogether alive.

It is no surprise to find in the superhuman just such a hierarchy of wholes and parts as we found in the subhuman. Isn't this exactly what we wanted to fill the gap above man, and balance the orders below him—this ascending scale of beings—planetary, sidereal, and galactic, but all finite—in which higher rank means more independence achieved, and more "dead" material raised to life? And isn't the life of man the indivisible life of the entire hierarchy—the upper half that he is in as well as the lower half that is in him—or nothing at all? —END

D. E. Harding is a British architect, author, and lecturer, who has spent many years thinking and writing on cosmological matters, with an emphasis on the reconciliation of science and religion. The above article is excerpted, with permission, from The Saturday Evening Post *of March 4, 1961, where it appeared in a lengthier version as part of the* Post's *Adventures of the Mind series.*

Piercing the plasma sheath...

When ICBMs, satellites or space probes re-enter the earth's atmosphere, frictional heating is so intense that air surrounding the vehicle becomes a "plasma sheath." This acts as a barrier to conventional radio telemetry. AVCO/RAD has developed a Direct Re-entry Telemetry (DRET) system for the U. S. Air Force. The DRET system has been flown on Atlas and Titan ICBMs and has successfully transmitted signals to airborne monitoring equipment. Engineers and scientists at AVCO/RAD are also working on techniques for continuous communications with re-entering manned vehicles, as well as on other conditions in which a plasma barrier exists and where signal penetration is required.

Airborne re-entry tracking team of Avco's RAD Division monitor an Avco Mark 4 re-entry vehicle launched by Titan ICBM.

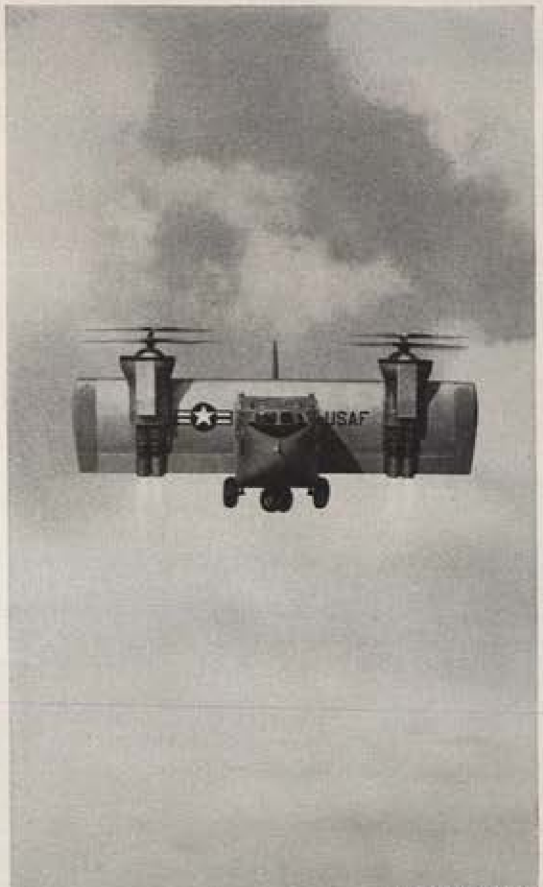
AVCO
Research & Advanced Development Division

AVCO CORPORATION, RESEARCH AND ADVANCED DEVELOPMENT DIVISION, WILMINGTON, MASS.

CHANCE VOUGHT "ADAM"

THREE STRONG RECORDS **COMBINED** FOR

RYAN X-13 VERTIJET
AND VZ-3RY VERTIPLANE



HILLER X-18

NAVY ARMY AIR FORCE

VTOL

Chance Vought, Hiller and Ryan—three key names in the advancement of vertical flight—have joined forces to design a new Tri-Service, VTOL transport aircraft for the Department of Defense.

These companies already have devoted millions of engineering man-hours to solving the design and test problems that will be vital in the development of the new transport. The complementing strengths and balance of the three-company team can be counted on to meet the challenge in the development of an operational VTOL prototype for the Army, Navy and Air Force.

Chance Vought's Aeronautics Division—a veteran systems manager with an outstanding record in design innovation, weight control and responsive field service—has developed VTOL background in a high-speed turbofan concept known as ADAM. Hiller, producer of light utility helicopters, pioneered the tilt-wing VTOL concept and developed the Air Force X-18, world's largest V/STOL aircraft. Ryan's Aerospace Division designed and built the X-13 Vertijet—World's first jet VTOL—and pioneered the Ryan VZ-3RY deflected slipstream Vertiplane.

Here, then, is an available "first team" with advanced experience and demonstrated accomplishment in the whole spectrum of VTOL—three strong records combined under the prime management of Chance Vought to provide the capability and experience required to put the new VTOL Tri-Service transport aircraft in the air by mid-1963.

CHANCE VOUGHT

HILLER AIRCRAFT CORP.

RYAN AEROSPACE

Air Rescue team trains to pick up first Astronaut . . .

DRY RUN for a WET JOB.....

Sergeant Klimis helps Sergeant Williams into his scuba gear. Suits will keep them warm in the sea.

Loaded down with his heavy equipment Sergeant Williams is pushed, pulled onto aircraft by Air Reserve personnel.

Important moment: On plane Sergeant Williams stands ready to jump, awaits signal from Drop Master McCall.

WHEN America's first Mercury Astronaut makes his scheduled landing at sea after returning from his epochal flight in orbit, a specially trained crew of USAF Air Rescue Service personnel will be standing by aboard search aircraft in the impact area—ready to parachute down to the floating capsule and welcome the spaceman back to earth.

Unless the Mercury capsule happens to land near one of the Navy ships, in which case the ship's personnel will free the Astronaut from his spacecabin, it will be the men of ARS who drop from the search aircraft into the water, fully equipped with scuba gear. They will make their way as fast as possible to the capsule, fasten on a flotation device, help the Astronaut out of the capsule, and give any help that may be necessary.

The ARS men being trained for this special mission are experienced pararescuers and expert medical technicians as well. To help prepare them for the Astronaut rescue job, they have completed the Navy underwater swimming course at Key West, Fla., and have received special instruction from the National Aeronautics and Space Administration, which is directing the man-in-space Mercury project.

On landing, the capsule will give off radio and smoke signals. When search aircraft pinpoint the

Mission under way: With half his parachute opened, Sergeant Williams hits the waiting team.

One on each side of the capsule, the two ARS pararescue men carefully attach the flotation gear.

Flotation gear attached, they wait to be picked up. In real thing, they'd be rescuing Astronaut.

Back on the pickup launch, they fill up on liquids, replacing body fluids which they have lost on mission.

capsule location, the first one on the scene will determine wind direction and velocity by dropping smoke pots and spotting chutes used to determine drift.

Next step will be to drop two twenty-man liferafts connected to each other by an 840-foot line, with three equipment packages hooked to the center of the line. On the water this combination will take a horseshoe shape and envelop the space capsule. The ARS pararescue men then will jump into the impact area and swim toward the capsule, which will have been "captured" by the horseshoe line.

They will attach flotation and stabilization gear to the capsule, help the Astronaut out, and then stay with him until he is successfully picked up.

These photos, taken by TSgt. Lloyd Borguss, Hq. MATS, of which Air Rescue Service is a component, show the first complete run-through of the ARS Mercury rescue operation.

Participating in the "dry" run are three skilled air rescuers, all with the 48th Air Rescue Squadron, Eglin AFB, Fla. They are: MSgt. Nicholas Klimis, with ARS for more than thirteen years and a veteran of 370 jumps; TSgt. Joe L. Williams, with ARS for more than twelve years, a veteran of more than 310 jumps; and SSgt. Robert L. McCall, flight engineer, highly experienced in his job of Drop Master and Safety Man.—END

The "scientific community" is pressing for a greater role in the formulation of science policy. . . . But before it can attain that role, it must explain its identity and be willing to participate actively in the democratic process. Politics is basic to that process and . . .

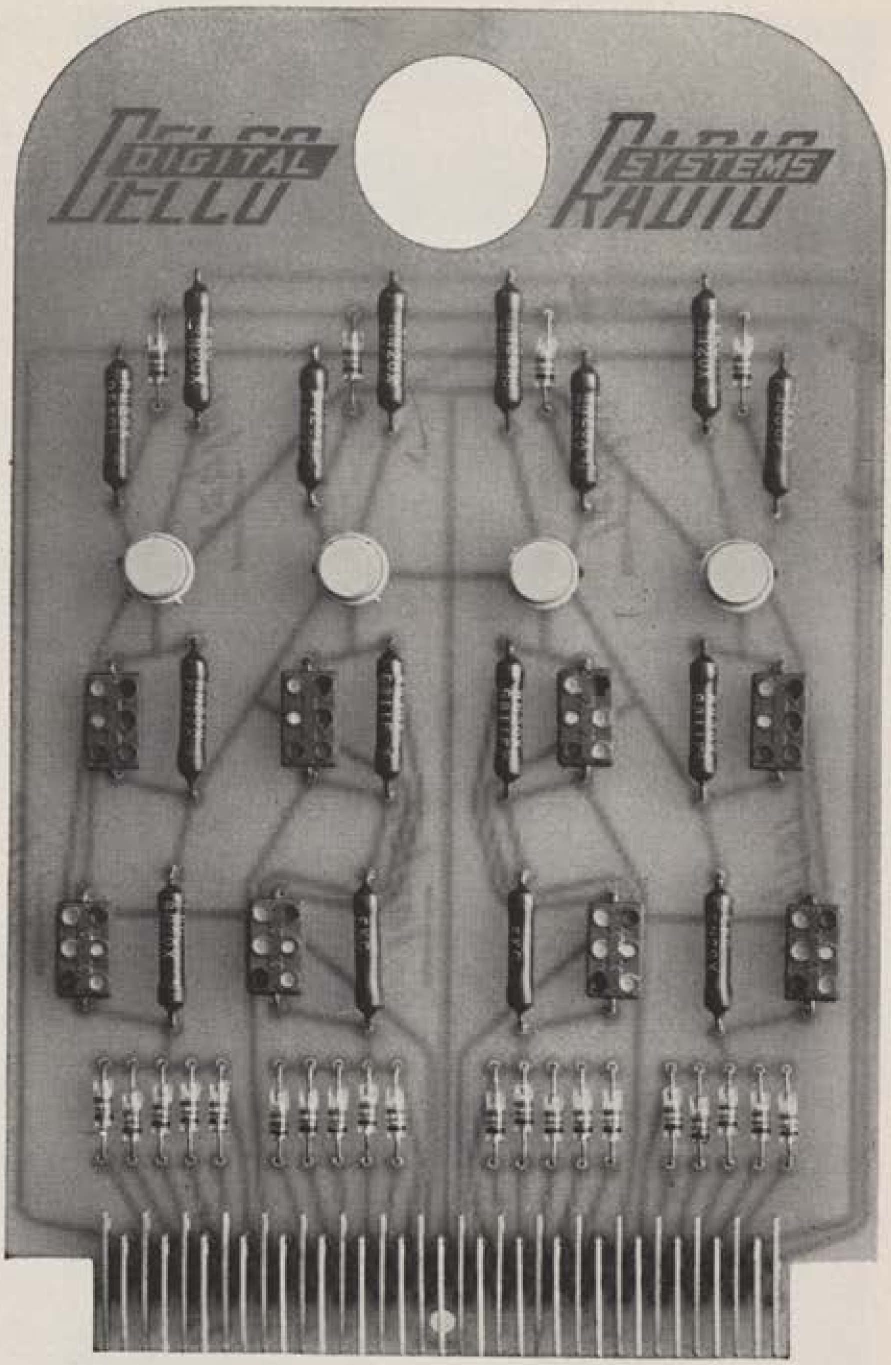
Scientists Are in the Battle—Not Above It

WALLACE S. SAYRE

IF SCIENTISTS are to be influential participants in constructing an American science policy, they will need to be self-conscious participants—that is, they must have a visible and concrete identity. That identity is now vague and elusive—to many scientists as well as to the other groups involved in the policy process. "The scientific community," a phrase often submitted as an identification, is a world of uncertain boundaries.

Who are the members of the scientific community? Is it an open community, hospitable to all who desire to enter, or is it open only to those who meet severe tests of eligibility? More specifically, are there "hard scientists," whose membership is taken for granted, and "soft scientists," whose credentials are dubious? Are physicists and chemists members of the scientific community by right, while other natural scientists must submit additional claims for admission? Do all engineers qualify, or only certain types of engineers? Do doctors of medicine have entry, or only research scientists in medicine? Are social scientists full members of the scientific community?

The difficulties raised by these questions suggest that "the scientific community" is most often used as a strategic phrase, intended by the user to imply a large number of experts where only a few may in fact exist, or to imply unity of view where disagreement may in fact prevail. The phrase may



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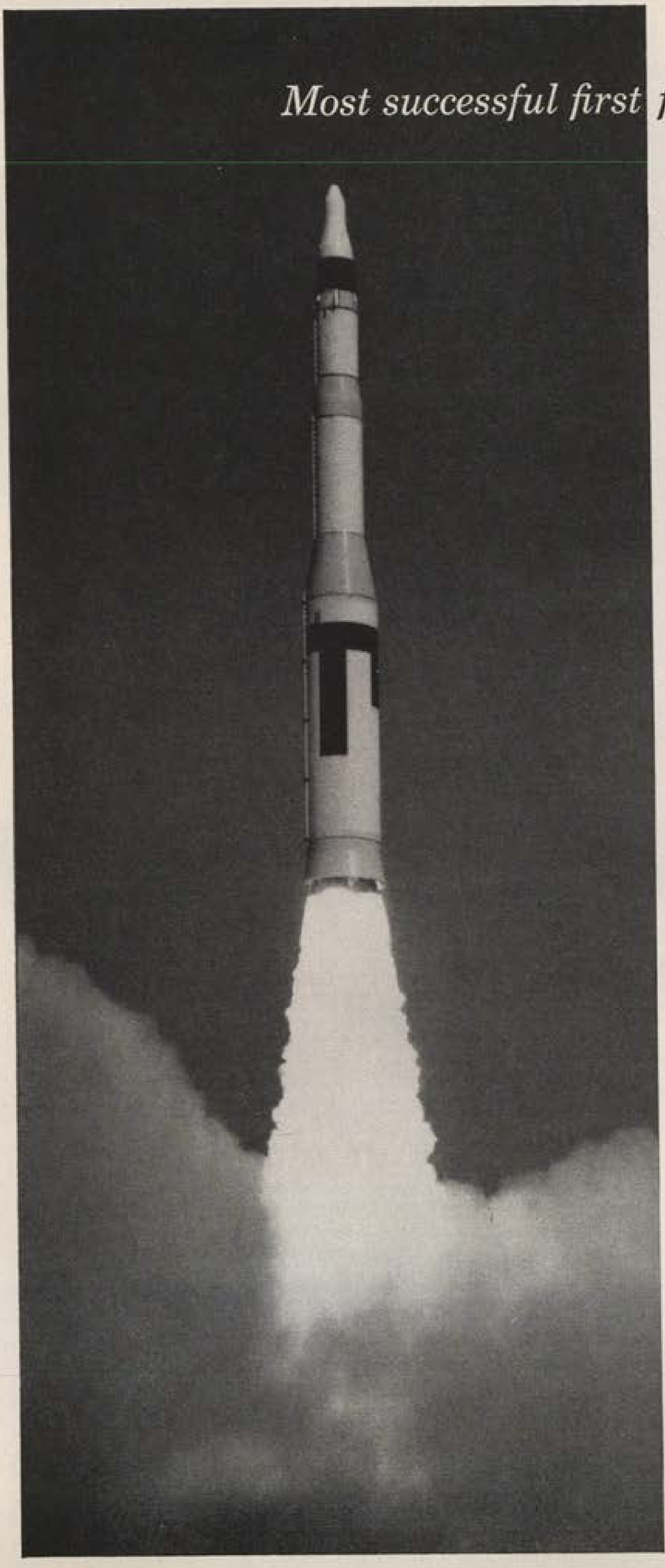

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thus belong in that class of invocations, so familiar to the political process, which summon up numbers and legitimacy for a point of view by asserting that "the American people," or "the public," or "all informed observers," or "the experts," demand this or reject that. There is nothing especially astonishing about this, since all participants in the political process indulge in the stratagem, and each participant learns to discount the claims of others, but there may be ground for mild surprise that the code of science permits its extensive use by scientists either as deliberate strategy or in genuine innocence.

If scientists are themselves uncertain as to who all their fellow scientists are, then some ambiguities attend their relationship to American science policy. Are they a small élite group (for example, the approximately 96,000 named in *American Men of Science* for the physical and biological sciences), or do they number several million (as they do if the engineers, the social scientists, and the medical profession are included)? If scientists want to be among the shapers of American science policy rather than simply the objects of that policy, then they must expect these and similar questions from the other participants in the making of science policy. The spokesmen of science will be asked: For whom do you speak? The scientists themselves confront a prior question: Who are to be the accredited spokesmen for the scientists?

The notion of an American science policy, a policy with which the scientists are to be influentially identified, requires the scientists to have leaders who can act as their representatives in that bargaining with public officials and other groups which accompanies the policy-making process. Not every scientist can participate directly in this process; there is not room enough, nor time enough, for a town meeting of all the scientists with all the other groups that have equally legitimate claims to be present. Some few scientists must be selected to speak for the many, but the scientists may choose these few in many different ways. They may let the science spokesmen nominate themselves; they may let nonscientists select the leaders of science; they may develop nominating and electoral devices for choosing their leaders through the votes of all scientists in a single scientist constituency; they may choose their leaders in numerous specialized constituencies; or they may combine these methods in various ways, or invent still other methods.

Tradition and recent practice have already provided some important patterns of choice. The his-

tory of American science is rich with examples of the articulate, self-directing, individual scientist of high prestige who felt it his obligation to speak often and boldly in behalf of science and the scientists. Few scientists, and fewer nonscientists, have been inclined to question his representative role, although his peers in prestige and self-confidence have often publicly challenged his advice. Another pattern has been provided by the habit which high-ranking government science officials have of speaking, from their position of special eminence and authority, for the interests of science as they perceive them; this would seem to be, for example, the primary function of some government science advisers and advisory committees. If these advisers are the spokesmen of the scientists, it is relevant to ask: What role did which scientists have in choosing them? Still another pattern has been demonstrated by the role of the National Academy of Sciences since 1863. This quasi-governmental body of scientists, its membership small and its new members elected on the basis of scientific eminence by those who are already members, has for many decades acted upon the assumption that it could and should speak for the scientists in the realm of public policy. The scientists who are not members of the Academy have not invariably agreed that the Academy spoke for them, or that its silence was to be taken as neutrality on their part on contemporary issues of science policy.

These patterns of individuals and small, élite groups, some self-nominated and some the designees of government officials, speaking for the scientists have been accompanied by several efforts to establish more comprehensive scientists' constituencies from which spokesmen might be chosen. The American Association for the Advancement of Science is the most durable of these constituencies. Its own membership is large, and its affiliated societies enlarge its base. Its officials, and especially its committees and its journal *Science,* often speak eloquently for the values and the priorities of science and the scientists. The Federation of American Scientists provides still another variation—an association of scientists quite explicitly committed to participation in the political process.

But the most prevalent pattern for choosing the spokesmen of the scientists is provided by the specialized associations of scientists. These spokesmen do not often speak with one voice upon a given aspect of science policy, nor do they often if ever concern themselves with the elements of a comprehensive science policy. Instead, the leaders of each specialized society tend to express their views upon the segment of science policy which touches significantly the interests of the society's own members. As spokesmen for the scientists, their voices are often competitive, emphasizing separate priorities, asserting specialized rather than general goals.

Who, then, speaks for the scientists? The answer would seem to lie somewhere in a broad zone of ambiguity. Only the scientists themselves can identify their authentic spokesmen. If they have already done so, it would seem to have been done privately and to have been kept confidential. When and if the scientists undertake an explicit identification of their spokesmen, it is not improbable that they will conclude that no one can speak for all of them, and that in a democratic society we will all, perforce, continue to be confronted by numerous, competing spokesmen for science, each often claiming to speak for more of the scientific community than he in fact represents.

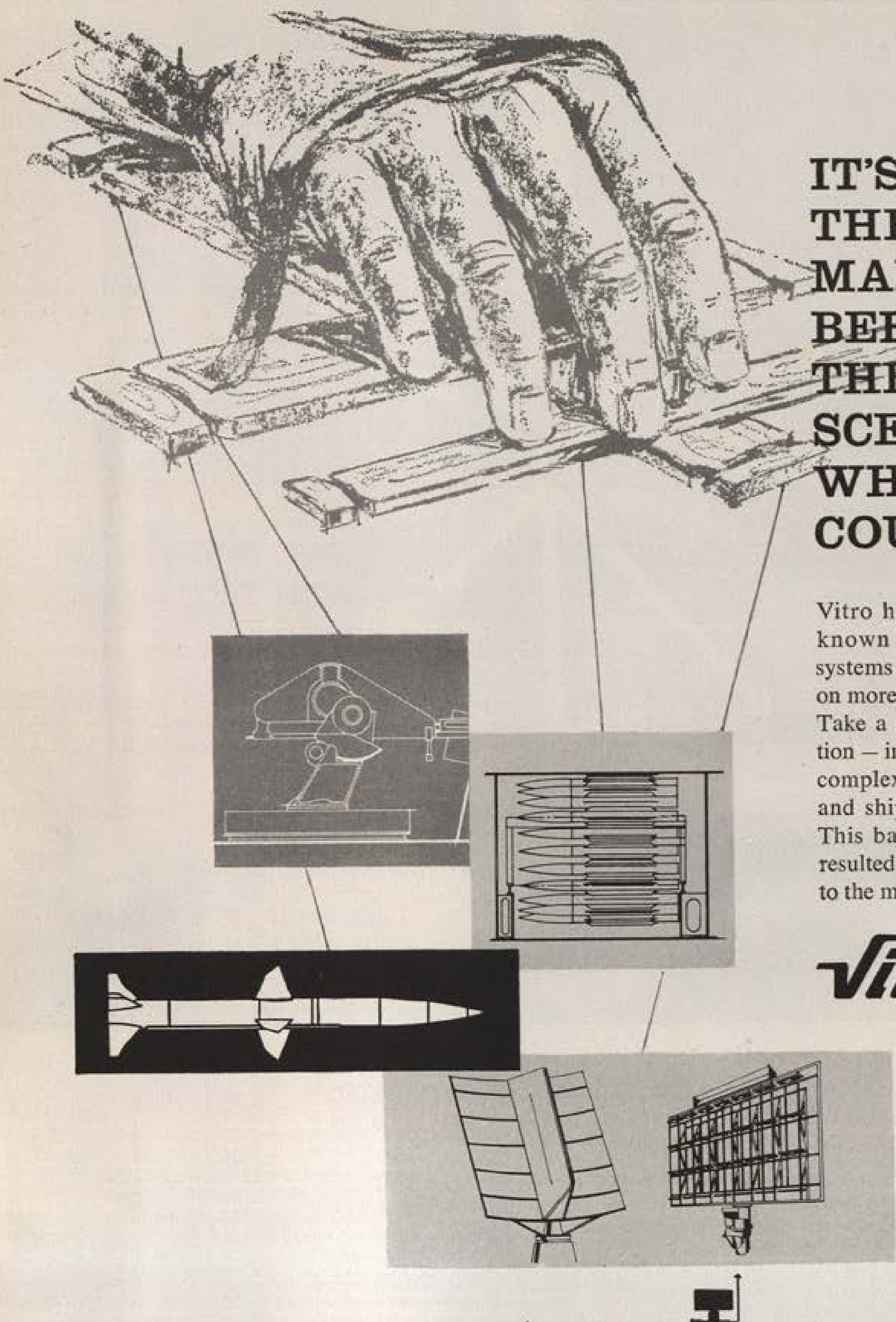
Uncertainty thus surrounds the question: Who are the scientists and who speaks for them? Ambiguity also characterizes the phrase "American science policy." It is not difficult to cite examples of particular science policies; these exist in abundance—from the patents clause of the Constitution to yesterday's progress reports of the National Science Foundation. But the unity and comprehensiveness implied by the phrase "American science policy" are not achieved by merely consolidating and codifying all these separate items of science policy. Something more than this is quite clearly implied and evidently desired by many of those who speak for the scientists. It may be assumed, then, that an American science policy is something aspired to but not yet achieved by the scientists: a unified, comprehensive, coherent, rational statement of goals and methods of science in the United States, accepted by and binding upon all the participants in the policy process, and including agreement upon the rules by which the policy may be changed.

If such a body of public policy existed, accepted by the scientists and legitimatized by the President and the Congress in a statute, thus attesting the consent of the nation, then an American science policy in the fullest implications of that phrase would have been established.

Is such a unified and comprehensive policy a feasible goal for American scientists? Do they in fact desire it?

If a 1961 Town Meeting of Science were to be assembled, despite the problems of deciding which scientists were eligible to attend, agreement could no doubt be reached on the preamble to an American science policy. Preambles, like political party platforms, are usually triumphs in ambiguity. A viable consensus could probably also be reached on the "working conditions" for scientists although ambiguity would overshadow precision here too. But beyond these two items the available evidence suggests that there are no other major elements of an American science policy upon which one could expect unanimity, or even a clear majority agreement, among the scientists themselves. The document which might emerge from the work of such an assembly of science would most likely be an unstable mixture of vague agreement and sharp minority dissents, a testament to the pluralism of science and the scientists.

Unity and comprehensiveness are thus not likely to be the hallmarks of American science policy. Talk of a single, comprehensive "American science policy" has an essentially fictitious quality. There will be many science policies, rather than a master science policy. Diversity, inconsistency, compromise, experimentation, pulling and hauling, competition, and continuous revision in science policies are more predictable continuing characteristics than their antonyms. This has been the history of American science policies and this describes their present state. We are accustomed to view this state



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of affairs as deplorable. But to live with diversity and accommodations of policy, and yet to be impatient of them, may be the process by which a democratic society achieves progress in science as well as in other fields. In any event, the future seems to offer American scientists more dilemmas than unequivocal answers in science policy.

Some of these dilemmas may be illustrated by a brief exploration of a few of the choices concerning governmental arrangements for science—choices which some scientists have helped to make in the past, or which nonscientists have made for them, and still other choices which must yet be made.

Science advisers. One of these choices involves the aspirations of scientists to give advice to officials at the highest levels of the national government—advice not simply in an area defined as "science policy" but also concerning those elements of foreign policy, defense policy, and domestic policy to which many scientists believe their specialized knowledge is relevant.

Attempts to define the role of such advisory institutions raise several important questions. Is their primary responsibility to advise the officials as an autonomous voice of the scientists, or are they, as agents or colleagues of the officials, to explain official policies to the scientists, or are they to participate in working out those accommodations in policy which will build a bridge of collaboration between scientists and officialdom? The history of these institutions of advice reveals the tensions, as well as the temporary adjustments, between these inherently competitive conceptions of the advisory role. For the scientists the dilemma remains unsolved: An autonomous science adviser is soon at the periphery rather than at the center of policy-making; an involved adviser is soon the advocate of all official policy rather than its critic, an ambassador from the officials to the scientists rather than the scientists' spokesman, or at best a broker between the scientists and the officials.

A department of science. Another choice involves the recommendation for a unified department of science, or for a department of science and technology. The proposal encounters today, as it has since John Wesley Powell advocated it before the Allison Commission in the 1880s, the stubborn pluralism of the scientists themselves, the uncertainties of the scientists about the boundaries of their interests, and the opposition of government scientists more willing to endure their existing, familiar organizational environment than to risk the unknowns of a new and untested arrangement. A department of science, then, waits upon the unlikely event that the scientists will soon be able, and will find it desirable, to decide who they are, who their accredited spokesmen are, and what their common goals are, and, most important, able to conclude that they are sufficiently unified to risk their separate interests to the leadership and fortunes of a single government institution.

An autonomous science agency. An alternative choice—the creation of an autonomous science agency, but with a limited assignment—has been at least temporarily decided upon. The National Science Foundation has completed its first decade; its durability now appears convincingly demonstrated. The independence of the agency from the supervision of officialdom is not as great as was hoped for by those spokesmen for the scientists who piloted the proposal. Annual budgets and annual appropriations are continuing reminders that autonomy is limited.

A close look at the composition of the National Science Board since 1950 also raises the question of whether the agency does not more nearly reflect the autonomous voice of university and other administrators of science, alumni from the ranks of scientists though they be, than it does the voice of scientists in the classrooms and laboratories. The task of representing the scientists on the Board has apparently been entrusted more to surrogates for scientists than was the expressed expectation of the sponsors and the officials in the discussions accompanying the passage of the National Science Foundation Act of 1950.

Specialized science agencies. Most existing government science organizations represent a different kind of choice for scientists. These science agencies are immersed in the political system of a large department or "independent" agency, the degree of autonomy of the science unit in that system varying widely.

The leaders of all these science units have links, strong or attenuated as the case may be, to the associations and institutions of scientists outside the government, but inside the departmental or agency system they share the powers of decision and compete for priorities with other members of the executive hierarchy, and they report to congressional committees whose concerns are not confined to questions of science or the preferences of scientists. In these many science enterprises the scientists are partners with nonscientists rather than autonomous decision-makers. They may employ the *mystique* and the *expertise* of science as strategies to maximize their autonomous role, but they cannot realistically expect to be more than senior partners. Most frequently they will be compelled to accept the status of equal partner with nonscientist officials; not infrequently, they will find they are actually junior partners. Their hopes for autonomy are, in practice, curbed not only by nonscientist officials in the executive hierarchy and by congressional committees but also by the activities of the interest-group associations in the science bureau's own special constituency.

Advice to Congress. Science agencies in the Executive Branch have occupied most of the attention of scientists. If they are to pursue their aspirations for a more distinctive and influential role in science policy, the scientists will find it necessary to formulate a general strategy concerning advice to Congress from scientists. No congressional committee is now organized and staffed to give exclusive and comprehensive attention to science policy and to listen continuously to scientists. Most scientists must pursue their congressional interests across almost the whole range of committees and subcommittees in both Senate and House. If unity and comprehensiveness in congressional action on science are desired—unity such as is sometimes proposed for science in the Executive Branch—scientists will be required to choose among several apparent alternatives; they can propose a joint committee on science and technology, with a wide-ranging jurisdiction over all the concerns of scientists; or they can propose a comprehensive committee on science and technology in each House, rather than a joint committee; or they can aim at the creation of a joint committee on science policy with a more limited assignment, or of such a committee on science policy in each House. If changes like these were to be made in congressional science committees (an event to be anticipated only after long and determined effort), the scientists still could not expect to enjoy a monopoly of attention from the new committees. The question which would soon confront the scientists would be, could they establish and maintain their own unity of goals and priorities before the new committees? The odds in favor of an affirmative answer do not seem to be high.

Scientists influential in the creation, maintenance, and modification of American science policy are scientists in politics. The spokesmen for the scientists need not be party officials nor candidates for, nor occupants of, elective public office, but they will have to be active participants in other phases of the political process—as high government science officials, as science advisers to executive officials, as spokesmen for science policies before committees of Congress, as organizers of opinion through the communication media, as officials and leaders of science associations and institutions. The leaders of the scientists cannot escape politics and remain leaders in science; since their leaders cannot escape politics, the scientists as a whole are in politics too—even their silence is interpreted as acquiescence.

Scientists in politics share the problems of other participants in the political process. No special dispensation exempts the scientists from the hard choices and continuing difficulties which the political process imposes upon all those who aspire to shape public policy. One course is to seek to maximize the unity of all scientists and to establish legitimacy for the spokesmen of a unified science community. An alternative is to accept diversity and competitive priorities among scientists and to establish the identity of the separate groups of scientists, establishing the legitimacy of their respective spokesmen. Whichever of these two main roads is chosen, the united or the separated, scientists will face the necessity of recruiting allies from among organized groups of nonscientists; the scientists cannot exercise a unilateral dominance in the making of science policy.

The scientists are now inescapably committed to politics if they hope to exercise influence in the shaping of public policy, including science policies. The leaders of the scientists, then, are perforce politicians. As politicians in a democratic order, they are effective in the degree to which they understand the political process, accept its rules, and play their part in the process with more candor than piety, accepting gladly the fact that they are in the battle rather than above it. The spokesmen for science have occasionally lectured the nonscientists, sometimes sternly, upon their obligations to understand science. Perhaps the advice may be reversed: The scientist has an obligation to understand, and to play his significant role forthrightly in, the policy.—END

Wallace S. Sayre is professor of public administration at Columbia University. The above article is condensed with permission from Science, *the publication of the American Association for the Advancement of Science, where it originally appeared March 24, 1961.*

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Speaking of SPACE

WILLIAM LEAVITT
Associate Editor, SPACE DIGEST

The Space Age—Prehistory and Future

Since the two principals are dead, we will probably never have the full truth about the now-celebrated controversy between Sir Henry Tizard and Frederick A. Lindemann, the two British World War II defense scientists, which is related as a kind of parable in the new book by C. P. Snow, *Science in Government* (Harvard University Press, $2.50). If you haven't read this eighty-four-page work, the mid-April triumph of cosmonaut Gagarin should spur you to spend the ninety minutes or so it takes to get through it.

Briefly, the Tizard-Lindemann struggle, as recounted by Snow, involved what he describes as the blind opposition by Lindemann to Tizard's campaign to push the British radar development program that helped win the Battle of Britain. At the time of the conflict, Tizard was dominant in British military-scientific circles, while Lindemann, though influential, was still some years from the high estate he attained later as top science adviser to Winston Churchill when Churchill became Prime Minister. Tizard won the battle to push radar development. But later, in the Snow account, Tizard lost a battle with a much more powerful Lindemann who believed intensely in strategic bombing of worker-class German homes. According to Snow, Tizard and others produced calculations suggesting that Lindemann's figures on strategic-bombing potential were many times too high. But Lindemann won his fight for the bombing program, which Snow deplores. Snow asserts that strategic bombing of residential areas was proved a mistake, but surely he could get an argument on that, not only from bombing advocates, but from some of the Germans who lived through the great raids.

Snow's little book, composed of his 1960 Godkin lectures at Harvard, was published to point up the problem of secret decision-making—particularly of a scientific nature—in a democratic society. This is a vital question, even more vital in the dawning space age, than it was in the dramatic '30s and '40s, and it is unfortunate that most of the attention given Snow's book has been paid to the battle of personalities, Tizard and Lindemann. Indeed some reviewers have criticized Snow for painting Lindemann too blackly and Tizard as too blond and brave a hero. Sir Robert Watson Watt, considered by many the inventor of British radar, has registered this complaint, although other British scientists have come to Snow's defense, saying that his account of the Tizard-Lindemann struggle is accurate.

But the struggle is not really the point of the book. The scientific role in society is what Snow is really talking about. Having portrayed Lindeman as the archetypical "gadgeteer" scientist he considers a menace, and having suggested that since the chances are remote of getting a scientific overlord such as his hero Tizard or another apparent hero, Vannevar Bush, Snow says that we ought not to give any single scientist "the power of choice that Lindemann had." He is probably right.

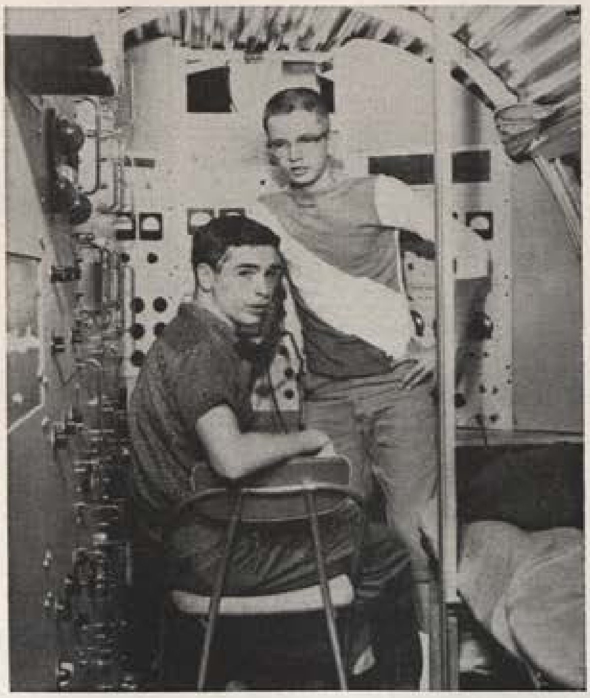
Yet he wants scientists "active in all levels of government." And he says, "by scientists . . . I mean people trained in the natural sciences, not only engineers, though I want them too. I make a special requirement for the scientists proper, because, partly by training, partly by self-selection, they include a number of speculative and socially imaginative minds. While engineers—more uniform in attitude than one would expect a professional class to be—tend to be technically bold and advanced but at the same time to accept totally any society into which they may have happened to be born. The scientists proper are nothing like so homogeneous in attitude, and some of them will provide a quality which it seems to me we need above everything else. . . . I believe scientists have something to give which our existential society is desperately short of; so short of, that it fails to recognize of what it is starved. That is foresight."

Snow is saying this in the context of his provocative and at least partially demonstrable belief that the West is a stand-pat society with little or no view to the future, as opposed to the tomorrow-oriented East. He has a faith that scientists in government could provide some of the foresight that we now lack in his view.

But is Snow saying enough, is he totally consistent, and is he placing the emphasis where it belongs? He comments that the Soviet Union has "a clear advantage [in] that they have right at the top of the political and administrative trees, a fairly high proportion of men with scientific or technical training," and that "in the fields where they have made better technical choices than either of us [the US or Britain], this collective influence has no doubt been a help." He allows that "though that is a real gain, it is secondary to what I have most in mind"—that is, the futuristic view.

Looked at a bit more closely, Snow's view of scientists, even the "good" kind he represents with Tizard, fizzles a little. He may claim that engineers tend to "accept totally any society into which they may have happened to be born," but can he dem-

This full-scale working model of a three-man space station at Convair's San Diego, Calif., plant will be capable of duplicating space environmental conditions with exception of zero-gravity. Manned tests within model are expected to begin later this year.

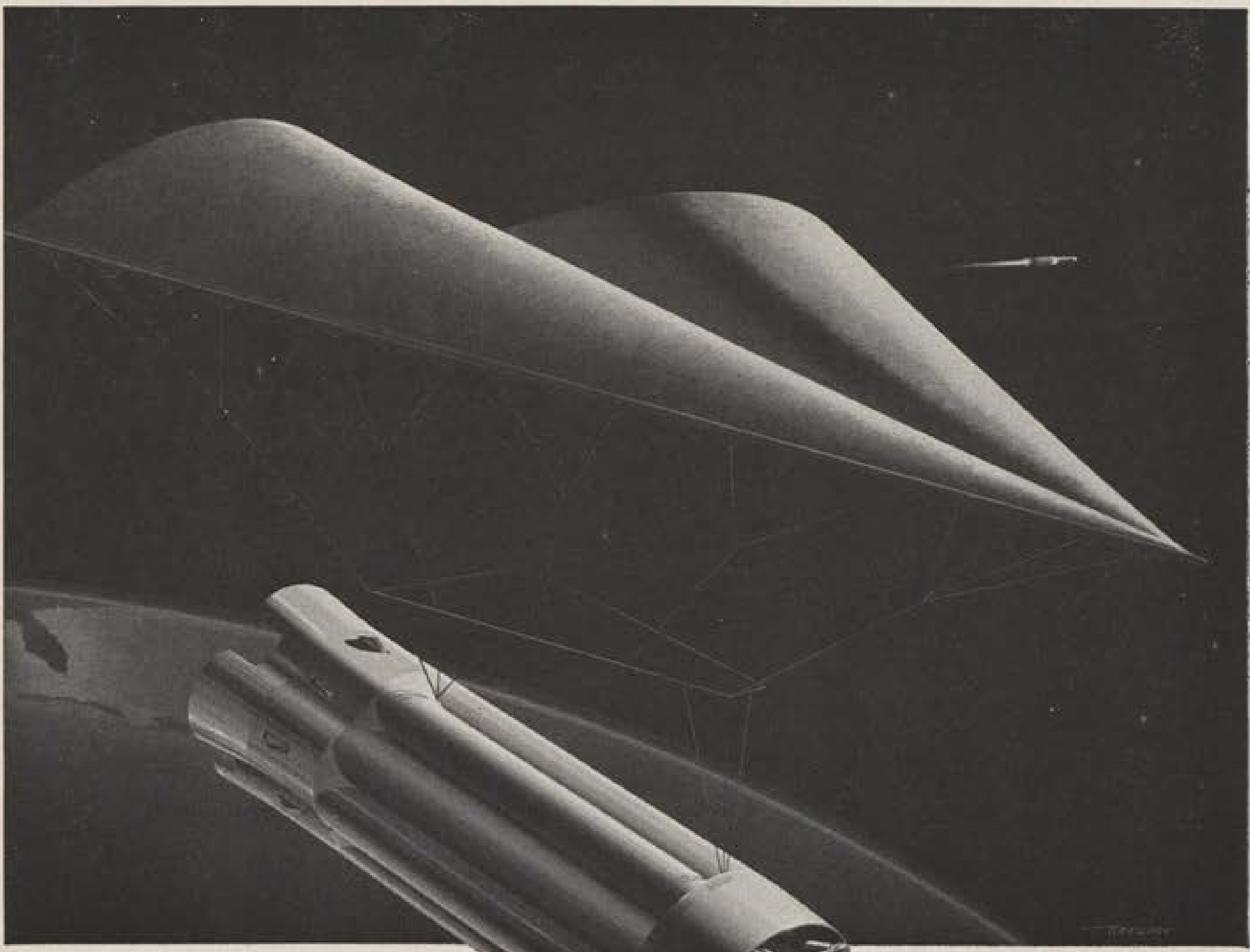


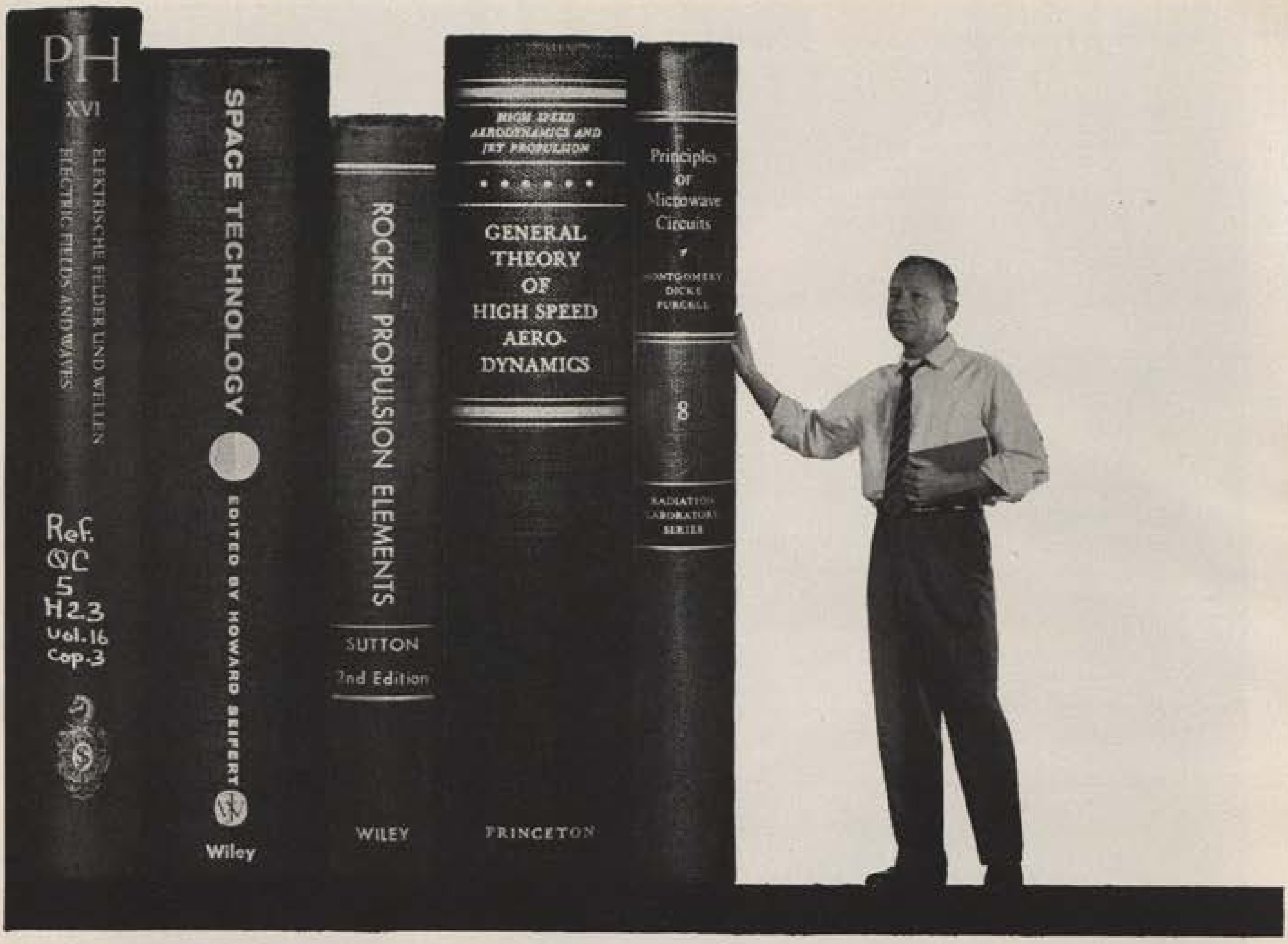
Junior astronauts, Greg Knight and Mark Depp, spent 24 hours in Electronic Communication Inc.'s Spaceship Simulator on a late-February "flight to Mars." During trip in the Florida firm's capsule, they ran controls and simulated a Martian landing.

onstrate that scientists as a group are much more discriminating? The scientists of the Soviet Union seem essentially satisfied with their authoritarian regime, especially in view of their high prestige in that regime, yet they certainly include many who through correspondence with or visitations to their Western colleagues have been exposed to what still is undeniably a freer society, despite the secrecies of the atomic age. In the Soviet Union there are no open Edward Teller vs. Linus Pauling battles over the problem of nuclear fallout. Yet a *poet,* Boris Pasternak, raised his voice against repression.

Snow, who is doubtless the most articulate of today's spokesmen for science but still one of many *(see "Scientists Are in the Battle—Not Above It," page 70),* may be missing a highly important point in discussion of the scientific role in society, our society.

This is that, even more important than their role as advisers and decision-makers, scientists must fill the gap that is rapidly developing between the great mass of laymen and themselves. In one sense, scientists are not at all as important as they think they are *(again see "Scientists Are in the Battle—Not Above It")* because as Professor Sayre points out, they are part of politics but can-





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Dr. Frank Dickey of General Electric's Electronics Laboratory, Syracuse, N. Y., demonstrates concept of a new soft lunar landing technique. GE plan would have earth-based microwave transmitter create wave field near moon which would guide spaceship landfall.

not rule it because they are human and cannot completely rule themselves. They must share their power with others. Yet in another sense, they are more important than they have ever imagined—in their proper adjunctive role as teachers.

This means that they must emerge from their self-created mists and spend much more time and energy in the business of communicating the significance of the world they have brought about to the plain people who must live in that world.

Space Capsules

On the basis of present understanding of the space radiation hazard, four conclusions are made by the Brookhaven National Laboratory's Howard J. Curtis. Writing in *Science,* he suggests that: "(1) Flight below the Van Allen belts seems reasonably safe without radiation shielding; (2) it is probably impractical to shield a rocket sufficiently to permit a man to remain in the inner Van Allen belt for more than about an hour, but it should be possible for him to go through it without serious harm; (3) shielding for the outer Van Allen belt is possible but would have to be quite heavy if a stay of more than a few hours were contemplated; (4) the primary cosmic radiation is not intense enough to deliver a serious radiation dose, even for exposures of a few weeks, and the heavy cosmic primaries do not seem to present an unusual hazard." . . . A Yugoslav researcher, Prof. Jevto Radulovic, believes that hypothermia, deep freezing, affords considerable protection against radiation hazards. Rats in his laboratory have been exposed, while in deep freeze, to 750 roentgens, and the number of deaths, compared to exposed subjects in normal temperatures, has been smaller. When deaths did occur, they happened two or three months after the exposure, as compared with the four to six days it took the heavy radiation to kill the normal subjects.

If you've been referring to the hypothetical natives of Venus as Venusians, you're wrong, according to Philip N. Bridges of Rockville, Md., who took the trouble to write a letter to the Washington *Post* on the matter. Mr. Bridges points out that adjectives formed from the names of the planets are based on the stems of the nouns, which come from the (Latin) genitive case of the noun. Hence "the name for the inhabitants of Venus should be formed from *Veneris,* the genitive of Venus, and . . . is correctly, *Venerian,*" Mr. Bridges adds that since Venus is one of the four Latin words which have a second stem for adjective formation *(Venustis),* one can be correct with the term Venustian also. . . . Planetary engineering of the *Venerian* (or *Venustian*) atmosphere to enrich it with oxygen by seeding it with algae is suggested by astrophysicist Dr. Carl Sagan of the University of California. The algae would produce oxygen in exchange for the carbon dioxide which is the overabundant principal gas in the Venerian atmosphere. At first, Dr. Sagan believes, the photosynthesis process might not make much headway in the production of oxygen and the elimination of carbon dioxide. But he thinks that eventually, with a steady flow of algae to lower altitudes and their consequent burning up in the probably very hot temperatures nearer the

Engineers Harold Sachs and John J. Russo of the Perkin-Elmer Corp. of Norwalk, Conn., examine infrared spectrometer to be carried to Martian vicinity by NASA probe to explore life possibility.

surface, and with consequent release of their water content, the balance would be created.

On the efficacy of algae as oxygen producers, it is interesting to note that not long ago the Air Force Aerospace Medical Center's DRS. HUBERTUS STRUGHOLD and OSKAR RITTER calculated that, given no biological enemies to check their growth, algae could theoretically fill the entire universe in a fairly short cosmic time. . . . They do have problems in the Soviet Union. In a recent issue of *Pravda*, M. LAVRENT'YEV, Vice President of the Soviet Academy of Sciences asks for a revision of scientific educational methods and a heavy increase in personnel for work in electronics, computers, and automation. Schools of higher education are using a curriculum based on the "science of yesterday." . . . DR. E. ROBERT BRITTON of Airtronics International warns that tomorrow's interplanetary astronauts may be seriously endangered by "space garbage," the rocket carrier remains of satellites launched by the US and USSR. The problem is significant, he says, because both major space powers choose the lunar cycle, days when the earth is closest to the moon for firing satellites. One of the solutions he suggests is development of a "space garbage collector," a space vehicle which would go into orbit, attract satellite remnants and "nudge" them into trajectories to send them back toward the earth's atmosphere where they would burn up.

ELECTRONIC INDUSTRIES ASSOCIATION is preparing a guidebook to familiarize school administrators and teachers with techniques of using electronic devices for teaching languages. Write to EIA, 1721 DeSales St., N. W., Washington 6, D.C., for information. . . . For an excellent account of algae and their potential as a new source of food for a burgeoning world population, see DR. E. LAURENCE PALMER's article, "The Marine Algae," in the March issue of *Natural History* Magazine. Write to the American Museum of Natural History, New York 24, N. Y., for information on availability. . . . The proceedings of the highly significant *Bionics Symposium* held late last year at Wright-Patterson AFB, Ohio, are now available in book form. The symposium covered developments in the new studies of parallels between living systems and machines. Interested persons should write to the Office of Technical Services, US Department of Commerce, Washington 25, D.C. Ask for *WADD Technical Report 60-600*.

For historians of astronautics and missilry: the House Committee on Science and Astronautics has released *A Chronology of Missile and Astronautic Events,* that starts with Sir Isaac Newton in 1686 and takes you through to February 1961. Available from the US Government Printing Office, Washington 25, D.C. at fifty-five cents. . . . Another interesting report available from the same source is *Research Needs for Salt Water Conversion,* also issued by the House space committee. . . . *Psychophysiological Aspects of Spaceflight,* edited by LT. COL. BERNARD E. FLAHERTY, USAF, the proceedings of a symposium held at the Aerospace Medical Center, Brooks AFB, Tex., is available at $10 from Columbia University Press or at your bookstore.—END

"Space for Peace" Conference Set for Tulsa

The First National Conference on the Peaceful Uses of Space, featuring reports by leading US space researchers, will be held at Tulsa, Okla., May 26 and 27. Announcement of the conference was made at the White House after a call on the President by SEN. ROBERT S. KERR, chairman of the Senate Committee on Aeronautical and Space Sciences; JAMES E. WEBB, Administrator, National Aeronautics and Space Administration; and HAROLD C. STUART, Tulsa Attorney, former assistant secretary of the Air Force and former Air Force Association President, who is serving as conference chairman.

The conference will be followed by a two-week "space for peace" public exhibition on the Tulsa state fairgrounds.

NASA and the Tulsa Chamber of Commerce are joint conference sponsors. Co-sponsors include: Aerospace Industries Association; Aerospace Medical Association; American Astronautical Society; American Institute of Biological Sciences; American Rocket Society; Frontiers of Science Foundation; Electronic Industries Association; Institute of the Aerospace Sciences.

Invitation requests are available from the First National Conference on the Peaceful Uses of Space, 616 S. Boston St., Tulsa.

TRACKING PIONEER V

for 22,500,000 miles, on its way to solar orbit, was aided by Motorola's frontier capability in solid state microwave technology. Compact, ferrite UHF isolators were especially developed to boost tracking receiver performance in order to detect the last faint whisper of available signal strength at this history-making distance.

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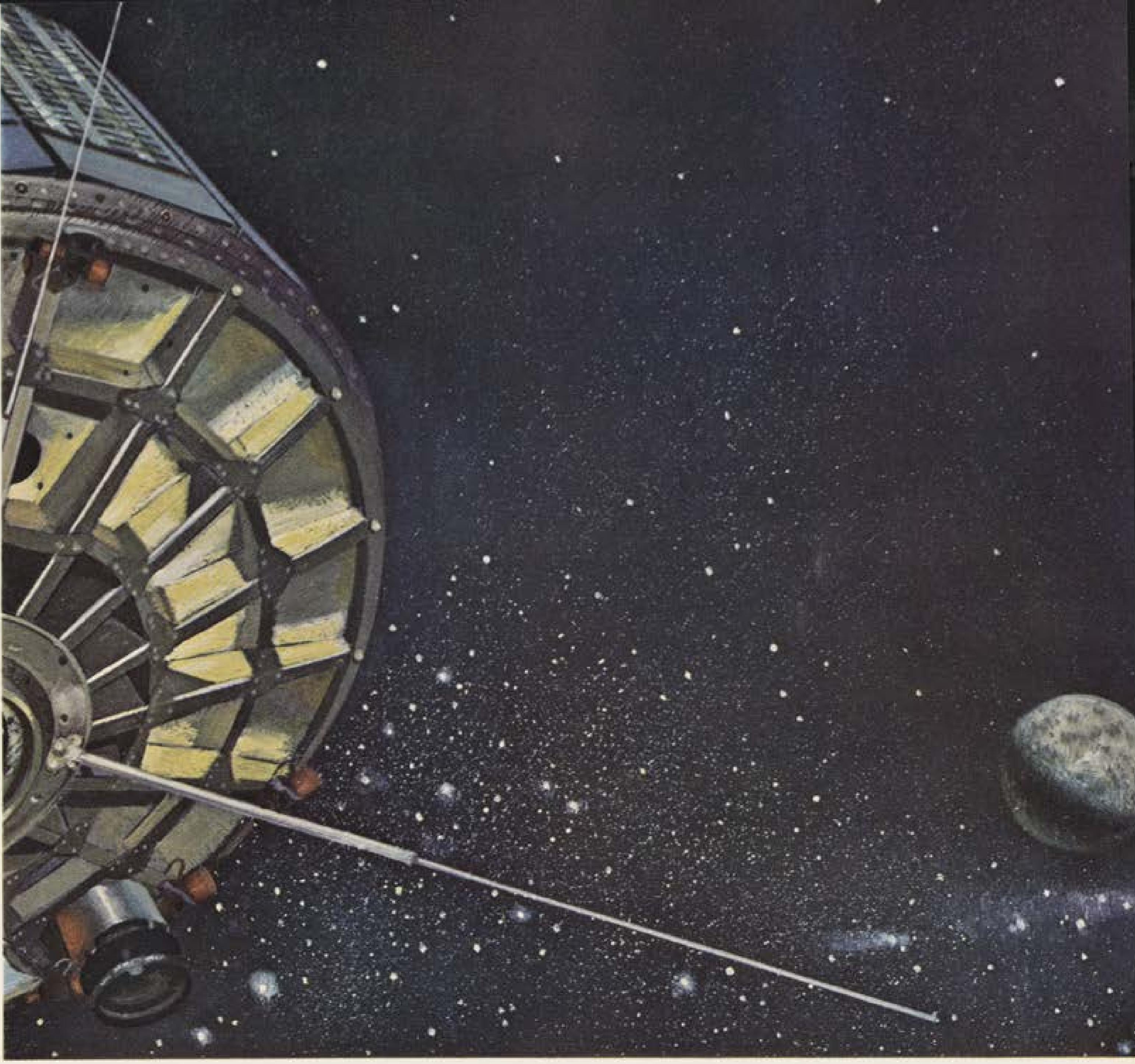

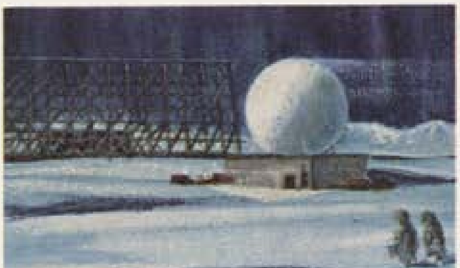

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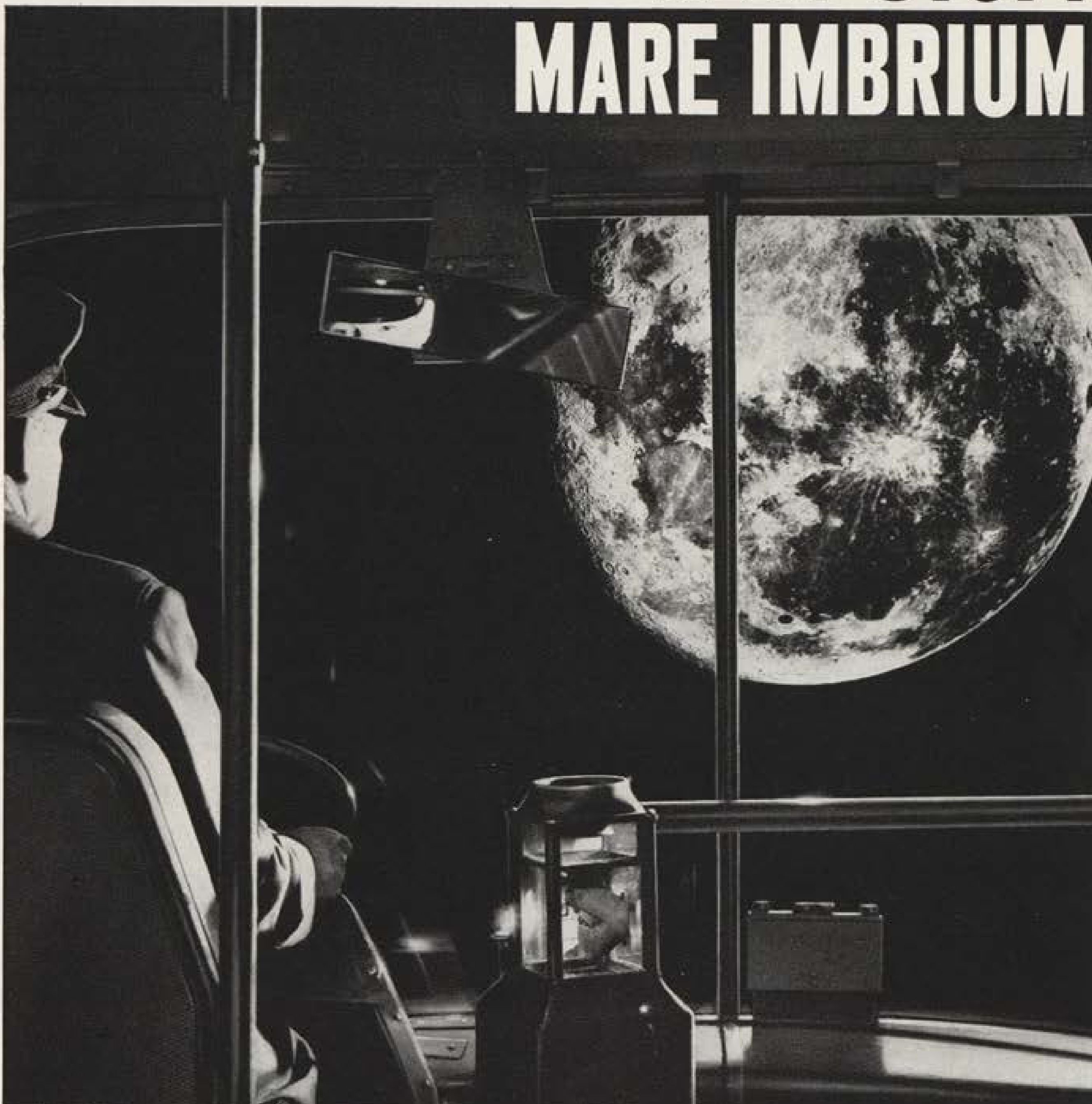

One of the primary needs in the next generation of our space program is for a reliable "space bus"—a vehicle versatile enough to carry a variety of exploratory packages to the moon and possibly to the near planets. Once it is injected into a lunar or planetary trajectory, this bus will have to guide itself to its destination, accomplish a soft landing, release and activate its payload.

The problems involved in the design and fabrication of such a vehicle, as well as the various payloads it might be expected to deliver, are being intensively explored at Norair. These investigations cover guidance, communications and position sensing systems, thermal and environmental conditioning, structural and material development and a host of other in-house capabilities. Expanded working groups in all essential areas are coordinating their efforts in the search for practical, integrated solutions to these problems.

This determination to research problems as thoroughly as possible, the ability to concentrate such a wide range of technologies toward their solution, and the added ability to translate the results into working hardware are prime assets of Norair in the space age.

NORAIR
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The Deputy Inspector General for Safety is responsible for all elements of the Air Force's safety effort—ground, flight, missile, and nuclear. With his office as focal point, USAF has mounted an increasingly determined, and largely successful, safety campaign . . .

AIR FORCE
MAY 1961

A SPECIAL REPORT ON USAF'S SAFETY PROGRAM

'HARD SELL' for SAFETY

Maj. Gen. Perry B. Griffith, USAF
DEPUTY INSPECTOR GENERAL FOR SAFETY

General Griffith has been Deputy Inspector General for Safety since August 1960. He previously served extensively in the field of nuclear weapon development and as a TAC Division Commander. He was USAF's Deputy Assistant for Atomic Energy from 1952 to 1955, took part in bomb tests in Nevada and the Pacific through the '50s, in WW II headed antisub units.

IT IS hard to realize that self-preservation, which should be the most salable product on the market, is actually the hardest to peddle. The National Safety Council will be the first to back up this statement since they have been engaged in persuading people against suicide for a long time. In spite of their efforts, any long holiday week end on the nation's highways convinces one that the American people are set on mass self-destruction.

The Air Force also has long been engaged in selling people on the idea of living as opposed to dying violently. We have been more than moderately successful, judging from statistical comparisons over the past several years—but we still have a long way to go.

The best year for safety in the history of the Air Force was 1960. We enjoyed an all-time low rate of 5.8 major aircraft accidents per 100,000 hours. But because of the increased cost of our hardware, our daily dollar cost of aircraft for accidents last year was still a prohibitive $1,022,000. Preliminary figures show ground accidents cost $26,676,000 in 1960 although we had a decrease of twelve percent from 1959.

There is no question that we have a job to do. Therefore the opportunity to reach the readers of AIR FORCE/SPACE DIGEST with the story of safety in the Air Force is welcome. We in the Office of the Deputy Inspector General for Safety are engaged in an all-out attack on the accident rate within the Air Force. It is right and proper that those most interested in Air Force problems, the readers of this magazine, should know of our purpose—and the methods we have used and intend to use in this attack. In the following four articles you will read something of the aims and efforts of the people assigned to the office of the Deputy Inspector General for Safety, who are engaged in the day-to-day struggle against the caprices of human nature which result in accidents.

The various Directors and Assistants working with me are concerned primarily, of course, with their particular safety areas as indicated by their titles. But it should be pointed out that the arbitrary division of safety into four separate areas is a management expedient, an organization for convenience of operation. In truth it is impossible to delineate a division of responsibilities into precise areas, because at the root of all accidents is human error. Whether a plane, automobile, or missile is involved in an accident, the cause factor is essentially the same: that someone, somewhere—whether he be the designer, the manufacturer, the mechanic, or the operator—has not done his job properly.

And so, a prime function of the Deputy Inspector General for Safety is to provide safety information and guidance—safety education—to all persons involved in working in or with the Air Force, and to impress on each individual the absolute necessity for doing his job right.

It was long ago recognized in the Air Force that safety of operation is not just a "blue-suit" problem. Industry must be, and is, a partner in the assault on the accident rate. Therefore, much of our education effort is aimed at industry through stories and articles in our publications; through Air Force-industry conferences; and through direct liaison by means of meetings, telegrams, phone calls, and factory representatives assigned to the Office of the Deputy Inspector General for Safety on a full-time basis. Happily, industry cooperation is wholehearted and we are grateful.

To give the reader a feeling for the scope of our problem, it seems to me that I should summarize briefly the history of the Deputy Inspector General for Safety organization and to furnish a few statistics. The Army smashed up its first airplane in 1908 but did not begin keeping formal statistics of such events until 1921. Not until the early 1930s did our Air Corps start any real kind of accident-prevention program. This loosely managed program produced few results, so in 1940 a headquarters-level flying safety division was established at Winston-Salem, N. C.

(Continued on following page)

At this time we were suffering 51 major accidents per 100,000 flying hours. By 1943, stateside training and ferrying mishaps were killing more pilots and destroying more planes than were being lost in combat. A parallel situation prevailed in the ground accident category. In 1942 General Hap Arnold directed the creation of a high-level ground-safety organization.

In 1946, the Office of Flying Safety was moved to Langley Field, Va. At that time in Air Force history our major accident rate was 61. In 1950 Gen. Hoyt S. Vandenberg ordered the transfer of the Flying Safety Field Office of the Air Inspector, as it was then called, to Norton AFB, Calif., where it remains today as the Directorate of Flight Safety Research. Since that time major flight accidents have steadily declined from 36 to 5.8 per 100,000 flying hours.

In 1959, responsibility for Air Force safety was elevated to Deputy Inspector General status, and all areas of safety were combined therein. Physically, the functions of ground missile and flight safety were centered at Norton and those of nuclear safety at Kirtland AFB, N. M.

Maj. Gen. Joseph D. ("Smokey") Caldara, now Chief of the Joint US Military Assistance Advisory Group in Spain, was the first Deputy Inspector General for Safety. Previously, for four and a half years, General Caldara had been intimately associated with this vital work as Director of Flight Safety Research at Norton.

I succeeded him in August 1960 after two years as a TAC Division Commander and, before that, nine years in the field of nuclear-weapon development in New Mexico and the Pacific. My service here at Norton has been eye-opening from the start. The safety business, from the inside, is extensive, stimulating, and truly challenging.

Lt. Gen. Joseph F. Carroll, as the Inspector General in Washington, D. C., has the ultimate responsibility to the Chief of Staff for our efforts toward safety. He directed the reorganization, which was conceived in 1959 and actually carried out in the summer of last year.

The reorganization came about with the realization that, as the accident rate continued downward, it would become increasingly difficult to maintain the trend in the right direction, particularly with missiles and nuclear warheads coming on so fast. We believe that we now have the organization and personnel to promote this effort with continuing effectiveness. If we are right we will enjoy another significant reduction in accidents in 1961 and a commensurate conservation of USAF combat potential, which is our ultimate aim and mission.

The four prime Directors and Assistants have as support the Assistants for Education and Training, Records and Statistics, and Life Sciences. The magazines, films, posters, and studies produced by the Office of the Assistant for Education and Training represent our major written educational effort. Col. Herman F. Smith, my Assistant for Education and Training—and soon-to-be Director of Leadership Studies at the Air Force Academy—supervises the safety courses which Air Force personnel attend at various civilian universities. These courses prepare them for their roles as safety officers within the several commands at all levels of operation.

William Russler, my Assistant for Records and Statistics, furnishes through his shop the information and machine data we need for our analyses of accident trends and keeps us up to date on our progress toward our elusive goal—zero accidents, zero loss of life, zero loss of materiel through accidents.

Col. Kenneth E. Pletcher, my Assistant for Life Sciences, monitors and directs our progress toward pinpointing and documenting those pressures, physical and psychological, which act on the human being and cause him to commit those errors which result in accidents.

Col. Paul P. Douglas, my Executive Officer, is especially well qualified for his present position. He served two tours under General Caldara. Colonel Douglas is a World War II fighter ace. He is believed to be the most decorated Air Force officer to emerge from that war. Colonel Douglas, incidentally, is one of three fighter aces in my command.

I leave it to my Directors to tell you more of the methods we employ to reduce accidents in their individual areas of responsibility. It is through them and those under them that the philosophy of safety as an inherent part of operations is brought to the attention of our people throughout the world. They are all disciples of the hard sell toward safety.—END

THEY SET THE PATTERN FOR USAF'S SAFETY PROGRAM

Two famous names in the history of the Air Force safety business are Maj. Gen. Victor E. Bertrandias and Maj. Gen. Joseph D. Caldara.

General Bertrandias, who passed away in March at the age of 65, was often called "the father of flying safety." An aviation pioneer in the classic mold and combat veteran of two wars, he left a Douglas Aircraft vice presidency in 1950 to take charge of USAF's then-lackluster safety program. He immediately instituted a dynamic across-the-board program that reduced the service's major aircraft accident rate from 36 per 100,000 flying hours in 1950 to 20 in 1954. The groundwork was laid for safety programing that has lowered the rate steadily through the years. An all-time low of 5.8 was attained in 1960.

General Bertrandias retired in 1955 after a military career spanning thirty-seven years. Much decorated, he served as an enlisted ground crewman in France in World War I, won his military wings in 1921 and flew in Billy Mitchell's aerial bombing tests against naval vessels. Actually, he had been flying both land and seaplanes since 1915. At one point, he established a 1,000-kilometer seaplane record. In World War II, General Bertrandias held logistical commands in the Pacific; he also voluntarily flew several combat missions.

General Caldara took over where General Bertrandias left off in the field of Air Force safety. He became the Director of Flight Safety Research at Norton in 1955 after wartime service in the Pacific and postwar service in SAC. Driving, energetic, and enthusiastic, "Smokey" Caldara saw the Air Force accident rate continue to drop as his own organization grew in stature and the service as a whole became increasingly safety-conscious. In 1959, after four and a half years of busy and sometimes "controversial" safetying, he was named USAF's first Deputy Inspector General for Safety. His office assumed one-tented responsibility for flight, missile, nuclear, and ground safety.

In July 1960, General Caldara was assigned to duty as chief of the Joint US Military Assistance Advisory Group in Spain. He was succeeded by the current Deputy Inspector General for Safety, Maj. Gen. Perry B. Griffith.—END

Sudden tragedy over New Mexico on April 7 dramatically accented the life-and-death nature of the Air Force safety program. An ANG F-100 fighter accidentally fired a Sidewinder missile at a SAC B-52 during a practice intercept. The bomber went down. Three crewmen were killed. An Air Force-industry investigating team, as described in this special report, flew to the scene. Practice intercepts with live ordnance were restricted. Maj. Gen. Perry B. Griffith told AIR FORCE on April 12:

"The most recurring causes of unintentional releases from modern jet fighters of items such as fuel tanks, bombs, and pylons are malfunctions of a mechanical nature. Other causes involve electrical shorts that cause firing circuits to become energized due to moisture, tiny foreign metallic objects, faulty construction, and human loading error. I hope that the Air Force-industry team now conducting this investigation will not only determine its exact cause but recommend a workable method of preventing such an accident from ever taking place again."

Grim work for Easter Sunday: When a giant B-52G plunged into the woods near Denton, N.C., just before the recent holiday, an eight-man team from the Directorate of Flight Safety Research, Norton AFB, Calif., flew immediately to the scene. Examining wreckage are Maj. Gen. Perry F. Griffith, left, USAF Deputy Inspector General, Safety, and his Executive, Col. Paul P. Douglas, Jr.

The Air Force has been extraordinarily successful in flight accident prevention, achieving a new low in this category in 1960 through a wide-ranging team effort. Nevertheless, too many preventable accidents do take place . . .

USAF's Safety Program

THE GOAL IS ZERO

Brig. Gen. Walter E. Arnold, USAF

DIRECTOR OF FLIGHT SAFETY RESEARCH

ONE DAY you pick up your newspaper and read the headline, LARGE JET BOMBER CRASHES OVER WEST TEXAS; THREE CREWMEMBERS PERISH. The final line of the story states, "A board of Air Force officers has been appointed to investigate the accident." This last statement may give the general public the impression that a rather routine and average group of officers will eventually get around to looking at the wreckage. Nothing could be farther from the truth.

By the time you have read this article, part of the Air Force-Industry Accident Investigation Board will have already arrived at the scene of the accident, and the remainder of the board will be en route by the most expeditious means of transportation. The investigation to follow will be the most painstaking and deliberate that one can imagine. What follows will point this up.

General Arnold has been Director of Flight Safety Research since July 1959, also heading missile safety for a year of this period. Formerly, he held SAC command positions for a decade, was Deputy for Plans, Sacramento Air Materiel Area. Commander of a bomb group in Italy in World War II, he was shot down, held a prisoner of war from August 1944 to May 1945.

The name "Air Force-Industry Accident Investigation Board" is almost self-explanatory. The board is composed

(Continued on following page)

of Air Force personnel from the Directorate of Flight Safety Research who are specialists in accident investigation and have knowledge of all current Air Force aircraft. These men are augmented by personnel from the prime Air Materiel Area, Wright Air Development Division, and other Air Force agencies who have intimate knowledge of the particular aircraft, its systems, powerplant, flight characteristics.

On the industry side, manufacturers' specialists on the aircraft, the powerplant, individual systems, and so forth, actively participate as members of the various appointed committees to investigate specific areas. It is my responsibility to determine when to convene the appropriate board. If my preliminary inquiry at the scene of an accident indicates the cause of an accident cannot be readily isolated, the entire resources of the board are alerted. When this summons is received, more than fifty highly qualified technicians from throughout the United States grab their packed bags and start traveling.

As the board members arrive, there is no lost motion. Each member is aware of his duties assigned in one of the specialized groups. They dig in and go to work.

As President, it is my job to direct the activities of the board, organize the investigation, and preside over the meetings and critiques. In carrying out this responsibility, the Coordinating Group acts as my chief of staff. It directs and coordinates the activities of the specialized groups along lines of common effort toward a solution of accident causes. It directs salvage and shipment of parts to laboratories or air depots, utilizes all available news media to request that all persons possessing information about the accident contact the Accident Investigation Board, and consolidates specialized group reports, testimony, and findings of the board.

Let's look over the various specialized groups that are so necessary to an accident investigation board.

The Flying Operations and Witness Group investigates all factors connected with aircrew operations, such as crew procedure, proficiency, experience, mission briefings, and flight path. This group obtains and evaluates statements from each witness to the crash, as well as additional operational factors such as Airways and Air Communications Service (AACS), FAA control, airfield obstructions, facilities, and crash-rescue activities.

The Structure and Flight Controls Group is responsible for investigating and analyzing the structural integrity and functioning of airframe, flight controls, mechanical controls, and landing gear. It investigates wreckage location diagrams. This group also determines the airworthiness of the aircraft prior to the accident.

Responsibility for investigation and analysis involving engines, fuel system, fuel tanks, and oil system belongs to the **Power Plant, Fuel and Oil System Group.** Engine instrument investigation is correlated with the other specialized groups.

While further specialized groups are no less important than the groups above, their titles are self-explanatory. They are: **Electrical, Electronic and Instrument Group; Escape, Survival and Oxygen Group; Pneumatics, Hydraulics and Air Conditioning Group; Explosion and Fire Pattern Group;** and the **Maintenance Inspection and Records Group.**

The talent and experience of the personnel constituting the board are impressive. They must be. When an accident destroys a $23 million B-58 or an $8 million B-52, the causes must be pinpointed and eliminated. Not only does the board find out why the accident happened, it spells out in clear, indisputable language what action should be taken to make sure that another similar accident doesn't occur. These recommendations may require changes in flying techniques by the aircrews, an engineering change in the aircraft control system, a structural modification, changes in the Pilot's Handbook of Instructions, or revision in existing training programs.

Fortunately, the convening of the Air Force-Industry Board isn't required often. If it were, it would indicate that my staff and I weren't doing our job. In order to accomplish our mission we exert most of our efforts on *preventing* aircraft accidents before they occur.

By preventing accidents we ensure:

1. An effective aircraft inventory for national defense.
2. National prestige through continuing success in our deterrent efforts.
3. That maximum dollar value is obtained from our aircraft inventory.

I've often been asked: "Is there some magic formula you can apply and end up with prevention?" Of course there's no such thing. It's hard, painstaking, deliberate effort by a large number of people. It's a twenty-four-hour, seven-day-a-week job of planning, searching, ferreting out, questioning, and educating.

Let's take a look at how the yearly safety program is developed. Each year, usually in September, the Deputy Inspector General for Safety sponsors an Annual Safety Congress. Some 300 flying safety officers meet to discuss and plan the flight-safety program for the following year. They are also briefed by my staff on over-all safety problems which affect the whole Air Force. They, in turn, present ideas and problems they have encountered in the field. Through this mutual exchange and the individual seminar meetings, at the end of the week we know the required direction of our safety efforts for the following year.

A word here about our flying safety officers in the field. Without their untiring efforts the Air Force program would be in trouble. These officers are highly qualified pilots, current in the mission aircraft and carefully chosen for their inquisitive minds. Usually the FSO is a part of the commander's special staff and has immediate access to the "boss man" so that he can bring to the commander's attention any factors that might lead to an accident. Very likely he has completed the flying safety officers' formal course of instruction at the University of Southern California. An important cog in the prevention program, this eight-week safety school technically prepares the flying safety officer to assume his duties at his home station. He is one of the most important members of the Air Force's safety team. We know it and he knows it.

Here again, in the field of accident prevention, Air Force-industry teamwork plays a major role. We have twelve full-time field representatives assigned to our offices by aircraft and engine manufacturers across the nation. We've had forty-six Air Force-industry conferences since 1954 on every major safety problem you can think of. These regularly draw the top executive and technical talent of industry as well as representatives of the Army, Navy, Marine Corps, Royal Air Force, and Royal Canadian Air Force. Our flight safety research and project engineers sit in on manufacturers' design study meetings and mockup boards.

Air Force safety publications publish articles of interest to the over-all safety effort submitted by aircraft and parts manufacturers. Some of these are solicited, but the majority are submitted voluntarily and thus reflect the intense interest that companies have in the safety of their products. Our editors make free and frequent use of scores of excellent house organs which come to us from industry. For example, our *Aerospace Accident and Maintenance Review* recently reprinted articles from Boeing's *Bomarc Service News* on static electricity and magnesium fires and another on "The Right Tools and the Right Torque."

Now, a look at the Directorate of Flight Safety Research, its responsibilities, and how it accomplishes them. As the Director, I have been given the responsibility for developing and monitoring Air Force policies, programs, standards, and procedures for the prevention of aircraft flight mishaps.

One of the most effective tools in carrying out this mission is the Flight Operations Safety Survey. The survey teams are composed of highly qualified operations, facilities, aircraft maintenance, physiology, and psychology specialists. The objectives of the safety surveys are to point out to the commanders of the units surveyed any situation, practice, method of training, or physical facility that is a hazard to safe operations. After arrival at the unit to be surveyed, the commander is briefed by the team chief as to the purpose of the survey and how the survey will be conducted.

Then work begins in earnest. The training program is evaluated, local flying regulations are reviewed, training and qualifications records of the aircrews are examined. The facilities specialists check the airfield for landing, takeoff, and taxiing hazards, IFR penetrations, and departure plans. Crash-fire equipment and rescue procedures are examined for adequacy. Airfield lighting and control tower functions are checked closely.

Concurrently, the Aircraft Maintenance portion of the team checks the airworthiness of the mission aircraft. Maintenance practices, standards, and records are compared against Air Force requirements. Maintenance facilities and ground-support equipment are examined for adequacy.

The Life Sciences member of the team looks at the escape, survival, physiology, and psychology factors pertaining to aircrew members. These cover a wide area such as care and maintenance of the parachutes, drag chutes, survival suits, dinghies, oxygen masks, aircraft oxygen, and ejection systems.

As the survey progresses, a two-way exchange of information takes place. Ways of accomplishing their job in a safer and more efficient manner are pointed out by team members and at the same time new ideas or local innovations from the unit are obtained which in turn can be passed on to other Air Force organizations.

Before leaving, the unit commander and his staff are thoroughly briefed by the survey team as to how the unit can operate in a safer manner. Safety is a direct function of command; it is quite natural that the commander appreciates the recommendations which are left with him. By following these recommendations, he can continue his quest for mission attainment with less chance for a tragic and costly accident.

While safety surveys are purely and simply a preventive tool of the first order, our other functions are no less important. I would be remiss if they weren't mentioned. For example, we are responsible for preparation of flight-safety studies and briefings, assuring adequacy of safety features in aircraft design, conducting studies and analyses of the safety aspects of the aircraft weapon systems, issuing special studies and analyses of aircraft accident trends, and attending Contractor Technical Compliance Inspections (CTCIs), mockup displays, and safety inspections. We also prepare flight-safety rules and regulations, review, analyze, and provide a final evaluation on all USAF aircraft accidents, incidents, and unusual occurrences. To sum up, each of our widely varied efforts are carried on for the one single purpose: To prevent aircraft accidents.

There is nothing like success to prove whether or not you are doing your job. It can be stated without hesitation that the Air Force prevention program has been an outstanding success. Here is the record for the past ten years:

	1950	1960	Improvement
Aircraft Destroyed	665	285	57%
Total Fatalities	781	275	65%
Pilot Fatalities	291	125	57%
Major Accidents	1,744	426	76%

Today, the Air Force has reached an unprecedented goal in flight safety. Ten years ago we would not have dreamed of such success. Though we are pleased, we are not content or satisfied with the present level of accidents. There is still room for substantial improvement. Too many preventable accidents still occur. Their price in terms of loss of combat capability is entirely unacceptable.

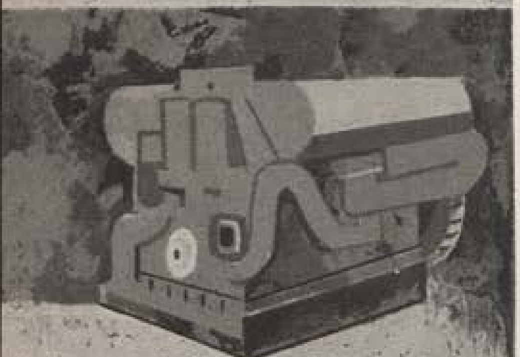
Air Force-Industry Accident Investigation Board experts study bits of wreckage collected from a B-47 which crashed at Little Rock, Ark. Although the aircraft disintegrated in midair without warning and wreckage was scattered widely, team was able to establish accident's cause.

We're constantly alert, therefore, to the need for new devices and techniques to prevent accidents. Although we have no contractual or procurement responsibilities, we do take a strong interest in what industry has to offer. We often have companies demonstrate new products—even proprietary items—to get our reaction. One West Coast corporation recently demonstrated a new device to detect clear air turbulence, a weather phenomenon that is still causing or contributing to some of our major aircraft accidents.

The midair-collision problem in the Air Force has been drastically reduced in the past ten years. USAF has not been involved in a collision with a civil air transport since May 1958. However, this Directorate is still keenly interested in development of an anticollision device. Under General Caldara the Directorate pioneered research into the requirement for such an instrument. Actual development of hardware has since been taken over by the FAA, and several companies as well as the Navy are working on the problem.

(Continued on page 102)

Machine Weight: 70,000 lbs.
Ground Pressure: 4.4 lbs. per sq. in.



Horsepower: 580.
Pounds per horsepower: 4.3.
Designed and built for Ordnance.

Instantaneous direction and speed change vehicle transmission.

Wear rates established quickly and accurately through use of isotopes.

Analog and digital computers resolve design and research problems.

Caterpillar... Capability in power

Research

Research of the components and vehicles we manufacture is only part of our research effort. It extends into materials and techniques used in manufacture, as well as lubricants in cooperation with major oil companies, tire materials and design with leading tire companies and many other areas affecting machine reliability, life, and performance. The objective: to improve the complete operating vehicle. Today, at Caterpillar, 1500 people are engaged in metallurgical, fluid mechanics, applied mechanics research, to cite a few continuing basic studies.

and mobility for defense

Development

Before designs are produced, three steps are taken: (1) design approach is proved by evaluating research findings; (2) preliminary production design is made to determine manufacturing and maintenance feasibility; and (3) final design is made to include changes and improvements indicated by first two steps. Thus military requirements are met in a controlled research, development, and production environment.

Proving grounds totaling 10,000 acres enable testing of military and commercial machines under all conditions of terrain and climate.

Production

Economical, quantity production of military equipment is assured with the machining, fabrication, assembly facilities, and manufacturing experience of Caterpillar. With rigid quality control at all phases, military needs are fulfilled with reliable products delivered on schedule. For further information about Caterpillar's ability to arrive at sound practical solutions for components and vehicles to meet the needs of defense, write for Bulletin No. 40-20265, Defense Products Department, Caterpillar Tractor Co., Peoria, Illinois.

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Research-Development-Manufacturing for Defense • Washington, D. C. • Peoria, Illinois

Traffic control receives considerable attention. Since both commercial and private pilots and planes are flying at altitudes which formerly were the exclusive domain of the military, the FAA and all military agencies have consequently geared their planning to meet this condition of crowded airways. Special high- and medium-control areas are now in effect, and more are planned. The problem of current and potential obsolescence in navigational aids cannot be overlooked here. Both contractual and independent research by some companies in this field is a healthy sign, and vast improvements can be anticipated.

Other instances of our interest in new developments include our support for new ejection seats to assure zero-altitude escape capability in jet fighters and trainers; new seats and personal equipment which would permit crew survival in ejections at supersonic speeds; and tail hooks for Century-series aircraft. These hooks would be used in conjunction with landing barriers. The F-100, F-101, F-102, F-104, F-105, and F-106 eventually will all be fitted with tail hooks. This project is now in progress.

Along with this program has been a stepped-up effort to modify the present MA-1 engagement barrier (developed by the Wright Air Development Division and built by Acme Precision Manufacturing Company) to be compatible with hook-equipped aircraft. Also, the new-type barriers BAK-6 (All-American Engineering) and BAK-9 (Bliss Barrier Company) are programed for installation to accommodate jets with tail hooks.

Another area of need for new devices stems from our high rate of accidents in the landing and takeoff phases. We still need better precision instruments to tell our pilots when to abort a takeoff, how to make a safer approach, how and when to land. Specifically, we need an improved takeoff monitor, a practical precision altimeter, more precise landing aids, and a total space attitude instrument for 360-degree maneuverability. Such a device would also be of value for future manned space travel. Although the immediate need exists for individual improved instruments, the ultimate contribution to flying will be made by the ingenious integration of instrument information so the pilot's task of identifying his position and deciding on a course of action will be simplified.

I might mention that we also need improved tires, wheels, and brakes. Accidents caused by malfunctions of these have been excessively costly to the Air Force.

Our flight-safety accident-prevention program is a going concern. While we'll have some aircraft accidents during the next few years, with industry support we hope the spectacular downward trend will continue until we reach that mythical goal of ZERO. And stay there.—END

In nearly two decades of missile research, development, and operations, USAF has suffered only a single loss of life. The record in this new field is gratifying. But problems will grow and continue to grow in the years to come as missiles increase in quantity and importance . . .

USAF's Safety Program

AMID THE BOOMS AND ROARS

Col. George T. Buck, USAF
DIRECTOR OF MISSILE SAFETY RESEARCH

ONE of the newest elements of the USAF safety program is the Directorate of Missile Safety Research. Amid the booms and roars and the multitude of long-range missile shots and occasional fizzles, we face this continuing need: We must preserve the nation's missile resources—weapon systems, associated support equipment, lives of our personnel, the astronomical sums of money that must pour into the program. These dictate the same positive accident-prevention measures that were and are spelled out in the manned-aircraft program.

Col. George T. Buck, Director of Missile Safety Research since August 1960, is a World War II fighter ace and a veteran missileer. He shot down six Germans as a wartime P-51 pilot. After the war, he served as operations officer, 1st Experimental Guided Missile Group, Eglin, and Chief, Missile Test Branch, Holloman, then flew fighter-bombers in Europe.

To accomplish our assigned mission, the D/MSR is divided into two separate divisions. They are Investigations & Field Operations and Research & Engineering. The I&FO Division looks at the missile weapon system vertically—and project officers are responsible for knowing every facet of the system. It is their task to identify safety deficiencies peculiar to the system. On the other hand, the R&E specialists look at all the systems across the board, identifying accident potentials that might conceivably exist in more than one system. Their job is that of examining common problem areas concerning subsystem elements such as propulsion, guidance, ground-support equipment, and the like. What is learned in the first generation of missiles is serving to make the second and subsequent

Atlas wiring gets safety inspection from seasoned technician while a student missileman in white coveralls looks and learns. Operational missiles need periodic inspections.

Missileman Capt. H. G. Ponder, J. V. Neeson, industry representative, Directorate of Missile Safety Research, check Atlas work stand during safety survey at Vandenberg AFB.

generations successively safer and operationally more successful.

With beforehand accident prevention in mind, the D/MSR surveys missile sites to assure conformance to safety standards and procedures. We also participate in missile weapon system development to assure the incorporation of safety features in the design and manufacture of the missile and its associated equipment. Not only does the Directorate participate in the formulation of safety rules but also investigates accidents and incidents in the field in order to pinpoint cause factors. Our project officers work with industry to review each missile weapon system on a continuing basis to assure that safety deficiencies are not repeated nor allowed to be incorporated in follow-on systems.

Safety surveys of our early missile sites disclosed a number of safety deficiencies. As an example, use of asphalt paving around liquid-oxygen storage tanks obviously created a problem as did the use of tar as a binder in concrete flumes. Future construction *will be* safer because of design and specification changes made concerning the requirement of lox-compatible materials. As in any new development, certain undesirable items that *should* have been perfectly obvious designwise somehow showed up in the finished product. Part of our job is to ferret out such deficiencies and eliminate them entirely.

Surveys have disclosed also that vital tools, test equipment, and technical documentation which are needed to do the job are often not received on a timely basis. This has obvious and sometimes ominous safety implications. We are at work with the responsible staff agencies in an effort to help overcome these problems.

One specific area of concern to us has been the high pressures associated with missiles and missile facilities.

Because materials and systems being utilized in missiles are being put to new uses, we do not yet have complete safety standards. The forty pounds of pressure in your household water system is adequately contained by standard plumbing fixtures, but notice what happens when you turn on the garden hose. Unless held, it whips all over the lawn. Pressures used in the missile environment are approaching the unbelievable figure of 10,000 pounds per square inch.

Another area in which we are involved on a sustained basis is the analysis of technical information—from drawing board to target. In our continuing assessment to assure safety, we are working with the using commands and the manufacturers to obtain and reduce data to pinpoint areas requiring corrective measures. In one system, since the first of this year, we have received more than 500 unsatisfactory reports. *Hazard reports, accident and incident reports, and survey reports* as well as a host of other data are being so reduced to provide meaningful information to the designers, to the manufacturers, and to the users on which successful safety programing may be based. It's a continuing effort and a beforehand effort.

Our program is designed to assist the Air Force effort in obtaining as safe a missile environment as possible. Through integration of safety into training, through establishment of environmental controls, through early review of new designs and modifications of design to ensure incorporation of safety features, we are working with the using agencies, with ARDC, with AMC, and with other Air Force activities, to develop completely safe systems. This effort is a cooperative one. In some instances, our activities are catalytic—wherein an expressed interest results in recognition and resolution of problems not otherwise identified as having safety implications.

In a complicated system, the missile is like the visible part of an iceberg constituting only about one-fifth of the whole. The launch complex of a typical missile involves many thousands of components (7,500 mechanical parts, 100 hydraulic parts, 1,400 pneumatic parts, 650 miles of wire, 27,000 terminal connections, and 1,500 other miscellaneous items) which are all subject to accident or failure unless positive prevention efforts are employed.

Our program direction is influenced a great deal by the high degree of automation in missile weapon systems. As noted earlier, man is no longer aboard to compensate for inaccuracies or to take over when automation fails.

As a result, we are devoting a large percentage of our effort to assure the safety of the eighty percent of the weapon that is represented by ground-support equipment.

For some seventeen years the Directorate of Flight Safety Research has used various publications, produced by the Assistant for Education and Training, to amplify the flying safety program. Among them are *Aerospace Safety*, the *Maintenance Review*, and allied periodicals. These are aircraft accident-prevention tools aimed at all levels of command. The actual value of such magazines has been established for a considerable period of time.

With the inception of the D/MSR, one of our first requirements was that of formulating an educational program patterned after the Flying Safety Special Study Kits. These are scheduled publications, produced in loose-leaf

(Continued on following page)

To avoid accidents, combined efforts of missile safety and regular ground safety specialists are necessary. In an operation such as airlift of a Bomarc via C-124 Globemaster, there is ever-present hazard. Consequently there must be continuous attention to critical Air Force safety procedures—on the ground, during transport, installation, erection, maintenance.

form, that cover a myriad of subjects as applicable to the over-all program—in this case, missile safety.

Although personnel in the field are exceptionally well-trained in their specialty fields, commanders and missile safety officers are faced with the requirement for constant updating of the capabilities of both officers and airmen. New equipment, new systems, new procedures, and progressive advancement of the art demand systematic study and application on the part of all personnel. One of the ever-present problems that face us is the attrition rate within the military structure. In-service transfers, retirements, reenlistments for other geographical locations and, in a few instances, environmental unsuitability, all take their toll. Obviously, additional on-the-job training beyond that received at service schools is needed. We hope to have our personnel "keep up" with this rapidly expanding field of technology. It is here, then, that the Special Study Publications assist the missile safety officer in keeping officers and airmen updated. Tips, techniques, posters, and safety suggestions are thus available on a continuous and timely basis for internal consumption.

Twenty-two major missile manufacturing concerns are cooperating with the Directorate of Missile Safety Research in allowing an interchange of failure data concerning their products. For instance, one firm may have accumulated a great deal of experience with high pressurization control. Another firm may draw upon this reservoir of knowledge to solve a particular problem. The Directorate serves as intermediary in some cases.

Industry supports the objectives of the Air Force Safety Program in other ways. Serving with the Directorate are resident representatives of four major manufacturers: Martin Company's E. P. "Bud" Jordan; Convair-Astronautics' Howard K. Meyers; Aerojet-General's Richard Kiefner; and Boeing's Thurman Jones. Other companies are currently studying the feasibility of providing the services of resident representatives. The resident reps provide day-to-day advice and assistance concerning their companies' products, participate in systems safety reviews, assist the Directorate on field trips, provide their firms with first-hand information concerning the safety problem areas being encountered which facilitates early corrective action.

Top industry officials, such as G. T. Willey, vice president of Martin-Orlando, participate in Air Force-industry conferences on missile safety. In addition, corporation safety directors like Dr. Thrift G. Hanks of Boeing, Jack Garrison of Convair, and Wallace Buxton of Aerojet-General visit the Directorate or participate in frequent meetings with Air Force missile safety personnel.

In nearly two decades of missile research, development, and operations, USAF has suffered only a single loss of life. This fatality occurred to a contractor employee in a nonoperational Titan mishap at Cape Canaveral in 1960. The recent Atlas site construction accident at Roswell, N. M., in which contractor employees were fatally burned when a crane fell into the silo, occurred under jurisdiction of the Army Corps of Engineers and was not considered a "missile accident."

There have been a number of explosions and fires on missile pads in recent years at Cape Canaveral and Vandenberg, including intentional destructs after launchings. Despite the great damage wrought to the test stands and launch sites in some instances, however, there have been no fatalities and only a few injuries—a really remarkable fact.

Less than a year old, the Directorate of Missile Safety Research is just beginning to be able to measure the progress of the Air Force missile-safety effort. Unlike ground safety and flight safety where hundreds of thousands of miles or flying hours can be used to compute accident rates, missile safety can only measure the Air Force accident experience against so many hours of possession of missiles. Missiles in quantity are still more a thing of the future than of the past. The record so far, however, has been gratifying. We believe that, with continued vigilance and effort, we can keep it so.—END

To the everlasting credit of commanders at all echelons and their personnel, the Air Force—in all its experience with nuclear weapons—has never had an accident involving the unintentional detonation of any nuclear weapon resulting in nuclear yield . . .

'SAFING' THOSE NASTY NUKES

Col. Charles B. Stewart, USAF
DIRECTOR OF NUCLEAR SAFETY RESEARCH

Colonel Stewart has been Director, Nuclear Safety Research, since the Directorate was established in September 1959. Possessor of a doctorate in nuclear physics, he has worked in the field of nuclear weaponry through most of the postwar period. His last previous post was Deputy Director, Division of Military Application, AEC. He was a WW II fighter unit commander.

THE POWER-PACKED punch of the United States Air Force arsenal of nuclear weapons is recognized by the entire world.

Our job in the Directorate of Nuclear Safety Research is to create the nuclear-safety environment in which neither this power nor our people will be jeopardized—a controlled environment which ensures safety without impairing the reliability of the weapon system and the accomplishment of the Air Force mission.

This environment—so integral a part of our Air Force operational capability—carries, in effect, the guarantee of safety in every phase of nuclear weapons activities from earliest design to ultimate employment on the target.

What are we doing to make good our guarantee?

We have set up two main objectives:

1. To prevent the weapon's detonation as a result of an aircraft or missile accident, or from accidental events anywhere in the stockpile-to-target sequence.

2. To prevent the unauthorized detonation of a nuclear weapon by either a saboteur or one of our own technicians who may become deranged.

Nuclear accidents are those producing nuclear yield; accidents or incidents, in our usage, are mishaps with no nuclear yield.

We approach our objectives ever mindful of the fact that no weapon is absolutely safe. All weapons are inherently dangerous; they are designed to be dangerous. The challenge, then, to those of us responsible for nuclear safety is to keep a reliable weapon safe and ready until it is intended to be dangerous.

How are we meeting this challenge?

Briefly, the underlying philosophy guiding the Air Force was expressed by the former Deputy Secretary of Defense, the late Donald Quarles, in a letter to the Chairman of the Atomic Energy Commission: "Explore all reasonable means of providing a higher degree of safety for present and future systems. Such safing should, of course, cause minimum interference with readiness and reliability. In order to achieve more positive safety, however, some handicaps might be acceptable as long as they do not jeopardize our operational capability."

Air Force exploration of "all reasonable means" includes the detailed study of the safety aspects of all Air Force nuclear weapon systems as early as possible.

Such study—the heart of the Air Force nuclear safety program—is inherent in, and exemplified by, six activities known as the Air Force milestones of nuclear safety:

1. **Initial Safety Study**—The Nuclear Weapon System Safety Group of the Air Force examines all available information about the new nuclear weapon system against the requisites of safety. The group is chaired and supervised by the Directorate of Nuclear Safety Research. Its members represent each major Air Force command having nuclear weapon responsibility, the Defense Atomic Support Agency, and the Atomic Energy Commission. The Air Force Special Weapons Center provides the technical input (called the Safety Analysis and Evaluation Study) for the group's consideration.

2. **Preoperational Safety Study**—The Nuclear Weapon System Safety Group conducts a second study of the new weapon system shortly before the system becomes operational. At this point the weapon design is definitive and the Air Force's plan of operations is clearly defined.

This investigation is extremely detailed. It considers every imaginable facet of the weapon system's life. It examines handling procedures, testing equipment, security measures, and emergency doctrines, among others. It produces refinements for safety and the proposed safety rules governing the peacetime operation of the weapon system.

3. **Safety Rules**—These proposed rules are reviewed extensively and carefully. After agreement by the NWSSG, the Directorate of Nuclear Safety Research, and the rest of the Air Staff, concurrence must be obtained from the Defense Atomic Support Agency and the Joint Chiefs of Staff. This concurrence must then be approved by both the Secretary of Defense and the AEC. When the weapon is to be carried in an aircraft during peacetime, presidential agreement is also required.

(Continued on following page)

Nuclear weaponry safety is a full-time job for experts. Here Maj. Gerald K. Hannaford, Chief, TAC Systems Branch, Directorate of Flight Safety Research, checks the cockpit switches and seals for nuclear weapon system carried aboard a B-57.

4. **Preoperational Survey**—Shortly before the operational date of the weapon system, the Directorate of Nuclear Safety Research conducts a field survey of a selected unit, examining the entire system in its operational environment. This is to ascertain if the safety rules for that particular weapon system are adequate, understandable, and usable.

5. **Operational Review**—It is evident that operational experience with a particular weapon system may produce ideas or information which may enhance operational safety. Hence, the Directorate of Nuclear Safety Research reviews the weapon system's safety again after it has been operational for a prescribed period of time (not over a year). This is just one more step designed to ensure the efficacy of the safety rules and operating procedures.

6. **Special Safety Reviews and Studies**—These are conducted by the Directorate of Nuclear Safety Research or the NWSSG whenever circumstances require them.

The above apply to all nuclear weapon systems for which the Air Force has developmental or operational responsibility. They detect and correct unsafe procedures, providing the Air Force with the means of meeting our main objectives as stated earlier.

These objectives focus on four basic problem areas: (1) accidents; (2) psychotics or saboteurs; (3) human error; (4) security.

To help overcome these four problems, we adhere to safety standards prescribed by the DoD for each of them.

First, in the accident area: *"There will be positive measures to prevent weapons involved in accidents or jettisoned weapons from producing nuclear yield."* This standard must be met by the military and by the design people before an atomic weapon system can be used. In general, the standard considers such features as bomb design, bomb storage, design and procedural use of safety switches, bomb release mechanism, and detailed safety procedures.

The bomb designer must design a bomb that will not trigger a nuclear reaction; that is, no nuclear fission or fusion, even if the high explosive of the bomb has been detonated during a crash, fire, or jettison of the weapon.

In storage the atomic bomb must be inert—not capable of electrically triggering its nuclear component. This is usually accomplished by a system of switches. These switches prohibit power from reaching the detonating element of the bomb. They must be thrown in proper sequence by a team of technicians before current can get from the batteries to the critical units. They are so located that one man cannot throw all the switches necessary to detonate the weapon. In brief, the weapon is designed so that it requires the efforts of a team of specialized personnel meticulously going through well-defined procedures in order to detonate the weapon.

These detailed procedures are simply precautions (each a check and double-check) to assure that mechanical devices operate as intended. Of course there are others. The important thing is that certain positive measures are taken in the form of safety rules—backing up each of these design and procedural schemes.

"There will be positive measures to prevent deliberate arming, launching, firing, or releasing." This is the second safety standard guarding against the second problem: psychotics or saboteurs.

It is attained by (1) burying safety switches and (2) using two or more equally knowledgeable persons when access to the weapon is permitted.

Burying switches? It is possible to bury one or more switches so that a person must literally tear the bomb apart to get at the switch. By unique design, this same switch provides safety until the weapon is delivered against the enemy.

The use of two or more controls refers to locked and sealed controls mounted in series but in different locations. Thus, one important switch could be activated only by two separate independent actions—sometimes requiring a key, sometimes the breaking of a seal.

The necessary presence of two or more equally qualified persons during access to the weapon further assures control of psychotic behavior.

Our third problem is human error. Its safety standard: *"There will be positive measures to prevent inadvertent arming, firing, launching, or releasing."*

We meet this by: (1) locking or sealing switches in the "safe" position; (2) using two or more controls; and (3) requiring the presence of equally skilled technicians when anyone has access to the weapon.

The same types of devices used for our second safety standard are applied here. Locks and seals prevent rash actions.

Using two or more controls to activate one switch is a double check against human failing; having skilled technicians working together is double protection.

The above standards are based on specific problems. To meet the standards of any given weapon we may rely on a mechanical device or a procedure. In either case security plays a vital part. Thus the fourth safety standard: *"There will be positive measures to ensure adequate security."*

Among the measures:

Physical restraint—This is relatively easy to accomplish in the storage area. In the operational area this restraint is mainly the guarding of the aircraft or missile nuclear system, as well as restraint through physical tiedowns and procedural security. As an example: The consent and action of several persons are required before a weapon system can be used. Until then, it is figuratively and in some cases actually tied to the ground.

Restricted access.

Alarm devices—These are readily adapted to storage areas where control is comparatively easy. When the weapon is moved to operational areas more reliance is placed on:

Armed guards—They do the job as well or better than the more sophisticated anti-intrusion devices but at a greater cost in manpower.

Security clearances—This is the means by which reliable personnel are selected before they are trained in any phase of the atomic weapons program.

And their training—like the search for increased nuclear weapon system safety—is a continuous process. A new course for nuclear safety officers was started recently at Lowry AFB, Colo. Another innovation is the Air Force specialty for officers in the nuclear safety career field.

What are the over-all results of this program?

To the everlasting credit of commanders at all echelons and their personnel, the Air Force—in all its experience with nuclear weapons—has never had an accident involving the unintentional detonation of any nuclear weapon resulting in a nuclear yield. In the transportation and storage of nuclear weapons, in dozens of training exercises, and even in unfortunate accidents, not one person has been endangered by the nuclear explosive force or the emission of harmful rays characteristic of nuclear weapons.

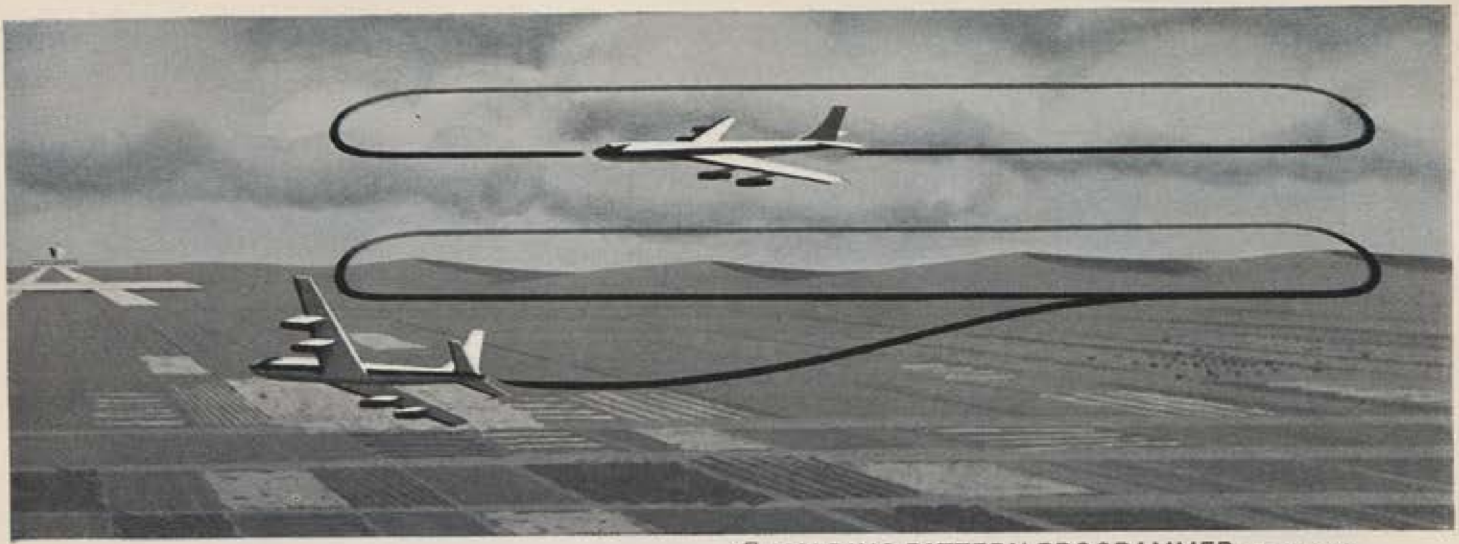
There have been, in the past three years, nine accidents involving nuclear weapons occuring in the public domain and publicly announced. Four involved B-47s, three B-52s, one a C-124, and one a Bomarc air defense missile. The Bomarc burned at McGuire AFB, N.J., last June. A great deal of publicity attended the first such incident with a nuclear-capable missile, but no nuclear yield resulted. In the two most recent accidents, one B-52 disintegrated in the air over North Carolina in January of this year, and a second B-52 crashed in northern California in March. Each plane carried two unarmed nuclear bombs; in neither case was radiation released. In each of these accidents over the past few years, the inherently safe design of USAF nuclear weapons was emphatically underlined.

This record—unparalleled in any previous radical advancement in weaponry—is the best spokesman for the Air Force Nuclear Safety Program.—END

MB-1 Genie is thoroughly checked during nuclear safety survey by Maj. Michael A. Hodock, Chief, ADC Systems Branch, Directorate of Nuclear Safety Research, Kirtland AFB, N.M.

Nuclear safety experts study causes. From left: Col. Ralph M. Lechausse, Chief, Life Sciences Advisory Group; Lt. Col. Francis S. Smith, Chief, Environmental Hazards Section, Advisory Group; Maj. Salvatore J. Tedesco, Nuclear Research Analyst; and Col. Charles B. Stewart, Director of Nuclear Safety Research.

(SEE PAGE 110 FOR GROUND SAFETY)

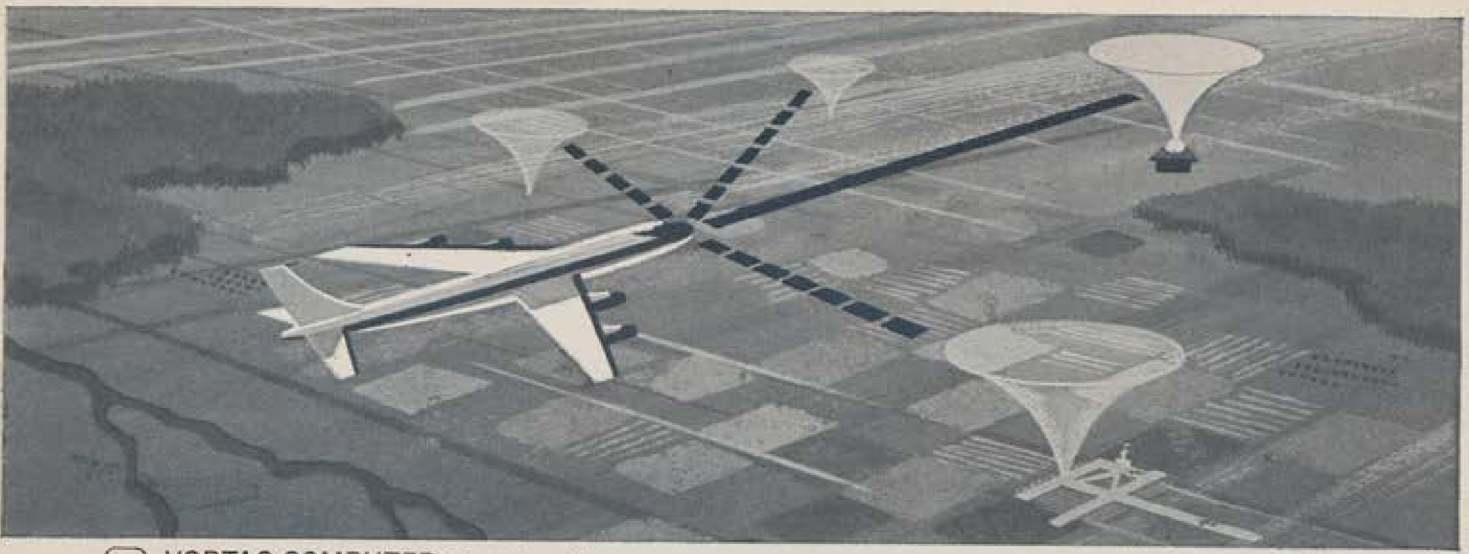


1 HOLDING PATTERN PROGRAMMER: Programs Automatic Flight Control System to fly prescribed holding patterns, automatically correcting for wind.

TRAFFIC CONTROL OF COMMERCIAL, MILITARY, AND BUSINESS AIRCRAFT TO BENEFIT FROM THESE 7 MODERN BENDIX AIRBORNE DEVICES

4 TO-FROM BEEPER: Gives audible signal during VOR station crossing, or at beam intersection, relieving pilot of tiring instrument concentration.

5 AUDIO CO-PILOT: An experiment in converting instrument flag warnings and selected flight data to audible signals (e.g.: calling out approach and take-off airspeeds).



VORTAC COMPUTER: Through airborne computation, creates phantom Vortac station where needed for parallel routing through congested areas and for direct flight navigation to destinations with limited navigation facilities. Provides constant readout of bearing and distance information.

Knowmanship in Action

Since introducing the "earth inductor" compass in aviation's early days, Eclipse-Pioneer has been responsible for a wide array of control and navigation equipment that has anticipated aviation's ever-growing, ever-changing needs. All seven devices shown on these pages are important new advances keyed to jet-age problems and ready to aid in relieving the cockpit pressures of navigation and traffic control.

TECHNICAL KNOWLEDGE + EXPERIENCED MANAGEMENT + SPECIALIZED CRAFTSMANSHIP = **KNOWMANSHIP**

For further information, write . . .
Eclipse-Pioneer Division
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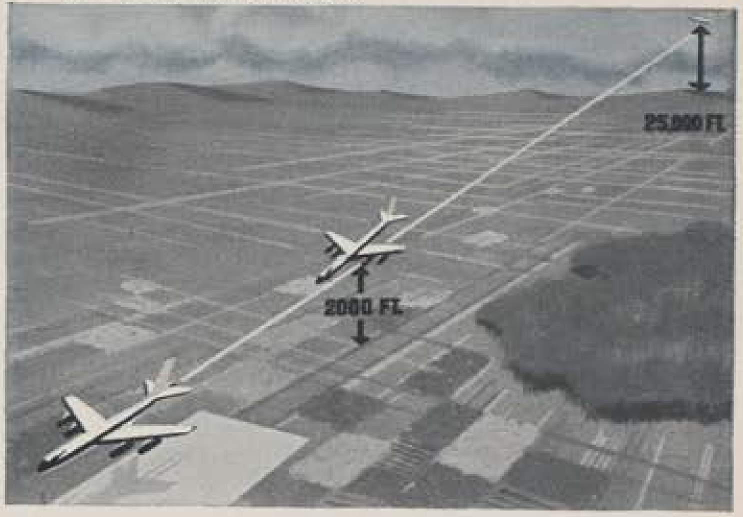
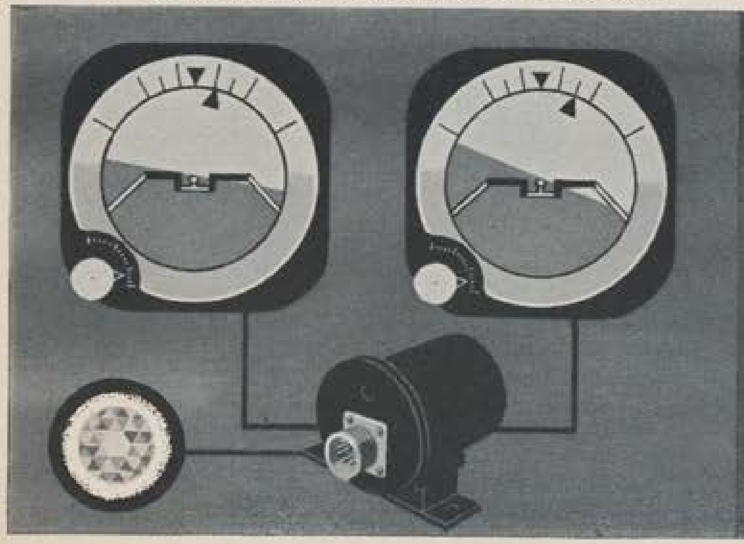
THE Bendix CORPORATION

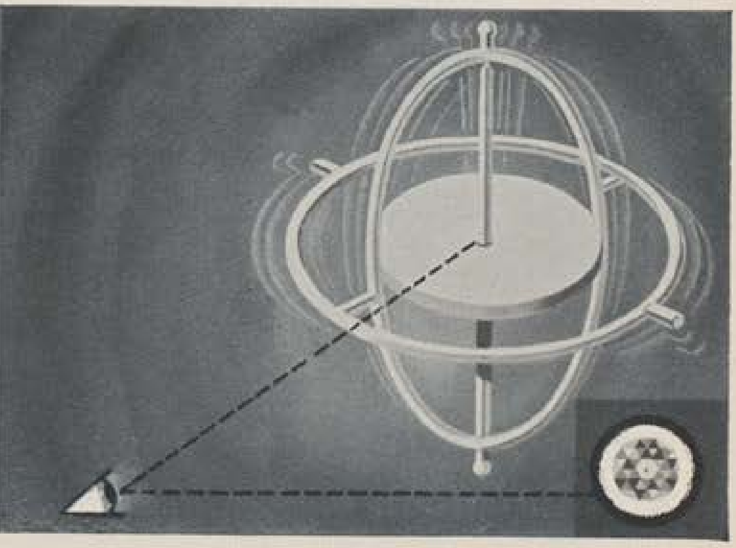
VERNAV (Vertical Navigator): Automatically computes and flies optimum climb or descent path to any preselected point in altitude.



SIGNAL COMPARATOR: Compares signals from two like systems (i.e.: horizons, compasses, any synchro signals) and warns when difference exists.



TWO-AXIS GYRO MONITOR: Warns when gyro is not erected to vertical. When used with a Signal Comparator in a dual system, tells which gyro is malfunctioning.



Through management, through research and engineering, through education and training, and through investigation and analysis, the Air Force has made great improvements in its ground accident record. Nevertheless, ground accidents continue to take their toll . . .

USAF's Safety Program

'A Problem of Magnitude and Complexity'

Col. Will L. Tubbs, USAF (Ret.)

ASSISTANT FOR GROUND SAFETY

Colonel Tubbs has worked in ground safety since the start of World War II, when he was Chief, Ground Safety Division, Assistant Chief of Air Staff. An infantry officer in World War I and insurance executive between wars, he was recalled in 1940, has headed USAF ground safety since 1942 with a postwar break of two years. He is now a retired colonel.

THE GROUND-accident prevention effort in the Air Force is primarily a management program. The first-line supervisor is in a strategic position to detect and correct on-the-spot situations that could lead to accidents. He is therefore taught that near-accidents are symptoms that something is wrong with men, methods, or materiel, and if corrective action is not taken promptly when these incidents are detected a serious and expensive accident might result.

The approach is to eliminate faulty design, improper procedures, and unsafe behavior. Since machines, buildings, and roads are governed by the unwavering laws of physics, the Air Force believes that it is easier to engineer "things" than it is people. If engineering won't do the job, then we look to command and supervision in an effort to correct improper procedures and unsafe behavior.

The program is aimed primarily at the prevention of unsafe acts and conditions that could lead to accidents. If we fail to prevent these unsafe acts and conditions, our goal is then the detection and correction of situations that could lead to or have led to accidents. It is a matter of record that the employment of these concepts results in improved effectiveness for the Air Force.

The ground-safety program in the Air Force was born in combat. Back in World War II, General Arnold discovered that ground accidents were causing a greater number of casualties than the enemy. He directed a survey of ground operations. As a result the ground-safety program, which then included only civilian employees, was expanded to include military personnel, motor vehicles, and other property.

Under the present organization described in the introduction to these articles, the Office of the Assistant for Ground Safety reports directly to the Deputy Inspector General for Safety and is comprised of two divisions: The Research and Engineering Division performs safety engineering tasks, conducts research studies, establishes technical standards, provides explosive safety guidance, and furnishes accident prevention consultation service. The Operations and Analysis Division conducts surveys and staff assistance visits, establishes educational and promotional requirements, analyzes mass accident data, and conducts a program to foster good community relations.

The Office of the Assistant for Ground Safety also works closely with the three Directorates which report to the DIG/Safety and whose functions you have already read about; with the Director of Missile Safety Research, because the prevention of accidents during the transportation of missiles and in the injury-producing areas of missile operations are ground-safety responsibilities; with the Director of Flight Safety Research in order to solve flight line and maintenance problems; and with the Director of Nuclear Safety Research to solve the mutual problems brought into existence by the introduction of nuclear weapons.

The Air Force enjoys the benefits and privileges of membership in the National Safety Council and thereby profits from the experience of American industry in promulgating ground safety. Ground-safety officers at Air Force installations subscribe to the educational literature, films, programs, etc., prepared by the National Safety Council for its industrial members. This is most beneficial to us since for the most part the problems of the safety director of any large industry will parallel those of our safety officers. The National Safety Council provides a two-way street for Air Force-industry cooperation, since our people participate in NSC conferences and have opportunity to compare problems and solutions with their counterparts in the civilian world. These problems will vary in nature from the handling of explosive chemicals to the hazards of Sunday driving.

Contrary to what one might expect, more Air Force people are killed in ground accidents each year than in flying accidents. Obviously we spend more time on the ground than in the air; thus we have more opportunities to get killed on the ground. This is not to imply that ground safety is more important than the other three safety programs. The *potential* of accident in the other safety areas is great. But in point of fact, ground accidents represent a problem of magnitude and complexity.

Most basic kind of ground safety—that of the airman in his car or truck—is dramatically stressed by such Air Force on-base displays as this smash-up exhibit at Wright-Patterson AFB, Ohio, which reminds personnel graphically what can happen very fast when motoring safety rules are broken.

Preliminary figures show there were a total of 562 Air Force people killed in all ground accidents in 1960: 431 in private vehicles, fifteen in government vehicles, and 116 in all other ground accidents. In other words, 365 more people were killed in ground accidents than in flying accidents.

About thirty-nine percent of all ground accidents are caused by vehicles; seventeen percent are sustained as a result of sports and recreation activities; nine percent are flight-line accidents; five percent result from horseplay and fights; four percent are derived from ordinary industrial operations; and twenty-two percent do not fall into any of these general categories.

The biggest problem facing the ground-safety specialist is the prevention of private motor vehicles accidents off base and off duty; thirty-eight percent of all Air Force personnel own private vehicles and they drive seven billion miles per year.

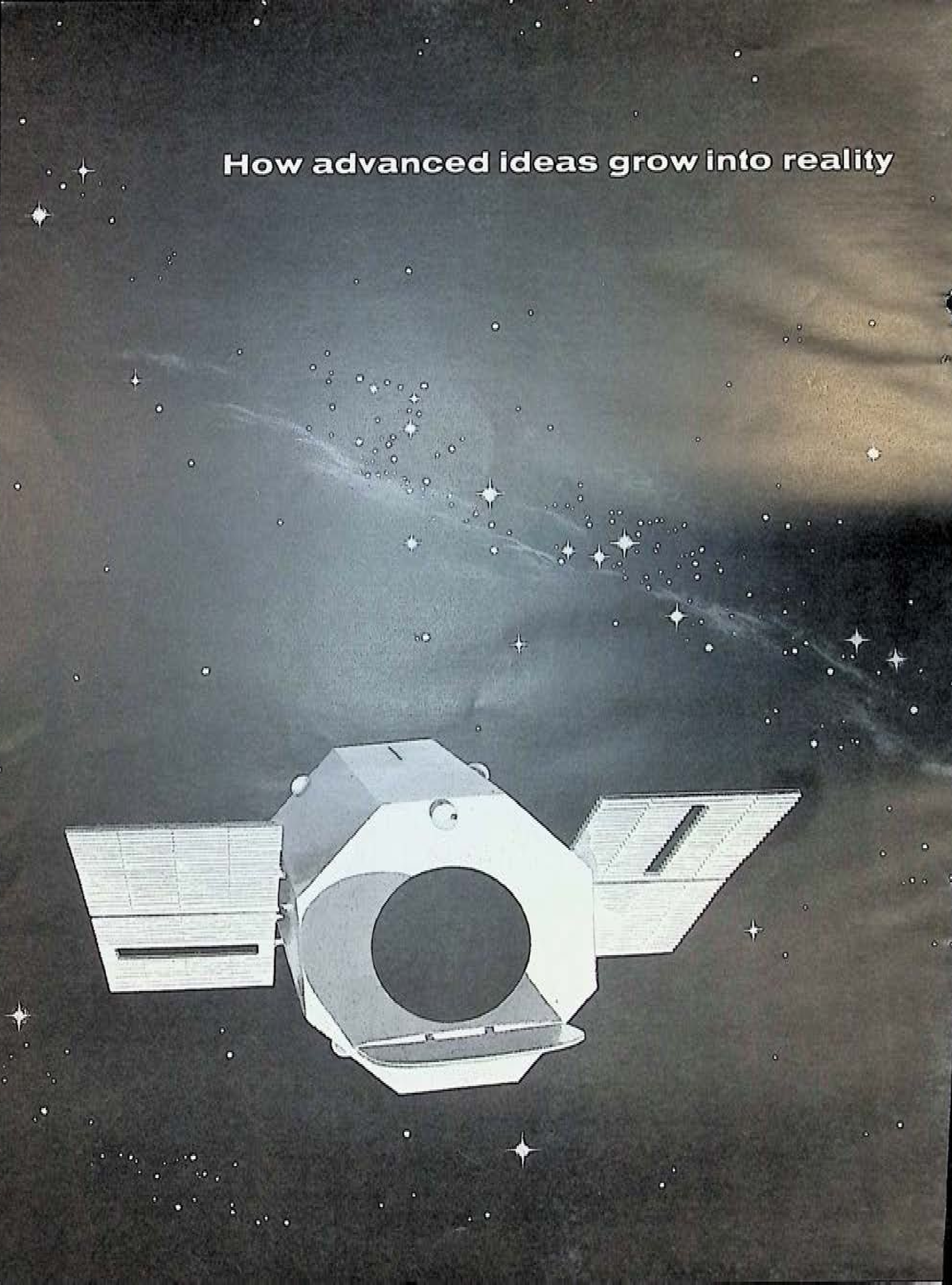
The private-vehicle accident-prevention problem is complicated by the fact that positive supervisory accident prevention controls which typify on-duty Air Force operations cannot be extended to off-duty, off-base activities. The present job of the ground-safety specialist therefore involves the employment of a progressive safety-education program designed to maintain safety consciousness both on and off duty.

It should be realized, however, that there is a tremendous severity potential involved in on-base, on-duty operations. Ground safety is charged with industrial accident-prevention responsibilities for Air Force operations which support some of the most awesome and dangerous weapon systems known to man. Therefore, it is necessary to employ effective safety engineering techniques as well as vigorous education and enforcement measures to maintain a constant war against on-duty accidents.

Sources of on-duty Air Force ground accidents cover a wide variety of activities, including aircraft engineering maintenance and repair, special-purpose vehicle operation and maintenance, supply warehouses, civil engineering shops, government motor-vehicles maintenance and repair, food-service preparation, air-police functions, administrative and clerical offices, ground radar and radio communications systems, physical-training programs, small arms training, fire fighting, fueling operations, weapons handling and storage, electrical facilities, and railroading.

This partial list of areas requiring ground-accident prevention effort in the Air Force serves to show the reader the breadth and depth of our task. Through management, through research and engineering, through education and training, and through investigation and analysis, the Air Force has made great improvements in its ground-accident record. In the final analysis, our goal is to provide a maximum return on the taxpayer's investment in aerospace power.—END

Air safety begins on the ground, a story the Air Force constantly tells to its people, and a point which is proved dramatically by this photo of the swath of destruction caused by this flight-line accident in which a Boeing KC-135 jet tanker, which unexpectedly went out of control, smashed to pieces three other parked aircraft, and wrecked a set of buildings.


How advanced ideas grow into reality

at Grumman...

Four capabilities qualify Grumman for advanced outer space projects:

FIRST: manpower—Grumman's labor stability has made possible the organization of a group of scientists, engineers and skilled workmen with high individual and collective experience.

SECOND: systems management ability—Grumman has repeatedly demonstrated its ability to administer complete, complex systems, from initial design to final utilization.
Most recent examples are the AO-1 Mohawk, the WF-2 Tracer, the A2F Intruder, and the W2F Hawkeye, all operational within the last 30 months.

THIRD: complete research and test facilities—Grumman's already extensive aero-space facilities were further expanded in 1960 by a new 5-million-dollar Electronics Systems Center which houses some of the most advanced equipment in the country. A major space environmental installation is also currently under way.

FOURTH: continuing space studies—For many months Grumman scientists and engineers have carried on extensive studies in such fields as stabilization and control, data processing, plasma physics, magnetohydrodynamics, hypersonic aerodynamics and related fields, to complement the company's outer space programs.

These four areas comprise Grumman's competence in transforming ideas into reality. This ability is being demonstrated in the Orbiting Astronomical Observatory (OAO) shown at left in an artist's impression. Conceived by Goddard Space Flight Center of National Aeronautics and Space Administration, and now under development by Grumman, the OAO will be used to study the unknowns of ultraviolet radiation from the stars . . . the life history of stars . . . the origins of the universe. Launching date: 1963. Grumman Aircraft Engineering Corporation, Bethpage, Long Island, N. Y.

Advanced ideas grow into reality at . . .

Grumman

the Ready Room

Fatal Intercept

The **Sidewinder missile** on an **Air National Guard F-100** accidentally fired and destroyed a **SAC B-52** over New Mexico early in April. Three of the eight-man SAC crew were killed. It was the **Air Guard's first intercept accident** in seven years of runway-alert operations.

Since July 7, 1954, when Air Guard squadrons began standing runway alert for the **Air Defense Command**, the Guard has performed 84,000 scrambles and 160,000 intercepts under ADC control. During these seven years, an average of twenty Guard squadrons has maintained at least two aircraft on five-minute runway alert each day. **Air Guard pilots have flown an average of 1.5 intercepts per day**, 365 days a year, for seven years.

Lt. James W. Van Scyoc, the 27-year-old pilot whose plane carried the ill-starred Sidewinder, **leads all pilots of his squadron in F-100 time.** He has logged **more than a thousand hours** in the Supersabre. His total of 2,236 flying hours includes almost 2,000 hours of jet time.

The Air Defense Command issued a statement in connection with the accident, quoted in part as follows:

"Our nation's interceptors must be combat ready. They must train under as realistic combat conditions as possible to be ready. . . . ANG interceptor aircraft, under ADC control, which are armed with live nonnuclear weapons, are scrambled from alert conditions to practice interception of other military aircraft. Many safety devices in the interceptors must be activated before such weapons can be fired. In this instance, these safety checks were made."

However, shortly after the accident, the Air Force called **a halt to practice intercepts against SAC aircraft,** pending a thorough study of the accident and of safety devices employed in all armed interceptors.

The order applied only to practice intercepts against other aircraft. But there will be **no letup in the runway-alert program for ADC or the Air Guard** in the vital mission of protecting the US against unidentified aircraft.

How Times Have Changed

Probably nothing points up the **growing stature of the Air Reserve Forces** more than their globally oriented, streamlined **training program.**

Already this year Reserve Forces have engaged in **combat exercises in Panama and Alaska.** In August, eight wings will join with active Army and Air Force units in **Operation Swift Strike** exercises in North Carolina.

Air Guard heavy transports are **spanning the Pacific** from the Golden Gate to Tachikawa, and will soon join in MATS European runs as well. **Reserve pilots** have delivered **C-119s to India** and ferried others **home from France.** Four Reserve squadrons are checking out in **newly acquired C-124 Globemasters,** preparing to haul troops and equipment anywhere in the world.

Reservists at **eighty-two training centers** are laying aside their books to **bolster the Air Force's deterrent power** by forming recovery groups and squadrons at civilian airfields.

A shortage of refueling tankers has kept Air Guard tactical fighters from deploying overseas this year, but the **122d Wing of Indiana** will simulate an Atlantic crossing by "island hopping" from **Myrtle Beach, S. C., to George AFB, Calif.** By next year, when the Air Guard has its own tankers, tactical fighters with state markings may be a **familiar sight** from England to the Middle East.

In **Texas,** Guard air defense units have **done away entirely with field training.** Instead, commanders schedule active duty for their men **as they need them** to meet ADC exercises and alert commitments. This concept may soon be applied to **other Air Guard units** assigned to ADC, and it could be used as well by **transport and troop carrier squadrons** performing year-round missions for their gaining commands.

Green Light for Recovery Units

The **Air Force Reserve** has been authorized to organize **more than 200 recovery units** beginning July 1, to operate at civilian airfields throughout the country.

Maj. Gen. Robert E. L. Eaton, Assistant Chief of Staff for Reserve Forces, says the new units will assign to more than **30,000 Air Force Reservists** a key role in US Air Force deterrent power. Recovery squadrons will provide **services and support for military aircrews and planes** which might be forced to land at civilian airfields if military bases are damaged in an enemy attack.

Fourteen recovery units—**seven groups and seven squadrons**—were organized in September 1960 to test the recovery concept. The new authorization will bring the **total number of recovery units** in the Reserve to almost 300—**eighty-two recovery groups and some 200 squadrons.**

Each of the eighty-two recovery groups is located at what was **formerly a Reserve Training Center.** Manpower for the new groups and squadrons will come **predominantly from Reservists** currently receiving training in the centers. However, recovery groups will continue to provide **center-type training** for individual Reservists essential to Air Force wartime needs but not required in the recovery units. A recovery squadron will **not necessarily be located in the same community as that of its parent group.**

These plans pertain only to recovery units based at **civilian airports.** But it is understood that USAF is also completing plans for an **increase in base support units,** designed to employ Reservists to help **restore USAF bases** to operating condition after an attack. **Six units** were created last fall to test this structure. **A total of 109** base support groups are planned for eventual activation under current planning.

Swift Strike

Six Air Force Reserve troop carrier wings and two Air Guard tactical wings will participate in **Operation Swift Strike,** which will take place August 6 to 20 in the Fort Bragg, N. C., area.

This exercise is the **fourth in the "Pine Cone" series** of joint maneuvers with **Army airborne forces** held annually since 1958. While Reserve Forces participation will be smaller than last year, the **scope of the exercise is broader** than ever.

Reserve wings will come from states ranging from **Massachusetts to Wisconsin and Texas,** to be deployed at half a dozen bases in the **Carolinas.** Air Guard units will operate from such faraway points as **Alpena, Mich., St. Joseph, Mo., and Gulfport, Miss.**

MATS, which will again provide **strategic airlift** for Army troops in the exercise, expects to call on many mobilization assignees to help meet its requirements.

Hot and Cold

Some of the units engaging in **Swift Strike** this summer will find the hot and dusty North Carolina weather a **welcome change** from the sub-zero cold they encountered in Alaska during **Operation Willow Freeze** in February.

Willow Freeze was a **joint Army-Air Force** exercise, with the Air Reserve Forces providing **troop carrier and tactical aircraft** to work with **6,500 Army ground forces.**

Brig. Gen. John O. Bradshaw, Commander of the 434th Troop Carrier Wing, Bakalar AFB, Ind., was in charge of the air units in the exercise. They included some **thirty C-119s** drawn from his wing and from the 403d at **Selfridge AFB, Mich.**; the 440th, **Milwaukee, Wis.**; and the 442d from **Richards-Gebaur AFB, Mo.**

The **Air Guard** provided **eleven F-86H** tactical fighters of the 102d Wing, led by **Col. John J. Stefanik of Westfield, Mass.; seven RB-57** tactical reconnaissance planes from **Kentucky's 123d Wing,** led by **Col. Verne M. Yahne of Louisville;** and **ten C-123s** from **Alaska's 144th Transport Squadron,** commanded by **Maj. John M. Podraza of Anchorage.**

General Bradshaw's troop carriers helped **airlift Guard and Reserve ground crews and spare parts** to Alaska, then airdropped paratroops and supplies for the mock battle which was waged over a rugged **2,000-square-mile area.**

The Reserve Forces units, serving in **both aggressor and defender roles,** were commended by exercise leaders for outstanding performances.

In **Operation Solidarity,** the **514th Troop Carrier Wing, McGuire AFB, N. J.**—augmented by individual planes and crews of other Reserve squadrons—became the **first Air Reserve Forces unit to participate in Composite Air Strike Force type** operation.

Under leadership of **Col. Campbell Y. Jackson,** 514th commander, the force of **thirty C-119s** joined with Tactical Air Command transports to fly **Army paratroopers and equipment from Fort Bragg, N. C., to Panama and back.**

The exercise was designed to demonstrate the ability of a **combined CASF and STRAC force** to deploy swiftly from the ZI to defend an area overseas—in this case the Panama Canal.

Operation Solidarity drew its name from the fact that troops from **several Latin American countries** joined in defending the Canal. The whole show was witnessed by the **President of Panama** and many other **Latin American VIPs,** in addition to US military observers.

The Reserve C-119s, carrying troops and weapons, departed from **Pope AFB, N. C.,** refueled at **Key West, Fla.,** and then proceeded direct to Panama at fifteen-minute intervals. After the initial airlift and airdrops, the Reserve crews flew **courier missions** throughout the maneuver area. One crew flew to **Lima, Peru,** to pick up military leaders and newsmen to see the exercise, then returned them to Peru before heading home.

In appreciation for the Air Force Reserve's **contribution to the exercise,** the Commanding General of the Caribbean Command **presented a plaque** to Colonel Jackson.

Tie Breaker

For the second year in a row, the **163d Tactical Fighter Squadron** of Fort Wayne, Ind., has been named the outstanding unit in the Air National Guard. It is commanded by **Maj. Eugene Royer.**

Last year the 163d shared the title with the **141st Tactical Fighter Squadron,** McGuire AFB, N. J., each scoring

Air Force Maj. Gen. Winston P. Wilson, chief of the Air National Guard, presents $100,000 check to USAF Chief of Staff Gen. Thomas D. White for the Air Force Academy Stadium Fund. Money was contributed by Guardsmen across the nation. Stadium construction began late last year.

a **perfect 1,000 points** under ratings established by the National Guard Bureau.

This year the 163d scored **1,066 points,** an achievement made possible by a revision in the Bureau's point system following last year's tie.

Major Royer and the 163d will be awarded the **Air Force Association's outstanding unit trophy** at AFA's 1961 National Convention in Philadelphia.

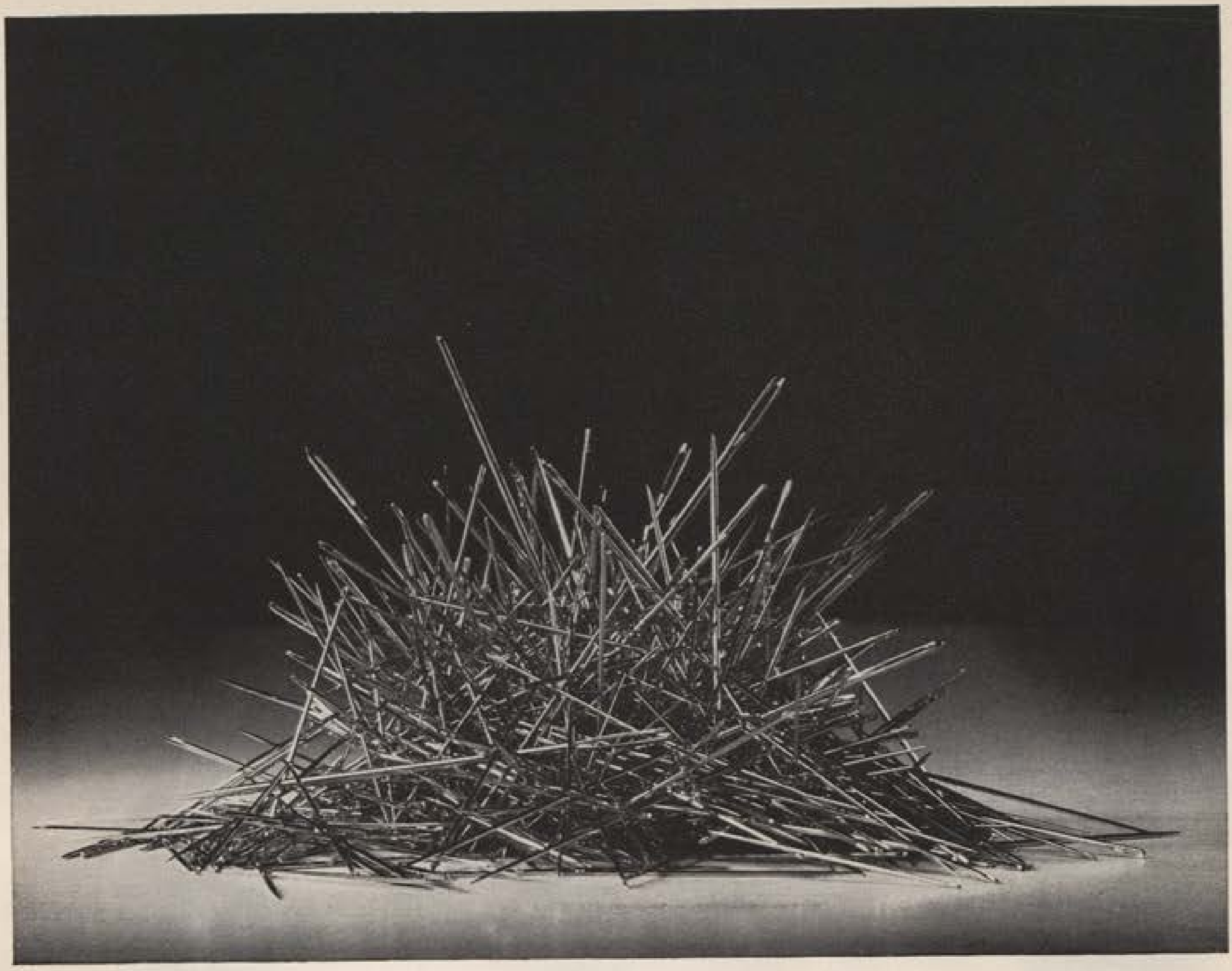
Second place among the ninety-two Air Guard tactical flying squadrons was awarded to the **104th Tactical Fighter Group** of Westfield, Mass., commanded by **Col. John J. Stefanik.** It scored 954 points.

The **Winston P. Wilson Trophy** for the Air Guard's outstanding all-weather unit was won by the **124th Fighter-Interceptor Squadron,** Des Moines, Iowa, commanded by **Lt. Col. Allan R. Packer.** This trophy will be awarded by the **Night Fighter's Association,** meeting concurrently with AFA in Philadelphia.

The **Air Force Reserve's outstanding unit** will be designated in May.

Short Bursts

New York's information squadron, commanded by **Col. Bob Keim,** staged its **sixth annual seminar** for USAF information officers April 19-21. Among many distinguished speakers were Air Force Secretary **Eugene Zuckert;** former White House press chief **Jim Hagerty,** now vice president of ABC radio-TV network; and **Dr. Arnold Toynbee,** the British historian. . . . The Reserve's unique **9999th Squadron,** made up of **senators, representatives, and congressional staff members** who are Air Force Reservists, visited SAC Headquarters April 17. Other field trips are scheduled to **TAC Headquarters, Cape Canaveral, NORAD, the Air Force Academy, and the Arnold Engineering Development Center. Brig. Gen. Barry Goldwater,** the Arizona Senator, commands the squadron. . . . **Sixty Air Guard squadron commanders** were to receive certificates at the ANG Commanders' conference at Ellington AFB, Tex., for a **zero accident rate** during 1960. Last year fifty-one unit commanders received comparable awards. . . . **Col. Frank J. Puerta** is a doctor in civilian life in Fresno, Calif., but he's a pilot in the Air Force Reserve and **mobilization assistant to the Commander at McClellan AFB, Calif.** Dr. Puerta has logged 3,500 hours, including 700 in B-47s, B-52s, and KC-135s. —END



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TECH TALK

J. S. BUTZ, JR.

USAF nuclear engine programs are on uncertain ground after cancellation of the entire nuclear airplane and turbojet program. The **Air Force's nuclear engine development management structure was completely broken up** after the nuclear aircraft termination. Related programs in which USAF has an interest—the **SNAP auxiliary power systems program**, the **Pluto nuclear ramjet program, gaseous reactor studies**, and other advanced developmental efforts—were up in the air.

It seems certain that the joint (Atomic Energy Commission-Air Force) **Aircraft Nuclear Propulsion Office (ANPO) will be eliminated** and its responsibilities dispersed. This group formerly was responsible for all lightweight nuclear powerplants except for the nuclear rocket, which is managed by NASA and the AEC.

As ordered by the President, the **AEC will assume responsibility for high-temperature material research and advanced reactor development.** In addition to this work AEC has placed the SNAP projects under a new office created by the commission to replace the ANPO. **Col. Jack Armstrong, USAF, has been placed in charge of this office,** with the title of Associate Director of Reactor Development, in charge of new technology and advanced nuclear systems. It is uncertain just what Air Force representation will be in this new setup.

The Air Force has asked the **AEC to restudy the management problem** while it does the same. One early suggestion that apparently has found wide support is to **handle all nuclear engines on a project-by-project basis.** There would be **no single group exercising control of all programs** for the Air Force and the AEC as the Aircraft Nuclear Propulsion Office did in the past. Under the separate project system, Air Force officers would participate in nuclear development work under AEC direction during the conceptual and early experimental phases. When a program advanced to the hardware stage, a **joint project would be formed with Air Force representatives coming from the interested command.**

It will also be necessary to establish a **management setup for Project Pluto and the nuclear ramjet program.** Current objective of Project Pluto is to prove the feasibility of the nuclear ramjet. Reactor development is still the big expense. The AEC has about four times as much money in the program as the Air Force. However, the Air Force recently increased its preliminary design and experimental effort to develop airframe and engine components for a vehicle that would use a nuclear ramjet.

Mechanical installation problems and minor accidents have **delayed the first Pluto reactor test for several months.** It is now scheduled for this month or next. The success of this test could have a big effect on the management scheme for Project Pluto during the next couple of years.

* * *

Britain's Bristol T-188 all-steel Mach 3 research airplane was scheduled to begin its **high-speed flight test program around** the first of this month. If all goes well, the **T-188 will be able to log more Mach 3 time on one flight** than has been recorded by all US research aircraft to date. US experience with full-scale Mach 3 aircraft flight is measured in seconds; the T-188 will be able to **maintain this speed for several minutes** at one time.

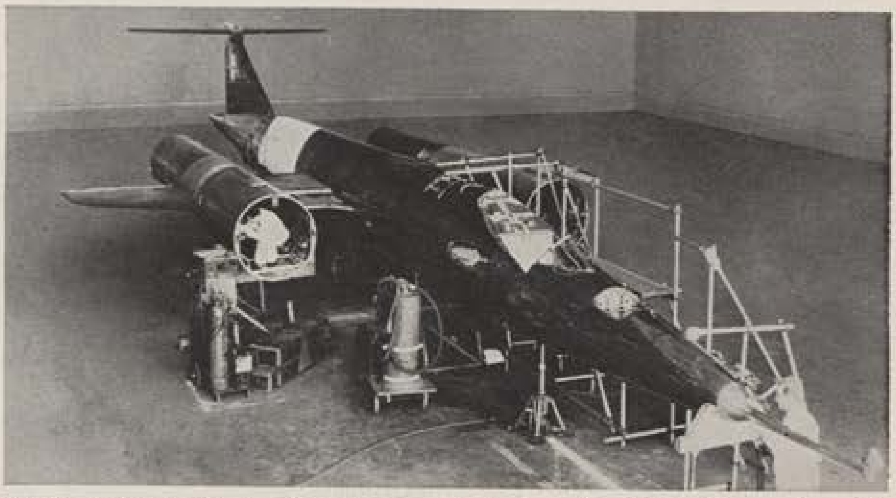
Britain's supersonic transport effort will benefit from the T-188 in several ways. The T-188's **powerplants are air-breathers.** The plan will be laid out so that a wide variety of turbojets and turbofan engines may be tested by making slight modifications in the nacelle structure. The **first engines** in the T-188 are **deHavilland Gyron Junior DJG-10 turbojets with afterburners.** They will each produce 10,000 pounds of thrust at sea level without augmentation, 14,000 pounds with afterburner. At an altitude of about 35,000 feet and a speed of better than Mach 2.5, the thrust with afterburner goes up to more than 20,000 pounds. This is **basically the same engine used in the Blackburn N.A. 39 Buccaneer Royal Navy fighter,** except for a few changes made to accommodate the high temperatures at Mach 3. A new steel compressor is perhaps the most important of these.

Another T-188 feature which will provide important data for the supersonic transport is its all-steel structure. Conventional skin-stringer-type construction is used on this airplane in contrast to the **steel honeycomb sandwich on the Air Force-North American B-70.** Skin-stringer structure is heavier but much cheaper than steel sandwich.

The cost advantage of skin-stringer design was doubly attractive on a one-shot project like the T-188. However, it is hoped that the T-188 experience will indicate ways in which the weight disadvantage can be overcome. If skin-stringer construction can be used, **the cost of materials, manufacturing, and quality control on a supersonic transport could be significantly reduced.**

Fabrication problems on the T-188 included **machining three 8,000-pound ring forgings for the wing carry-through structure** in each nacelle down to a final weight of about eighty pounds. The main structural element in the fuselage is a twenty-seven-foot-long steel forging which serves as a keel.

(Continued on following page)



Bristol T-188 Mach 3, all-steel research airplane is slightly larger than Air Force-McDonnell F-101. Skin-stringer construction is used on the T-188 and the tough steel skin is cut in large sheets in order to reduce the number of joints.

TECH TALK

US space vehicle designers wait pen in hand until more is known about the **performance of liquid hydrogen under zero-gravity.** Final plans for several US space vehicles may be affected by work in this area now being pushed by USAF and NASA. **Centaur, Saturn,** and the **projected nuclear rocket** are **among** these vehicles.

Major unknown is the heat-transfer coefficient to be used in designing liquid-hydrogen tanks for space vehicles coasting in parking orbits. If the **liquid-hydrogen load bubbles as it boils off,** heat transfer to the tank walls would be **considerably higher** than if the load experienced film boiling.

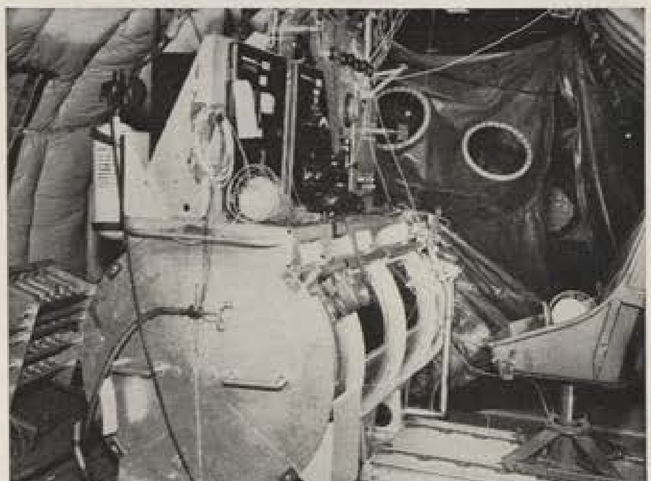
NASA and the Air Force are working together to get the test data needed to solve this and other problems regarding liquid hydrogen. Others are concerned with pumping and feeding systems. NASA has fired the first of **several small half-filled liquid-hydrogen tanks** into a zero-G trajectory from Wallops Island, Va., using an **Aerojet-General Aerobee rocket.** In these tests the heat-transfer data is telemetered to the ground. Movie film showing the action of the liquid is encased in a recovery package. **Good telemetering data was obtained** from the first test, **but the films were lost at sea.** Total weight of the model tank, instrumentation, and recovery unit is 250 pounds. Zero-G time is just over five minutes if the right trajectory is achieved.

Air Force portion of the investigation is being conducted at Wright-Patterson AFB in a **specially modified Boeing KC-135** which can produce a zero-G condition for about thirty seconds by flying along the proper trajectory. This airplane will allow a great mass of data to be taken under close observation and closely controlled conditions.

The explosion hazard of handling hydrogen aboard an aircraft will be **minimized by conducting the experiments inside a large nitrogen-filled tent suspended in the cabin.** Crewmen handling the model tank will enter the protective tent through an airlock and wear oxygen masks (*see cuts*).

* * *

Small aircraft **with kitelike flexible wings made of cloth** are receiving enthusiastic attention from many segments of the Army. The potentially



Tent inside of Boeing KC-135 is used to test liquid-hydrogen tanks and pumping systems under zero-G conditions. Tent is filled with inert nitrogen to reduce explosion hazard if hydrogen leaks in the aircraft. The heavy aluminum cylinder in the foreground is airlock for crewmen.

Spacious area inside of tent is needed to allow the liquid-hydrogen test rigs to float free as zero-G condition is created inside of the KC-135. Crewmen breathing oxygen will be inside of the tent to monitor the test rigs and keep the instrumentation in working order.

CONTINUED

low cost, ruggedness, and piloting ease of these aircraft have raised hopes about giving very large units airborne mobility on the battlefield and freeing them from dependence on ground transport.

Flexible wings have been under test for years by **Frances Rogallo** at **NASA's Langley Research Center.** These tests indicate that flexible wing airplanes could fly at treetop level at speeds below sixty mph, and they could get in and out of fields less than 1,000 feet long. Piloting such aircraft would resemble flying a blimp as much as an airplane. The airplane essentially could not bank. **Pitch and yaw would be effected by reeling in some of the lines holding wings to**

Radar for space use which uses a light beam rather than microwave radiation has been developed by Hughes Aircraft Co. The lightweight unit above is used for signaling as well as target detection.

fuselage. This would change the inclination of the lift vector and alter the direction of flight. The cost of the flexible wing is indcated by the fact that a wing for a 1,000-pound-gross-weight airplane would weigh about forty-five pounds, and it would be about as complex as a sail.

Ryan Aeronautical Company has built and is testing a **four-wheeled man-carrying platform** powered by a small piston engine to test the flexible wing. This vehicle is covered by an Army contract. Ryan also has a NASA contract for a **flexible wing recovery system for the Saturn booster.** Several firms are studying flexible wings made of metal cloth that would be used to support space vehicles during their reentry.

The new interest in the flexible wing follows about ten years during which Rogallo couldn't get anyone to believe the wing would work or had a use.—END

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NATIONAL CONVENTION

IN PHILADELPHIA

SEPTEMBER 20-24, 1961

GENERAL INFORMATION

Listed on opposite page are the names and rates of the official hotels and motels for the Air Force Association's 1961 National Convention and Aerospace Panorama, to be held in Philadelphia, September 20-24. Headquarters for the Convention and Panorama will be at Philadelphia's Convention Hall, where registration, major meetings, and banquets will be held. The AFA business sessions will be at the Sheraton Hotel. All of the hotels and motels are within 10 minutes by cab of the Convention Hall. All of the motor hotels listed are new. Additional motor hotels and lower-price hotels are available on request.

RESERVATION PROCEDURE

AFA has established a Housing Office at the Philadelphia Convention Bureau to handle all requests for rooms and suites for the Convention and Panorama. Requests are being confirmed on a first-come, first-served basis. ALL requests for rooms and suites must be sent to the AFA Housing Office in Philadelphia at the address shown on the reservation form. Be sure to list THREE choices of hotels or motels, your arrival DATE and HOUR, and your departure date. The number of rooms and suites allocated at any one hotel to any individual or company will be limited by necessity. If you plan to arrive after 6:00 p.m., your reservation request must be accompanied by a written guarantee of payment.

and AEROSPACE PANORAMA

WATCH YOUR ARRIVAL TIME

Nothing is more important at a convention than your hotel room. Make sure that you give the Housing Office sufficient information to confirm the type of reservation you want, when you want it. Sometimes we receive complaints from persons who claim that they had a confirmed reservation but, when they arrived at the hotel, there was no record of it. In checking, we found that, in the majority of cases, the person had received confirmation of his reservation, but had later changed his arrival time and had failed to notify the hotel. If you change your arrival time in Philadelphia from that shown on your reservation confirmation, make sure that you notify the hotel; otherwise, your reservation will be CANCELED. Send all reservation changes to the hotel, and all cancellations to the Housing Office.

AFA HOTELS, MOTOR HOTELS, AND RATES

HOTEL	Single	Twin & Double	1 b/r Suite	2 b/r Suite
Adelphia	$ 6-10	$14-18	$25-35	
Barclay	SOLD OUT	SOLD OUT	SOLD OUT	SOLD OUT
Bellevue Stratford	$10-17	$14-23	$32-60	$52-80
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5-61

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Reliability increased 700%. MTBF raised from 17½ to over 150 hours with a service life in excess of 2000 hours.

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Government officials estimate savings on maintenance costs alone of the Hoffman-designed AN/ARN-21C will amount to over $125 million.

* *Hoffman is the only manufacturer now delivering airborne TACAN equipment in quantity to the Air Force.*

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AFA NEWS

SQUADRON OF THE MONTH

Tucson, Ariz., Squadron, Cited for

effective and successful support of AFA objectives in the community, particularly for its Fifteenth Anniversary Program and a series of indoctrination tours of military installations.

Many of AFA's units have sponsored programs in the past few months observing the **Fifteenth Anniversary of AFA's formation.** None had a more impressive event than the **Tucson, Ariz., Squadron.** The Squadron on February 3 hosted an **"Air Force Appreciation Luncheon"** to mark the anniversary. It was kickoff function of a week-end civic program, **"Aerospace in Arizona Days,"** an air show.

The event attracted more than 700 people, including civic and military leaders of the southwest. **Jack B. O'Dowd,** Commander of the Tucson Squadron, was in charge of the program. His Program Chairman was **Donald S. Clark, Jr.,** Secretary of the Squadron.

Brig. Gen. Robert L. Scott, Jr., USAF (Ret.), delivered the principal address to the luncheon guests (*see cut*). General Scott, now living in Phoenix, is the author of several novels, including *God Is My Co-Pilot.*

Top guests at the speaker's table included **Maj. Gen. John D. Stevenson,** Commander, 28th Air Division, Hamilton AFB, Calif., who will be remembered as military host at the **1960 AFA National Convention** in San Francisco; **Maj. Gen. Archie J. Old, Jr.,** Commander, Fifteenth Air Force, March AFB, Calif.; **Brig. Gen. Frank P. Lahm,** USAF (Ret.); and **Harry J. Weston,** Commander of the Sky Harbor AFA Squadron, Phoenix.

Tucson Squadron has also been carrying out a series of weekly tours of Davis-Monthan AFB, Ariz., for members and guests, and reports that a great deal of community interest is exhibited.

In recognition of the outstanding anniversary program and these tours, we're proud to name Tucson as **AFA's Squadron of the Month** for May.

Pittsburgh's AFA Squadron and **Area B-2, Arnold Air Society,** on March 4 cosponsored an **Aerospace Education Seminar** at the Pittsburgh Hilton Hotel. The Seminar was combined with the **Society Area's Conclave** and an Installation Banquet for new Pittsburgh Squadron officers.

More than 400 educators, civic leaders, and AFA and AAS members attended the function, which actually

(Continued on following page)

Tucson Squadron dinner marks AFA anniversary. Left to right, John Albright, Tucson Chamber of Commerce President; speaker Brig. Gen. R. L. Scott, USAF (Ret.); Squadron Cmdr. Jack O'Dowd; 15th AF Commander Lt. Gen. Archie Old.

At Magic Valley Squadron, Twin Falls, Idaho, education program: Squadron Commander Warren Murphy; state education superintendent D. F. Engleking; Space Technology Labs' Nan Glennon; Dr. C. H. Reed, University of Nevada.

San Diego Squadron's Muriel Tolle, Commander Walter L. Jones, Past Commander Frank Brazda, with local school students who will use aerospace reference material given to San Diego school system in Squadron education program.

AFA Board Chairman and former President Howard T. Markey addresses aerospace luncheon sponsored by Cleveland Sales Executive Club. He spoke on national preparedness.

AFA's James Straubel receives airpower award from Billy Mitchell's sister, Mrs. Martin Fladoes, in ceremony at Milwaukee. AFA Squadron Commander Gary Ortmann looks on.

USAF, AFA celebrated Jersey City's 300th anniversary with dinner. Squadron, Air Force members in function photo are, left to right, seated: SSgt. Gil Schneider, recruiter; Maj. Douglas Eden, Commander, Recruiting Service, State of N. J.; Lt. Col. John Makely, Commander, 141 TAC Ftr. Sq. N. J. ANG; William L. Bromirski, Commander, AFA Hudson Squadron; Edward J. Donnelly, Bert Humes. Front row: Lloyd Nelson, AFA State Commander; David Erwin; Herbert Tiedeman; Richard Dimeola; Thomas Rolosuk; George Alves; Eugene Rodar; Frank Cerosky; Hector Feliciano; Henry Carnicelli, State Vice Commander. Second row: Edward Zadzielski; Raymond Barnett; William Barba; Douglas Stewart; Lawrence Keber; Frank Condello; Raymond Masser; and Adam Gmiazdowski.

got off the ground on Friday evening with a "get-acquainted" reception at the Variety Club. Saturday's events included the Seminar sessions, the Banquet, at which AFA Board Chairman **Howard T. Markey** was guest speaker, and an Aerospace Education Luncheon. Address here was delivered by **Dr. Charles H. Boehm,** Superintendent of Public Instruction for the Commonwealth of Pennsylvania. Dr. Boehm is a member of **AFA's Aerospace Education Council.**

Individual performances are almost impossible to enumerate, but among those who turned in great jobs on this affair were AFA Director **Carl J. Long; Lt. Tom Cindric,** Past National Commander of AAS (and now Vice Commander of the Pittsburgh AFA Squadron); **Miss Pauline Luntz; Mrs. Ruth Young; Nicholas Grebeldinger, Jr.,** Area B-2 Commander; and **Leland Brown,** Chairman of the Conclave. Many others also took part in making this significant meeting a very great success.

• • •

Cleveland Squadron on March 6 sponsored its **4th Annual Aerospace Day** program in conjunction with the Sales Executive Club of Cleveland. **Howard T. Markey,** Board Chairman of AFA, was the principal speaker at the luncheon held in the Hotel Sheraton-Cleveland before more than 250 civic leaders of the area (*see cut*).

Ray Saks, Commander of the Cleveland Squadron, reports that this program has grown into one of the most impressive annual events on the Cleveland scene, and has brought the Squadron much recognition for its efforts.

Next major item on the agenda for the Squadron is its annual **Kids' Day observance,** cosponsored with the **Cleveland Kiwanis Clubs,** and planned for August 10.

• • •

Warren Fackenthall, 326 Tulane Pl., N. E., Albuquerque, was named Commander of the brand-new **New Mexico Wing** at the organizational meeting held on April 1. Other officers elected at the meeting, which was attended by representatives of the **Albuquerque and Alamogordo AFA Squadrons,** are **Homer Sanders,** Vice Commander; **Verle Simpkins,** Organization Director; **Francis Williams,** Secretary; and **Richard Harris,** Treasurer.

We're delighted to welcome this new Wing in AFA, and look forward to increased activity in the Southwest Region as a result of its formation. The Wing immediately planned to send representatives to the **Western States Aerospace Conference** in Las Vegas, as well as to future local and national AFA functions.

• • •

CROSS COUNTRY. . . . Friday, April 7, was the date selected by the Philadelphia Squadron for its annual Installation Banquet, held in the Bellevue-Stratford Hotel. **Robert C. Duffy** was installed as new Commander, succeeding **Miss Sally Downing.** Duffy has accepted **President Stack's** appointment at General Committee Chairman for the 1961 National Convention, and will no doubt become far better known to all AFA leaders come September. **W. Thomas MacNew,** Editor of *Aircraft and Missiles Manufacturing* Magazine, delivered the address at the Banquet, on the topic "Space—Is It Too Far Out for You?"

—Gus Duda

SEAGOING TURBOCOPTER FOR OVER-SEA DUTY. For recovering target drones, nose cones and capsules, the Sikorsky S-61 is the one helicopter that offers the over-water safety of a true boat hull. The S-61, with twin-turbine reliability, also provides the speed, extended range, lifting power and maneuverability essential for recovery missions. And the S-61 meets all requirements for transporting personnel and supplies to offshore Texas Towers. All-weather capability and an integral navigation system augment its other safety factors. From its conception, the S-61 was designed to operate in the environment of the sea.

SIKORSKY AIRCRAFT Division of UNITED AIRCRAFT CORPORATION Stratford, Connecticut

airman's bookshelf

Prisoner of the Reds

***The Endless Hours*, by Capt. Wallace L. Brown, USAF (Norton, New York, 1961, 254 pp., $3.95)**

Reviewed by Richard M. Skinner

Air Force 2d Lt. Wallace L. Brown, a B-29 copilot, flew his first and last combat mission in the Korean War on January 12, 1953. Brown's B-29, *Stardust Four-Zero*, was on a night leaflet-dropping mission over North Korea when it was jumped by MIGs and shot down. The crew parachuted. Brown landed at the edge of a field and made his way up the side of a mountain but was captured the next afternoon and turned over to the Red Chinese for imprisonment, not in a POW camp in North Korea but in prisons in China proper. He was not to be a free man again for nearly thirty-one months.

The Endless Hours is Brown's straightforward account of his 2½-year imprisonment: detailed descriptions of the various cells he lived in, sharp characterization of his guards—those who were cruel and those who were merely detached—recollections of the wretched and wretchedly little food and the cold and the indignities, his abortive escape attempts, and the things he thought about to pass the time. But mostly Brown documents the endless hours of his interrogation.

His Chinese captors tried—unsuccessfully as it turned out—to break Brown's will, to extort from him, and from other surviving crew members whom Brown did not see again or even know were alive until after months of captivity, confessions that the B-29 had deliberately violated the Chinese-Korean border. All of the now-well-known techniques were used: marathon question periods, curses and threats alternated with promises of better treatment, solitary confinement in a constantly lighted cell with a spy hole in the door, punishment if Brown should fail to sit at attention during the prescribed hours during the day or to sleep at attention at night.

Through this somber book runs evidence of Brown's sense of humor—perhaps one of the things that not only helped Brown resist the efforts of the Chinese but enabled him to come out of captivity with his sanity. Little practical jokes played on the guards became immensely important to Brown, just as practical daydreams became a means of passing time. Brown's daydreams consisted not of orgies of self-pity but of elaborate plans for making complicated machines. One was a superior record player, created in his mind down to the last cam and gear. After "making" it and watching stacks of records drop and play (his imagination, he says, "was not vivid enough to allow me to hear the music"), Brown decided the phonograph would be too expensive to market.

Architecture was another time-passer. Brown built many houses: "Mentally I dug each foundation trench, laid each brick, drove every nail, and hung every door. If I discovered I had put a roof on without rafters or made some similar error in construction, I started all over again. . . . My dream house took several weeks to perfect. . . . Each time I completed one of my houses, I furnished it and then lived in it a while just to see how good a job I had done."

Brown, now a captain and instructing at an Air Force base in Florida, actually lives with his family in one of the houses he designed while a prisoner.

(Continued on following page)

'A Brilliant Tapestry'

***The Wild Blue: The Story of American Airpower*, Edited by John F. Loosbrock and Richard M. Skinner (G. P. Putnam's Sons, 1961, 620 pp., $5.95)**

Reviewed by Pat Frank

When World War I ended, American airpower was just beginning to feel its muscle. Its flyers, always daring, were attaining skills. A professional viewpoint was being sharpened. Still, only a trickle of warplanes found their way from factory to front. In September of that year, 1918, Air Force Magazine was founded. In the beginning it was only a weekly newsletter.

In *The Wild Blue*, the best articles from Air Force have been brought together. Edited by John F. Loosbrock and Richard M. Skinner, they form a brilliant tapestry in which is woven the whole story of American military aviation. There is much that is wonderful, and much fascinating material that would otherwise be forgotten, in this hefty book.

The stories begin, as they should, at Kitty Hawk. They tell of our struggles to get into the air in World War I, and of the barnstorming period, when a small group of dedicated young men, like Billy Mitchell and Hap Arnold, risked their lives and careers to keep military aviation in being. They tell of the growing pains of the thirties, and then the impact of World War II. Finally, there is a large section devoted to aerospace—and the future—ending with the predictions of Lt. Gen. James H. Doolittle as to what we may see before the end of the century.

Picking the brightest nuggets from all this wealth is an impossible task. All a reviewer can do is indicate some of the stories he personally liked best.

I was fascinated by James C. Law's story of Frank Luke, the Arizona "balloon buster," called by Rickenbacker "the most intrepid air fighter who ever sat in an airplane." I was also fascinated by "The Last Flight of the X-2," as told by Clay Blair, Jr., military affairs writer of *The Saturday Evening Post*.

But I think the stories of the "stunt era" in military aviation stir nostalgia and admiration, in equal quantities. Writing of "Kelly, Macready, and the T-2," Len Morgan says, "Appropriations barely covered the payroll, with little left over for gas and operations costs or even paint for barracks." In those bleak days stunt flying was necessary in order to remind the public that the airplane actually existed. It was for this reason that Kelly and Macready made the first nonstop coast-to-coast flight. It was infinitely more hazardous, I am convinced, than going into orbit.

In the same genre is a little gem of a story about how Lt. Gen. (then Lieutenant) James Doolittle flew the Andes with both legs broken. "He had a portion of the cast that extended above the knee taken off and clips fastened to the bottom of the casts so he could manipulate the rudder bars. Then he was carried down and put into the plane."

In this way, heroes were made. And in this way, the Air Force was made. The whole story is bound between these covers.

About the Reviewer: *Mr. Frank is the well known author of* Alas, Babylon!, Forbidden Area, *and other books in addition to numerous articles on airpower and national-defense matters.*

The Endless Hours is not a pleasant book to read. There is nothing pleasant about suffering with the author through his agonies of interrogation. Especially distressing is Brown's account of his record six-day question period—less than one hour's sleep in 165 hours, nearly a week. "My body," the author says dispassionately, "was so swollen that it looked more like a dead stump than a human being. The pain I had endured was much greater than I ever dreamed the human body could bear."

The reader, whether he is a military man or not, asks himself what he would have done if he had been Brown—how would he have reacted to being imprisoned, humiliated, beaten, half-starved, half-frozen? One hopes that he would have had the strength to acquit himself proudly and bravely—as did Lieutenant Brown.

About the Reviewer: Mr. Skinner is managing Editor of AIR FORCE/SPACE DIGEST *and one of the editors of the new anthology* The Wild Blue.

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

Air-Age Swashbuckler

Successful pilot-author Ernie Gann (*The High and the Mighty, Island in the Sky, Blaze of Noon*) turns to nonfiction in *Fate of the Hunter* (Simon and Schuster, $6), which takes a long look at transport flying from the years of the DC-2 to the mid-1950s.

Gann sketches the high excitement and drudgery of commercial flying during the years before World War II. He describes exhilarating flights pioneering early wartime ferry and cargo routes across the North and South Atlantic, over Africa to the Far East, over the Arctic, flying the "Hump" out of Chabua, Assam, and charting little-known Brazilian airspace.

Gann also gets very personal. He analyzes himself as man and pilot. His prime conclusion is that, in his own words, he is a modern air-age swashbuckler whose "sword is made of tin."

• • •

Mel Hunter combines his talents as photographer, writer, and artist to create a picture story of SAC today. *Strategic Air Command* (Doubleday, $4.95) portrays in more than 225 photos the many facets of the US primary offensive force of bombers and missiles. Captions and chunks of solid narrative deal with strategy, tactics, doctrine, deployment, and combat operational training. Primary emphasis is on the men of SAC at work and leisure. The author also provides a close look at up-to-date SAC hardware.

Yesterdays, Tomorrows

Man Alive in Outer Space, by Henry Lent (Macmillan, $3) is a small volume on the work of USAF and NASA aerospace medical scientists attempting to solve the problems of survival in spaceflight. Lent is one of the top writers for the young adult audience. He explores USAF and NASA research programs, experiments, and training.

Two professional-level volumes deal with space medical problems in depth. *Human Factors in Jet and Space Travel: A Medical-Psychological Analysis*, edited by Dr. S. B. Sells and Lt. Col. Charles A. Berry, USAF (MC) (Ronald Press, $12) consists of fourteen chapters, each by an outstanding specialist. The essays cover the psychological, physiological, medical, and mechanical problems of high-speed flight within the atmosphere and projected to space travel tomorrow. USAF's Surgeon General, Maj. Gen. Oliver K. Niess, provides the foreword.

Another major volume is *Aerospace Medicine* (Williams & Wilkins, $18) edited by Maj. Gen. Harry G. Armstrong, USAF (Ret.), former AF Surgeon General. Twenty-one contributing authors, each a medical specialist, discuss in detail some thirty-two separate areas of this science.

• • •

Two new autobiographies cover widely different aspects of flight. *Three Years Off This Earth*, by Alexis Klotz (Doubleday, $4.95) is the detailed personal story of a TWA Boeing 707 captain, a former Air Force colonel. It spans thirty years of commercial aviation. A 1927 graduate of the Air Corps Flying School at Kelly Field, Klotz soon resigned to follow a bizarre flying career through the turbulent '20s and '30s. He was recalled during World War II as a senior transport pilot to fly VIPs on wartime missions. The book is not well written, but it contains much fascinating detail of commercial transport development and wartime transport operations.

Hell in the Heavens, by Capt. John M. Foster (USMC Res.) (Putnam,

(Continued on page 131)

from the reaches of space

Unretouched time exposure shows Echo I communications satellite (long line) crossing heavens right to left. Shorter lines are stars "in motion."

Actual undersea photo of telephone cable off coast of Florida.

to the depths of the sea

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When industry and government needed a way of gathering huge amounts of coded information from distant points, we were ready with our vast telephone network and Data-Phone, which transmits at extremely high speeds.

Far in the frozen north, our engineers are putting together the communications system for BMEWS, the nation's Ballistic Missile Early Warning System.

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$4.95) is unique in war-book publication. It covers the South Pacific World War II experiences of Marine pilot John Foster, who in several years of combat against the Japs never succeeded in shooting one down, never became a hero. Its detailed description of the life and duty of an average combat fighter pilot provides a real contribution to the history of air war.

• • •

Primarily for young adults, but also a handy home-office-library quick reference to all aircraft and missiles in the USAF inventory, is *Our Air Force*, by the Editors of AIR FORCE/SPACE DIGEST (Putnam, $2.50). Each piece of equipment is shown in photo with table of design and operational specifications. A brief, running narrative provides a general over-all picture of how each weapon fits into the AF's mission and operations.

Also . . .

Outward Bound for Space, by David O. Woodbury (Little, Brown, $4.50), a history of space research from 1924 to date.

Rockets and Earth Satellites, by Patrick Moore (Sportsshelf, $3), new edition with updating of recent developments.

Victory over Space, by Albert Ducrocq (Little, Brown, $4.95), the last decade in space exploration and what we have learned of this new science.

Observer's Book of Aircraft, by William Green (Frederick Warne, $1.25), tenth edition covering aircraft of all nations.

The Arm of Flesh, by James Salter (Harper, $3.50), a novel of an American fighter squadron in peacetime Germany.

DH: An Outline of the deHavilland History, by C. Martin Sharp (Faber and Faber, London, $5.88), a full history of the deHavilland aircraft industry.

Man's View of the Universe, by R. A. Lyttleton (Little, Brown, $3.50), summary of our knowledge and speculation of the astronomical universe.

War in the Desert, by Sir John Bagot (British Book Center, $6.25), the RAF campaign in the desert, World War II.

Man and Space; The Next Decade, by Ralph Lapp (Harper, $4.95), survey and study of USSR and US space programs focusing on possible developments to 1970.

Fighters: War Planes of the Second World War, Vol. 1, by William Green (Hanover, $2.75), illustrated history of all aircraft of combatant countries.

Tiger by the Tail; And Other Science Fiction Stories, by Alan E. Nourse (David McKay, $3.50), collection of science fiction for teen-agers and adult readers.

Combat in the Sky, by Arch Whitehouse (Duell, Sloan & Pearce, $3.50), collection of Whitehouse fiction-based-on-fact stories of World Wars I and II and Korea.

Technical Aerospace

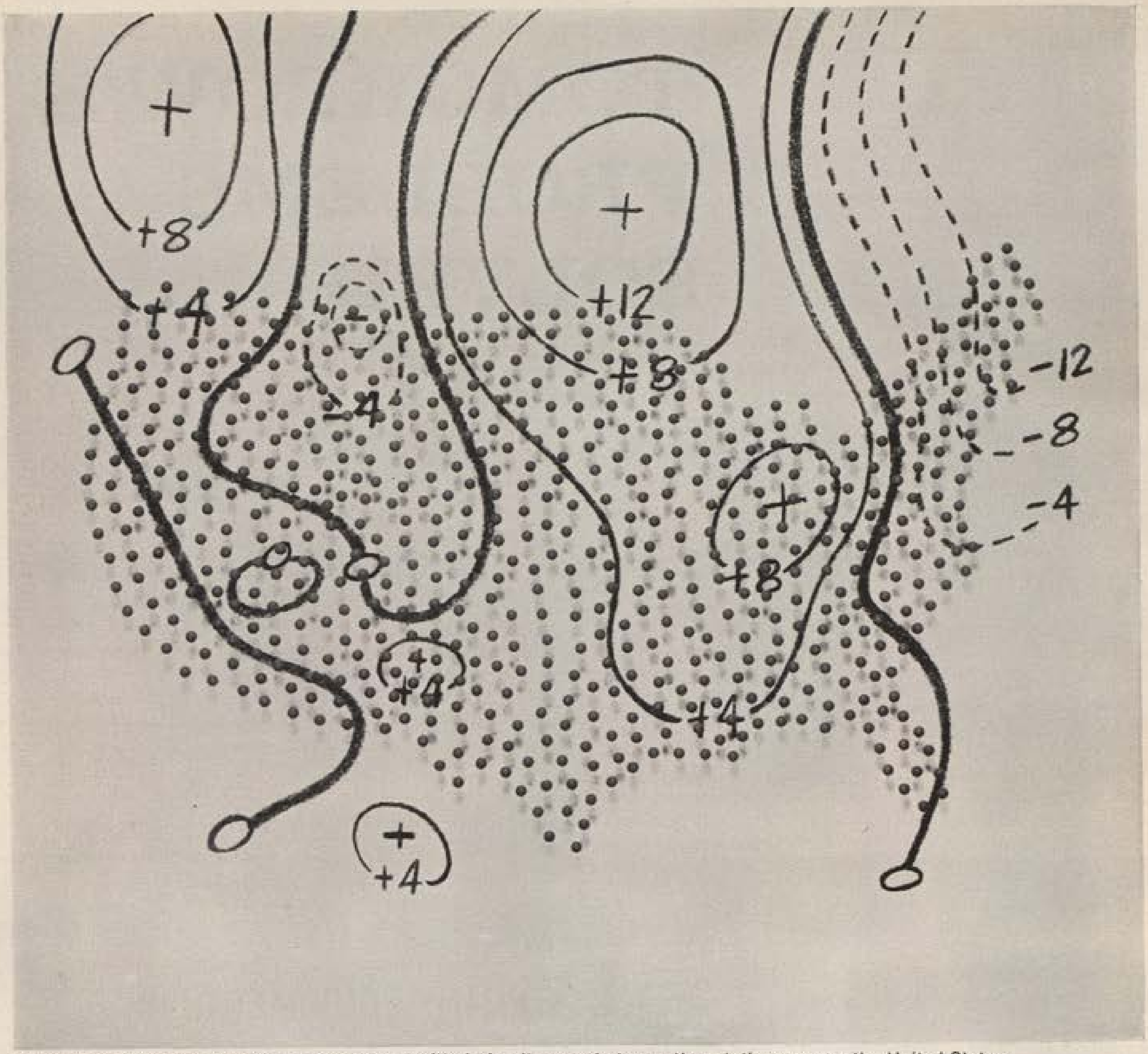
Airborne Radar, by Donald J. Povejsil, Robert S. Raven, Peter Waterman (Van Nostrand, $17.50), airborne radar systems in aircraft and missiles.

Advances in the Astronautical Sciences, Vol. 6 (Macmillan, $22.50), the proceedings of the 6th Annual Meeting of the American Astronautical Society.

Tables of Blackbody Radiation Functions, by Mark Pivovonsky and Max R. Nagel, USAF Cambridge Research Laboratories and Harvard Computation Laboratory (Macmillan, $10), Planck radiation functions and tables and instructions for their use. For scientists and engineers.

Aircraft Engines of the World, 1961, by Paul H. Wilkinson (privately published, $15). New updated version of this valuable technical reference.

—MAJ. JAMES F. SUNDERMAN, USAF



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From the Weather Bureau in Washington, D. C., weather maps speed out in picture data form to 600 stations in 330 cities. This system serves the Weather Bureau, the Air Force, Army, Navy, Coast Guard, commercial airlines, public utilities and other nonmilitary subscribers.

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Now, for any kind of weather, the nation is better able to predict in time, prepare with certainty . . . from data transmitted in exact, error-proof, written form.

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USAF on Film

These and other selected USAF films are available for loan from the Air Force Film Library Center, 8900 S. Broadway, St. Louis 25, Mo. Requests, which are welcomed from both military and civilian groups, should contain Air Force serial numbers and correct titles to avoid delay in processing. Because of heavy demands for certain films, particularly those on missiles and space, the Film Library Center recommends that requests indicate both alternate films and showing dates.

FR 121—The Mission of SAC—SAC Film Report Number 2, 1961—Gen. Thomas S. Power, SAC Commander, discusses the SAC mission. Sequences of SAC crews, bombers, and missiles in action are included. 12½ min., black and white.

SFP 645—Missile Safety at Vandenberg AFB—A general description of Vandenberg's physical layout points out unique hazards and dangers peculiar to missile operations and explains why stringent safety procedures must be rigidly enforced. 23 min., color.

SFP 1052—Mobile Yoke—A TAC Composite Air Strike Force is deployed on a good-will and training exercise to Thailand. Briefings and support, preflight, inflight, and good-will activities in Thailand show how TAC's air strike forces are geared for immediate action against aggression at any point in the world, at the same time provide our country a powerful tool for peace. 16 min., color.

SFP 691a—Maintenance Management—Maintenance Man-hour Reporting and Control—Both parts of this film deal with the Air Force maintenance management concept in terms of greater efficiency and higher morale among personnel. 23 min., black and white.

SFP 691b—Maintenance Management—Collection and Use of Maintenance Data—Explains procedures for detailed reporting of all maintenance actions and shows how man-hour utilization and maintenance data are compiled into important weekly and monthly reports. 29 min., black and white.

TF 1-5356—Mudjacking Concrete Pavement—Covers procedures for leveling concrete slabs with hydraulic pressure, drilling, mixing special mortar, pumping mortar into cavities, and observing pressure limitations. 11 min., black and white.

AFIF 99—Old Glory—Traces the evolution of the American flag and US history from 1607 when Britain's colors flew over Jamestown, Va., to 1960 when the new fifty-star flag became a reality. 28 min., color.

TF 1-8170b—Industrial Medicine in Action—Toxic Chemical Agents—Stresses importance of studying working conditions in shops and on flight lines; emphasizes need of protecting workers from toxic chemical agents; illustrates danger of exposure to fumes, mists, acids, vapors, and gases. Points out the advantages of periodic physical examinations, protective equipment, proper ventilation. 29 min., color.—END

INDEX TO ADVERTISERS

"INTERDICT"

Silencing the Skies at Canaveral

. . . and what it means to you

Cape Canaveral, a serious r-f interference problem, and a group of experienced Capehart engineers. This was one salient phase in the operation we call "INTERDICT," for Interference Detection and Interdiction by Countermeasures Team. The exact nature and reason for this operation, and the engineering service that is now available to all r-f installations, comprise our story...

You probably already know of the r-f interference experienced at the Cape: the large number of radiating and receiving equipments there were creating undesirable field conditions. Origin of these conditions was unknown. Capehart's engineers were asked to analyze all the site's r-f sources—radars, telemetry links, communications equipment, etc.—and to predict and determine the interference sources. What they found is now history. Many of the spurious signals stemmed from higher harmonics of radar and communications systems. Once these had been defined and located, and other sources of rfi also isolated, the engineers of INTERDICT recommended ways to still the noise, so that the skies over Canaveral could be silenced.

Next: Vandenberg. After their mission at Cape Canaveral, the Capehart engineers were called to Vandenberg Air Force Base. Once again, r-f radiation was causing interference and hazard problems. Once again, the Capehart INTERDICT team went to work: performed field measurements, analyzed spurious signals for carrier frequency and source, analyzed instrumentation and all r-f equipments functioning at Vandenberg. As a result of Capehart's recommendations and countermeasures, the noise could be silenced at Vandenberg, too.

If you have site problems or r-f interference on any military or industrial communications-electronics equipments, the engineers from Operation INTERDICT are at your service. Their background in this field is unparalleled, and their experience and knowledge of all current types of equipment can now be offered to all. This is the first such service we know of, and we're proud to make it available.

Note: As you well know, interference and noise can come from a variety of sources. Spurious transmitter and receiver signals are close to inevitable in electronics installations of any complexity. Our function is to determine what is interfering with what, and to take the correct remedial action. We also perform diagnoses as to possible electromagnetic radiation hazards to personnel, squibs, ammo or fuel, and suggest the proper remedies for these hazards.

In short, Capehart's INTERDICT service is performed in compliance with all applicable MIL Specifications and systems requirements. INTERDICT, under the direction of Dr. Joseph H. Vogelman, offers you complete, world-wide, packaged services for the prediction, detection and elimination of r-f interference, personnel and material hazards. To learn more about these services contact:

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"We know what each Air Force job demands, and we go out and look for the kind of man we need to fill it." This is credo of the Air Force recruiter, and he fulfills it with the delicacy and diplomacy required of . . .

Recruiter, right, WAF he recruited in a Philadelphia radio interview.

PERSUADERS

IT WAS still dark outside when Joe Lingle's alarm clock went off. The time was 5:30 a.m. He arose quietly, shaved, dressed, and tiptoed downstairs to make his own breakfast. A half hour later, Joe loaded a motion-picture projector, films, slides, and posters into his car. He returned to the house, kissed his wife good-by, and sped off for the city 150 miles away.

Joe's first stop was an all-night diner halfway to his destination. He ordered a cup of coffee and chatted with the proprietor. "Sir, I wonder if I could ask a favor of you?" he asked.

"What kind of favor?"

"Well, I'd like to place a small poster in your window for a while," Joe answered.

"Sure, go ahead. Put it in the window the way you want it."

Smiling, Joe went to his car, selected a poster, and placed it on display. "See you next trip, sir," he called. "If you find any customers for me, my address is on the poster."

On the outskirts of the city, Joe stopped at a fire station and talked briefly with the duty crew. Again, he left a poster to be displayed on their bulletin board. Next stop was the parish house of a local church where he exchanged a few words with the minister. As he left, he waved good-by and said, "Reverend Greene, if any of your parishioners want to get in touch with me, I'm still at the courthouse on Thursdays."

At 10:30 Joe Lingle strode briskly into the office of his superior. He talked over some ideas with his boss, gave him a progress report, and caught up on office gossip. At 11:30, Joe attended a Kiwanis Club luncheon where he talked vigorously with the secretary of the local YMCA during the meal. By 3:00 o'clock he was giving a sales talk before an assembly of high-school seniors. At 7:00 p.m., he was forty miles away exchanging greetings with the program chairman of a church men's club and setting up his projectors. He was to be the principal speaker for the meeting that night.

It was 11:30 p.m., eighteen hours after that alarm clock went off, before Joe Lingle drove into his driveway. It had been a long day for Joe Lingle, longer than many. Joe is a salesman, not unlike many thousands of other men in "gray flannel suits." But there are some important differences. Joe is not a commission man; he works on a straight salary. He doesn't sell a product; he sells a career. He doesn't wear gray flannel; he wears a serge uniform in a special shade of blue. You see, Joe Lingle is TSgt. Joseph Lingle, a recruiter for the United States Air Force.

* * *

The Air Force, like most industries, is on the lookout for manpower. It needs talented, specialized, *quality* manpower to man the complex weapon and space systems of today's and tomorrow's Air Force. Getting the right kind of people to cope with the complex responsibilities of the space age is just as tall an order as producing the weapons they may have to use.

Brig. Gen. Henry G. Thorne, Jr., now Commander of the USAF Recruiting Service, summed up the

Scene in armed forces recruiting booth, Boston, USAF "persuader" getting the message across to group of interested young men.

Recruiting Service Commander Brig. Gen. H. G. Thorne, Jr., presents award to Ralph Rowe, CBS-TV, for support of AF recruiting.

Above, twin recruits Charles A. and Edward H. Schellhorn of St. Louis, Mo.

Below, recruiter talks to youth group at Baptist church in Kansas City, Mo.

IN BLUE

Lt. Col. Carroll V. Glines, USAF

job of the Air Force recruiter when he said recently, "The recruiter's job today is no soft touch, not only because of the long hours but because of the difficult challenges he faces. He must compete in the market place for the same technicians and specialists that are needed so badly by industry.

"And competing in the market place," he continued, "means that we do not go out and try to get warm bodies and then squeeze their individual capabilities into a job. It's just the reverse. We know what each Air Force job demands, and we go out and look for the kind of man we need to fill it. When we find a man with the potential, we train him and put him on the job after he has signed up. Of course, this is exactly what industry does, and since we are looking for the same men, this is why competition is so keen and our job so hard."

At the present time, the Recruiting Service maintains six Groups and forty-eight Detachments with offices strategically located all over the continental United States to perform its mission of recruiting quality men and women.

Awaiting these men and women that the Recruiting Service brings into USAF is a network of 250 major bases that the Air Force must maintain to perform its mission. This takes a force of 825,000 active-duty officers and airmen of many skills. The 19,500 bombers, fighters, and other aircraft that make up the Air Force's ninety-six-wing aerial armada need hundreds of specialists to keep them flying. Here, especially, quality manpower is vital because no longer is the crew chief the complete Jack-of-all-trades and master of his plane. He is now a supervisor of engine, fire control, electronic, radio, armament, and structural specialists who require long months and even years of training to reach their skill levels.

In addition to those, the recruiter must also provide technicians and specialists for the dawning aerospace force, which requires skills not even dreamed of a decade ago. The men of these units must have a higher education and more potential learning ability than their counterparts of yesteryear. To get these men and women requires a continuing, aggressive campaign.

There is an old axiom among Air Force officers that "if you want an impossible job done, all you have to do is tell your NCOs it's impossible, then watch it get done." Recruiting an annual force of some 100,000 superior men and women capable of performing complex tasks is one of those impossible jobs. Yet, a force of 1,300 recruiters covers the entire three million square miles of the continental forty-eight states (recruiting in Alaska and Hawaii is handled from each base there), hitting each town of any size at all at least once a month. Tapping the nation's twenty-seven million manpower pool means overtime work from a dedicated, motivated, enthusiastic group of men.

"Fortunately, we've got them," comments Col. William D. Cairnes, deputy to General Thorne. "Our average recruiter is a technical sergeant, has twelve years of military service, is a high-school graduate,

(Continued on following page)

married, and has two children—in other words, solid citizens. They are in the best motivation years—not recruits and not near retirement—and are active members of the communities in which they reside. They are all volunteers and have been thoroughly trained for their jobs at our Recruiter School at Lackland Air Force Base."

The recruiting effort is a many-sided one. Col. John E. Condron, chief of advertising and publicity for the Recruiting Service, puts it this way: "We'll use all media of communication. We use the standard devices like information films, radio transcriptions, spot announcements, and TV clips to be used as public-service announcements or programs. We take every opportunity to display posters, give out circulars, folders, and 'mail backs' to prospective enlistees, and set up static displays.

"These things are substantially routine," the Colonel continues, "although each of them requires a knowledge of advertising and imagination to make them and good timing to use them. It is the 'unusual' or 'different' where our recruiters can show their individual ingenuity and initiative to get the message to those we want to reach.

"Take the case of TSgt. Harold LaMarche, who is assigned to our Boston office. He's a ham radio operator who operates a rig in the Greater New Bedford, Mass., area. While broadcasting, he is asked many questions about the Air Force by fellow hams many miles away. Although he is aware that many radio operators are not Air Force prospects themselves, he has acquired a number of enlistees indirectly because his unseen buddies have sold the advantages of a military career to friends and relatives for him.

"Or take MSgt. Roy H. Pfingsten, operating from our Sioux City, Iowa, office and SSgt. Harry A. Harper of our Frederick, Md., sector. They approached the presidents of local bakeries and persuaded them to use bread end labels with an Air Force recruiting slogan. Millions of these labels were used to remind the public that we are looking for good people.

"Another advertising idea along the same line," Colonel Condron added, "came from Sgt. James H. Wyland of Chambersburg, Pa., who persuaded a local dairy to print a recruiting message on milk cartons about the need for Air Force nurses, dieticians, and therapists. All three of these recruiters reported an increase in the number of enlistments in their areas during the times these ads were used."

The recruiting business has changed in the past few years—in line with USAF's changing personnel needs.

The basic difference is that several years ago, the Air Force looked primarily for lads who qualified physically. When they passed this hurdle, they were given aptitude tests. However, this style of recruiting resulted in the enlistment of many who were not trainable and who had to be weeded out of the Air Force later. After basic training, for some technical training would follow. Recruits were assigned to schools where there were vacancies and not necessarily where their aptitude tests indicated they should go. This procedure sometimes led to poor assignments. In these cases it left much to be desired on the part of both the Air Force and the recruit.

Today, the Air Force is no longer in the "warm-body" business. Requirements for specific career areas are known and forecast in advance. The quotas go out to the recruiters, who look for individuals to fill those requirements. The first step today is to administer screening and aptitude tests to prospective volunteers right in their local communities. Those whose test results indicate they are qualified to join, and who have an aptitude for which the Air Force has a stated requirement, are counseled and advised of opportunities available to them. Those who react favorably are then given mental and physical examinations. The relatively few who pass are then officially sworn in.

"We believe this shift of personnel procurement policy has done a great deal for the Air Force in recent years," comments General Thorne. "We have happier recruits now who are more aware of what the future can hold for them. This makes the whole Air Force more efficient—AWOL rates are lowered, guardhouses are emptied, and a unit commander generally gets better replacements for his vacancies than he got before."

A look at the Air Force being manned by recruits coming in under the new highly selective system reveals some interesting changes in the nature of things. Gone are the days of the perpetual KP private and the guaranteed thirty years for mere performance of minor tasks. Today, hundreds of prospective enlistees are turned away from recruiting offices because they can't measure up to the raised standards. Today's recruit has a higher level of education than ever before. Seventy-three percent of all young men entering the Air Force have high-school diplomas. Five years ago, only forty-nine percent were high-school graduates.

Today's airmen are actually healthier, too. Noneffectiveness for medical reasons has been lowered to less than one percent. Not only the Air Force but the taxpayer has gained through this selective recruiting because reenlistment rates are up, and money that might have been spent for training replacements can be used elsewhere.

The "persuaders," the individual recruiters who play such an important role for the Air Force, are carefully chosen. They must not only be good salesmen, but they must themselves be public-relations men, administrators, compelling public speakers, accomplished psychologists. They don't get that way overnight, but each volunteer salesman is given a good start at the Recruiting School. He receives eight weeks of intensive training in sales techniques, public speaking, community relations, fundamentals of radio and television, news photography, advertising, public-information techniques, and planning of special events. Field trips are made to various Air Training Command facilities to give the recruiter a close-up picture of what happens to recruits after they are sworn in.

In spite of the long hours and extensive traveling, many recruiters

(Continued on page 141)

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If you would like more information about any or all of them, please fill in the coupon below. We will send you complete details by return mail. We also welcome and encourage comments and suggestions from our members about these policies.

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____

feel their four-year tour is the most exciting and worthwhile of their service careers. The speeches and appearances, the traveling, and the wide variety of human contacts are extremely stimulating to most of USAF's recruiters.

One veteran recruiter, SMSgt. Charles R. Linderman, formerly an instructor at the Recruiting School and now assigned to the Recruiting Service's headquarters at Wright-Patterson AFB, Ohio, offers this tongue-in-cheek observation.

"The recruiter must be all things to all men. He must be able to walk at least eight hours through rain and snow without losing the razor-edge crease in his uniform or the mirror shine on his shoes. He must be able to work in hot and dusty chairborne positions without perspiring or losing his sparkle. He must love children, cats, dogs, horses, flowers, idle chatter, and classical music. He must be an expert driver, diplomat, scrounger, financier, elocutionist, and fingerprinter. He must have a working knowledge of biology, psychology, criminology, geography, aeronautics, astronautics, military strategy, atomic energy, and engineering."

General Thorne, in another vein, concludes: "Today, the miraculous black boxes we put in our equipment are fast replacing many human activities. The Air Force is becoming automated, but still the human element is necessary. As the equipment and its use become more important and complex, the need for higher-quality manpower increases in direct ratio. Quality manpower is our paramount need, not simply black boxes. We hope, and trust, that we are meeting the need."—END

Colonel Glines, whose byline will be familiar to readers, is coauthor of Grand Old Lady, *recent book on the Douglas DC-3. Currently Chief, Planning Team, Monitoring System Group, Directorate of Operational Requirements, Hq. USAF, his last contribution to these pages was "Getting the Message Through," in the March issue.*

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The Air Force Association is an independent, nonprofit airpower organization with no personal, political, or commercial axes to grind; established January 26, 1946; incorporated February 4, 1946.

Objectives

• To assist in obtaining and maintaining adequate airpower for national security and world peace. • To keep the AFA members and the public abreast of developments in the field of aviation. • To preserve and foster the spirit of fellowship among former and present personnel of the United States Air Force.

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