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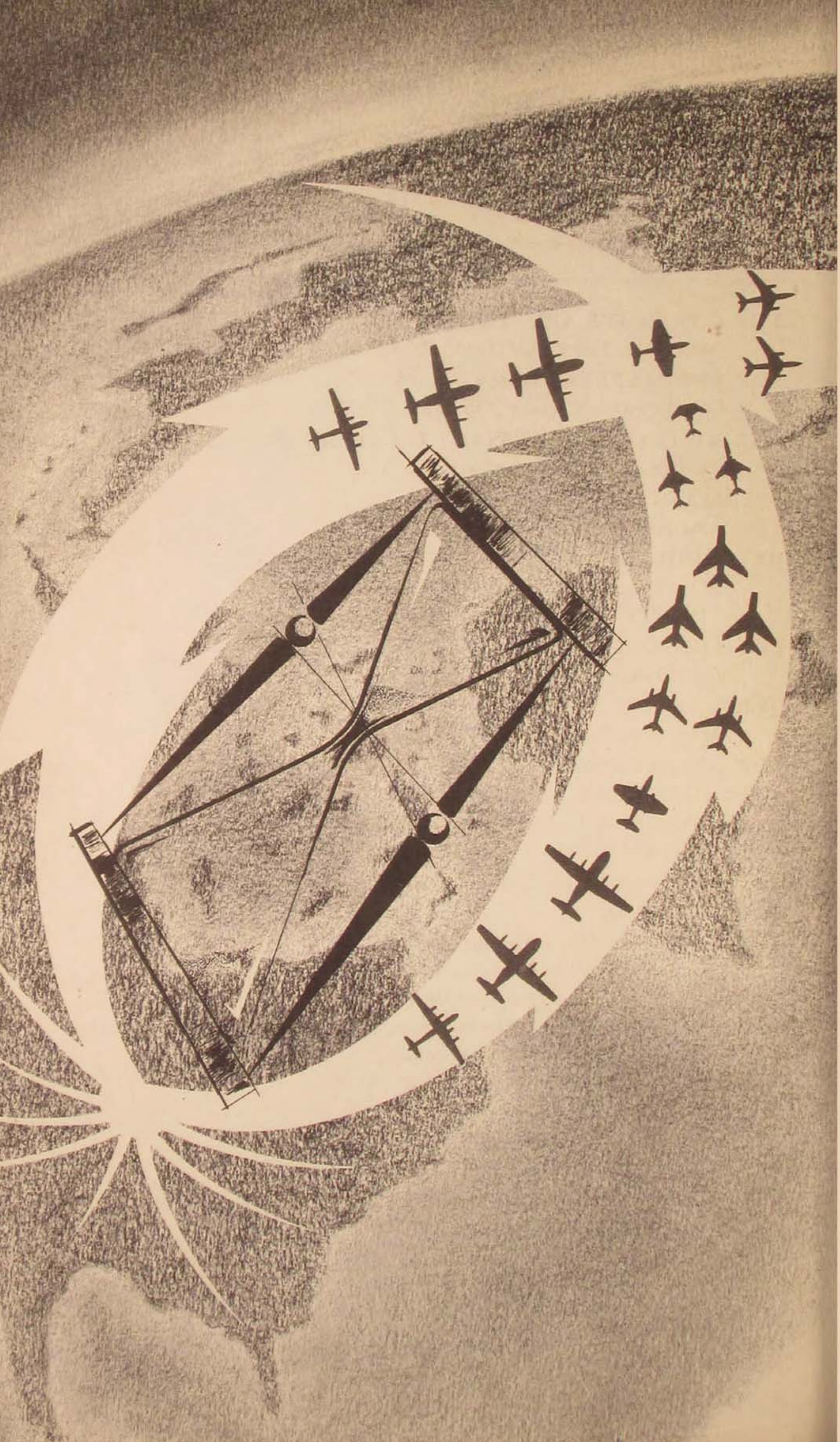

The Composite Air Strike Force 1958

Major General Henry Viccellio

ICARUS had a new concept, which he fondly developed, followed up with operational and logistics planning and, we assume, with training. But he neglected one small yet vital detail, and on the great day . . . his wings fell off.

In the early days of this decade Tactical Air Command developed a new concept: the rapid deployment of tactical air forces to any theater in the world to deter or to fight small or "limited" wars. The concept was followed up by creation of Nineteenth Air Force and the Composite Air Strike Force (CASF) in 1955. Planning for and training of the CASF was continuous for three years. Finally, on 15 July 1958, CASF Bravo was ordered to deploy to eastern Europe in response to the tense Middle East situation. On 29 August another CASF, Xray Tango, was deployed to the Far East during the Quemoy crisis. Like the Greek aeronaut Icarus, we had the concept, the training, and the faith in our planning. Here the parallel ends. No vital detail had been overlooked. Everything worked.

The concept of a Composite Air Strike Force was born of necessity. During the period following World War II, when the United States enjoyed sole possession of nuclear weapons and the means of delivery, the Union of Soviet Socialist Republics was thwarted in its policy of global expansion by the deterrent force inherent in the Strategic Air Command. Communist tactics were necessarily limited to infiltration and subversion of governments oriented toward the West and, militarily, to attempts to overthrow democratic governments through internal revolution. The pot was kept boiling, but the Kremlin took pains to see that the lid didn't blow off.

With the development of a nuclear striking capability by the Soviets, the situation was considerably altered. It was more important than ever that SAC be kept poised to react to a Soviet nuclear attack on the United States. The U.S.S.R., realizing that the United States would now be more reluctant to use any portion of SAC for other purposes, was then in a better position to permit her satellites and Communist groups in other countries to initiate armed conflict at times and in areas of her choosing and with her support. During this same period, economically and politically unstable areas throughout the world were reacting to various pressures which threatened to erupt into hostilities. As a counter to these threats to the peace, the USAF directed Tactical Air Command to develop a force capable of deploying rapidly to any area of the world where outbreak of limited war was imminent. This force would free SAC and the theater air forces from the necessity of opening gaps in their general war posture in the event of minor conflicts.

In carrying out this mission, Tactical Air Command activated Headquarters Nineteenth Air Force, whose sole responsibility is the planning for deployment and employment of the Composite Air Strike Force. Nineteenth Air Force has no assigned units and assumes operational control of the CASF only during maneuvers, exercises, and limited-war deployments. At the same time

CASF Bravo

Operations conducted by CASF Bravo were based at Incirlik Air Base, Adana, Turkey. (1) Nineteenth Air Force command element and weather detachment personnel direct activities from the Air Operations Center. All equipment shown, including the shelter, was airlifted from the ZI. (2) At the sound of the alarm to scramble, F-100 pilots run to get their planes airborne. (3) Air reconnaissance crewmen carry an aerial camera to be loaded on their RB-66. (4) Combat readiness of three B-57's is ensured by the close proximity of aircrew tent quarters and bomb dump. (5) In 114° heat a solitary figure guards two rows of F-100's parked on the ramp at Incirlik Air Base.

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with an assist by Military Air Transport Service when necessary. Quick turn-around is provided at destination to permit strikes, either nonnuclear or nuclear, almost immediately. With some CASF units maintaining a rapid-reaction alert posture and a number of tanker aircraft prepositioned en route, we can expect to launch strikes from operating bases 5000 miles from home less than twenty-four hours after initial deployment alert. Of course problem areas still exist, and some, like the poor, will probably always be with us. But the two CASF deployments of 1958 validated the concept of the CASF as a stabilizing influence in trouble areas and a deterrent force against minor war, and they demonstrated that the CASF planning was sound.

CASF Bravo, July–October 1958

The first test of the CASF came in July 1958 in response to the tense situation generated by the Middle East crisis, which was caused by political instability in Lebanon and Jordan and the simultaneous revolt in Iraq.

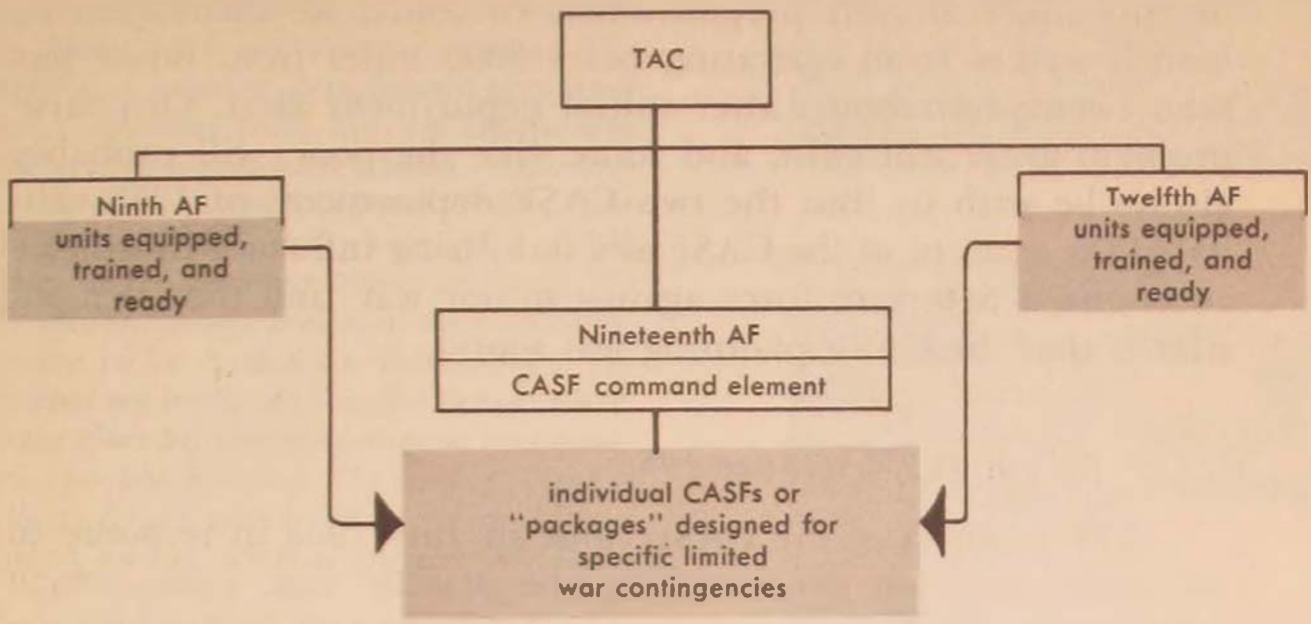
At 1500 GMT on 15 July 1958, in compliance with an order from the Joint Chiefs of Staff, Tactical Air Command ordered the deployment of CASF Bravo to Incirlik Air Base near Adana, Turkey. The force consisted of a command element and squadrons of F-100Ds and B-57's and KB-50J tanker support. Reconnaissance aircraft included RF-101's, RB-66's, and WB-66's. C-130's and a communications-AC&W package completed this force. In addition to the TAC units, United States Air Forces Europe provided F-86Ds and air rescue support aircraft to the CASF.

The command element composed of Nineteenth Air Force personnel departed Foster Air Force Base, Texas, on 15 July and arrived at Incirlik Air Base on 17 July, forty hours after alert was ordered.

The tactical aircraft deployed over preplanned routes, utilizing air refueling from TAC KB-50Js. The entire support elements, both personnel and equipment, were transported over preplanned routes by the CASF C-130 troop-carrier squadrons. The major portion of the force was in place and operational forty-five hours after the first alert was received.

There were no serious problems during the deployment phase of CASF Bravo. Most of the problems that did exist were caused by the lack of advance warning. Whereas the CASF is now on a "no warning" type of alert and planning is geared to this posture,

The Tactical Air Command Composite Air Strike Force



selected units were assigned to CASF from which various "packages," tailored for individual contingencies, might be drawn. These units, all combat-ready, are assigned to and trained by Ninth and Twelfth Air Forces until released to Nineteenth Air Force when required.

TAC organization for limited war

In the three years following the inception of the CASF, the main emphasis was on operational and logistic planning and the testing of CASF concepts and capabilities. As capabilities increased with the delivery of improved aircraft types and equipment, the concept was reshaped to its present form.

At present the CASF is a self-sustained force composed of tactical fighters, day, night, electronic-countermeasures, and weather-reconnaissance aircraft, KB-50J tankers, and C-130 and C-123 transports. In addition to the tactical squadrons and their support personnel and equipment, we have communications and aircraft control and warning (AC&W) packages designed to provide the CASF with internal communications and ground-controlled interception and aircraft recovery capability. Deployments are air refueled nonstop from staging bases to destination when possible, utilizing TAC KB-50Js. TAC C-130's provide the airlift at the time of the Bravo deployment the concept envisaged a certain minimum interval of alert during which preliminary actions could be taken. Since this time was not available, all actions had to be taken simultaneously. Troop-carrier movement was somewhat slower than planned and made it difficult for the Deployment Control Center to maintain tight control of troop-carrier movement. They did not impede the flow of tactical aircraft. The success of the deployment validated the quick reaction concept that was then being developed and provided the experience necessary to avoid many problems in the future.

The fact that the CASF is now geared to a "no warning" alert posture does not make advance warning any less desirable. Although the "no warning" posture permits deployment of a certain number of squadrons in a certain interval of time, advance warning will permit TAC to take actions that will increase the flow of aircraft once the decision to deploy is made. During the Middle East situation some Army, Navy, and Air Force units were in fact being moved before the CASF was alerted. This points out the need for a standard, joint alerting system that will filter the alert to all interested defense agencies. Steps are now being taken in that direction.

The arrival of tactical elements of the force in advance of the command element was another undesirable feature of the Bravo deployment. If advance warning is received, this situation will not occur. The command element can deploy to an en route base, await further instructions, and then continue to the employment area with the main force. If no advance warning is possible, this situation can be remedied by using more advanced aircraft types now in the USAF inventory.

Bravo employment. Now that the deployment has been discussed, let us turn to the employment of CASF Bravo. Upon arrival at Incirlik Air Base, Turkey, the CASF came under the operational control of Commander in Chief, Specified Command, Middle East (CINCSPECOMME). Under the joint control of CINCSPECOMME were the air, naval, and land components. Nineteenth Air Force, in addition to providing the CASF command element, was also designated as the Air Component Command (COMAMAIRFOR). Naval forces were drawn from the Sixth Fleet and commanded by COMAMNAVFOR. The Marine and Army forces were integrated under COMAMLANFOR.

During the first few days of the employment phase the facilities at Incirlik were hard pressed to sustain the load. In addition to the CASF and elements of Naval air, there were Army troops standing by to be airlanded or air-dropped in Lebanon. Living conditions were far from ideal and everything in the way of Air Base Group support was in short supply, even including water. The rough living and working conditions hampered but did not delay operations.

Employment operations consisted principally of mass fly-bys over Lebanon, sometimes in concert with Naval air from the Sixth Fleet; leaflet drops with C-130's; airlift of Army troops to Lebanon; photo, visual, and weather reconnaissance; and air defense readiness. Since the U.S. was not engaged in a shooting war, the greatest operational requirement was for photo and visual reconnaissance. Most of this was flown at the request of the Army.

Air defense alert was maintained twenty-four hours a day with F-86Ds and F-100's. One occasional problem was the necessity to scramble and identify commercial air carriers that had strayed from scheduled times and tracks. We had excellent cross-tell ties with COMAMNAVFOR (the Sixth Fleet disposed generally west-southwest of Lebanon), with the Royal Air Force on Cyprus, and with the Turkish Air Force. We had difficulties working with the Turkish air defense system, mostly because of language differences.

Areas of Responsibility

Initially all B-57's and F-100's were kept on offensive alert with full armament loads. As the political situation began to ease, we were able to reduce the strength on active alert and devote sorties to training, development of new tactics, and the like. Training consisted primarily of air-refueling plus rocketry and bombing sorties on Turkish ranges.

We had personnel and equipment available to establish an Air Support Operations Center, but we found this unnecessary. Our air support missions devolved into direct COMAMLANFOR-to-COMAMAIRFOR requests, which were filtered by the CINCSPECOMME operations center.

After 100 days in the operation, CASF Bravo redeployed on 19–23 October. All aircraft were withdrawn from Turkey on one day, the nineteenth, and cleared the theater area by the twentieth.

Several problems were encountered during the employment phase, none of which proved particularly alarming at the time, but which could have had some serious consequences if the CASF had been required to conduct maximum combat sortie rates upon its arrival.

For example, there was the lack of accepted interservice procedures for the conduct of joint support operations. While these were subsequently developed by the component staffs on the scene, there was a period during the initial phase of the operation when air support operations would have been hampered to some degree by lack of accepted joint standard procedures. The solution to this vexing problem is obvious, though difficult. Over the years the Army and Air Force have been developing air support doctrine, tactics, and procedures. These are still far from complete agreement in all details. It now is apparent, at least in the sphere of limited war, that the Navy and Marine Corps must be included in future development of such joint agreements.

In the materiel area we encountered the usual difficulties that occur away from home bases. At the time of deployment our flyaway kits of aircraft spares were incomplete. Transportation was the most critical element in resupply, since we were operating beyond the end of most regularly scheduled military or commercial routes. We often had airplanes grounded for parts that were awaiting last-leg transportation. Our amended plans now include provisions for this critical short-haul transportation. We were occasionally disappointed when returned requisitions instructed us to local-purchase items, such as photo chemicals, "unavailable" in the United States, which were just as unavailable in the Adana market place. Field maintenance support was established at USAFE bases, as Incirlik's base maintenance capability had not yet been developed. Generally our maintenance was paced by "G.I. ingenuity" and spirit, which combined to support the programed sorties at an amazingly low abort rate.

Intelligence personnel, who often work on the sidelines at home, found themselves surrounded by a heavy workload that demanded much of them. Our supply of large-scale ground support maps was inadequate at first and caused some concern for a while. The flow of intelligence was sporadic and indicated an area of detailed attention for the future.

Possibly the most basic of all items, unit administration, proved to be a problem. We found that a few individuals had failed to make any provision for allotments or other means of family support, and their cash over the pay table in Turkey was of no value to the families in the States. We discovered the need for more full-time administrators at every echelon, especially in the command element.

CASF Xray Tango, August–December 1958

While CASF Bravo was involved in the Lebanese operation, the Chinese Communists elected to threaten the Taiwan Strait holdings of Nationalist China. The Tactical Air Command began reviewing its plans for limited war in the Far East. As in the case of other world hot spots, we had some specific plans ready. It was interesting to note the development of two "pressure" situations simultaneously, a possibility we had considered very likely. In the absence of Nineteenth Air Force, the Twelfth Air Force alternate command element received its initial warning alert on 9 August. On 29 August the deployment order was given and CASF Xray Tango was dispatched. MATS provided the bulk of the airlift for Xray Tango as well as for Air Defense Command F-104's that went to Taiwan.

In addition to the command element, Xray Tango consisted of F-100, F-101, B-57, C-130, RF-101 squadrons, tanker support, communications and control elements, plus usual support. That exercise, which had been TAC's first large-scale CASF demonstration in the Far East, proved its worth at this time, our lessons having served to eliminate many bottlenecks.

Again, there were no serious difficulties in this deployment. The long distances of Pacific hops, headwinds, typhoons, and the scarcity of weather reporting points do complicate deployments somewhat, and the over-all deployment time is naturally greater than that required across the Atlantic. Generally elements of the force were released in staggered segments and required two or three days from home bases to final employment areas. As planners, we were especially gratified with the smooth adherence to our pre-computed deployment schemes and again disappointed with the saturation of communications that our reporting procedures caused. This saturation will be minimized by new procedures.

Xray Tango employment. Upon arrival in the theater, Xray Tango was emplaced at various bases in the Philippines, Taiwan, Okinawa, and Japan. The geography of the area and the theater force dispositions seemed to make this split-up necessary and resulted in a different role being assigned the CASF command element than was the case with the Bravo force. The Commander of Xray Tango ran the United States–Taiwan Joint Operations Center, an agency of the United States Forces Taiwan. Other portions of the CASF command element assumed roles at various employment headquarters in the area, generally being integrated into existing command structures and directing operations of the segments of the CASF. Our troop-carrier force was integrated into the theater air logistic organization.

While partitioning of CASF Xray Tango appeared desirable in this particular situation, such a scheme bears close examination for future use. In addition to the traditional desire of the commander and the individual for unit identification and integrity, I think the validity of a *complete* CASF package is obvious. All our training, doctrine, and plans are slanted toward the complementary interrelationships of CASF units in a complete entity. Below the command element our combat reporting and combat control procedures are designed for our use; field maintenance functions and supply procedures are built around economy through consolidation; unit administration, discipline, and funding are based on centralized control.

Operational missions during the employment period ran the gamut from semioperational to pure training, depending on location and the situation of the moment. Fighter units generally were charged with air defense alerts and were armed with Sidewinders. For offensive readiness they had various weapons available. Reconnaissance sorties were varied and often produced interesting examples of Allied cooperation. On some sorties, prints were produced by Nationalist Chinese technicians who sent their product through Chinese channels to both Chinese Air Force and USAF addressees. The tactical bombardment boys sharpened their all-weather bombing skills and maintained aircraft on offensive alert, while the tanker crews stayed ready for various eventualities.

The TAC radars and communications elements were integrated into existing systems in the theater. Our Control and Reporting Center (CRC) on Taiwan was used for forward-telling in the CHINAT defense net and actually had some Chinese plotters who performed a valuable service as cross-tellers. Training conducted by Xray Tango was similar to that in Turkey—bombing and gunnery, air refueling, navigation, plus orientation missions in the Taiwan area.

The redeployment of CASF Xray Tango was ordered on 10 December and completed by 18 December. Again no special problems developed. Everyone found this an excellent opportunity for further practice and refinement of control procedures.

A major employment problem again was the command and control communications between the control headquarters and the scattered elements of the force. The Air Force must give utmost emphasis to the establishment of secure communications capabilities, fixed and reliable, in the probable contingency areas.

Other problems during the employment period were along anticipated lines and similar to those of Bravo. The splitting of CASF Xray Tango, previously discussed, is a matter for resolution. We expect some more definite preplanning in this area. Actual operational problems were relatively few and can be ignored in this discussion. In the materiel area there were some frustrating but not crippling problems involving tanker drogues and first-rate external drop tanks. The CASF commander was warm in his praise of maintenance personnel, who, as in Bravo, supported a higher-than-normal in-commission rate throughout the period.

In this operation a problem of resupply transportation also developed. A backlog of cargo built up in California awaiting MATS transportation. This jam-up was finally resolved by using commercial air carriers under contract to MATS and by diverting some priority cargo to water shipment. The latter solution was not, of course, satisfactory under the emergency conditions prevailing. To prevent recurrence MATS has been given greatly increased authority to hire commerical air carriers in the early stages of cargo jams.

Recognition for CASF Xray Tango came when TAC was awarded the Mackay Trophy for the professional standards and skills displayed by pilots and ground crews in twice traversing the vast Pacific with such gratifying results.

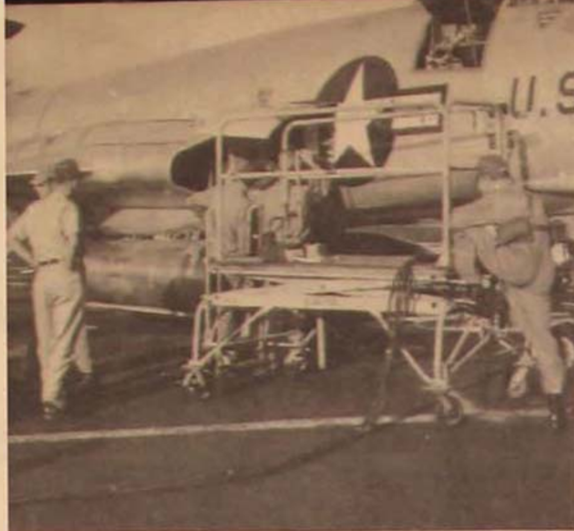
appraisal

In this account, I have omitted mention of many problem areas in the two operational employments of CASF. As all readers must imagine, we have had our headaches in the development of this concept and in its actual implementation. In the large view, however, our problems have generally been anticipated, and we are expecting continued progress toward our goals.

As one of our axioms we have adopted the proposition that limited wars or actions are becoming far more likely for the future. CASF's first characteristic is the conviction that quick reaction, readiness to fight, is our strongest trump. Who can dispute that a nuclear-armed CASF to Korea in June 1950 might have prevented three years of bloody fighting? In 1958 the willingness and determination of our nation to commit American forces—CASF—to Lebanon and Taiwan helped immeasurably to halt these flare-ups before world-wide nuclear exchange became a possible result. It seems almost inane to state that a major objective of these limited actions is to keep them limited, but because this is so basic we regard adequate warning and quick reaction as indispensable. Further, we think that a certain amount of publicity is desirable for limited-war deployments. During the early stages of the Taiwan reaction, as well as in the Lebanese operation, greater effect could have been achieved by the publication of more information. Limited wars have a psychological overtone, and announced movements can have a desirable reaction.

A logical extension of the first characteristic develops the second characteristic of a CASF—its self-contained versatility. Having arrived on the scene after a rapid deployment, the CASF is in a position to halt the proceedings by a mere show of force that expresses our insistence on peace. Failing this, the CASF must be able to operate at any level of the modern weapons spectrum. In supporting operations the ability to perform effective tactical reconnaissance is priceless, as is the ability to airlift troops, and so on down the line. Versatility is to us far more than a glittering generality—it enables us to produce the exact degree of force at the right place at the right time.

The very obvious location of potential hot spots develops a third CASF characteristic. The CASF is complementary to other



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CASF Xray Tango

CASF Xray Tango units were deployed to the Far East via Pacific routes during the Quemoy crisis in 1958. (1) Maintenance men check a McDonnell F-101 Voodoo aircraft during a stopover in Hawaii. (2) A CASF pilot raises the canopy of his B-57 tactical bomber after landing. (3) In the early dawn a crew chief completes work on his F-101. (4) A postflight check of an F-101 on the flight line is started by the crew chief before the pilot has time to leave the cockpit.

American forces. When the Soviets increase their pressure on remote hot spots, we must intensify our counterpressure with SAC, with far-ranging carrier forces and submarines, and with the permanent forces in Europe and the Far East. With CASFs in both the Middle East and the Far East last year, our other forces world-wide were poised for instant full-scale operations, and the other side knew it. This pressure by our big stick is one other means of keeping things limited.

Participation in joint forces, a fourth characteristic, is obvious from our experience and from hot-spot geography. I think that even some of our CASF people were surprised to be operating with land and sea units last year, but it must now be apparent to all that unilateral action by any one component will be very infrequent. The refining of our cooperation procedures with Army, Navy, and Marine units is an obvious need that we have recommended. A corollary need is that we must be able to operate with indigenous forces anywhere, in spite of language and procedural differences. In the Taiwan operation several instances of success in this respect were attained; in the Lebanon-Turkey area, the working contacts we had with our opposite numbers produced similar satisfactory results.

One of our greatest hopes is that evolution of the CASF will further modernize our forces. The first need is simplification and miniaturization of equipment to allow us to reduce our airlift requirements. One of our main claims to the limited-war mission is *mobility*. We find now that our airlift requirement is not excessive; but it is obvious that certain bulky items, such as complete radars, MA-2 servicing units, and the like, can be replaced by more mobile substitutes. The advance preparation of suitable operating facilities will further increase our mobility.

Our weapon systems, as good as they are, can stand improvement. Our long-range objective is a multipurpose aircraft or family of aircraft, with ferry range sufficient to eliminate the need for air refueling. Until that time we need a truly modern tanker to replace the jet-augmented KB-50. We are looking forward to vertical take-off and landing or short take-off and landing aircraft and to armament racks and pylons that are truly universal. At this time we use four different types of F-100 pylons to enable us to achieve the versatility spectrum mentioned before. Payload increases for the C-130 are desirable on a few critical deployment legs. We expect the F-105D to improve our all-weather capability.

Our radar equipment must have a considerably longer detection and control range to give us increased capability. It must be reduced in weight and size to optimize its use. We are looking forward to increased radar range in airborne facilities to give initial positive control and fill gaps in forward operation areas.

The reliability and security of our command and control communications must be improved. We must take advantage of advanced propagation techniques such as tropo and meteoric scatter. Maximum miniaturization of all components and power sources is needed to retain tactical flexibility. Digital data transmission should be applied to reduce the amount of manual operation.

Perhaps more than anything else, we in TAC are anxious to establish the proper emphasis on limited war versus general war. While our equipment and our missions are compatible with either circumstance, the *acceptance* of both possibilities we believe will lead to a full appreciation of our military and political environment. We want to see these facts accepted throughout the military establishment and by the American public. This general realization at all levels of national activity will allow us to develop very firm employment plans, with preconceived courses of action—what to do, when we must react to the ambiguous challenge offered by "local" situations, and under what conditions we will or will not use our various weapons.

THE airman's claim for the effectiveness and mobility of air power is substantiated by the CASF. The inherent versatility of tactical air power, often overlooked or downgraded, has been displayed. The TAC arsenal—from iron bombs through nuclear weapons, its reconnaissance, troop-carrier and logistic support aircraft, tankers, and self-contained communications and radar units —has again proved its worth.

Participation in the first joint command specifically for "modern" limited war—Specified Command, Middle East—was extremely inspiring and points the way to the future. The ability to react to two or more limited-war situations simultaneously has proved to be a necessity.

Our dealings with Chinese, Turks, and British in various phases of these operations demonstrate the professional satisfaction and the effective results of our alliances and our foreign aid programs.

We in TAC are justifiably proud of the CASF record and the giant strides of the command during recent years. That the CASF concept is sound cannot be questioned.

Headquarters Nineteenth Air Force

The Enigmatic Camera

Colonel Edward N. Hall

TOWARD the end of World War II two young officers informed high authorities that they had located a marvelous camera in Germany which simply could not take bad photos, even under the worst conditions and in the hands of a rank amateur. It was called the "enigmatic camera" and was available for inspection. The reaction from headquarters was prompt. Obviously some mistake had been made or someone's enthusiasm was leading him astray. There must be limits to the operating ranges of the device. Did not its effectiveness drop at low light intensity?—at short range?—under high vibration and shock? All these queries were answered negatively by our two heroes. After a further exchange of detailed correspondence, headquarters sent a "qualified team" to inspect the wondrous device. The team was shown a small, solid, black iron cube on which was stamped, "Enigmatic Camera."

The camera sounded good. All the information transmitted to headquarters concerning it by our two amateur friends was correct. But they were amateurs. They would not have known a good camera had they fallen on it.

The military might of the United States today poses an enigma somewhat similar to that of the camera. At the close of World War II the United States was incontestably the most powerful nation on earth. Today, within fifteen years, in spite of comforting statements from various quarters, there is a feeling of military insecurity afoot. How has this come about? What is its significance? Should something be done about it? What?

Because of the intimate relationship today between military development and civilian industry, it is not possible to fully consider the factors involved and keep the consideration totally within the military sphere. The U.S. has at its disposition a truly magnificent industrial machine whose output is the highest in history. The consequences of this phenomenon, however, are not always obvious. The widespread attainment of extremely high efficiencies in technical development, production, agriculture, and distribution has tended to remove key efforts in the competition for industrial survival into other areas. Advertising, sales, market surveillance, etc., have become highly important. The very efficiency of the nation's production and distribution machine has not merely permitted but has encouraged diversion of a significant proportion of its manpower into lines of endeavor that are not directly productive. In turn, the application of these new, subtle, psychological tools has called into being extraordinary management configurations.

It is important to recognize that concentration of effort into these indirect channels is rarely profitable until the state of the art in question is well established and development, production, and distribution techniques have become highly efficient. Moreover these tools must always be applied with caution, since determination of their usefulness is frequently not simple. Fortunately in civilian industry there exists a simple, universally applicable criterion of merit, by means of which the effectiveness of a tool can usually be gauged. That criterion is profit. The pattern of our civilian industry thus has become quite complex, and many heavily supported functions that are only indirectly related to supply of needs have become firmly established. The sole discipline preventing the transformation of these useful knobs into raging cancers has been the necessity to achieve a profit or die.

It is immediately apparent that this simple discipline does not and cannot extend to military research, development, and production. Many persons of exalted station have publicly demanded that the military be run in a businesslike fashion. While this would be admirable to some extent, it is evident that application of the profit-seeking criterion to military operations would necessarily lead to cessation of all military activity. Military activity

About the only things that are keeping pace with military technology today are the rise in unit cost of new weapons and the percentage of the nation's total firepower that is being built into each unit. All these factors—the pace of technology, high cost of items produced, and concentration of firepower in fewer operating elements—place a tremendous premium on wisdom and dispatch in the conduct of military research and development. Colonel Edward N. Hall, currently engaged in technical activity associated with the IRBM in Europe, contends that the nation is dissipating precious time and talents because of the way research and development programs are organized and because of the manner of making essential decisions and judgments. The military scientist, says Colonel Hall, is seldom assigned in a position where he can offer more than peripheral advice.

is never directly profitable, and the less of it the smaller the loss.

It is believed that the enigma of the status of the defense of the United States is closely wrapped up in the relations between military research and development and civilian industry, in the complex managerial structure of civilian industry, and in the lack of profit-motivated disciplines on the part of the military. The wrappings have been so effective, moreover, that the loudest participants in the national debate on this subject have ignored these factors and concentrated upon magnitude of budgets. To many minds the problem has been reduced to a mere determination of the appropriate number of dollars to be spent. This must be regarded as misleading and downright dangerous. The dollars expended for national defense can be equated to men times hours times efficiency. In the competitive and highly developed civilian industry of the United States, such dollars are frequently channeled into activities remote from direct production, but efficiency is ensured by the necessity to earn a profit. What ensures that military expenditures will be handled equally efficiently or even reasonably efficiently? The failure to appreciate and face this problem directly must be regarded as one of the greatest threats confronting the nation. To summarize the situation:

The sophisticated pattern of U.S. industry has inevitably led to incorporation of a large group of people in management structure who are only remotely related to productive effort. The size and status of this group in civilian industry have been regulated by competitive profit-seeking. The close relationship of civilian industry to military development has inspired the creation of similar structures within military R&D. No such management discipline as profit exists in the military, and so there is a possibility that extensive uninhibited employment of marginal promotional and sales techniques can reduce U.S. military R&D efficiency to a very low figure. If this condition prevailed in other nations, it might be of little consequence. It does not. No other nation's industrial machine has yet developed to a productivity level where such activities can be supported profitably. As a consequence we in the United States face the very real threat that during the next few critical years, as the U.S.S.R. and western Europe rapidly build up their military potentials, we may fall far behind in spite of the expenditure of huge sums of dollars.

The modern sales-promoter type of executive, in which the nation abounds, is accustomed to manipulating a heavily staff type organization as contrasted with the line or line-and-staff kind.

In typical civilian industry he has a right to expect that his chief engineer and chiefs of development, production, design, and other technical departments will all be expert in their respective fields, and he acts accordingly. A new model of automobile, television set, washing machine, or what-have-you, destined to keep his company in a competitive position, is preceded by a balanced amount of imaginative intuition by top people, analytical confirmation by a lower level, and extensive empirical test and rework by a massive group constituting the major element of the firm's engineering organization. It is this balance, varying from field to field, that is important. Only through the existence of such highly competent, balanced groups, established along lines traditionally developed, can a promotional type of executive operate effectively. And what are the consequences of unbalance in such a company? If the sales element is supreme, we may assume that supporting funds will be forthcoming from the board of directors for the project specified and that the public will be prepared adequately as reflected in healthy demand for the product at the time scheduled for its debut. At this point deficient intuitive engineering vision will lead either to rapid obsolescence, if the new device is too mundane as compared to a competitor's superior product, or to unacceptably poor reliability, leading to public antipathy and eventual bankruptcy, if the reverse is true.

And what about the balance between intuitive vision and analysis? Good analysts, in common with all good craftsmen, like to do a job thoroughly. And what is the job? In many instances, unless inhibited by self-assured management, the job no longer is merely to confirm or reject the validity of the products of the imaginative vision of the gifted thinker but rather is to indulge in a game called "optimization." The larger the analytical staff, the more thorough and complete is the "optimization." The word "optimum" seems straightforward and is defined as the best or most favored degree. To optimize, then, presumably means to render best. But this is not a simple concept. Best in terms of cost, shape, or function is frequently not best with relation to time. Our promoter executive's staff engineer may intuitively mate feasibility and cost with performance for a selected time scale and produce a functionally and esthetically mediocre device far superior to anything else available at that time. A large analysis staff might find such a design far from "optimized," insist on more study prior to fabrication and test work, and eventually lead the firm to produce a delight to the eye and a joy to the heart, ten years after the commodity in question had been rendered completely obsolete by new developments. The most nearly "optimized" surrey today would not enjoy a favorable sales position relative to a poor automobile. Carrying this logic further, it becomes evident that a "most nearly optimized" device based upon physical properties alone is *never* what is sought. Man is an imperfect beast and therefore he can indulge in active "optimization" for years on even the simplest gadget. Such activities inevitably result in production of obsolete equipment. Although the course of an actual typical major military development program is so cluttered with detail as to obscure this aspect, an excellent simple fable exists that clearly demonstrates the point.

Three men, "A," "C," and "D," were suddenly constrained to hasten by car from Los Angeles to Chicago. "A" stepped into his car, pushed the starter, and was off. He was extremely uncomfortable crossing the desert at 2 P.M. because he had not planned his itinerary carefully. He ran out of gas on a back road in Colorado and lost five hours hitchhiking to a service station. He was soaked in Iowa because he failed to bring a raincoat. Finally, a day late, wet and miserable, he arrived in Chicago.

"C" insisted on optimizing his journey. He carefully studied five sets of maps to determine road grade and surface conditions; mean temperatures and wind velocities anticipated; locations of gas stations, restaurants, and hotels; availability of water supplies; and times for sunrise and sundown. To his horror, he found that his latest map had been published a year previously and his hotel guide was several months old. He therefore telephoned the highway departments at key locations and inquired about the current status. Great was his satisfaction to find that several sections of the road he planned to use were torn up and detours had been substituted. His route was painfully replanned during the next two weeks, and all important highway conditions were carefully verified. During the interim, hotel prices had changed and the times of dawn and dusk had altered. Three months later "C" arrived in Chicago in an ambulance. His car had been overtaken by a tornado and destroyed, although his computations had shown that the probability of this occurrence was one part in 2.89 times 10 to the 7th power.

"D" had an IBM 704 at his disposal (on cost-plus-fixed-fee) and consequently was able to take into account many times the number of factors considered by "C." Unfortunately, for the first year, every time he completed a machine run several important variables had changed. By last month he had so organized the machine that only one variable changed during each run. He expects to leave for Chicago before the end of fiscal year 1962.

Obviously none of our unfortunate men represents a good balance between imagination, empiricism, and analysis. That good balance is represented in our lad "B." There is no point in itemizing the trip of "B." It would be relatively uninteresting and would not sell well. It is the conviction of the author that "B" has become scarce in military R&D for the same reason. Modern major missile programs typically are sold as composed of "off-the-shelf, well-proved components capable of operation in six months," à la friend "A," or as worthy of several years of intense study (computers of course) before initiation, to guarantee obsolescence when achieved à la "C" and "D."

At the present time one of the nation's most highly publicized missile programs, now in its third year, was initiated on the basis of philosophy "A"—six months and on the shelf. Another is a wasteful duplication, contributing little of technical or strategic value in return for its enormous cost. Another was "accelerated" by "optimizing" it to the point of introducing years of delay. It is interesting to contemplate that, had this "optimization" not occurred, the nation would now probably have rocket engines capable of matching the space feats of the Russians. That these events could occur must be ascribed at least partially to high-level management failure. In light of this, it would seem interesting to explore further the hypothesis that our efforts have suffered because of an unbalanced approach.

These facts must be construed not as condemnatory of individuals but rather as lampposts illuminating the changes that should be made. All too frequently in recent years efforts to analyze and rectify have descended into the abyss of personal vilification and abuse. Little doubt exists that the individuals involved in these activities were motivated by the most high-minded objectives. The author firmly believes that to impute to others baser motives than one's own is presumptuous; but it should be clear that good intentions alone will not solve our crisis. Efforts to criticize or remold personalities are futile. The key to our dilemma lies in selection of the right people for essential tasks and in the delegation to them of sufficient authority to achieve the ends required.

If unbalanced management is indeed an important constituent in the creation of our unhappy military development dilemma, what is the detailed mechanism through which it operates? Let us examine the case history of a fictitious major development program in the hope that some clue may be provided. Through the usual ill-defined process by which the requirements of farseeing operations people are mated with technical potentialities, a general operational requirement for weapon system "W" has been established. A military director has been designated and the program has assumed an active status. In line with a tradition which seemingly stems from Napoleon and earlier times but which is actually the product of the last half dozen years, the director selected to conduct this technical program is not a highly qualified engineer but a "well-rounded" type. It has been argued and accepted that for technical comprehension he can rely upon expert staff. His should be primarily the virtue of ability to exercise objective, unbiased judgment. Through mysterious procedures drawing heavily upon black magic, voodoo, and "personnel," a staff is provided this gentleman, and the position of his organization with relation to other elements of the Defense Department is established.

Now, among the first tasks confronting the infant organization are (1) development of crude, preliminary designs for the missile element of the system and (2) consideration of methods of operation. Should the device be launched from trees, tanks, barges, trains, ships, airplanes, the moon? With respect to preliminary design, the organization is faced with a choice of power plant type, guidance system approach, structural alternatives, and so on. At this point in, say, a new refrigerator development program, the civilian industrial director can confidently turn the development and production elements of the program over to his expert engineering staff and proceed with scheduling, budgeting, and advertising. In recent years the typical choice for director of the weapon system "W" office has also tended to proceed this way. However, because the military of all our services have chosen in recent years to delegate ever more of the development task to civilian groups, technical competence among the uniformed staff members of project "W" can be expected to be spotty. This fact, the magnitude of public funds projected for the program, the director's personal lack of expert skill in technical development, and the fear of subsequent investigation lead the program office to *appear* to leave no stone unturned in seeking the best course.

As a consequence of this situation, born of a lack of faith by the staff members in their own and their subordinates' judgment, vast numbers of analytical studies are now launched, both in house and under contract, if the program office feels that its franchise is well established. If, on the other hand, DOD approval is felt to be weak, a collection of on-the-shelf items is rapidly concocted into a questionable device and a firm franchise established; then the same course of action is pursued. It has become important at this point to place significant numbers of massive computers at the disposal of these analytical study groups so that they will ultimately be able to prove, by waving miles of sacred read-out paper, that adequate care has been exercised in the expenditure of public funds.

This pattern of massive program execution is impressive and is obviously motivated by the laudable desire to achieve the most for the public dollars expended. But is it effective? How does it compare with its civilian counterpart?

We recall that the civilian project chief also placed the entire design, development, and production package in the hands of his staff. But the chances of his approving the expenditure of many millions of dollars on analytical studies before selection of a given preliminary design are zero. Even when put in terms of percentages of funds to be expended for initial analysis and computations, as compared with total expenses anticipated, the figures for the refrigerator and for the weapon system are grossly dissimilar. Does this dissimilarity spring from difference in the degree to which subtle, imperfectly known, advanced scientific facts and thoughts must be incorporated into the romantic weapon system as compared to the mundane refrigerator? It is the author's firm conviction that this disparity accounts for only a small fraction of the dissimilarity. The rest has unfortunately come to be regarded as normal in the eyes of military directors and reviewing agencies, although it frequently serves merely to hide a lack of originality and assurance in technical thought within the highest echelons of the program. Somehow during the last few years we seem to have forgotten that all basic, good ideas stem from the imaginations of gifted people and that an infinitude of analysis and computation can do nothing more than partially confirm or deny the validity of these thoughts.

Our refrigerator program director knows that his chief of engineering will come up with a good starting point. There will be little internal analytical confirmation of this and no external. A preliminary design will be generated in a short time at low cost. It must be so, to maintain the company in a competitive position. Why is the director confident of this? Availability of study group reports? Acres of computers? Much read-out paper? No. Simply because of the background and experience of his technical chief. Experience has repeatedly demonstrated that within his mind this man can relate state of the art, costs, esthetic appeal, competitive developments, and feasible time schedules, so as to evolve a winning design. From this point, precise determination of detailed designs, to account for stresses, corrosion, noise, etc., is laborious but rarely critical to the life of the program. Development is accelerated to full speed long before final corroborative computations can be completed in all aspects. As these figures become available, perhaps months after full initiation of the program, they can be expected frequently to show that a course selected was not best. For instance, the best course for the development of some component might have been along an azimuth of 80 degrees, whereas that pursued was 70 degrees. How much better it was, however, to have proceeded in the 70-degree direction for six months and then correct to 80 degrees than to have delayed all work for six months! The greatest crime in civilian as in military development is not pursuit of a wrong direction but vacillation and delay. The engineer in civilian industry who is possessed of a high dither index doesn't last long—unlike his military counterpart. Moreover our refrigerator chief engineer knows the value of time in his competitive market and consequently minimizes expenditures aimed at superficial "optimization."

It has been maintained that the civilian course of action is not available to military weapon developers because of the general lack of experience in modern weapons. The idea seems to persist that these devices, especially when they are rocket-propelled and cover long ranges, constitute such a complete break with past aerodynamic experience that the number of tried and experienced people capable of dealing with their development is extremely limited. While in a narrow sense there is some truth to this assumption, the procedures to which it has led are fallacious. The methods of design, development, and production of the major elements of these long-range rocket devices differ only insignificantly from those of their predecessors. Moreover, as a class they are much simpler and should be less costly than modern combat aircraft. The ability to recognize broad, potentially profitable approaches, to advance from these to good, intuitive designs, to discriminatingly and extensively test these and rework them expeditiously—this still constitutes the hallmark of successful development in the fields of guidance, propulsion, and structures, as always. The problems of mating these into a system are complicated by the need to operate under stringent environmental conditions. Methods to ensure compatibility and controlled interaction of components have changed little, however, and must be pursued along well-established lines. Actually the main causes of difficulty encountered in current major programs, as ever, have been mundane failures of simple mechanical parts that were designed in complete ignorance of whether their destiny was the moon or some bathtub.

In point of fact the same criterion of competence can be applied, although in a different organizational pattern, to military weapon developers as to refrigerator developers: demonstrated possession of the habit of success. Not success in performing spectacular individual experiments of little significance to our military strength or in whipping up public enthusiasm for prospective military devices. These are indeed of significance and are perhaps of great psychological moment, but they should not be regarded as signs of fitness for conduct of military development programs any more than our refrigerator management should replace a poor designer with a good advertiser or chemist.

The men who recognized the military potentials of liquid rockets in the United States and who drove the major development programs through to successful completion are known to the professional participants in these programs. Those who performed a similar service in laying the groundwork for high-performance solid rockets can also be identified. The same is true for inertial guidance development and in fact for all the major component fields of modern long-range ballistic missiles. To a surprising extent this relatively small number of unsung individuals has scored repeated successes in guiding development programs of vast potential to successful conclusion. They have done it generally under adverse conditions of publicity, funding, and personal career politics. Missile development programs that have deviated from the unhappy norm and produced militarily significant results in short time periods at relatively low costs have been similarly guided.

Thus the consistent employment of technically insecure people at key posts of recent military development programs does not stem from lack of defined and adequate sources of good development engineers. Rather it springs directly from the emulation of private industry in deliberate selection of primarily sales-minded people for key engineering development positions. As we have seen, this can work very effectively in the profit-disciplined atmosphere of private industry operating in well-established fields of endeavor. Its application to military engineering, however, has proved to be of questionable merit. The lack of technical assurance on the part of key, high-echelon people has led to a gross unbalance in program effort, suppression of truly original thought, and consequent expenditure of vast sums to establish the validity of uninspired, mundane activities.

Critical programs suffer not merely because promotion-minded directors and staff people cannot themselves evaluate the technical merit of an idea but because, since they are not operating in a well-established craft, they dare not place faith in their subordinates or normal consultants. This has led to the creation of a truly unprecedented network of special study contractors, management contractors, review committees, approval agencies, and enormously swollen analytical departments in established development and production contractors. Inevitably most of the members of these special organizations are relatively unfamiliar with details of current massive military R&D (or they would be engaged in it).

Since any massive military R&D project involves a series of trenchant conflicts between the will of the director to meet schedules, budgets, and performances and the connivings of unpredictable fate in the guise of lost parts, strikes, weather, poor inspection, etc., projected schedules are never met. This is true whether the schedules are valid or not. The seasoned program director knows this and further knows that if such schedules are extended by 100 per cent the slippage will probably be just as great and at much greater cost. Review committees, however, stimulated by knowledge that past program schedules have never been met, always recommend that those under review are too "optimistic" and insist upon material extension as "good sound engineering planning." This simple action, repeated many times each year, has probably doubled development costs in the United States and profoundly extended critical development timetables.

Operational research organizations, study corporations, and scientific review agencies inevitably categorize a novel concept (frequently the result of years of thought on the part of the originator) as unsound and absurd if it promises great economies in development cost and capital and annual expenditures as compared to its predecessors. They can show statistically that during the last 6.32 years no system devised has deviated from the mean of its antecedents in gross cost by more than 4.68 per cent; therefore, they say, this new one must be unsound. Such verdicts have often been promulgated and adhered to in face of the fact that none of these preceding systems had ever operated, or, on many occasions, the fact that they were devised to be soonest and not best, whereas the new one was carefully tailored to be best on the basis of more recent, far superior knowledge.

The pattern of operation we have depicted is solidly established, well-nigh universal, and ominous. Its philosophy in essence: since we cannot trust our program directors and they have no faith in themselves, let us prevent the occurrence of costly errors and dishonest activities by surrounding development operations with battalions of negatively oriented agencies. "Negatively oriented" since each seeks to minimize or prevent some undesirable event but none can contribute positively to a novel, brilliant thought.

Is there not something strangely reminiscent about all this? Recall that our enigmatic camera could not take bad pictures under any circumstances. Unfortunately, it could not take good ones either. It seems to me that we have approached perilously close to the same position in our military development programs, upon the effectiveness of which the very life of the nation depends. Regardless of the fact that major missile systems today under development are generally intrinsically simpler than their predecessors, costs and development time scales soar even higher into the most remote regions of space (even if the missiles themselves and the engineers' imaginations don't). Have we been evolving an enigmatic military development system? Have we perhaps, by attempting to eliminate risk and by institutionalizing procedures, nearly destroyed creative thinking that leads to simple devices and low costs?

WHAT is to be done? It seems quite clear that it is of the greatest importance to place competent, self-assured, seasoned engineers in key *line,* executive positions—as opposed to staff positions—in major military development programs. These men should be carefully selected on the basis of demonstrated competence in imaginative and successful direction of massive, meaningful military R&D programs. There need not be many of them, but they must be good. To permit these men to work effectively, it will be essential to place them in well-defined executive positions with unambiguous authority to carry out their responsibilities. If the military are expected to assume responsibility for these programs, these people must be military. If civilian agencies are to be made responsible, naturally these posts should go to civilians. But under no circumstances should a situation be tolerated where authority is split, whether openly or deviously. This is an invitation to disaster. The excessive reliance upon analysis and review groups must cease. The delusion engendered by the functioning of these groups, that improper and unprofitable activities will be minimized, must be discarded in favor of trust in the imagination, skill, drive, and integrity of competent directors to do the right thing when the occasion demands.

It should be recognized that these recommendations can only be implemented effectively through recourse to a type of man who has become an anathema in recent years. The director and key engineers cannot be "unbiased, objective, uncontroversial" characters. No gifted man worthy of his salt in this business can fit this popular mold. After spending years in this trade, one can only remain unbiased if he is stupid. Further, it is impossible to conduct these enormous projects intelligently, vigorously, and economically without rousing intense controversy. We must choose between bland, bumbling insecurity and driving, competitive intelligence. Our nation did not become great through the efforts of "nice" people with high innocuity indexes. It will not survive this dangerous era through their gentle bumbling.

Changes in policy of the type discussed probably cannot be effected abruptly without warping the fabric of continuity beyond tolerance. Recognition of the deficiencies elucidated and resolution in principle to eliminate them with all feasible haste are, however, mandatory if the United States is not to fall hopelessly behind in the technical race for survival. Our bright future, as our past glory, must stem from intelligent acceptance of inevitable risk. In institutionalizing our military development procedures and carefully eliminating the risks of improper activity or the consequences of any but mediocre thought, we also eliminate the risk of pursuing creative novel approaches, which alone can ensure survival in an age of rapid scientific advance. An Enigmatic Program Office can no more readily accomplish effective military development than the Enigmatic Camera could take good pictures.

United States Mission to NATO

The Military Potential of the Moon

Lieutenant Colonel S. E. Singer

IN AN immediate sense, military concern with space programs is based most directly on the fact that current programs utilize military hardware and facilities. In a more profound sense, there is military interest because space technology so obviously represents future opportunities and future dangers. Whether these interests are selfish or lofty, ill-conceived or sound, is a matter of judgment or perhaps opinion. In the author's opinion, too much of the expression of this interest has been rhetorical rather than objective or analytical and has shown an astounding disregard for the vastness of space. But there can be no denying the interest itself, and especially Air Force interest.

As this is written, much of the Sputnik-induced furor—even hysteria—has died down. We have created two new agencies to assist in the solution of many of our space-age problems. These newcomers are the Advanced Research Projects Agency (ARPA) and National Aeronautics and Space Administration (NASA). The American public, satisfied that the United States was at last in space in earnest, meanwhile had settled back into a complacency only somewhat less rigid than that of the pre-Sputnik era.

To the author, this seems precisely the right time for objective study and analysis of our space posture. It is too late to be accused of visionary dreaming and yet early enough to change our plans and concepts if they are ill-founded. It is the author's purpose, then, to make some contribution, however modest, to such study and analysis.

knowledge and attitudes

In part, it is this concern with modesty that restricts this study to the question of the military potential of the moon. Man has studied the moon exhaustively. We know a great deal about it. The Russian Luniks and the U.S. Air Force and Army attempts to orbit or probe the moon indicate clearly that even our current crude technology makes an eventual manned lunar landing a certainty. There is no longer a question of if, but only a question of when and by whom. The moon is nearer to us than any other natural celestial body. The distance is only a few hundred thousand miles. This is a large distance by earthly standards but still a modest distance in space terms, for we do measure it in miles and not light years or astronomical units. Yet reaching the moon does indeed involve true space flight and at least an introduction to most of the problems associated with it.

So it seems reasonable, timely, and important to ask, does the moon have a military potential? Would this nation derive any strategic value from lunar bases?

It is necessary to examine these questions within two distinct contexts, one physical and one psychopolitical.

The physical context. The first of these is relatively easy to define: The moon revolves around the earth in an orbit which places it never closer than 221,463 miles and never farther than 252,710 miles. In round figures, 240,000 miles is usually taken as the average distance. One such revolution, as measured from any one point in space, takes slightly more than 27 days. But we see the moon only by the light it reflects from the sun. And since the earth pursues its orbit around the sun independently of the moon's orbital travel, we "see" the moon taking slightly more than 29 days to go from full moon to full moon. The moon's orbit lies in a plane inclined to the plane of the earth's orbit by about five degrees. The most striking feature of the moon's motion is that it revolves around its own axis at a rate such that the same side of the moon always faces the earth. Thus there is one side of the

Among the various schools of thought on military use of space, there is one that would accept a 600-mile ceiling on military space activity. In their view, ground- and air-launched missiles can accomplish, within the atmosphere and over comparatively short terrestrial distances, what others would attempt far out in the vacuum of space and over interplanetary distances. Lieutenant Colonel S. E. Singer, physicist at the Defense Atomic Support Agency, Washington, writes on behalf of those who cannot accept a line of demarcation limiting aerospace power —whether it be drawn at the first 60, 600, or 6000 miles of space. Particularly in the case of the moon, Colonel Singer contends there is a potential of great military value offering several possibilities, notably a lunar-based deterrent force.

moon which can never be observed from the earth. As a result of this relatively slow rotation, a lunar day lasts slightly less than an earth month.

The moon is much smaller than the earth. Its diameter is 2163 miles compared with the earth's 7917 miles. Its mean density

is 3.4 whereas that of the earth is 5.5. Consequently the moon's mass is only 0.0123 that of the earth. It follows also that the gravitational force of the moon is only 0.16 that of our planet. This reduced gravitational pull means that a speed of only 1.5 miles per second is required to escape the lunar gravity field as compared with the earth's escape speed of 7 miles per second.

In a crude and cursory sense the surface of the moon is somewhat similar to the surface of the earth. There are plains, hills, valleys, and mountain ranges, all with dimensions not greatly unlike our own. The mineralogical composition of this solid lunar crust is probably similar to that of the earth except for a reduced abundance of the heavier elements. But even the gross differences between so-called selenography and our own geography are very great. There are innumerable craters ranging in diameter from hundreds of feet to hundreds of miles. There are about two thousand clefts that are approximately a mile wide, hundreds of miles long, and as much as a mile deep. Much of the surface is covered with a layer of dust of unknown depth. And there are no seas on the moon; in fact, there are no large masses of free water whatever.[1]

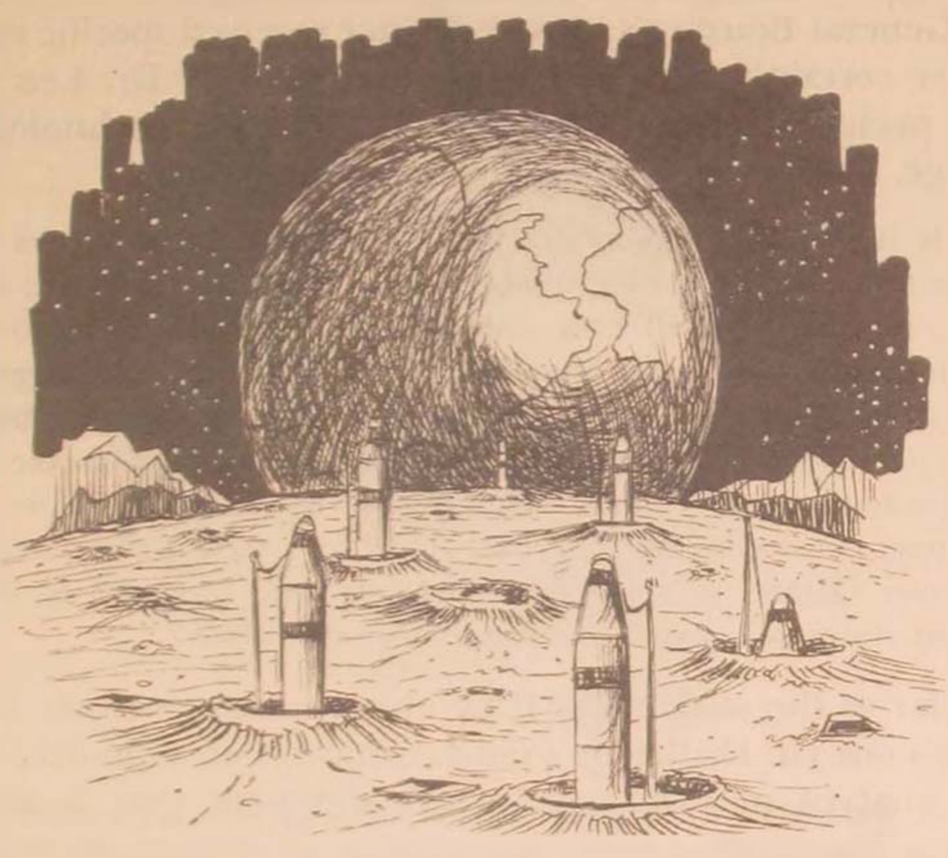
Perhaps the most significant difference between the earth and the moon, other than the lack of water, is the fact that the moon has no atmosphere like the earth's. This means no direct source of oxygen to support human life, no weather as we know it, nor even any moderation of the heat received from the sun. The temperature near the surface of the moon is +248°F when it is in sunlight and —200°F when it is in darkness. There are other less obvious consequences of the lack of an earthlike atmosphere. There can be no propagation of sound as we commonly observe it. There can be no corrosion, which implies the possibility that such elements as iron occur in the free state. There is no atmospheric friction to retard vehicles or inertial devices of any sort. There is no atmospheric attenuation or distortion of any type of radiation.

Some authorities hold that the moon may well have an extremely thin atmosphere of sorts. While by earth standards this atmosphere would correspond to an extremely high vacuum, these authorities consider it dense enough to preclude any substantial meteoritic bombardment of the moon's surface. And it may contain some water.[2]

The psychopolitical context. It is much easier to describe the physical features of the moon than to define or describe the manner in which the probing or basing or conquest of the moon interacts with the affairs of states and the minds of men. It is in part a recognition that the free world is battling with the Communist world for the minds and the political support of the uncommitted nations and that many of the peoples involved are not impressed by logic alone, if at all. It is the realization that the psychosocial, the economic, the military, and the political elements of national power are profoundly interrelated. It is the interdependence of military posture and technological progress and the dependence of both on psychosocial, political, and economic interest and response.

the moon as a base for deterrence

The first thoughts on the military potential of the moon that attracted attention in the United States were expressed by Air Force Brigadier General Homer A. Boushey in a speech before the Aero Club of Washington, D. C., on 28 January 1958. Fundamentally, General Boushey's thesis was based on the concept of using the moon as a missile base from which a retaliatory attack



could be launched against the Soviet Union. The gist of his position is contained in the following quotation:

> From an energy standpoint only 1/5 or 1/6 the energy is required to shoot a warhead from the moon to earth as vice versa . . . from an energy viewpoint the moon represents the age old military advantage of 'high ground' . . . a missile launched earthward could be observed and guided from start to impact. The reverse is not true. . . . a missile attack launched from the earth to the moon could be observed from the moon with perhaps 48 hours to take counter action. . . . The moon provides a retaliation base of unequalled advantage. If we had a base on the moon, either the Soviets must launch an overwhelming nuclear attack towards the moon from Russia two to two-and-one-half days prior to attacking the continental U.S. (and such launchings could not escape detection) or Russia could attack the continental U.S. first, only and inevitably to receive, from the moon—some 48 hours later, sure and massive destruction.[3]

Thus General Boushey envisions lunar bases as a nonconventional, indeed quite extraordinary, extension of our current concept of deterrence.

General Boushey has received some support for his views from within the Air Force and from the missile-space fraternity generally. This support, however, has been more in terms of general aid and comfort to a fellow space *aficionado* than in terms of explicit indorsement of this particular lunar base strategem.[4, 5, 6]

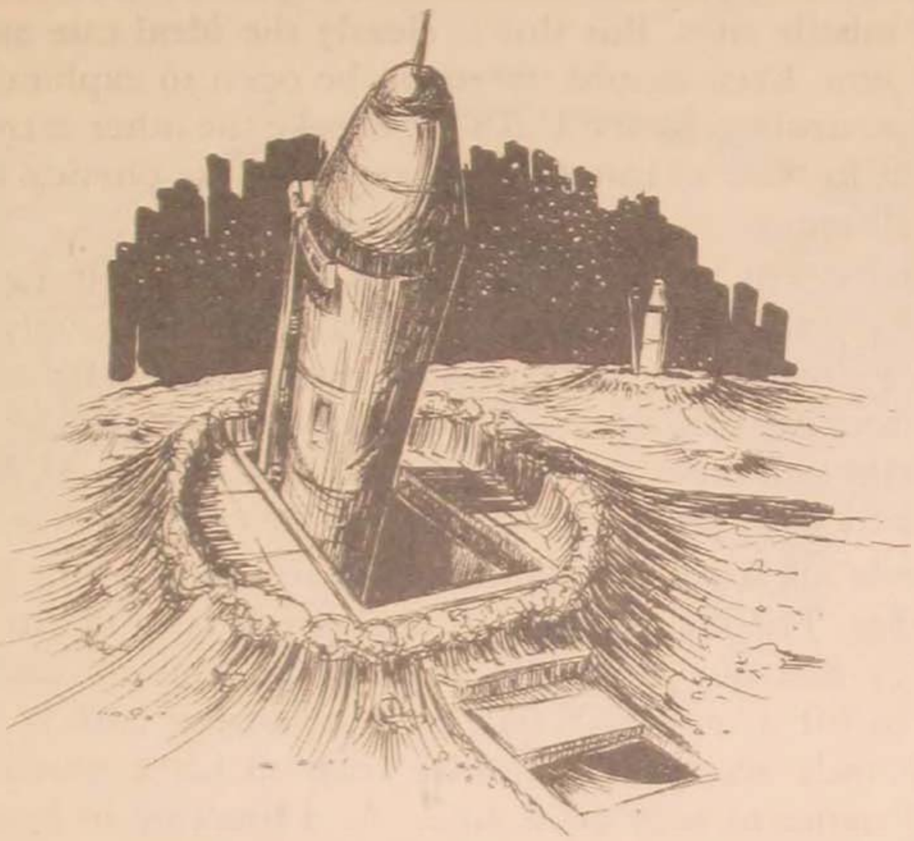
If General Boushey's views have not received specific support, they have certainly been seriously questioned by Dr. Lee A. DuBridge, president of the California Institute of Technology. Dr. DuBridge, who is also a noted physicist, has stated:

> It is my firm opinion that this [launching weapons from the moon to the earth] is utter nonsense. Why transport a hydrogen warhead, together with all men and equipment, 240,000 miles to the moon, just to shoot it 240,000 miles back to earth when the target is only 5,000 miles away in the first place? If you did launch a bomb from the moon to a target on earth . . . the warhead would take five days to reach earth. The war might be over by then. . . . Can we use the great new technologies of space travel for peaceful and scientific purpose? Or are we going to be led into wild programs of Buck Rogers stunts and insane pseudomilitary expeditions.[7]

So far as the author has been able to learn, neither General Boushey's nor Dr. DuBridge's remarks have been supported by any specific analysis or extensive logical argument that is generally available. Therefore it seems appropriate at least to try to analyze the facts about deterrence and the moon.

Site hardness. From a military point of view, the fundamental basis of deterrence is the capability of launching an overwhelming retaliatory attack regardless of enemy action. One's own force either must be completely safe from attack or must be so constituted that those elements which survive the enemy's first blow are still sufficient to ensure an overwhelming counterblow. The deep belief in this premise is amply demonstrated by current USAF concern with such programs as Strategic Air Command alerts, base hardening, and dispersal. The value of lunar bases in a deterrent strategy, then, depends strongly on whether a lunar-based force would be less susceptible to loss by enemy action than one based on earth.

If we envision the moon as sovereign United States territory and deriving from this status all of the perquisites against encroachment that sovereignty implies, then it would be possible to construct lunar missile launch sites that could be made almost completely impregnable. These could be underground sites similar conceptually to current USAF plans for the Minuteman weapon system. It is possible that the topographic features of the moon, its many craters and clefts, would provide a very large number of



potential sites requiring little or no additional construction and affording a very large degree of natural concealment and protection.

Under the assumption of sovereignty, such a lunar weapon system would be tremendously "hard" simply because it would be relatively easy to keep it hidden. Direct observation of site locations from the earth, difficult at best, could be avoided completely by locating the launch sites on the far side of the moon, the side that never faces the earth. Closer inspection, as by enemy observation vehicles, would constitute the same sort of encroachment of sovereign territory as would enemy aerial observation of the United States.

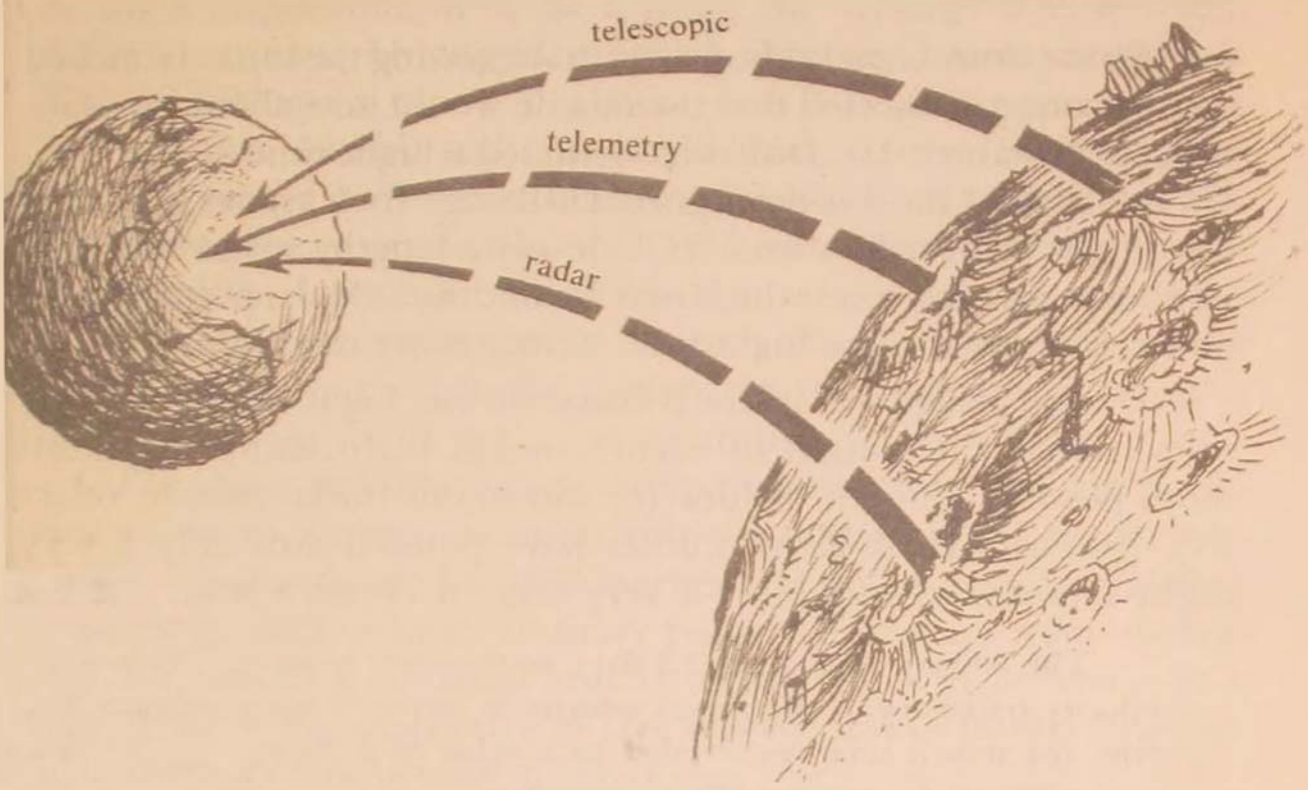
As General Boushey pointed out, lunar missile sites would be very difficult to destroy even if their locations were known to the enemy. Since the moon has no appreciable atmosphere, even a nuclear attack would produce no blast effects. Only radiation effects and ground shock could result from nuclear detonations on the moon. The range of ground shock is very small (on the order of hundreds to a few thousands of feet), and radiation effects are comparatively easy to shield against. Thus the physical destruction of lunar missile sites would be far more difficult than is the case for missile sites on the earth.[8,9]

The requirement that the moon be a sovereign possession of the United States permits the strongest argument for the hardness of lunar missile sites. But this is clearly the ideal case and not a *sine qua non.* Even should the moon be open to exploration and possible occupation by the U.S.S.R., to take the other extreme, the arguments for ease of concealment and intrinsic physical hardness would still apply.

Employment requirements. It is all very well for missile sites to be hard, but missiles serve as deterrents only if they can be employed. The concept of threatening the U.S.S.R. with missiles from the moon may be questioned on the grounds of force size, missile accuracy, and strike time. The matter of force size is essentially a question of cost and will be considered separately.

Missile accuracy. The question of accuracy can be answered in two ways. The first answer lies in terms of faith in our existing technology and our ability to improve it. It is obviously more difficult to hit a moving target from a moving launch site with a 240,000-mile separation distance than to hit a moving target from a distance of only 5000 miles. As a function of range, what is required is an improvement in accuracy of about a factor of fifty. In a crude way, this requirement can be compared with the improvement in accuracy and range achieved in the ICBM as compared with the V-2's of late World War II. The V-2, with a range on the order of a few hundred miles and an accuracy worse than the dimensions of London (about 15 miles), was the progenitor of the ICBM with its range of more than 5000 miles. In terms of range, then, the ICBM is a V-2 improved by a factor of twenty or thirty, with a simultaneous accuracy improvement by a factor of perhaps five to ten. The fact that this ratio is at least the same order of magnitude as that required for a lunar ballistic missile "proves" nothing, of course. But it does at least provide a basis for asserting the reasonableness of a faith in the possibility of further improvement in what is, after all, an infant technology.

A second answer to the question of lunar-launched missile accuracy, an answer of greater technical sophistication, has been suggested by General Boushey. This is the possibility of launch-to-impact guidance. Because of the earth's rotation, every point on earth except a small portion of the polar regions is directly visible from the moon for at least half of every earth day. Depending upon the relative positions of the earth and the moon, that hemisphere of the earth facing the moon is either in direct sunlight or direct moonlight or some combination of the two at all times except for brief periods of eclipse that do not exceed two



hours in duration. It follows that a missile launched from the moon could be more or less directly guided to any earth target, provided allowance were made for proper timing with respect to the earth's rotation. The telescopic, telemetry, guidance, and radar techniques which might be required are now in existence.[10]

It has been argued by Dr. DuBridge that this concept is invalid because much of the earth's surface is covered by clouds much of the time. This argument depends on the assumption that a target must be seen to be hit. Two established techniques, radar bombing and bombing by offset aiming points, do not require direct visual observation of the target; hence the assumption is erroneous. There seems to be a better argument: Since an ICBM requires a minimum of one navigational fix in the sense that its launch point is always known with respect to the target, likewise a lunar-launched missile nearing its earth target might require a minimum of one earth fix to permit its final flight path to be established within the accuracy limits now attainable with the ICBM. This fix could be in any part of the earth's hemisphere "visible" to the moon or the missile at the time. Thus the general presence of clouds does not invalidate this concept unless one insists on making the problematical assumption that an entire half of the earth is likely to be completely covered by clouds. And even this assumption is negated if one envisions a missile equipped with radar sighting devices.

Strike time. General Boushey, in suggesting the lunar-launched missile concept, asserted that the missile would take about two days to reach its target; Dr. DuBridge assumed a flight time of five days. On the basis of the five-day figure, DuBridge then argues that "the war might be over by then."[11] Obviously a lengthy strike time also implies a warning time which may be undesirable. In point of fact, however, both of these flight-time estimates are too high.

Dr. DuBridge's estimate is based on the flight time which results from a calculation of earth-to-moon flight using the minimum possible amount of fuel (or minimum initial missile velocity). But, as several Rand studies have pointed out, only a very slight increase in fuel gives a very large decrease in flight time:

> The longest flight time, 5.5 days, corresponds to the minimum-velocity trajectory. If the initial velocity is increased by only 1 percent, the transit time is decreased to a value of 2 days. The flight time planned for the Air Force Pioneer Moon shots was about 2.6 days, while that planned for the Army Juno II Moon shots was only 1.4 days. . . . this sharp difference in flight time involves a velocity difference of only about 2.5 percent.[12]

Thus Dr. DuBridge has chosen to argue from a most conservative point of view, and General Boushey has apparently based his position on the time programed for the Pioneer probes. More seriously in question are their implications that flight times from moon to earth will be the same as from earth to moon. Because lunar escape velocity is much lower than the earth's, a given amount of fuel for a lunar-launched missile can be employed either to carry a much larger payload than for an earth-to-moon transit or to give a much higher velocity. For this reason all earth-to-moon transit time calculations approximate upper limits for the reverse route. Thus, judging from Juno IV's 1.4 days, not to mention Lunik I's 1.8 days, even current technology is capable of sending a missile from moon to earth in considerably less than two days. The improvements in space and missile technology that will be required actually to put man on the moon will perforce include the means for reducing moon-to-earth transit times to the order of hours. And it may not be unreasonable to assume that the time can be reduced to minutes if the requirements of deterrence or employment so demand.

Cost. Strictly speaking, the question of dollar cost is not relevant to an assessment of the military potential of a strategy or force disposition. It is in making the strategy *decision* that dollar cost must be considered and often becomes paramount. This is perhaps a nice distinction, but it is an important one.

Cost is a relative and elusive yardstick. The military budgets of today would have been considered fantastically high in 1948. Yet many persons argue now that even an annual military budget of more than forty billion dollars—three times pre-Korea levels—is insufficient to meet our military needs. Their arguments may be subsumed under the general notion that the price of survival is incalculable. And this is an argument difficult to counter.

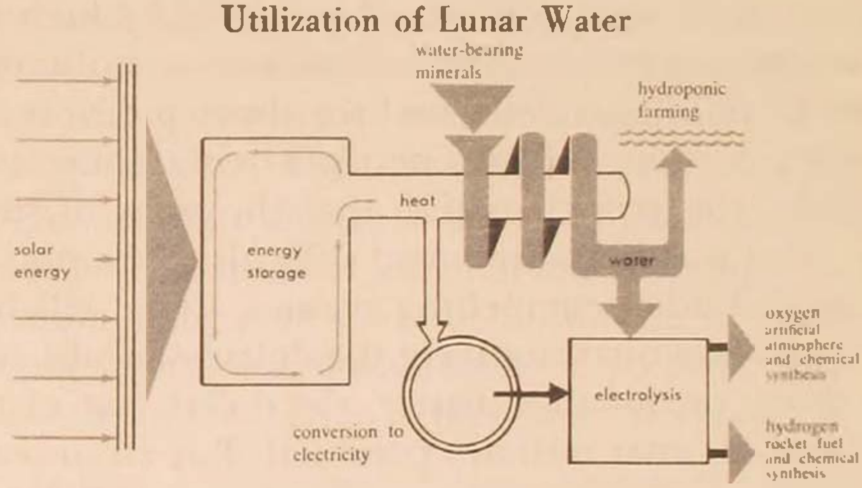
For these and other compelling reasons, there will be no attempt here to analyze quantitatively the dollar cost of basing missiles on the moon or, for that matter, the dollar cost of realizing any other aspect of lunar military potential. But an order-of-magnitude indication of dollar cost is useful and will be made as a matter of giving perspective to this subject and of forestalling any accusation that an issue is being dodged.

Dr. Herbert York, Department of Defense Director of Research and Engineering, has estimated that it would cost about six billion dollars to put a man on the moon.[13] This may be compared with a current expenditure for all United States missiles and space programs of about four billion dollars a year.[14] Thus the beginnings of a lunar exploitation program are clearly a matter of billions and of a magnitude comparable to that of current programs. It would probably not be unreasonable to assume that any significant exploitation of lunar potentials might cost tens of billions. Whether or not higher expenditure levels would be required is a matter for far more careful analysis. However, there is one aspect of dollar costing of lunar exploitation that is easily overlooked and that could affect the cost figures profoundly. This can be termed energy costing.

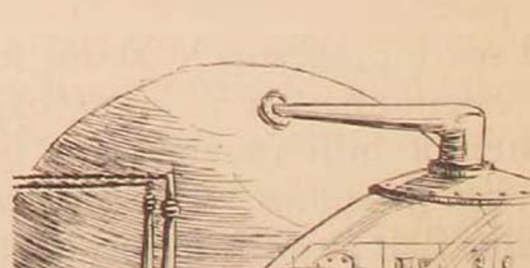
It is usually assumed that the moon is so completely barren, so devoid of available resources, that man could exist on the moon only by hauling from the earth all that he requires. Under these circumstances by far the largest fraction of the cost of a lunar pro-

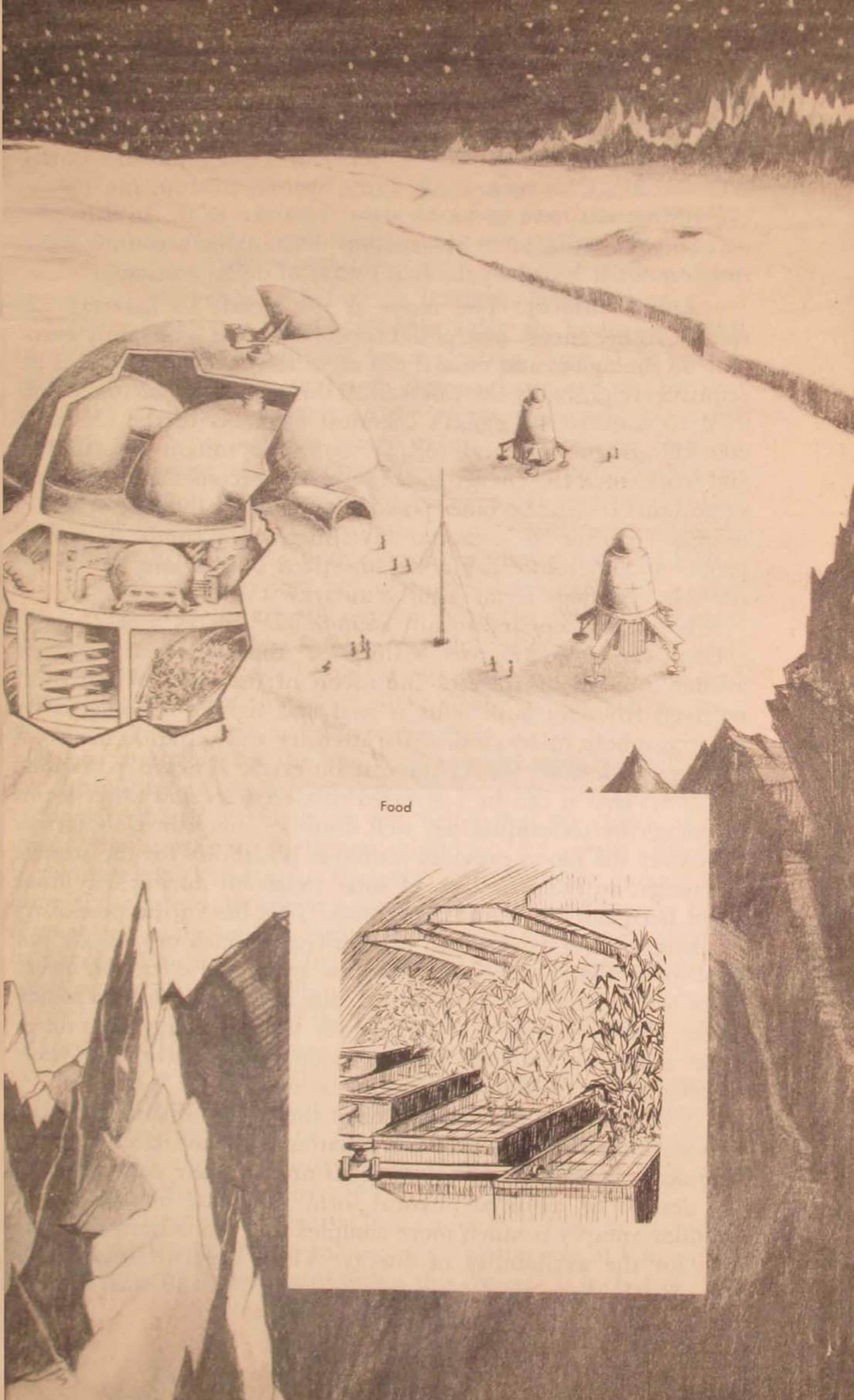
Base on the Moon

Utilization of Lunar Water



Air and Water





Food

gram, in an ultimate sense, is the cost of the energy needed to move from the earth to the moon absolutely everything required there. This assumption will certainly be valid for man's initial lunar landings. Oxygen, food, water, shelter, instruments, tools—everything will have to be brought from the earth. In this context energy costing is an elegant but meaningless accounting distinction, for it is plainly the lion's share of dollar costing.

Lunar autarky. The moon is not nearly so barren as it seems. All the energy man could conceivably use is certainly available on the moon, and most if not all of the chemical elements he requires are probably there as well. If this energy can be stored and used to convert the moon's chemical elements to the chemical compounds and physical forms needed to sustain human life and work, then the energy costing concept becomes tremendously important. It then becomes possible to consider the cost of earth-to-moon hauling as a capital investment that could yield rich profits and therefore could be amortized over a long period of time. In economic terms, a lunar autarky is thus conceivable.[15]

Is this concept technically sound? The energy aspect of the concept can be summarized as follows: Abundant heat energy is available on the surface of the moon in the form of radiation received from the sun. This is heat and light unattenuated by an atmosphere or by clouds. Its intensity and duration are completely predictable, unlike the case on earth. If heat is available, it follows that it can be converted to electricity and other forms of energy by techniques too well known to require elaboration. Moreover the moon provides a unique possibility for the storage of energy, so that the lack of solar radiation during the lunar night need not constitute a problem. This lies in the possibility of using inertial flywheels to store energy.[16] Such devices are not used for this purpose on earth because atmospheric friction makes them too inefficient to be practical. Since the moon has no atmosphere, this very simple technique for storing energy on a large scale would be practical on the moon. Other techniques—heat reservoirs, for example—could also be used.

Given energy, the attainment of the means of sustaining life and work on the moon becomes a matter of the availability of the chemical elements basic to all needs and of their conversion to the desired or required physical form. The case for this aspect of lunar autarky is much more complex and less certain than the case for the availability of energy. There are two reasons for this. In the first place, our conclusions as to the solar energy available on the moon and its conversion to other forms are based on indisputable theoretical and instrumental considerations. But our knowledge of the moon's composition is completely theoretical and cannot be confirmed until the moon's surface is sampled and analyzed. In the second place, chemical and biological processing are intrinsically more complex and demanding technologies than is the capture, conversion, and storage of energy. Man learned to use fire long before he learned chemistry.

Nevertheless it is possible to make a case for finding a wealth of elements on the moon and for exploiting them. The essence of such a thesis can be outlined: Although we are certain that there are no bodies of water on the moon, there are reasonable grounds for believing that water exists in a trapped form in certain lunar minerals.[17] If this be the case, then both the human and technological requirements for water can be met by distilling it from these minerals. Electrolysis of the water, a very simple process, would then yield both oxygen, to sustain life, and hydrogen, to serve as rocket fuel or raw material for chemical synthesis.[18] With both water and oxygen available, two of the most significant requirements for hydroponic agriculture have been met. Viewed very crudely and briefly, then the elemental and compositional bases to sustain life on the moon are possibly available from its own natural resources.

The argument for the existence and availability of the elements and compounds needed as a basis for a more complex lunar economy is based primarily on our belief that the chemical elements which make up the moon should not be greatly different from those which make up the earth. Thus all the metals and nonmetals, indeed the entire periodic table, are held to have been represented in the moon's composition at some very early time in its history. This much is almost certain. But how these elements combined or failed to combine and how they are now distributed over or near the surface of the moon and which ones might have escaped into space—all these factors are really unknown. If the moon's crust is highly similar to the earth's, which is the scientific consensus at this time, then the availability and exploitation of lunar minerals may well be similar to their availability and exploitation on earth, at least in terms of the technologies and energy expenditures required.[19]

The concept of an eventual lunar autarky cannot be excluded from consideration, and no analysis of the dollar cost of long-range lunar programs is meaningful unless this concept is included.

the moon as an observation base

Since the earth can always be seen from the moon, it follows that an observer on the moon can view objects and activities on the earth to the degree that his optical system and the earth's rotation, illumination, and weather will permit. It is for this reason that General Boushey has referred to the moon as "high ground." He suggests that with moderate-sized telescopes lunar observers could distinguish objects on the earth about 100 feet long. With somewhat larger telescopes, he envisions that one could "monitor the positions of all ships at sea, all major new surface construction and the exact position of all above-ground missile launching sites."[20]

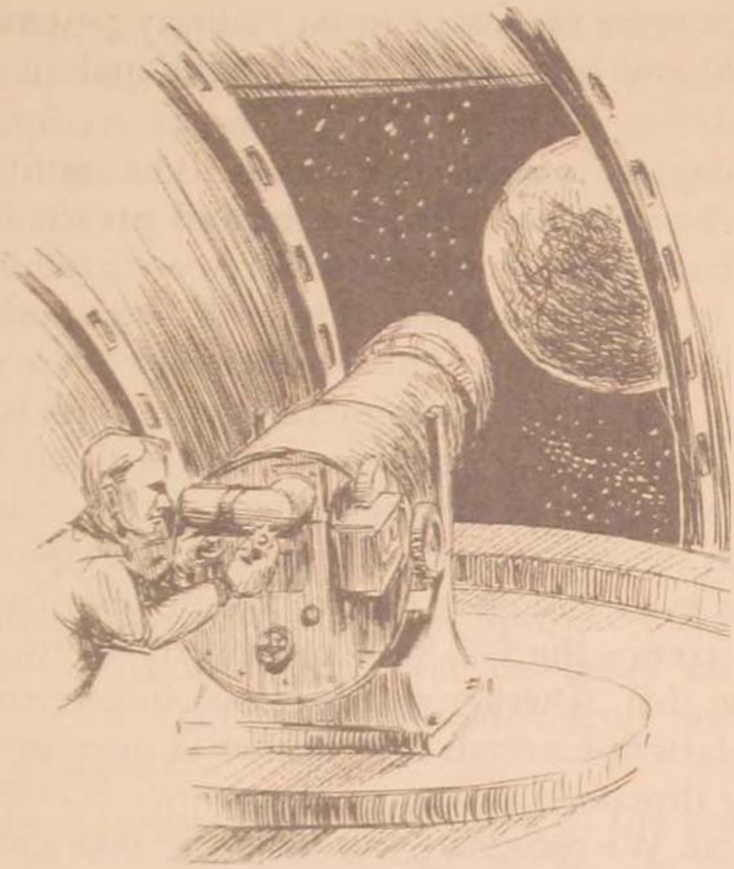
As with the deterrence concept, Dr. DuBridge is strongly opposed to this suggestion. He has stated that ". . . it is a bit optimistic to plan on detecting manmade objects from a distance of 240,000 miles, especially since the side of the earth facing the moon is in darkness a good part of the time and covered by cloud another part of the time."[21]

This issue is much easier: One may simply point out that photographs of the moon showing features with dimensions of less than one mile are not uncommon.[22] Further, Zdenek Kopal, Professor of Astronomy at the University of Manchester, has estimated that an observer on the moon using a 200-inch telescope could distinguish objects on the earth with dimensions as small as 20 to 30 yards.[23] Data on the resolving power of the 200-inch Palomar Observatory telescope confirm Professor Kopal's estimate.[24] Dr. DuBridge's optical argument does not appear to have received the support of scientific fact to the extent enjoyed by General Boushey's viewpoint.

We have already commented on the question of the darkness of the earth as seen from the moon—the side of the earth facing the moon is always in some combination of sunlight and moonlight except during brief, infrequent, and completely predictable periods of lunar eclipse. One may then treat this portion of Dr. DuBridge's argument in three ways: In the first place, military observation by moonlight is distinct from observation in darkness and is doubtless as old as warfare itself. In the second place, should such optical observation be less fruitful than desired, it appears reasonable to expect that the light amplification techniques now being developed could be used to overcome this shortcoming. Finally, even if direct observation of enemy territory should be practical only during periods of daylight, this would still make possible daily observation during more than half the days of each lunar month.

Cloud cover is another matter. Observation from the moon would not involve violation of another nation's airspace. The lunar observer would have the additional advantage of a fixed base and a long and repetitive observation period.

In this Dr. DuBridge apparently offers no direct objections to



the concept of large-scale meteorological observations of the earth from the moon; if anything, his remarks on cloud cover offer indirect support for it.

other military potentials

Thus far we have considered the military potential of the moon in more or less conventional terms. Deterrence, however prominent a concept it has become in recent years, has always been a concomitant of military force. Thus far we have done no more than examine these concepts in a new and startling environment but still in terms of rather well-established technologies and philosophy. This is a necessary and perhaps even an inevitable approach. Man can only approach the future rationally in terms of the present and the past. Even so, it is well to recognize that progress is not always attained in terms of today's conventions and reasoning. Man first tried to fly by flapping birdlike wings, but modern aircraft do not use this principle; nor do modern railroad cars bear much resemblance to the horse-drawn carriage prototypes. There must be a somewhat visionary or even fanciful approach to the future as well as a conventional one. The arguments to support this approach will necessarily be less well-grounded, but the ultimate rewards of such speculation may well be great indeed. Let us therefore consider some aspects of lunar military potential that are less conventional and less susceptible of rigid analysis than those previously treated.

Psychological military potential. The military concept of deterrence, as we now both practice and preach it, is deterrence in an ultimate form in that the force with which we threaten retaliation is a very real one. There is also another form of deterrence that is powerful. This is deterrence backed up by a force that may or may not be completely real. This is no more than saying that it is possible to win at poker without having the best hand. This variation on the deterrence theme would probably be foolhardy in the extreme should we adopt it vis-à-vis the U.S.S.R. at this time, even though it may very well describe to a degree the sort of deterrence the U.S.S.R. now exerts on us. It is important to recognize that, whether or not a real force reinforces a threat, deterrence fails or succeeds only insofar as the minds of men accept or deny the threat. In this sense, deterrence is always more or less psychological. We recognize this when we take pains, even with a real force, to conceal its weaknesses and extol its strengths.

In this context, there is a psychological factor operative in considering the military potential of a lunar-based deterrent force. Should the United States claim the moon and be in a position to enforce respect for such a territorial claim, then the number of missiles we must base on the moon to exert a deterrent threat becomes a strong function of how much we dare bluff. As a lower limit, no actual force or capability whatever would be required so long as we took pains to hide the actual state of affairs and took even greater pains to claim a nonexistent strength. This is an extreme case, of course, and would be a very dangerous strategy. It would be far less extreme if combined with a real deterrent force based on earth.

As in our earlier discussion, control of the moon is not an absolute requirement for this strategy. There are enough craters and clefts on the moon to hide a large number of real or pretended actions even in the presence of neighbors. Should the neighbors include the Soviets, however, one would certainly run the risk of being hoisted with one's own petard!

There is another side to the psychological aspects of lunar military operations by the United States. This lies in the effects that a real or imagined lunar military strength would have on our allies and on uncommitted nations. The allied support we enjoy stems from the respect the noncommitted but non-Communist nations have for our integrity and our strength as a world power. Any sort of United States military operation on the moon, regardless of its real military import, would be likely to reinforce this symbiosis simply because it would symbolize strength. It may be even more important to recognize that there is a corollary to this proposition: any Soviet operation on the moon would surely be interpreted by many as indicating a lack of United States strength vis-à-vis that of the U.S.S.R.

Technological war. Both symbolic and real strength are involved in what we have come to call technological warfare. It is easier to recognize elements of this kind of warfare than to define the term itself. Certainly Sputnik I was such an element. Its psychological impact was stunning. But Sputnik I constituted a Soviet victory in the technological war for more tangible reasons: it demonstrated a superiority in missile science and hardware that we did not anticipate.

The moon is obviously another element of the technological war. The battle has already been joined in the race to get to the moon. The Soviets have had more success with their Luniks, while we have lagged somewhat behind with our own lunar probes. While it may be argued that lunar probing and exploration are purely scientific pursuits, this is a distinction that includes rather than excludes military interests. All our current missile and space science programs either have a direct military basis or share military facilities, equipment, and know-how.

We in the Air Force must recognize that there is a military potential in any lunar scientific activity in the same sense that there is military potential in the pure research activities sponsored by the Air Force Office of Scientific Research. This is a generality. It is possible to be more specific. Burgess, for example, suggests that the space-gun scheme proposed by Jules Verne might be practical on the moon, since it is primarily the earth's atmosphere that makes it impractical on this planet. This scheme involves using huge cannons to hurl missiles through space. The propellant might be chemical or it might be flywheel-stored and converted electrical energy.[25] If the huge amount of solar energy incident on the moon can be stored, converted, and focused, it is conceivable that it could be used to affect or even control the earth's weather. Are such schemes really more visionary than the transistor was a few decades ago?

The greatest payoff, both military and purely scientific, is perhaps most likely in developments that are now barely conceivable. The moon's remarkable high-low temperature cycle and lack of atmosphere make possible cryogenic and high-vacuum research that is hopelessly impractical on earth. It is not unreasonable to expect that the employment of such research opportunities may lead to inestimable scientific and military gains. This is no more than acknowledging that military potential is inextricably bound up with scientific and technological competence. We may deplore this union, but it is a fact and one we cannot ignore.

Doctrinal development. If there is any validity whatsoever to any of the preceding thoughts on the military potential of the moon, then it or they imply one other lunar military potential—that of doctrinal development. General White and other Air Force leaders have spoken of "control of space" in a manner analogous to Douhet's and Mitchell's "control of the air" and Mahan's "control of the sea."[26] The Air Force slogan for 1959 is "Aerospace Power for Peace." It may be argued that control of space, interpreted literally, is an exceedingly presumptuous concept in view of the incomprehensible vastness of space. Yet unless one is unrealistic enough to assume that man has learned to live in peace with his fellow man, it is inevitable that warfare will be planned for and perhaps accomplished in and through the new environment of space. Accordingly, a doctrinal development is necessary. And where can one begin except with an extrapolation based on successful precedents?

A beginning is obviously not enough. We must recognize that "control of space" is a rather shaky beginning based solely on precedents that are by no means universally accepted. Moreover none of the Armed Forces has been given any clear-cut space mission. The Army, the Navy, and the Air Force have space-related projects, to be sure, but all these activities are either reasonable extensions of existing missions and capabilities or are scientific pursuits assigned to the various services for wholly pragmatic reasons. The Vanguard program does not imply that it will be the Navy's mission to exploit space or employ armed forces in space. The Air Force's ICBM and X-15 *intrude* upon space in going from one part of the atmosphere to another more than they truly operate *in* space.

Military doctrine is a product of both vision and experience. But its very essence is experience. The distinction between vision and fanaticism is a very narrow one that can only be made with validity in terms of experience. Mitchell's visionary views were vindicated by experience and not by the rhetoric that surrounded them. Only experience will permit the evolution of a meaningful space doctrine.

The moon is our closest neighbor in space. It will doubtless be the site of man's first extraterrestrial explorations. The technologies required to explore the moon are almost at hand. The moon is man's introduction to space and the introduction is about to be realized. All this connotes an opportunity for the experience that develops sound military doctrine.

Space warfare and limited war. It can be argued that a military doctrine for space is unnecessary because man need not or should not ever wage war in space. We have already taken explicit exception to the first part of this argument with our discussion of lunar-based deterrent forces. As to the second part, strangely enough it is possible to argue the contrary on essentially moral grounds: space in general and the moon in particular might be the best possible place to wage war if war must be waged

Since Korea the term "limited war" has enjoyed great popularity. But the Korean encounter did not give birth to this concept. It has been in existence in one form or another as far back as warfare can be traced. Whether for moralistic or pragmatic reasons, all wars have been limited to some degree. David and Goliath fought a limited war, though larger forces were available to settle the issue at stake. The concept of combat limited to champions took a long time to die—if indeed it is truly dead. More modern wars have been limited not only in terms of firepower, terrain, and mobility but also by certain scruples regarding the treatment of prisoners, the distinction between military and nonmilitary targets, etc. The history of warfare is a history of limited wars. Whether this has owed more to man's inability to wage truly total war than to his desire not to is surely debatable. Modern nuclear warfare makes this issue irrelevant. Man now does have the ability to wage truly total war. Indeed even if he does desire to limit a war, modern nuclear weapons and the possibility of miscalculation make limitation a doubtful and dangerous concept. This is a dilemma which remains unresolved.

Space warfare as a form of limited warfare is a possible solution to this dilemma, and the moon and its environs are close enough to the prospective combatants to be convenient but far enough from the inhabitants of earth to ensure their safety.

At first blush the use of the moon as a locale for conducting limited war is surely somewhat fanta. ic. The possible annihilation of mankind in a total nuclear war is also fantastic. Perhaps a fantastic problem requires a fantastic solution.

Is this thought really fantastic? Let us return to what is by now an old theme. Assume that both the U.S.S.R. and the U.S. are busily engaged some years hence in constructing missile launch sites on the moon. Would a lunar battle for control of the best sites necessarily involve combat on earth? Yet settlement of the lunar issue could conceivably preclude the need for settling earth-bound issues by combat on the earth. Contrast this hypothetical situation with a similar clash of forces over oil rights or IRBM bases in the Middle East. What are the prospects for limiting such a war?

In sum, what can be said of the military potential of the moon?

Deterrence. It is hard to escape the conclusion that there is military sense to General Boushey's concept of a lunar-based missile force. Viewed in terms of site hardness and employment capability, the concept is sound; it does not violate military or physical principles. It may even be sound in terms of the more popular and demanding criterion of cost, particularly if some significant degree of lunar autarky is achievable. If deterrence does indeed involve "The Delicate Balance of Terror" that the title and text of Wohlstetter's brilliant paper suggest, then the lunar-based deterrent represents the sort of imaginative thinking that is indispensable to a favorable balance.[27]

Nonconventional potentials. It is possible to envision elements of lunar military potential in terms of psychological warfare, technological warfare, and the development of military doctrine. And it is even possible to speculate on the moon as a locale for limited war. These nonconventional considerations are more provocative than they are subject to proof; like other types of speculation, they may offer a greater return for a given investment.

Command and Staff College

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Overseasmanship

Colonel Richard C. Harris

THE UNITED STATES Government and hundreds of American firms whose foreign interests require them to send representatives abroad are discovering that special training in the fundamentals of *overseasmanship* can pay big dividends. For businessmen overseasmanship pays off in dollars. For government the payoff is in increased capability to influence the attitudes and behavior of foreign groups toward the United States, toward our policies and objectives, and toward the strategy and tactics we employ to obtain those objectives.

Within the past few years it has become increasingly evident to the American public that the attitudes of foreign groups, particularly in the uncommitted nations, can and do influence the degree of success we are able to achieve in our foreign policy. To an appreciable extent, and for better or for worse, foreigners adjust their attitudes toward the United States to conform to their attitudes toward our representatives as individuals. These adjustments may be minute, and our influence as individuals may not be great, but collectively Americans abroad represent a potentially powerful force for exerting a positive influence on the minds and attitudes of peoples in nearly every part of the world. If through their actions and utterances our representatives overseas create hostile or contemptuous attitudes toward us, the long-range result can impede the achievement of our cold-war objectives. If on the other hand they create friendly attitudes and respect, the achievement of our cold-war objectives will be facilitated.

our cold-war responsibilities

Until recently our military services had no directed responsibility for exerting any influence on foreign groups other than the powerful deterrent influence of our hot-war capability. Although for many years the United States Air Force has been developing a psychological warfare program that can be adapted in part to cold-war situations, it has been only within the past two years that

Joint Chiefs of Staff directives have given the military services the authority and responsibility to operate under anything other than a hot-war mandate. The impetus behind these new directives was a growing realization that the "big stick" concept of persuasion is not and cannot be enough. If the premise upon which we have based our policy of deterrence is valid, then Communists must either abandon their avowed long-range objective of world domination or seek it through political, economic, and ideological encroachment rather than through a deliberately initiated hot war. And Soviet leaders have recently been loudly confident of their ability to "bury" democracy without resorting to armed force.

Whether or not the Soviet boast is true, it at least represents

> *Overseasmanship,* in its most basic form, is the ability to adjust to overseas living conditions and to foreign cultures and customs without losing our identity and our dignity as representatives of the United States. The word implies a sufficient knowledge and understanding of foreign cultures and customs to enable us to avoid being unknowingly or unintentionally offensive. In a more advanced form overseasmanship implies the cultural empathy, understanding, and skill in human relations to influence foreign groups or individuals into desired channels of thought, action, and reaction.
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> . . . *Author's definition*

a realistic threat. And it is a safe assumption that the democratic institutions which our Armed Forces are charged with safeguarding would not survive Communist domination regardless of how that domination were achieved—whether through armed force or through the strategy and tactics of cold warfare. Thus it has become evident that, without sacrificing or impairing our capability to wage hot war and without attempting to usurp the roles and missions of other Government agencies, the Armed Forces must exploit to the utmost every aspect of our cold-war potential.

Today, in consonance with this philosophy and because of our enormous influence in world affairs, every significant action taken by the Department of Defense is first weighed carefully for its probable impact on foreign attitudes. In addition, DOD is now considering a number of actions that may result in radical changes in those service policies which govern the selection and training of personnel for key overseas positions.

responsibility of the individual

But military responsibilities for influencing foreign attitudes are not strictly confined to the policy-making level. In a letter directed to the Department of Defense in May 1956, President Eisenhower said:

> . . . clearly, there will never be enough diplomats and information officers at work in the world to get the job done without help from the rest of us. Indeed, if our American ideology is eventually to win out in the great struggle waged between the two opposing ways of life, it must have the active support of thousands of independent private groups and institutions and of millions of individual Americans acting through person-to-person communication in foreign lands.

The emphasis which President Eisenhower places on "individual Americans" is particularly noteworthy. It is in this respect, as a controlled group of individual Americans, that the military services represent a far greater potential for influencing foreign attitudes than do all other groups of Americans combined. Approximately one third of our total military strength is deployed overseas on all six of the world's major continents and within the territorial borders of more than seventy-five sovereign nations.

Some interesting statistics and comments on Americans who live and work abroad are contained in a book entitled, *The Art of Overseasmanship,* coedited by Harland Cleveland and Gerard J. Mangone and published in 1957 by the Syracuse University Press. In one of the studies Dr. Mangone reports that in the spring of 1957 there were approximately 100,000 American civilians living and working abroad as compared to seven times that number of U.S. soldiers and airmen. Of the civilians more than 23,000 were

Both in numbers and in roles, the military bulk large in representing the United States abroad. In 1957, for example, overseas military outnumbered civilians ten to one. The great size of the military group, their round-the-world distribution, plus the importance of diplomatic-type duties performed, mark the group as an extremely important facet of American contact with foreign populations and governments. But how well prepared are they for their quasi-diplomatic roles? Colonel Richard C. Harris, Chief of the Plans and Requirements Division, DCS/Operations, Hq Air University, concludes that considerably more can and must be done to prepare the Air Force officer and his dependents as American representatives abroad. The author is Air Attaché designate to the American Embassy in Mexico.

employed by the Department of Defense, less than 6000 were officers and employees of the Department of State, and about 6000 were employed by other U.S. Government agencies. The remaining sixty-odd thousand were businessmen, missionaries, students, and representatives of philanthropic foundations and various other international organizations and agencies. None of these figures includes dependents.

the military diplomat

The fact is that American military officers stationed abroad on diplomatic and quasi-diplomatic assignments today considerably outnumber similar representatives of our Department of State. Dr. Mangone's statistics showed that of the nearly 6000 Department of State personnel serving abroad in 1957 only 2692 were of officer rank. On the other hand he noted that "some two thousand" military officers were assigned to advisory groups or training missions in foreign countries. In describing the duties of these officers he said,

> Thrown into a close working and social relationship with foreign statesmen and their own counterparts, these officers have found that the success or failure of their mission depends more upon linguistic skill, cultural empathy, and the insights of politicology than on the mathematics and engineering skill they learned in a military academy.

Dr. Mangone made no mention of the many hundreds of additional military officers whose duties include direct negotiation with influential foreign military and civil authorities. Overseas commanders, base level and above, would certainly be included in this category. So too would some of their key staff personnel, particularly those charged with responsibility for community relations programs. Many of our overseas base commanders are involved almost daily in discussion and negotiation with civil governors, city mayors, police commissioners, air traffic controllers, tax commissioners, customs officials, postal authorities, public works officers, labor union representatives, and local church and school authorities. The subjects of discussion and negotiation run the gamut from sanitation problems, wage disputes, and rent control to right-of-entry agreements and jurisdiction in criminal cases. All of this is done in addition to the constant discussion and negotiation with our opposite numbers, the military representatives of the host nation. And in this connection it must be remembered that in many countries the military man has far greater influence in national affairs and in formulating national policy than he does in this country.

Also there are our attachés and our representatives on the many combined staffs that have developed from the host of bilateral and multilateral security agreements in which the United States is involved. In addition to being highly qualified in their professional skills, these officers must be sufficiently skilled in the more advanced forms of overseasmanship to be able to influence foreign groups and individuals into desired, and in some cases deliberately preplanned, channels of thought, action, and reaction. Frequently their duties involve a considerable amount of social representation. This is an added drain on their physical and mental stamina. Far from being the glamorous business popularly supposed, it is more often than not the most grueling sort of drudgery. In this area the wife's role is as important as is that of her husband.

language and selection problems

The ability to influence foreign groups and individuals into deliberately preplanned channels of thought, action, and reaction requires not only intelligence, cultural empathy, a talent for human relations, and a specialized knowledge of the particular foreign culture and customs involved but also in many cases the ability to communicate forcefully and effectively in a foreign language. While it is highly desirable that influential people of other nations learn to communicate with us in our language, for the same reasons it is equally desirable that we learn to communicate in theirs. This poses special problems not only in the education and training of our key overseas representatives but also in their selection and assignment.

With rather rare exceptions it is nearly impossible for American adults to perfect a foreign language not learned during childhood. Since very few of us receive foreign language training before high school, we are notoriously poor linguists. Most of the officers selected for key and special-mission overseas assignments spend from six to twelve months as full-time language students, at a cost of several thousand dollars to the Air Force (in addition to the cost of pipeline times involved). Yet when they arrive on station even the most conscientious students among them are unable to hold their own in anything more than the most basic sort of direct conversation. A great many of the words they hear in a normally intelligent conversation, and almost all the innuendoes and indirect implications, are lost to them. After three years on the job a few of the most able of these officers will have achieved a reasonable degree of fluency. But under present personnel assignment policies, and with only rare exceptions, those few will never again be assigned to duties requiring the hard-earned proficiency they have developed.

It would seem only fair that the man who sweats out two or three years on a barren Pacific island should be given his crack at the French Riviera when next he comes up for an overseas stretch; and our overseas assignment policies are based on this premise. But with so much at stake, can we afford to be strictly fair when filling key slots in our overseas network? Two base commanders, one in the Orient and one in Europe, may each have worked hard and diligently, at considerable expense to the Air Force in time and in dollars, to master the language, culture, and customs of his foreign assignment. Several years later, having swapped assignments, each may have to start from scratch to learn the completely different set of foreign skills that the other has already mastered. There just isn't enough time in the span of years covered by the average Air Force career to permit such luxury! And even if there were, I doubt whether the Communists would be willing to slow down to match our pace.

As for special-mission assignments, there is a traditional but no longer valid tendency among military men to regard them as relatively unimportant contributions toward our basic mission—the safeguarding of American institutions. (It is true that when officers without proper qualifications are assigned to such jobs very little positive contribution is made toward the achievement of our objectives.) These assignments are treated as plums to be distributed as widely as possible, only one to the customer.

This practice has obvious disadvantages in the light of modern requirements. Whenever possible, and without robbing our combat units, it would seem more effective to select our senior representatives on combined staffs, as well as senior attachés and chiefs of mission, from among those officers who have previously performed outstandingly as assistants on similar assignments. This would certainly ensure more effective representation abroad. In many cases it would also effect a considerable saving to the Air Force in dollar cost and pipeline time represented by the special schools and language training usually prerequisite to such assignments. A by-product would be the added incentive for assistants to perform outstandingly.

One of the traditional and most often repeated objections to permitting second tours on special-mission assignments is that the officer on such duty is "out of touch with the Air Force." The contrary is true. Most officers on such assignments are required, by the very nature of their duties, to keep more closely abreast of current Air Force doctrine, policy, strategy, and tactics than the average poor devil buried in the bowels of the Pentagon can find time to do.

But even if our personnel assignment people are allowed more latitude in selecting officers for key overseas positions they will still be faced with a difficult problem—that of identifying, from among applicants who have had no previous opportunity to prove their competency, properly qualified husband-wife teams. By properly qualified I mean that the officer must be professionally competent and that both he and his wife must have the potential to achieve a high degree of skill in the more advanced forms of overseasmanship —including linguistic proficiency if required. The many theses in the Air University Library on the problem of identifying such people, written by former overseas commanders, attachés, and mission chiefs, attest to the fact that no satisfactory solution has yet been devised.

THE Department of Defense is now carefully studying a number of recommendations which may partially solve this problem. My own recommendation for an immediately practical first step toward the solution would be to revise our personnel assignment policies to permit greater utilization of language proficiencies and proven skills in the more advanced forms of overseasmanship. To accomplish this the revised policies should:

- provide for extended tours for officers who are performing outstandingly in key overseas positions
- permit second tours in the same area for officers with special linguistic qualifications or special knowledge and understanding of the culture and the people
- select senior overseas representatives for key positions, as a rule rather than as the exception, from among those officers who have previously performed outstandingly as assistants on similar assignments

the ugly airman

Although it is our key overseas representatives who have unusual opportunities for influencing foreign groups and individuals, our total potential in this aspect of cold warfare is most certainly not limited to key people. Much publicity has been given to the many airmen, frequently of low rank, who have done such splendid work in organizing volunteer good-will projects abroad. Even more publicity has been given to those few individuals who, through malice or just plain stupidity, have touched off anti-American riots and international incidents that have made Communists all over the world shout with glee. Fortunately these latter individuals are the rare exception; but as many an overseas air base commander knows, the benefits of a carefully planned and executed community relations program, or the enthusiasm evoked by mercy flights and good-will demonstrations, are all too frequently nullified by the wave of public indignation resulting from a single thoughtless act of one airman or Air Force dependent. Unfortunately the criticism engendered by such waves of public indignation is seldom directed at the offending individual but rather at the society which the individual presumably represents.

Discipline, of course, is a fundamental requisite. One group of Air University's Command and Staff College students, in discussing USAF representatives abroad, reached the conclusion that "any act by an individual which tends to discredit the United States or the USAF is tantamount to 'giving aid and comfort to the enemy' . . . [and] should be as gravely punished as disobedience, desertion or cowardice in the face of the enemy in a shooting war."

But most of the individuals responsible for creating hostile attitudes toward us do so thoughtlessly or even unknowingly and through ignorance, rather than by intent. If we are to prevent unfortunate incidents, Air Force commanders overseas must supplement firm discipline with a vigorous and mandatory program of continuous education and indoctrination in overseasmanship. Wherever possible such programs should include not only officers, airmen, and DOD civilians but also adult and school-age dependents.

Air Force Pamphlet 34-3-12 provides a good starting point on the basic airman and school-age dependent level for this type of program—but it is only a starting point. On a more advanced level, the recently published Air Force Regulation 55-11a (March

1959) provides a list of do's and don't's for overseas representatives, as well as some good philosophy on doctrine and a dozen excellent rules for communicating with foreign peoples. Even this, to be effective, must be expanded by the commander and related to the particular country and set of customs with which he is concerned.

the pretty American

Many American families find that their first and most difficult lesson in overseasmanship is that of adjusting to strange living conditions. Some unhappy families never do get over this first hurdle. For example, one otherwise charming Air Force wife—who is typical of many to be encountered in various overseas posts—limited her interests to the confines of the commissary, the B.X., the American Officers' Club, and the American movie theater. Repeated cautions about comparative standards of sanitation had made her afraid to take a chance on the famed cuisine of European restaurants. In her home she found herself thoroughly frustrated by the same sort of plumbing fixtures and cooking devices that both her mother and her grandmother had coped with quite cheerfully. She was vexed by her servants and by the marketing system. On top of all this there was the language barrier. She complained frequently and with feeling to her uncomprehending maids, who also became unhappy. Her husband, infected by the contagion, would escape to the office and let off steam by making scathing remarks—within earshot of his "native son" clerks—about the inefficiency of the local authorities.

Both the maids and the clerks reacted just as any loyal American would react were the situation reversed—they accepted the slurs and complaints of their foreign patrons as insults to their nation. Being unable to reply in kind (for fear of losing their jobs) only made the bitterness worse. And, as is so frequently the case, these indigenous employees formed the closest contact between this particular American family and the local community. As employees of the foreigners, they were considered by the local populace to be experts on our manners and mores—and they were only too anxious to spread the word. The otherwise charming Air Force wife, unable to understand the apparent inhospitality of the local populace, attributed it to anti-Americanism. Nor could her husband ever understand why he was unable to get to first base with the "inefficient" local authorities.

Under similar circumstances in a passionately nationalistic Latin-American country a few years ago, an American lady was murdered by a maid who had been driven to desperation by the constant slurs of her foreign mistress. The courts of the land refused to punish the maid on the grounds that "her assault had been motivated by national pride and was therefore an act of defense."

Americans are foreigners

As Americans abroad we are always foreigners. Our dress, speech, and actions are strange to the local populace. At times, unless we make a few concessions to local custom, we are even offensive. In most countries of the world the ladies, although perhaps skimpily clad on the beaches and charmingly décolleté in the evening, do not do their daytime shopping in sunsuits—nor do their husbands wear sports coats to evening social functions. In one Latin country it is against the law for a man to appear on the street in his shirt sleeves. Some Americans living in that country fail to understand that here a man's shirt is still considered to be an undergarment and therefore hardly proper attire for a shopping tour or for receiving guests in home or office.

Fortunately not all Americans find it so difficult to adjust to the strangeness and inconveniences of foreign living. The majority show the same consideration for local customs and sensitivities that all of us expect from foreigners who visit our own country. Many are even ready and willing to sacrifice a modicum of physical comfort in exchange for the rich cultural adventures that are always available to those who are curious and interested. These are the Americans who will easily and surely master the fundamentals of overseasmanship. They will not only be happier and richer in experience than those who do not but they will also be *positive* rather than negative factors in the shaping of foreign attitudes toward our nation and our objectives.

basic overseasmanship

No program for teaching the fundamentals of overseasmanship should attempt to make over each individual airman into an "ambassador in blue." But neither should such a program be entirely negative in character, i.e., only teaching our representatives how to avoid offending our foreign hosts. The ultimate goal must be to prepare our people to command the respect and admiration of the peoples among whom we serve, not only for the sake of ourselves as individuals and as professional airmen but for the Air Force and for the ideals we represent.

We most certainly should encourage each airman and Air Force dependent to prepare himself to discuss American institutions and ideals intelligently and to defend them when necessary, but without belittling the institutions and the ideals of our host nations. And in this connection we must remember that it is not our mission to persuade non-Communist peoples that they should abandon their own institutions and their own way of life in favor of ours. Most peoples of the world, even some of those under authoritarian governments, are as proud of their way of life as we are of ours. They will deeply resent any attempt on our part to change it. Usually they will respect our institutions only to the same degree that we respect their right, not only as individuals but also as nations, to govern themselves in the manner they consider most suitable.

We must remember also, when we feel inclined to flaunt the high standard of living enjoyed by most Americans, that our comparative luxury can appear decadent and odious to many of the underprivileged peoples of the world. Particularly is this true when compared to the dedicated frugality and commonality of purpose which is popularly attributed to Communists. Nor in most cases should we attempt to compare and evaluate personal liberties and responsibilities. The man who struggles from dawn to dark six or seven days a week merely to provide food and shelter for his family is not apt to be overly enthusiastic about achieving freedom of the press or even freedom to participate in government. In fact many American ideals and principles hold little attraction for the majority of the people on this earth.

Instruction in overseasmanship, to achieve optimum results, must teach us to know and respect the personal dignity, the culture, and the customs of other peoples. Above all, it should teach us to see ourselves as foreign peoples see us, so that we may recognize our own vulnerabilities and thus be more tolerant of the weaknesses we see in other ways of life. If we constantly remind ourselves that many of our own customs are as repugnant to the foreigner as some of his are to us–and if we can recognize those customs–we are well on the road to a high degree of achievement in the art of overseasmanship.

a positive program

Instruction in overseasmanship has already been incorporated to some extent in the indoctrination provided to Military Assistance Advisory Group personnel in the recently inaugurated Military Assistance Institute in Washington. Although the MAI provides a certain amount of specialized training which would be of benefit only to MAAG personnel, it is not at all impossible that at some future date the facilities could be enlarged and the overseasmanship portion of the curriculum expanded to accommodate all personnel of all three services who are destined to fill key overseas positions. Most certainly applicable portions of the instruction kits which are now being assembled at the MAI can and should be furnished to all overseas commanders and special-mission personnel.

Other recommendations currently being considered by the Department of Defense, in addition to a re-examination of personnel selection and assignment policies in all three services, include:

- greater emphasis on language study in military dependents schools, in the ROTC programs, and in the service academies
- incentive awards for language proficiency
- special incentive awards, in the form of increased pay or extra time accredited for retirement purposes, for those who specialize in the more exotic languages and who are willing to serve for long periods in the less popular foreign areas
- utilization of civilian or noncommissioned language and area specialists on long-term contract in overseas posts—to provide more continuity
- increased orientation and training in overseasmanship, not only for those who have already been selected for overseas jobs but at all levels of military training and professional education

These are but a few of the many positive considerations and recommendations which are currently being studied by DOD and by the three services. Certainly we will not be able to solve all our problems overnight. But at least we now know that the full extent of our cold-war responsibilities is recognized in the highest military and governmental echelons, and that there is steadily growing support for positive actions, on the part of all three military services, which will enable us to more adequately fulfill those responsibilities.

There can be little hope that our foreign commitments and responsibilities will decrease appreciably within the foreseeable future. On the contrary, there is every indication that the USAF role as an instrument of foreign policy will grow increasingly important, not only as a deterrent but also as a positive force for containing Communist encroachment. Without sacrificing the buildup of our hot-war capability, then, we must develop overseasmanship by every practical method available to us.

America's position of world leadership implies many grave responsibilities. "We are not," as many Air Force commanders are fond of saying, "running a popularity contest." But neither can we stop Communist ideological encroachment with a stick. Leadership by threat and by force is never difficult and is seldom entirely successful. Real leadership implies a great amount of understanding on the part of the leader and a considerable amount of respect and trust on the part of those who must follow.

It is this sort of leadership that the United States and the USAF must provide if we are to win the cold war and preserve the institutions we cherish. It is this sort of leadership that we expect from every Air Force officer assigned to a position of special responsibility and authority in a foreign land. Every airman and every American abroad can and must contribute to the effectiveness of our leadership and to the successful achievement of our objectives.

Headquarters Air University

Meteorology in Plans and Operations

Major Charles F. Roberts and Major Alvan Bruch

SEVERAL years ago the Air Weather Service reorganized, from a geographic command alignment to a functional alignment. Each major air command has since had the support of weather units with the primary mission to provide weather information for that command alone. For some time, then, weather units have been specializing in the types of meteorology that particularly affect the mission of the command they serve. These actions have resulted in improved weather service. Nevertheless it is our opinion that in too many instances weather information is neither adequate nor properly utilized.

There are two reasons for this: (1) the meteorologist cannot produce exactly the information the planner or operator says he needs; (2) the operator or planner cannot use in any intelligent way the information he requests, even if it were completely accurate. The first reason arises from the tenuous nature of the atmosphere and the difficulty of observing or describing the meteorological elements of interest in military problems. The second arises from the fact that military planners, largely ignorant of the fundamentals of meteorological data and advice, design their operations in such a way that weather information can only be applied once –and then at the time when operational flexibility has been removed. At this point, if the operation is at all weather-sensitive, the weather information must be single-valued, and the entire decision—perhaps go or no-go—may rest on the weakest element. If the operation is not weather-sensitive, the futility of seeking weather advice at all is obvious.

This is not to say that weather information cannot aid the military planner. To the contrary, any operation conducted out of doors can be modified to advantage by sound weather advice. The adverse effect of weather will never be completely engineered out of such operations, if only because the economics of such a task would make such an undertaking absurd. So long as an adverse effect can result, weather information must be considered. But the fruitful application of weather advice to plans and operations requires understanding and skill on the part of all concerned. All possible combinations of the plans and the pertinent weather must be considered.

Recognition of present deficiencies leads inescapably to the conclusion that the existing weather support doctrine, as outlined in Air Force Manual 105-6, does not provide for application of all the weather information available to the general planning or operational problem. A sound weather support doctrine must be based on a realistic assessment of meteorological capability–the form and quality of weather information–and on a full and specific knowledge of the operational or planning requirements. It is our purpose to propose a doctrine for the use of meteorological advice that will match the military requirements for meteorological information with the capabilities of the science of meteorology.

military requirements for meteorological service

Our intent is to examine both the meteorological requirements of military forces and the capabilities of the science of meteorology to meet these requirements, then to locate and define a proper balance between the two. Let us begin with the military requirements for meteorological data.

Why are meteorological data required in military operations? The demand for this information arises from the strong influence that the environment exerts on personnel and weapon systems employed in warfare. Nearly all military operations are carried on within the environment of the atmosphere. Consequently the plans and strategies for these operations will be sensitive in some degree

There is unfortunate agreement, according to the authors, between Air Weather Service units and operational personnel and planners that those providing and those utilizing weather information are out of step. The onus for this situation is mutually shared: weather units cannot isolate solely "military" weather information desired by the planner or operator, and the planner or operator cannot design operations with sufficient flexibility to allow more than single application of weather data to a mission. Major Charles F. Roberts of Scientific Services, Hq Air Weather Service, and Major Alvan Bruch, AFIT doctoral candidate at New York University, offer a "planning equation" and other recommendations to better military preparation and use of weather forecasts in military operations.

to atmospheric effects. Consideration of weather and other meteorological conditions is generally incorporated into the plan of any operation that has a significant degree of environmental sensitivity.

What the planner really needs to consider is the effect of environmental factors on the operation he is planning. If unrelated to a particular activity, environmental information has for him neither meaning nor military value. It is necessary to keep in mind, then, that meteorological data have military value only when related to a particular operation and only when presented in terms of operational factors.

To understand how weather information is used in military planning, we should first examine the planning process itself. Planning proceeds very much like the process of problem solving. First there is the stated objective. To accomplish this objective several possible strategies are listed. These may be chosen from the experience of the planner or they may be taken out of classical military theory. Each individual strategy or plan is then tested separately for its ability to attain the objective at the lowest cost. When these tests are completed, the final selection of a plan is made. This becomes the operational plan to be used in accomplishing the objective stated.

The expected success of most plans will be influenced to some degree by the weather factor. The exact amount of influence is sometimes hard to fix in advance. Help can be obtained from analysis of weather effects reported from test exercises, maneuvers, and battles. Ideally the effect of weather on all standard military operations should be expressed quantitatively in simple algebraic formulas. The development of these formulas would appear to be within the operations analysis function.

Without belaboring the reader with mathematical detail, we will simply point out that when the relationship between a weather element and the expected gain from a military operation can be handled quantitatively, the planning or decision-making function can be reduced to a mathematical operation identical to that characteristic of game-theory analysis.

Both the source and the nature of the weather requirement in military planning and decision making are revealed by such an analysis. The result is what we will call the "planning equation." Several rather important implications grow out of this relationship. Notice that the planning process is able to use whatever element of uncertainty is present in the meteorological data. As a matter of fact it is the distribution functions of the data that are actually required for solution of this equation. The analysis also clearly shows how the value of weather information to the planner is proportional to his operational flexibility.

An example of the use of the planning equation may illustrate its significance. This example is greatly oversimplified, with only one operational factor and one weather factor involved. Its only purpose is to show method. Let us assume that the commander of a bomber force must decide on the most effective employment of his force against a particular target area. Either he can employ his force in a high-altitude bombing run using visual sighting, or he can use radar bombing under protective cover of whatever cloud layers are present. Naturally the commander is anxious to achieve maximum effectiveness from this operation. A study of the current campaign by operations analysis has provided a set of guides that the commander can use in formulating his decision.

Assume that the per-cent effectiveness of a visual bombing mission has been found to be related to enemy fighter activity and cloud cover in the following way:

$$E_v = 97 - 8C - n$$

where E_v is effectiveness in percentage, C is target cloud cover in tenths, and n is the number of fighter aircraft committed by the enemy. Assume that the relationship for radar bombing missions was found to be

$$E_r = 55 - n + 2C$$

(using same terminology as in the visual case).

The intelligence estimate has produced the following probability regarding expected enemy fighter activity: 30 aircraft, 40% likely; 35 aircraft, 20%; 20 aircraft, 20%; 40 aircraft, 10%; and 10 aircraft, 10%. The weather forecast presents the following probability distribution for target cloud cover: 4/10, 35%; 6/10, 20%; 3/10, 20%; 2/10, 10%; 7/10, 10%; and 1/10, 5%. These data now provide all the information required to optimize the strategy by use of the planning equation.

For discrete variables the planning equation can be written in matrix notation:

$$G_i = [F_i]\,[P_o]\,[Q_w]$$

Where G_i is the expected gain from the operation, $[F_i]$ is the matrix of the function $F_i(O,W)$. $[P_o]$ and $[Q_w]$ are the probability vectors of the operational and weather elements, respectively. The present example then becomes

$$G_1 = [E_v]\ [P_n]\ [Q_c]$$

$$G_2 = [E_r]\ [P_n]\ [Q_c]$$

When the appropriate values of cloud cover, fighter activity, and their assigned probabilities are substituted in these equations, $G_1 = 42.8\%$ and $G_2 = 47.9\%$. This indicates that under the expected conditions a radar bombing mission would be more effective.

The real significance of systematic use of uncertainty factors is seen when an attempt is made to select an optimum strategy from single-valued "best estimates" of the operational and environmental factors. This approximation involves use of the most likely values of c and n in the formulas for determining effectiveness percentage. This procedure results in values $P_v = 35\%$ and $P_r = 33\%$, indicating a different course of action—in this case a less favorable one—than that determined by the planning equation.

To sum up, (1) the military requirement for weather information is greatest where plans are being prepared and decisions promulgated; (2) the selection of a true optimum course of action requires knowledge of the distribution functions of the weather and operational elements.

present weather service capabilities

Now that we have established the nature of the requirements for weather information, let us ascertain the capabilities of the science of meteorology, as practiced by the military and national weather services, to meet these requirements.

A weather service necessary to meet the requirements which we have established can properly be asked to produce (1) data on the existing physical state of the atmosphere for any place on the surface of the earth, (2) the same data for any time in the past, (3) the same type of data for any future time. The sources of these three types of information lie in the three basic functions of a weather service: observation, climatology, and forecasting. The ability of a weather service to perform these functions will determine how well it can meet the operational requirement. Let us consider the three functions in order.

Observation. The limitations on our ability to satisfactorily observe meteorological elements with complete accuracy arise from (a) limitations in sensing apparatus and (b) representativeness of the observation with respect to the operation. In general, one can say that observations are precise within their resolution limits.

The sensing limitation is purely an instrumental difficulty—one of designing sensors of sufficient precision. By far the greater source of trouble in our observations lies in the question of their representativeness. That is, how faithfully does the observation report those elements which it purports to observe and how relevant is the observation to what should be observed? Consider the difficulty of determining a minimum temperature for an area of very uneven terrain. It is a well-known fact that the variability of temperature in uneven terrain is such as to all but rule out a true representative value. The problem of the relevancy of what is observed to what is needed by the user is illustrated by the difficulty in precisely defining in a physical sense many of the operational parameters that have come into wide usage in military operations and planning.

As an example of the trouble encountered in the measurement of some operational parameters, consider atmospheric visibility (the distance at which objects are visible). The value of this element depends rather strongly on the environmental or background illumination, the visual acuity of the observer, the ability of the observer to distinguish color and light contrasts, and finally, of course, the degree to which the atmosphere transmits light. Of these, only atmospheric transmissivity is subject to complete determination by physical measurement on every occasion.

The lack of precise physical definitions, coupled with this ultrasensitivity of the atmosphere to small-scale local influences that are well below our present detection thresholds, is the source of much of the indeterminacy in weather prediction. These two effects combine to produce a fundamental uncertainty in all weather information.

In short, our capability for meeting the military requirements for meteorological data by observational methods is generally satisfactory for all purposes except those involving elements which lack precise physical definition. These for the most part are operational factors, whose imprecision will often produce weather values that spread over a sizable interval around the "expected" or measured value.

Climatology. When the perspective is changed to one of looking backward to determine what meteorological conditions existed for a particular period in the past, our capability improves to some degree. There is the obvious opportunity to eliminate random error from the original observations. Then too, the difficulties occasioned by the minor fluctuations become less acute due to the smoothing involved in the analysis of a long sequence of these data. However, the same handicaps experienced in weather observation for some of the operational factors are also encountered in providing climatological information for operational purposes.

The climatological capability is limited, in a global sense, by the lack of data for remote areas. The degree of precision is reduced considerably whenever the distribution of weather elements must be inferred from data at another point, because our knowledge of geographical modifications is still only approximate.

The most natural form of these data is the distribution function. Within the normal range of the weather element the distribution is reasonably stable when there is available a modest period of record. How long this period should be can be determined statistically. The use of climatological data in planning implies stationary climatic conditions. The factors controlling climate change so slowly that they may indeed be regarded as constant for the period required by most military plans.

Forecasting. As to the future state of the weather, forecasts have all the uncertainties present in both observational and climatological data, plus a number of others peculiar to the difficulty of prediction itself.

Predictions of any type must be arrived at through one of the following methods: either they must result from the solving of an initial value problem in which the element to be forecast is defined in terms of its initial value and its time derivatives, or else the future values must be obtained from the extrapolation of a time series of the element in question. The first method requires a substantial knowledge of the physical processes involved in producing changes. The second can be carried out with empirical data; but to gain insight into the dynamics of the time series an enormous amount of data must be processed.

At the outset it is necessary to distinguish between weather forecasting and numerical forecasting—more accurately called dynamic prognosis. So far dynamic prognosis has been concerned with simplifying and solving the basic equations of hydrodynamics which describe the behavior of the atmosphere's motion field. For the most part these efforts have been directed toward predicting horizontal motions. Although vertical motions are generally thought to be strongly related to most weather parameters, very little has been done on their prediction except as vertical motion associates with the development of horizontal circulations.

With weather, we have neither a definition of the problem nor an understanding of the processes involved. Both of these are required if the prediction problem is to be stated so that firm solutions can be obtained. The weather element, then, must be treated as a stochastic variable in a prediction system based on extrapolations of time series. It is rather surprising to most people that we still do not even know exactly what data must be on hand in order to make accurate, single-valued predictions of weather conditions at a particular time over a small area.

The fundamental difficulty in the prediction of meteorological or atmospheric phenomena stems from the fact that the atmosphere is a medium in which cause and effect relationships are always multiple and complex. In contrast, most of the physical phenomena treated by the sciences of physics, chemistry, and biology are characterized by causations that are single and direct. It is worthwhile noting that the social sciences are likewise plagued with complex cause and effect relationships, with consequently poor results in the prediction of sociological events and phenomena.

The slow progress in developing dynamic prediction techniques has been accompanied by practical difficulties in fully exploiting statistical extrapolation methods—unavailability of sufficient data, large amounts of data-processing equipment required, cost of developmental program. As a result present forecast capability can only provide a distribution of probable meteorological events that more or less peaks about their most likely value. It is still the practice to issue single-valued forecasts for only the most likely event. This ignores all other possibilities, some of which are nearly as likely as the expected value, and is tantamount to withholding useful meteorological information. Moreover, the value of any forecast should not be judged only on its accuracy in forecasting the most likely event. Certainly the isolation of a probability distribution much narrower than that obtained from climatological frequencies may be a most significant contribution to military planning.

The economic or military value of a *predicted* probability of the occurrence of a weather event, as contrasted with the statistical probability obtainable from pure climatology, can be enhanced by careful analysis of the effect of the weather factor on the planned operation. This analysis should seek a profitable trade-off between operational and weather factors.

As a general rule, if the prediction is based on sound physical principles its military value for planning and decision making is greatly enhanced when the following conditions are met: (1) The normal weather has been engineered out of the operation. (2) The timing of the operation is kept flexible so that the execution order can be given when the probability distribution is strongly peaked, i.e., when the prediction system is near its maximum efficiency. (3) The number of values or classes of the meteorological element is reduced to a minimum.

The present capability of the weather service to provide meteorological forecasts suitable for consideration in military plans and operations appears to be about as follows: Elements determined by direct observation over a long period of time can be forecast with considerable confidence, provided the information is presented in the form of probability distribution functions. Elements indirectly derived are subject to much wider probability distribution and lower confidence values. Information that must be provided in the form of precise, single-valued predictions must be regarded with little confidence. Information supplied at long range will have a distribution approaching that obtained from climatology, but the confidence in such predictions may actually increase over that in certain short-period forecasts.

Finally, there is one other consideration in connection with the proper use of meteorological predictions. The great uncertainties and difficulties characteristic of all forecasting demand that the forecasts used to support military operations be simplified as much as possible. Ideally the forecast should be most applicable at a fixed time, at one place, and for a specific operation. Forecasts are much more likely to produce useful information when they are completely tailored to meet the needs of a specified operation than when provided to serve as general information.

operational analysis of the weather factor

In many instances data will not be available for establishing a definite mathematical relationship between the weather elements and the outcome of a particular operation, such as is required for use in the planning equation. For these cases the operational analysis of the weather factor will have to rest on certain qualitative principles relating weather and human activity.

The effect of weather on any activity that has been properly planned should not be continuous, since modern engineering technology can reduce the handicap of natural environmental factors. A good deal of engineering effort has already been expended in reducing the effects of weather on most human activity. Protective clothing, automobile chains and snow tires, radiator antifreeze, and even the umbrella can be cited as the fruits of engineering technology aimed at reducing the weather influence.

The degree to which weather influences can be eliminated is limited only by the laws of economics. In a military operation one should always make certain that if adverse weather effects produce losses greater than the cost of design changes necessary to eliminate them, the changes are made at the outset. When the cost of continuous weather protection or immunity is higher than the expected net losses, the weather factor will remain as a costly and important consideration. Operations with this sensitivity will require continuous weather forecasting support so that the commander can take whatever periodic protective measures are available to reduce his weather losses.

This principle may be illustrated by the circumstances that led to the development of the all-weather fighter. The old World War II day fighter was quite sensitive to adverse landing-weather conditions, which meant a considerable reduction in the usability of the aircraft. In some combat areas the loss in usability might run as high as twenty per cent, an unacceptable figure when compared to the cost of developing a fighter aircraft with an all-weather capability. Note that the loss in usability of the old day fighter could in no way be made up by forecast weather information, no matter how accurate the predictions. A good weather service could merely ensure that no more flying time was lost in attempting to protect against the weather than was necessitated by the conditions that actually occurred.

In general, the adverse effect of weather elements within the normal climatological spectrum in which the weapon system or strategy will operate must be engineered out in the original design. If this has been taken care of in the design of the weapon system, the planner for any specific operation should find that for his purposes the first real effect of weather will ordinarily be found just outside the normal climate of the area in question. It is at this first discontinuity point that the operator should begin to make systematic use of *forecast* weather.

Indeterminacy in weather information, especially in weather forecasts, has always been difficult to handle effectively. Part of the difficulty lies with the planner himself. Unfortunately most laymen believe that any science worthy of the name is completely deterministic in its treatment of physical relationships. This attitude will, of course, change as more and more probability and game-theory methods are used in planning; but unless the fundamental fact that all physical systems are in some degree indeterminate is recognized and accepted, it will be a long time before a method of integrating weather data into military plans is effective.

The proper use of meteorological information requires that the uncertainty element be recognized as an inherent part of the data, particularly forecast data, and that this be accepted and dealt with in the same way as the other chance elements characterizing military operations. The recent developments in game theory have provided methods for using uncertainty in a completely rational and intelligent manner. Meteorological data must be treated in the same way if their full value is to be realized.

The national weather services themselves are not being very helpful in this regard. For the most part they have denied, by implication, that weather forecasts have large uncertainty factors. To hide the inherent indeterminacy in every forecast, an artificial degree of confidence and precision has been introduced, even into those areas of the forecast where it cannot possibly have practical value. This practice has done military meteorology a great disservice, for many potential users having a genuine need for weather data are driven away by the colossal failures of these precisely stated yet completely trivial forecasts.

To recapitulate, weather information has military value only insofar as it relates to a military plan or operation. It has utility only at those points where plans are being formulated or operational decisions being made. The effect of weather in any operation should be made discontinuous. Its effect should be smallest where weather losses would be high in comparison to the cost of permanent weather protection obtained by a change in design or modification of plan. Its effect is strong when the cost of protection is high in comparison to expected net losses. For an operation that is "weather wise," the influence of a particular weather element will be small near its normal value and will grow as the departure from the normal value increases. The weather forecast should, therefore, be concentrated on reducing the weather losses in the operation, rather than on minimizing error in the forecast. The forecast should provide the most likely value of the weather element in the ranges of operational uncertainty and should state the probable error or uncertainty factor in the forecast. For completely rational use in planning, the data should be supplied as the distribution functions of weather elements and operational factors.

summary

We have attempted to develop and present a general weather support doctrine aimed particularly at the problem of preparation and use of weather forecasts in the planning and execution of military operations. The doctrine rests on certain principles which should be axioms for the military meteorologist or the meteorological staff officer:

- In the initial stages of planning, the meteorological implications of all new plans and designs must be tested.
- Full weather information should be introduced for military consideration only at those points where plans or decisions are being made for operations that are significantly sensitive to weather effects.
- Proper use of meteorological data requires recognition and assessment of the indeterminate character of the atmosphere. The uncertainty factor is as important, and as useful, as is knowledge of the weather element itself.
- The distribution functions of the weather elements are the most useful forms for data to be used in the planning phase of an operation.

To achieve full implementation of this doctrine there are certain requirements:

- that the meteorologist be a consultant to all new plans
- that he be given the right to examine all old plans for faulty "weather injection"
- that he be permitted to substitute self-briefing aids for use in routine operations or for operations that are not weather-sensitive
- that he be encouraged to examine the climatological weather effect that cannot be eliminated by forecast service

When the meteorologist acts as a consultant to new plans, he should be charged with examining the flexible operational factors and applying a climatic analysis to determine:

- the combination of operational factors which stands the best chance of success, in view of the known climatological weather spectrum

- the absolute probability of success with current engineering, and the engineering required if this probability of success is not satisfactory
- the portions of the weather spectrum for which forecast techniques must be developed and the form the weather forecast must take to be useful

After such determinations, the forecast techniques must be developed. The final step is to mechanize the technique so that it can be produced by unskilled personnel or machines, if the operation becomes routine.

The effect of this doctrine would be to have weather detachments generate weather information for three purposes only: (1) for direct placement in self-briefing aids, (2) for centralized processing and return as self-briefing aids, and (3) for development of climatic analyses and forecast techniques by consultant and development meteorologists.

Headquarters Air Weather Service

The Air Force Reporting Problem

. . . and what should be done about it

Colonel Harry F. Cruver

ONE of management's most urgent challenges during the coming decade, according to Mr. Ralph Cordiner, will be in the area of organizing, communicating, and utilizing information for decision making. If this challenge is and promises to be of such significance in civilian administration, then what can be said of its importance within the Defense Department and more specifically within the United States Air Force?

The Rockefeller Report points out that "one of the greatest problems in administering the Department of Defense comes from the difficulty of obtaining complete, accurate and understandable information on which to make decisions."

The problem is not a new one. It has received considerable attention within the United States Air Force. Innumerable surveys and studies have been conducted to determine how improvements could be effected in the reporting system. These have generally started from the premise that the reporting workload is becoming more and more unbearable and that the way to reduce this outlay of manpower, money, and time is to reduce the number and frequency of reports, eliminate duplication, etc. The studies have been conducted by ad hoc committees in major commands and in other headquarters, by special efforts of inspectors general, by personal efforts of commanders, and the like. All these efforts, no matter where initiated or how well intentioned, have yielded little results compared to what is realistically possible of accomplishment.

The reason the reporting system has, by and large, defied concerted efforts toward improvement is that the past approaches have been inadequate to the task involved. Nothing short of a complete and exhaustive overhaul of the reporting structure will suffice. Until all the reports are examined from a systems point of view and management decides *what* information is needed at *what* echelon, the problem will remain one marked by elusiveness and frustration.

The reporting system in its entirety must be subjected to a careful examination, moving down the echelons to the receiving end, scrutinizing the gamut of reports, regardless of who generates the reporting requirement. The "receiving end" is the installation or base or depot, with its organizations and functional activities. When the whole system is examined, there will be very little room for encouragement. Indeed the studied grass-roots conclusion is that the reporting situation is not only festering with greater rapidity but deepening in the process.

Take just one example of how the reporting colossus impinges on the basic organizational unit, the squadron. A recapitulation was made of the recurring and one-time reports required of a fighter-interceptor squadron in the Air Defense Command. Each report was annotated, its frequency considered, and the incidence computed for one year. When all recurring reports had been subjected to the procedure, the total number added up to 1100 reports per year per squadron. The one-time reports for a fighter squadron numbered 15 from 1 January to 30 April, making a projected figure for the year of 45. At Western Air Defense Force, staff personnel annually receive, process, and transmit 18,320 reports from fighter units alone. At the headquarters of Air Defense Command its 60 squadrons have multiplied the number of annual reports to about 69,000. No reasonable person would deny that this is a fantastic paper-work juggernaut burdening our primary mission units.

Decision making may derive a final edge from the experience or sheer flair of the person making the decision, but the rock foundation of consistently good decisions is consistently good information on which to base them. When an organization becomes as large, as diverse, and as rapidly changing as the United States Air Force, the task is to ensure a flow of information that provides enough material to support the right decisions at each level but pyramids only necessary and consolidated information to the higher levels. Colonel Harry F. Cruver, now Chief of the Programs Branch, Directorate of Personnel Planning, DCS/Personnel, Headquarters USAF, analyzed the Air Force system for reporting information when he was a student at the Air War College. He found it piecemeal and lacking a conceptual scheme for organizing management information so that needs throughout the Air Force can be served. His remedy: a complete overhaul, starting with fewer and more intelligently directed reports and going on from there.

My analysis of the faults of the existing system and ideas of actions necessary to build a better one fall naturally into two parts.

Part I. Criticisms of Current Reporting

Since an understanding of what is wrong with the Air Force informational system is pivotal in deciding what to do in the way of betterment, my criticisms of it are specific and are presented in detail at the risk of some repetitiousness or overlapping.

1. *Current reporting fails to provide standards so that results can be evaluated against goals.*

Reports should have built-in standards as a basis of comparison. This point is perhaps the most important. Every report should facilitate the evaluation of actual results by comparison with what they should have been. This concept is almost completely absent in current reporting. What we have are not management reports but detailed quantitative status reports—numbers of personnel assigned at end of month (EOM), obligations through expired periods, bills of lading processed, tons of scrap moved, etc., without reference to what these figures *should* be. By and large, raw data are being transmitted forward rather than having the data analyzed and related to standards or goals, then relaying the results of performance to higher headquarters. True, higher headquarters can take these unfiltered data and through management analysis or otherwise can compare reported results with what they should have been. But this is time-consuming and takes more headquarters personnel. Most of the time it is not done at all except in selected areas. Moreover data that have undergone a series of consolidations at successive echelons become less amenable to productive analysis and intelligent explanation.

To make this point of criticism clearer, let us take just one report as an example, the Surplus Property Report (RCS: AF-S13). This report is prepared monthly and contains 751 items of information on this relatively insignificant base function. Nowhere is there an arrangement of data to indicate the effectiveness of the salvage and disposal operation, which should be a primary concern. Some of the data needed to arrive at this type of evaluation are recorded, but they are incomplete or inconclusive. Included is the full-time and part-time payroll cost for those military and civilian personnel who were assigned at month end; but what it should be is not shown. The manpower expenditure is indicated; but what it should be is not shown. A vastly improved reporting procedure would merely report the results against a predetermined standard.

The same situation that pervades surplus property reporting exists in literally scores of other periodic reports and demonstrates what happens when a new dollar accounting and reporting system is superimposed on an older existing system with no effort at integration. What I emphasize is that masses of raw, unfiltered, and duplicatory data do not provide the ideal flow of information for control and decision making. They do represent a most exasperating malfunction of a bureaucratic system. As Bross remarks in this regard:

> Data may be regarded as the fuel of the Decision-Maker. This fuel must be of good quality if the mechanism is to function properly. Ordinarily statistical decision does not use raw data—it operates on rather highly refined information. Unless considerable care is devoted to the process of refining data, even the fanciest chromium plated decision maker will operate at low efficiency.[1]

2. *Current reporting is increasingly encumbered with ponderous individual reports containing such an abundance of information that they are undigestible.*

These superabundant reports are so loaded down with figures and data that the recipient must devote scores of hours if he is to intelligently decipher the content. With the personnel reductions assessed a couple of years ago on all Air Force headquarters down to division level, the man-hours necessary for analysis are no longer available, if indeed they ever were. So the detail is filed away in the already overloaded statistical archives where it may be consulted some day in the future. As a consequence very limited utilization is realized from this detail, and what is realized could not justify the enormous dollar and personnel costs for its recording, collection, classification, and summarization.

3. *Mechanization makes possible greater masses of detailed information; this has in many respects aggravated rather than simplified the reporting and management problem.*

Mechanization as used here includes all types of machines that are able to improve on the manual procedure, e.g., punch-card systems, transceivers, computers. These make possible the accumulation, processing, and dispatch of vastly larger volumes of data faster than on a manual basis. This capability has been exploited rather promiscuously by higher headquarters to demand more and more detail. One consultant observed that the capacity to produce management information has outstripped the capacity to assimilate it and use it intelligently in running the business.

A more pointed purpose than mere proliferation of detail has been expressed by Mr. Cordiner:

> This deep problem of communication is not solved by providing more volume of data for all concerned, or even by faster accumulation and transmission of conventional data, or by wider distribution of previously existing data, or through holding more conferences. Indeed, the belief that such measures will meet the communications challenge is probably one of the great fallacies in business and managerial thinking. What is required, instead, is a far more penetrating and orderly study of the business in its entirety to *discover what specific information is needed at each particular position in view of the decisions to be made there.* [Italics supplied][2]

This is precisely what has not been given any orderly examination within the Air Force. In the past five to ten years a sort of mechanization neurosis has overtaken much of our thinking, aided and abetted by the vendors of these gadgets. In our enthusiasm for such programs as base mechanization, we may be unwittingly contributing to management sterilization.

With a much greater flow of detailed information to higher headquarters, the tendency is to centralize decision making and control. With a greater abundance of facts and figures, higher headquarters staffs are more prone to interfere with line operations, thus making a decentralization program a mere façade.

Unless electronic equipment is used to provide management with *better information* than it now has, a significant opportunity for improved management and decision making will be lost.

4. *Current reporting requires that too many reports go too far through the USAF organization.*

A good control system provides the tools for management action at all levels and requires that appropriate action be taken at the lowest possible level of management. Under a poor control system, too many reports go through too many levels of organization without action. Good control means fewer reports, better and quicker action, more management time for more management duties. Routine reporting fills file cabinets; advisory reporting gets action.

An excellent example of a report that traverses the entire chain from base headquarters to Headquarters USAF is the Monthly

Report of Individual Projects (RCS: AF-K5). This is a detailed listing of installations work projects—all maintenance, modification, repair, and minor new construction as well as nonappropriated-funds projects. It includes for each project under $2000 eleven items of detailed information. A check at a few bases indicated that 85 is a likely average number of such projects to be reported upon. Roughly two man-days would be required to prepare the report. Extended to the 650 Air Force bases world-wide, that would be 1300 man-days required to report 607,750 items of information on 55,250 work projects, monthly. How can the installations personnel of Hq USAF stay abreast of or profitably use this plethora of line-item detail?

This instance in the area of installations work projects represents not only the acme of reporting absurdity but also the tendency to overcontrol at high levels in spite of the efforts to give greater financial flexibility to the base commander. Operations and maintenance money is now allotted to the base commander at the program level (P 450-570). Therefore the work projects are competing with supplies, civilian personnel pay, and other requirements within a larger money pot. But specialized staffs in higher headquarters are insisting on segmenting out work projects and identifying them with the more restrictive fiscal projects in which they have an inherited interest and which they are obliged to perpetuate because of bureaucratic control procedures laid on by Air Force directives.

The solution is a complete overhauling of the centralized procedures prescribed in Air Force Regulation 93-3 and associated directives, moving the flexibility down to a level where a more businesslike operation can be conducted. With line-item control decentralized, thus paralleling the money control, there should be a similar diffusion of installations personnel from the top echelons where they are now ensconced.

5. *Current reporting is increasingly burdened by one-time (OT) reports.*

The full significance of one-time reports should be understood. Headquarters USAF is cognizant of the problem and has a Reports Control Group to review and evaluate its requirements for one-time reports in the same manner as recurring reports. But this has no effect on the large number of one-time reports required by Office of the Secretary of Defense, Air Materiel Command, Air Materiel areas, major commands, and other agencies outside Headquarters USAF. In any event the manpower outlay occasioned by one-time reports is not in the higher headquarters. The real effort is at the source of the information, the base, with lesser effort at the intermediate headquarters that have to relay the instructions, receive the data, and check, consolidate, and transmit the information, frequently under very tight and unrealistic deadlines. The actual difficulty is at the base. In many instances the requirement is for data extending back several months or into past fiscal or calendar years. Extensive research is therefore necessary in files, records, accounting ledgers, etc. With the recurring reports, personnel can maintain the data in an orderly manner, updated and cumulated, so that it is fairly simple to draw off the report at the known due date. As one base official remarked, "The recurring reports are bad enough, these one-time jobs are killing us!" If all one-time reports, not just the USAF ones, could be reduced by fifty per cent, the manpower saved would be difficult to quantify in numbers of man-years but it would represent an astonishingly large figure.

One other feature of these one-time reports needs to be mentioned. They usually treat a delimited, specialized area of concern and are normally regarded as a separate and distinct phenomenon from the recurring report. A closer examination of the OT reports shows that they in fact contain data closely associated with and frequently duplicatory of data in the periodic reports. This leads to the obvious conclusion that OT reporting could be alleviated to a large extent if the recurring reports were re-engineered to obtain the information that is repeatedly required on a one-time basis.

While the foundation of the reporting system must rest on the periodic, recurring report, there is a definite relationship between it and the OT report. In industry the nonrecurring report is usually called a special report. Recurring reports point out the areas or objects that need to be followed up with special reports. The special report has a definite place in that it provides a more complete analysis of problems, portrays the basic causes of difficulties, and indicates alternative courses of action that might produce the desired results. In other words, the special report has the more detailed and time-consuming task of establishing cause and remedy.

6. *The proliferation of reports has stultified rather than motivated action on the part of responsible officials.*

There are entirely too many routine periodic and one-time reports. The current system is entirely higher-headquarters-oriented and is not designed for the operating level. At base level the enthusiasm of the working personnel naturally falters before the seeming impossibility of meeting the deadlines on all the required reports. To be most effective a control and reporting system must be designed around the needs of all personnel involved, with the greatest need for detail at the lowest level. The excessive demand for information at the highest level implies that this is where the most effective control can be exercised, whereas quite the contrary is the case. With so little attention given to incorporating control information into the reporting system, it is understandable that these curious inversions do arise. Once the need for more refined control information is recognized, the problem is to provide information in the detail and form needed at the lowest levels while still ensuring a flow of information to meet top management problems.

7. *The reporting system does not provide a systematic framework so that requirements below the top level can be incorporated within the system.*

> There seems to be no thought given to the varying nature of information needed by the different levels of command. What will assist the squadron to do its job would bog down USAF Headquarters and what would help this top level would be meaningless to the squadron.[3]

If a pyramidal flow of data were in existence on a systematic basis, the greater detail required at lower levels could be successively filtered out as it moved upward. Under the present system it is necessary for lower levels to issue their own directives and instructions, obtaining related data for the same time period and from the same reporting units as those already obtained by higher echelon. For example, there are eleven combat-readiness and combat-operations reports, plus nine reports of commands engaged in combat operations, all of which end up in the Pentagon. Major command and subordinate headquarters, finding these data inadequate for their needs, require additional information from their tactical units. To take a case in point, Air Defense Command has its own system of operational-readiness reporting (RCS: ADC-V20). This report covers such items as numbers of primary duty aircrews authorized, assigned, training, alert ready, operationally ready, and other; equipment (other than aircraft) authorized, operational readiness of this equipment on hand, hours flown by primary duty aircrews, etc. This information is sent directly to Headquarters ADC from the tactical units, with information copies to the defense forces and divisions. This ADC internal system is quite independent of the reports that must go from ADC to Hq USAF.

It would seem to make a good deal of common sense if all reports were scrutinized in detail so that basic data emanating from the unit could be made adequate for all echelons selectively. All the reports could be synthesized and controlled by a single or related series of reports control symbols, with lower echelons merely supplementing and augmenting where necessary.

8. *Current reporting abounds in errors and inaccuracies.*

Inadequate instructions, turnover of personnel, inherent complexities of some reports (e.g., morning report)—all make for a diminution in quality and accuracy. Consolidation of quantitative data at each level permits egregious errors to become lost in the aggregate. Errors, in number and in amplitude, are concealed beyond the capability of detection by higher headquarters. This at once demonstrates the key role of error control at the *source,* the base, and of next importance, at the numbered-air-force level. There is imperative need for more checks and audits at the source of data accumulation. For example, fuel consumption per flying hour by type of aircraft is rendered much more accurate by the use of maximum, average, and minimum rates that are allowed to be reported—a sort of go-no-go check that can be used profitably by relatively unskilled clerical personnel.

9. *Reporting instructions frequently fail to specify the purpose and use of the report in a meaningful way.*

Personnel engaged in reports preparation and administration will do a better job as to timeliness and accuracy if they realize the urgency of the report and the uses which it is to fulfill. In one regulation the purpose was stated "To prepare additional reports and provide information to higher echelons of command." The purpose should be substantive, particularly if a large workload is engendered. With a few extra words a clear-cut, sincere explanation could be given as to its management applications at its destination and at each intermediate command level.

10. *Current reporting does not make sufficient use of sampling techniques in gathering data.*

There is always the desire of those requesting data to obtain a census or 100-per-cent inclusiveness, rather than using a carefully selected portion of the whole and projecting to get a result that would be adequate to the problem at hand. This is particularly true of one-time demands for reports for a specific purpose. The more extensive use of selective sampling would contribute directly to the reduction of reporting workload and the personnel cost associated with data gathering. What is being done now in this direction is only a fraction of what could be done. The materiel and logistical area is an especially fertile one that has barely been scratched.

11. *Current reporting focuses too much on the past and too little on the future.*

Data and statistics reflecting what has happened merely describe what is already beyond change. If no effort is made to connect the past to the current and the future, the information soon becomes perishable and its utility degraded even at the source.

"Management reports should include a liberal number of predictions and predictors rather than aim solely at a meticulous reporting of historical data. Indicated trends are far more useful to management than determination of so-called exact profits for a short-time period."[4]

If the reporting system becomes a slave to historical figures and does not focus on the future, it cannot accent significant trends on out-of-line performance so that danger areas are spotted in time to take preventive action. In this sense the Air Force system is doubly handicapped; with no built-in standards or common measurements, managers cannot be provided with a way of detecting deviation from standards in time to do anything about it. With common measurements, current operations and information on recent operations provide a means to make continuous and purposeful adjustment of the operation. With the accent on historical figures, coupled with the lack of standards, it is little wonder that much of the information in the system is ready for the archives when it reaches its destination.

12. *Current reporting makes demands for precise data at the highest levels when less detailed and summary data would suffice.*

At times it is necessary to have information reported and consolidated in a very precise manner. An example of this would be the reporting of appropriated monies. Many reports, however, have taken on this requirement for exactitude when it not only is unnecessary but is, upon closer analysis, self-defeating.

13. *Current reporting does not provide a flow of information based upon the relative importance of functions, activities, and resource areas.*

Since current reporting is not related to any conceptual scheme, it must be expected that the organization and utilization of information will not provide coverage such that different areas are treated in reports in accordance with their relative importance, as, for example, in supporting an assigned mission.

There are over forty supply reports feeding into the Directorate of Supply and Services, Hq USAF, including a comprehensive Base Supply Report (RCS: AF-S1) that reflects consolidated base supply operations world-wide. By contrast, only four reports are submitted to the Director of Maintenance Engineering, and these are mostly specialized equipment reports. A more systematic approach to reporting would be to assess the relative importance of all functions within the materiel area of responsibility; refine the data based upon the decisions to be made in each area, the extent of control to be exercised, and the personnel and materiel resource investment involved; and evolve a graduated scale determining where the reporting effort should be focused.

14. *Current reporting is characterized, for the most part, by a one-way information flow upward from the source with negligible feedback of information to the base.*

This one-way siphoning action is to be deplored, since only limited utilization is realized of all reporting agencies' efforts. If higher headquarters periodically informs each reporting level of its performance in relation to other units, this has a salutary effect. Not only does it provide a competitive environment, thus stimulating improvement, but it demonstrates to reporting units that the information is being used. Other by-products are realized, such as more accurate data submission. The Strategic Air Command's publication of management control statements is a signal example.

A successful decentralization program means increased attention to the passing down of information to the field organization.

15. *Current reporting has failed to integrate financial or cost data into other related management information. This has caused duplication and ineffective utilization or nonutilization of available dollar data.*

At a world-wide Comptroller Conference held in September 1954 a panel discussed the subject: "What procedures, reports, and other actions currently required for comptroller purposes can be eliminated through our reports control system, when new type financial data becomes available for financial control?" The discussion supported a view similar to that of this thesis:

> . . . the real problem is not which reports can be eliminated, or how many reports can be eliminated, but rather, *what data is needed by the manager and in what form* . . . the primary objective is not elimination of reports but rather the defining of an over-all source of management information so that the objective of the plan is accomplished. That is, better management for the Air Force.

The panel concluded by recommending:

> That the Air Staff review existing reports presently received, consider the data in these reports as to its essentiality and then determine to what extent the information can be more efficiently collected through the proposed system. This means the financial control plan must be either designed to produce this data, since it has been deemed essential or it will simply become another system imposed upon the existing system of reporting.[5]

Unfortunately the latter is exactly what has happened. Extensive systems of cost, stock fund, and allotment accounting have been installed in the last five years. These accounting systems have been superimposed upon the existing system without any effort toward systematic integration. As a result there are now over fifty periodic reports of a pure cost, funds, and accounting nature required by Headquarters USAF alone, not to mention one-time reports or recurrent reports required by subordinate commands or agencies other than Headquarters USAF. The Financial Management System was developed under AFR 170-6 and under its "bluebook," *A Financial Control Plan for the United States Air Force,* 7 November 1953. At that time and during operation of the test bases, little thought apparently was given to what monetary information would be needed and in what form above base level. Consequently it can be stated with assurance that the effectiveness of financial reporting has progressively deteriorated even since the quoted panel discussion at the 1954 conference.

Financial data are made more meaningful and their usefulness is enhanced if they are tied in with other management information:

> Maximum effectiveness of financial management is achieved only when it is fully integrated into total management and is tied in with

> other aspects of management, such as effective manpower utilization, full utilization of industrial engineering techniques, and vigorous inventory management through modern mechanicalizing methods where applicable. The financial viewpoint should be *one* of the factors on which policies and decisions are made.[6]

General Cork has re-emphasized this thinking in more dramatic language:

> . . . They are trying to keep financial data separate, pure and clean from operational data and vice versa. Neither one, I would like to point out, is worth anything unless they are completely intertwined and mixed up until they both become very dirty. Operational data has got to be dirty with financial data and vice versa to amount to anything. . . .[7]

The reporting of certain financial information, e.g., on appropriated monies, is governed by statute, and therefore definite limits are placed upon reporting latitude. This does not offer adequate explanation, however, for the large number of financial reports that could be reduced or eliminated by incorporating their significant dollar data in other periodic reports.

The comingling of dollar and operational data, together with their common reports codification, would contribute materially to streamlining the Air Force information structure. Control, decision making, and management actions would be facilitated.

16. *Current reporting lacks integration and unity.*

Information emanating at base level is activated by specialized interests at higher levels, and the data are not tied together at their source or as they move upward. We have parallel series of data pertaining to the same subject matter on money and costs, materiel, personnel, and operations, which never become synthesized in a meaningful way. The use of the word "system" when referring to present statistical reporting is ill advised because no real system exists. The report structure currently in effect is strikingly similar to that described by Gustafson:

> Instead of being a coherent, understandable whole, a report structure often tends to be a hodgepodge of unrelated bits and pieces—some overlapping or conflicting, some clear, some confusing. It is not difficult to see why this condition develops. In most companies the structure of management information is neither the product of one mind nor one time. Its parts are seldom developed according to any conceptual scheme. *Each came into being without any thought as to how that part related to the whole.* What we should strive for is a re-

port structure as a whole which represents an integrated plan of control under which the information given to all levels of management is tied together and simply becomes more condensed as higher levels of management are reached.[8]

A well-designed structure of reports should provide each executive with the planning information necessary to make the decisions for which he is responsible and should provide each executive with the control information necessary to relate performance with the planned goals of the activities for which he is responsible.

Part II. Recommendations

The foregoing discussion has emphasized how the instrument panel in the front office of Air Force management has not kept pace with our complex weapon systems and our modern technological air power. To get that instrument panel attuned to today's Air Force, a dynamic approach is in order. Management information must be made into a real decision-making and control tool. With this end in view, I would like to present my ideas as to needed action in the form of these specific recommendations:

1. *That USAF undertake, under the aegis of the Comptroller, a comprehensive research study of all existing reports at all levels down to and including the base, as well as reports required by agencies outside the Air Force.*

This study should *not* be tied to the make-up of existing reports but should be initiated with the concept in mind of completely rebuilding the information structure. The objective should be to ascertain what information is needed, in what detail, at what locations. Further, the specific information needed at each location should be considered in light of the decisions to be made and the control that will be exercised.

The project should proceed in much the same manner as the General Electric Measurements Project.[9] Personnel with detailed know-how in designated areas are selected to work in those areas. They are called study groups or task forces and work under the supervision and direction of the project monitor. The project monitor is responsible for establishing ground rules and guidelines so that all the parts when developed will fit into and be harmonious with the whole.

The entire project should at all times be cognizant of the needs of top management for information, but it should be oriented toward the base and lower echelons where the need for detailed control information is the greatest.

The objective of the project should be a completely redesigned reporting system that, as a minimum, will—

- set forth standards for comparison
  To facilitate decisions, reports must compare results with anticipated goals.
- point out danger areas
  Accenting out-of-line performance will show quickly what is good or bad.
- be timely
  Operating information is perishable; reports must show current conditions.
- cover critical areas
  Often important elements of performance go unreported.
- be simple
  Mechanization has modernized figures, but forms are still old-fashioned.
- be clear
  The one who sees the paper should say, "Here's what I wanted to know."
- focus on the future
  Indicated trends are far more important than exact figures for short periods.
- integrate the report system
  The system must have unity, with one report leading naturally to another.

Participation of intermediate headquarters as well as base-level personnel should be encouraged in each area. For example, subordinate commands should be requested to send in copies of their directives requiring periodic and one-time reports within each area. These could be analyzed to discover what information is required at the different echelons. The Air Materiel Command, which requires so many intercommand reports, as well as agencies outside the Air Force demanding information, should be brought actively into the subject. Certain commands, such as Strategic Air Command and Air Materiel Command, could furnish a wealth of data on standards and measurements that should be built into the USAF-wide structure.

A systematic segmentation of all Air Force informational and reporting areas should be accomplished early in the project. The new groupings should not be affected by the current haphazard classifications. The groupings presently used are inadequate for structuring management information and only highlight the fact that no carefully thought-out system is in effect. Once the project is completed, all reports control symbols would be coded and follow a pattern prescribed by Headquarters USAF. The new reports control coding system should make provision for periodic and one-time reports within each area. Periodic reports should be allocated blocks of numbers, leaving room for one-time reports. These should be identified in sequence by area on an annual basis. This will permit a review of the incidence of one-time reports by area and by the echelon at which they are being generated. The arrangement of the information groupings and their codification should provide for the fixing of responsibility for the creation of reports, i.e., by staff and substaff area.

It is recommended that one area be developed in its entirety as a prototype for all the rest, so that they will have a concrete model from which to work. A suggested prototype might be the motor vehicle operation and maintenance area, which is of considerable concern to all commands, to AMC particularly, to OSD, and to Congress.

2. *That the study teams, in conjunction with their efforts to rebuild the information structure, also develop within each area detailed quantification of objectives.*

This should be done with the view of ultimately achieving improved management results. Carefully organized general and specific objectives stated in terms of time, quality, and quantity will in themselves ensure sufficient control and avoid the tremendous reporting detail as intended by the new system.

3. *That the research study project produce a single, integrated reports manual.*

This manual would contain the principles, policies, and procedures of the new reporting system. More important, it would constitute the *sole* source of authority for all periodic reports. The most common present authority for reports is Air Force regulations, but authority is further diffused in manuals, pamphlets, procurement instructions, technical orders, letters, messages, etc. This diffusion of authority causes disunity and inflexibility in the system and confusion in the field. Regulations, manuals, and other media will, of course, continue in force; but all references to reporting will contain some such standard phrase as: "Reporting will be in accordance with instructions contained in AFM———, Integrated Reports Manual."

This manual should be loose-leaf. The format should be standardized and carefully designed to cover the purpose of the report in some detail, the frequency, due dates, management uses of the information at different levels, D-day status and precedence, standards and measurements applicable, etc. The manual and changes thereto should be distributed promptly to all echelons, including bases, so that subordinate-level reporting requirements can be further dovetailed into the system. This will relieve lower echelons of the necessity of maintaining files and records of Reports Control Symbols, frequency, due date, authorities, etc., as they are now doing.

4. *That an integrated information center be established at all bases in implementation of the proposed reporting system.*

This center would serve primarily a catalytic function—that of assembling, auditing, and collating all information emanating from the base, pertaining to costs, materiel, personnel, flying hours, etc. The center might be visualized as a converter: retail data fed into the center are converted into wholesale information and tailored to the needs of higher headquarters. The data would be refined and filtered so that more meaningful information would be moved up the echelons. Critical performance indicators would be brought together at this center. Other functions of the center should be delineated, such as quality control of reports originating at the base. This would include systematic collection of error data, analysis of these data, and corrective action to eliminate causes.

Key individuals currently working on data collection and reports in various activities of the base should be assigned to this center, e.g., installations, supply personnel, etc., under the supervision of the information center director. This director should be a civilian so as to provide continuity and to ensure a comprehensive knowledge of all phases of reports administration.

A base should be selected on a pilot basis to develop the detailed procedures of this information center—its manning, functions, relationships with other base activities, etc. Upon completion of the over-all research study project, integrated base-level information centers could be activated USAF-wide. Similar centers at all headquarters might be desirable; but the base-level centralization of data flow is regarded as essential.

5. *That the Office of Manpower and Organization, Headquarters USAF, publish a regulation in the 25-series spelling out and making more explicit the USAF philosophy of managerial decentralization.*

The brief reference and generalization contained in Air Force Regulation 25-1 are inadequate, considering the importance of the matter. This relates directly to the reporting problem, since decentralization will work if real authority is delegated and will not work if details then have to be reported, or, worse yet, if they have to be "checked" first. One of the important factors to a successful decentralization program, as Professor Hansen points out, is "the creation of the attitude that decentralized decision-making is really wanted by top management. This involves the willingness to bear the cost of mistakes if these are necessary to demonstrate the sincerity of the objective."[10]

In addition to the publication of this regulation, the Chief or Vice Chief of Staff, USAF, should issue a letter over his signature, expanding on this decentralization theme and relating it more specifically to the information flow problem. This should be timed to coincide with the completion of the research project.

6. *That Air Force Regulation 25-1, "Work Measurement System," and Air Force Manual 25-4, "USAF Work Measurement System," be voided and completely rewritten.*

The new regulation and manual should not be delimited to present manpower coverage but should be expanded to include all areas amenable to measurement in terms of quantity, quality, cost, and time-use. The expanded work-measurement program should emphasize the relationship of measurements and standards to the financial account structure so that financial information will have more significance at all levels. This would be more in harmony then with the plans to improve the capability to provide financial management service to command. The Comptroller and the Director of Manpower and Organization should conduct a joint effort with respect to a more inclusive work-measurement program. This program should be implemented as soon as possible so that it can contribute to the research project.

THESE recommendations and the preceding criticisms should not leave the impression that the system being proposed is to rely solely or even primarily on techniques or statistics. As Mr. Cordiner warns:

> To adopt a system or approach that relies primarily on statistics could easily foster a dangerous tendency to assume that anything which cannot be expressed numerically does not actually exist. Such a theoretical approach could lead to excessive rigidity, and to overlooking many of the most important factors, especially the human factors.

It is a commonplace observation that too often management techniques are stuck onto organizations like adhesive tape. *People make techniques perform; techniques do not make people perform.*

One of the key elements in a dynamic decentralization program is to achieve

> . . . a successful blend of personal dealing and impersonal report control. It is a mistake to regard these two forms of control as interchangeable. They are not; they are complementary. Reports can never replace the understanding which results from face-to-face dealing; face-to-face dealing can never achieve the impartiality nor compel the study of facts as the statistical report does. In fact, impersonal reports give the point to personal control.[11]

Air War College

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Quick Strike Equation

Major General Dale O. Smith

WITH the space-missile age dramatically drawing our attention, many people are suggesting that we withdraw from our advance bases. It is extremely costly to keep these outposts manned and supplied all over the world. Wouldn't we do better to invest that money in missile development and production? Wouldn't this help to avoid the "gap" that some are predicting, when the Soviets will have more operational intercontinental missiles than we?

Overseas bases give us many political headaches, too. The Department of State is overworked negotiating base rights and status-of-forces agreements. Our overseas bases are potential sources of trouble with our allies. Wouldn't it be better to chuck them altogether and rely on launching attacks directly from the zone of interior?

There is one compelling reason for holding on to these bases. A simple tactical equation can illustrate the great strategic advantage derived from advance bases. Let us call it the "quick strike equation."

Let d equal distance from a friendly launch pad to an enemy target.

Let D equal the distance from an enemy launch pad to a friendly target.

Let v equal missile or aircraft velocity, both friendly and enemy. (Assumption of equal velocity for friendly and enemy is based on equal technological progress.)

Now let time of flight equal t for friendly missile, T for enemy missile.

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Then

$$t = \frac{d}{v}$$

and

$$T = \frac{D}{v}$$

If

$$d < D$$

then

$$t < T \quad \text{in every case}$$

No matter how much v varies, whether it be 600 mph or 60,000 mph, t will always be less than T.

Thus, regardless of increase in weapon velocity, time of flight remains a function of distance, and the ratio between t and T will remain constant, whatever the change in velocity v.

True, as v increases, the raw values of t and T will decrease; but t will always be less than T as long as d is less than D.

If for no other reason than this, advance bases must be held. Distance is a constant factor that provides a constant advantage, regardless of speed, in the quick strike equation.

Of course, as velocities increase, the difference between t and T will decrease. But *never* will t become greater than T. The psychological importance of this fact is tremendous.

It means that should an enemy decide to launch his missiles and we learn about it, our missiles from advance bases would hit him *before* his missiles reached our zone-of-interior installations. This is a sobering thought for any would-be aggressor.

Advance bases do not promise defense against his missiles if he decides to trigger the first blow. But they do provide us with a distinct psychological and tactical advantage, as shown by the quick strike equation.

It is not likely that the first exchange of missiles will decide the war. Since the time of flight is less from advance bases, succeeding strikes can be launched more rapidly. Hence the rain of destruction from advance bases will be heavier than that issuing from more distant launching sites. There are many reasons why this is so.

First, with respect to manned aircraft or missiles that may be used more than once, the turn-around time is quicker.

In the case of unmanned, one-shot missiles, there is still the problem of evaluating the results, and one must wait until the missile strikes before such an evaluation is possible. Whether the evaluation be accomplished by television, radar, or eyeball, the missile must strike before its accuracy can be determined and corrections made for the following shots. This evaluation occurs sooner for the advance-base missiles simply because time of flight is less.

There is also the question of accuracy. Should two missiles of equal sophistication be fired, one from an advance base and the other from a rearward base, the probability is greater that the missile of shorter range will be more accurate. In the first place a shorter time of flight provides less time for something to go wrong. Thus even when target-seeking missiles are employed, the shorter range missile has the accuracy (and reliability) advantage. Should pure ballistic missiles be employed, without guidance, we would have an artillery situation, with accuracy varying inversely with range at all times.

Reliability advantage for shorter range missiles can definitely be predicted. Shorter range missiles do not require as much power, as much fuel, as many boost stages, as much weight, and as much general complexity for the same amount of blast yield.

This is not an either/or argument. Certainly long-range missiles provide some distinct advantages. They are better protected and nearer to the source of supplies. But to consider intercontinental missiles as the end-all of military weapons is to be blind to the mechanics of war.

Advance bases provide us a constant advantage that can only be overcome by a distinct technological advantage gained by the enemy. If we stay at least even with him technically, we are on top of his gun with advance bases.

Since the technological race is keen and is open to some question as regards who has the advantage, it behooves us to hang on to our advance bases regardless of the expense or inconvenience. The advantage of geographical position will *always* be a real asset in war.

Headquarters 313th Air Division

The Operational Posture of the Royal Air Force, 1959

Wing Commander C. W. Hayes

On 1 April 1958 the Royal Air Force celebrated the fortieth anniversary of its formation. During these forty years there have been many far-reaching changes in the tasks, size, and equipment of the Force. The four years which have passed since the last article on this subject appeared in the *Quarterly Review** have been no exception. During this period United Kingdom defence policy has been reviewed in detail. To understand the function, size, and composition of the Royal Air Force of today and tomorrow it is necessary to look briefly at United Kingdom defence policy as a whole.

United Kingdom defence policy

The principal factors which have been taken into account in the formulation of United Kingdom defence policy in the past two or three years are:

- developments in the nature, effectiveness, and cost of weapons and military equipment
- developments in the international situation and the nature of the Communist threat to the free world
- the United Kingdom's national economic position

The development of megaton weapons and of missiles—particularly those for strategic bombardment—has changed the character of military planning. The power of weapons of mass destruction has made all-out war nonsensical. At the same time, so long as the West maintains an effective deterrent, the Communists are likely to pursue their aim of world domination by means of cold-war activity and limited military operations. From this springs the necessity of collective Western defence. To play her part effectively

*"The Royal Air Force—A Gallant Force Re-equips for the Jet-Atomic Age," by Wing Commander M. H. Le Bas, *Air University Quarterly Review*, VIII, 1 (Summer 1955), 22.

in the free world Britain must maintain a viable economy and a healthy export trade. Thus in determining the scale of military expenditure the importance of maintaining the country's economic strength must be borne in mind.

In the light of these factors the principal objects of United Kingdom defence policy can be placed in a general—though not necessarily mutually exclusive—order of priority:

- to maintain an effective deterrent, both for national purposes and as a contribution to the Western deterrent
- to play her part in cold-war activities and in resisting any limited aggression, in concert with her allies or in some cases alone
- in addition to her obligations as a full member of collective defence pacts such as N.A.T.O., the Baghdad Pact, and S.E.A.T.O., to fulfil her special responsibilities for the protection and defence of her colonies and of countries to which she has special commitments
- to play her part in global war should the deterrent fail—an aspect which requires little further discussion

To achieve these objects it is the United Kingdom's policy to provide compact forces—which will be all-regular by 1962—with a high degree of mobility and with the most up-to-date equipment. Mention must also be made of the importance which the United Kingdom attaches to interdependence. The "Declaration of Common Purpose" by the President of the United States and the Prime Minister of the United Kingdom emphasized the special and important relationship between the two countries in this respect.

role of the R.A.F.

Within the broad framework of United Kingdom defence policy the R.A.F.'s principal tasks are:

- to maintain an effective British deterrent force and provide for its defence. This is the primary task of Bomber Command and Fighter Command, with the forces assigned or earmarked for N.A.T.O. as a necessary complement.
- to provide forces to meet the needs of the cold war and local operations and to deal with limited operations. For this purpose the R.A.F. maintains in the main overseas theatres—the Mediterranean and Middle East, the Ara-

bian Peninsula and the Far East—forces adequate for immediate theatre requirements. It also provides for their reinforcement at short notice with combat aircraft and with troops from the United Kingdom and from other theatres should the need arise. Forces committed to N.A.T.O. (in whose area limited war is not feasible) also represent a cold-war effort, since they contribute to the cohesion of the alliance in addition to being a necessary complement to the deterrent as already mentioned.

- to be ready to resist aggression should global war break out despite the deterrent.

Let us look now in a little more detail at how the R.A.F. meets these tasks.

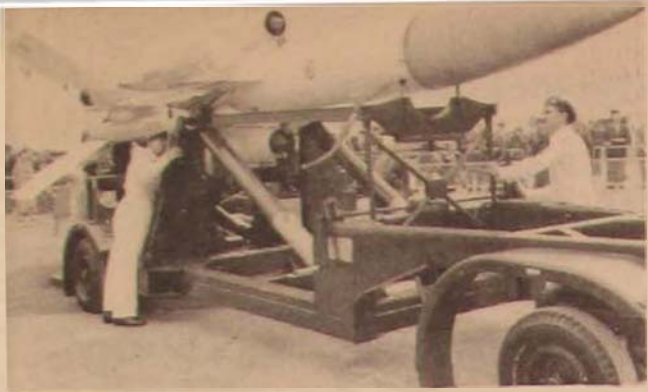
the deterrent and its defence

Bomber Command provides and maintains the United Kingdom nuclear deterrent. An increasing proportion of this strategic bomber force is equipped with Vulcans and Victors, and later marks of these aircraft with even greater performance are to be brought into service. In the meantime the performance of the Vulcan and Victor remains unsurpassed by any bomber aircraft in service today. The Valiants are now developing tanker techniques to give additional flexibility and range to the strike elements of the Force.

The relationship between Bomber Command and Strategic Air Command is a very close one, as General Power recently emphasized. Indeed it is vital for the West that this should be so, for should the deterrent ever have to be launched, Bomber Command would, for reasons of geography, form the spearhead of Allied attack. A more widely known example of this close relationship between the two forces is Bomber Command's participation in the SAC Bombing Competition, in which it achieved ninth and twelfth places out of 164 entries in 1958.

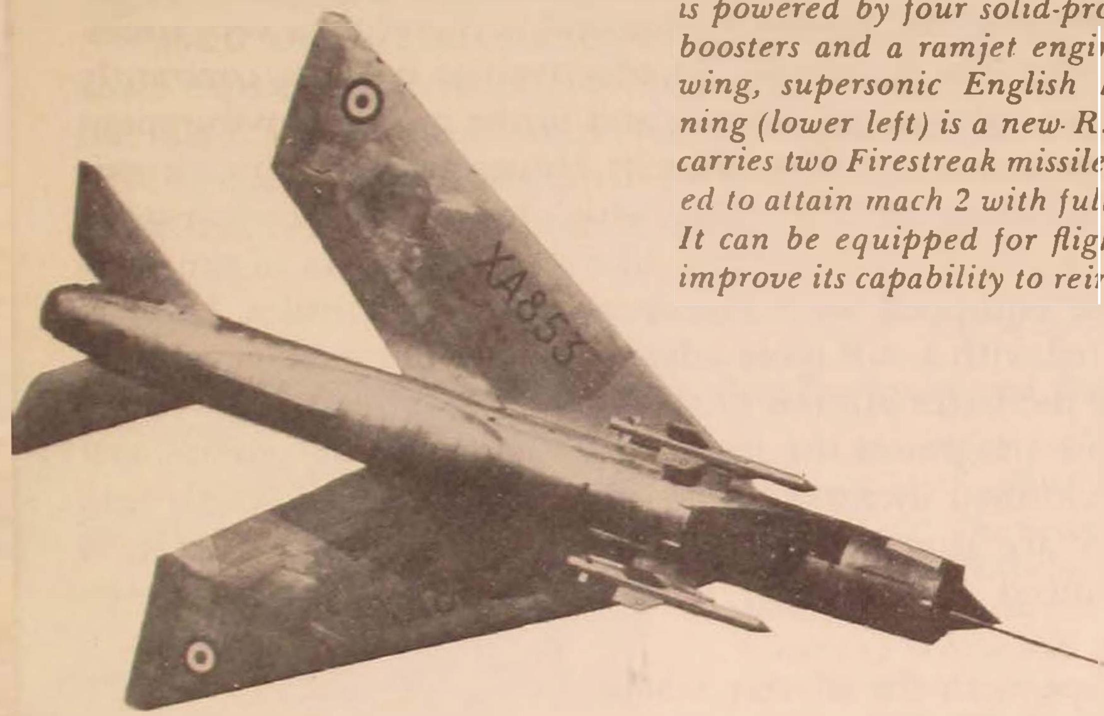
As to weapons, since the successful testing of thermonuclear bombs at Christmas Island, deliveries of British megaton bombs to the R.A.F. continue. Kiloton weapons have long since been tested at Maralinga and put into production. In the nuclear weapons field the exchange of information now taking place between the U.S. and U.K. is most valuable.

A significant extension to the effectiveness and the life of the V-bombers will be obtained from the development of a propelled



The Defence

The supersonic Bristol/Ferranti Bloodhound (left), Britain's first surface-to-air guided weapon system, has undergone test firings at the R.A.F. station at North Coates since July 1957. This interceptor missile augments Fighter Command's over-all defensive system for the United Kingdom. It is powered by four solid-propellant rocket boosters and a ramjet engine. The swept-wing, supersonic English Electric Lightning (lower left) is a new R.A.F. fighter. It carries two Firestreak missiles and is expected to attain mach 2 with full military load. It can be equipped for flight refueling to improve its capability to reinforce overseas.



stand-off bomb. At the same time the introduction of ballistic missiles will supplement the effective striking power of Bomber Command. As a preliminary step in this armament, U.S.A.F. Thor missiles are now being deployed in the United Kingdom as R.A.F. weapons, the launching of which would be ordered only on the joint decision of the two Governments. The decision when to classify these weapons as operational rests with the British Government and depends on the successful completion of test firings. In the meantime the R.A.F. will reap considerable benefits, since training in the operation of these missiles and organising the essential maintenance and logistic support will pave the way for the introduction of the British Blue Streak missile. The latter is being developed for underground launching, and the test vehicle, Black Knight, has been successfully launched.

The strike elements of course need photographic reconnaissance support. This is provided by Victor, Valiant, and Canberra aircraft from Bomber Command. One interesting point in this respect is the promising development of the technique of radar photography, which has already been used to complete a radar mosaic of the United Kingdom.

But no deterrent can be effective if the enemy believes he can smother it by pre-emptive attack. Whilst dispersal and rapid reaction time (which is now down to less than six minutes from crew room to airborne) both have an essential part to play in making the enemy's task more difficult, an active air defence of the deterrent is indispensable. Fighter Command is therefore a very necessary adjunct to the deterrent. Its effectiveness is being constantly improved, in missiles and aircraft and in the ground environment in which both operate. The present Hunter and Javelin aircraft will be replaced by the Lightning, which has already flown at twice the speed of sound. This aircraft, like the later marks of the Javelin, will be equipped with Firestreak air-to-air missiles. Later it will be fitted with a still more advanced weapon system capable of destroying the faster aircraft of the future.

As time progresses the task of defending the deterrent bases will be performed increasingly by Bloodhound ground-to-air missiles, which are already being deployed in an operational role. A more advanced ground-to-air missile system is also being developed.

To cope with the shorter reaction time available for air defence and to meet the needs of co-ordinating control of fighters and missiles, the Control and Reporting System is being further streamlined and provided with more powerful radar as well as electronic computing equipment. There is close liaison between the United Kingdom Control and Reporting System and those of other N.A.T.O. countries, and co-operation between them is frequently exercised.

Despite the increasingly important part played by missiles in air defence, fighters will still be required to deal with manned aircraft at longer ranges, to investigate unidentified movements, to prevent reconnaissance, and to deal with the stand-off bomber and jammer while these threats continue. In addition, Fighter Command aircraft will be needed to reinforce overseas theatres, as explained later in this article.

R.A.F. contribution to N.A.T.O.

In Germany the R.A.F.'s main contribution is to the shield forces of N.A.T.O.—an essential complement to the Western nuclear deterrent. At the moment, fighter defence is provided by Hunter and Javelin aircraft, but these forces will be progressively reduced as the German Air Force builds up its strength. To assist in this buildup, so vital to the Supreme Allied Commander's defence requirements, one hundred flying instructors have recently been loaned to the German Air Force. The R.A.F. is also training German Air Force personnel to take over the Control and Reporting radar stations in northern Germany.

Swift and Canberra aircraft provide photographic reconnaissance capability. Its effectiveness can perhaps best be judged by the fact that the Royal Air Force provided a major contribution to the success of the 2nd Allied Tactical Air Force which won the Royal Flush II and III photo reconnaissance competitions in 1957 and 1958.

The Transport and Patrol

(1) De Havilland Mk. 2 Comet aircraft made up the world's first jet transport squadron. (2) The long-range Avro Shackleton Mk. 3 is Coastal Command's latest maritime reconnaissance aircraft. (3) The Armstrong Whitworth 660 military transport has a short-range, heavy-freight role. (4) The Bristol turboprop Britannia 253 has the greatest payload/range capability of any Transport Command aircraft.

R.A.F. (Germany) also includes Canberra squadrons with a nuclear capability and they contribute considerably to the strike potential available to Supreme Allied Commander, Europe. There are also nuclear bomber squadrons based in the United Kingdom and assigned to S.A.C.E.U.R. These are currently equipped with Canberras and will later be re-armed with Valiants.

In passing, a tribute should be paid to the long and valuable service given by the Canberra (the U.S.A.F. version of which is the B.57) in a variety of roles. As a successor to the Canberra for tactical strike and reconnaissance, a general-purpose aircraft designated T.S.R.2 is being developed. It will have a supersonic, low-flying, all-weather nuclear bombing capability. It will also be able to operate from short and lightly constructed runways, which will give a high degree of operational flexibility.

Finally there are the Maritime Reconnaissance forces of Coastal Command based in the United Kingdom and of the R.A.F. in Malta. These are equipped with Shackleton aircraft capable of employing all known airborne antisubmarine weapons. By virtue of their long range and endurance, their varied armament and carrying capacity, these are particularly versatile aircraft that can also be used for sea/air rescue, troop carrying, reconnaissance, and bombing.

Middle East Air Force

The headquarters of the Middle East Air Force is in Cyprus. The main functions of the Force are to provide support for the Baghdad Pact and to fulfil specifically British responsibilities in the Mediterranean and Levant, such as our defence obligations to Libya. The air defence and radar facilities in Cyprus itself also contribute to the protection of the southern flank of the N.A.T.O. area.

The main elements in this Force are the Canberra squadrons, which provide both a nuclear strike potential for the Baghdad Pact and photographic reconnaissance, and an air defence element consisting of Hunters and Javelins. The Force also has its own tactical transport element, equipped with Hastings, and Sycamore helicopters for the sea/air rescue role.

Arabian Peninsula

The fact that the West can no longer guarantee that the Suez

Canal will remain open in times of tension or emergency, and that the air space between the Near and Middle East can be restricted, has led to the establishment of a new and separate command in the Arabian Peninsula. The opportunity was taken to introduce the system of unified command, i.e., to place the three Services under a single commander responsible for operations to the Chiefs of Staff. This system has worked well and may be introduced into other overseas theatres. At the present the over-all commander in this theatre is an air officer. The primary task of the Command is to keep the peace in Aden and in the Persian Gulf states under British protection.

The Arabian Peninsula Command is equipped with Hunters to meet the day-fighter/ground-attack requirement and with Meteors for fighter reconnaissance. The versatility of the Shackleton is of particular benefit in this area, for in addition to its maritime and air-trooping roles it has proved to be very useful for normal policing operations over undeveloped territories. Heavy theatre transport is available in the form of Beverleys (particularly valuable where movement of bulky loads is almost impossible by surface means), while short-range transport is provided by Pembrokes and Twin Pioneers. Both these aircraft can be fitted with voice equipment for air broadcasting, so useful in operations over these underdeveloped territories. As in Cyprus, the Sycamore provides the sea/air rescue element.

Far East Air Force

The main tasks of this Command, in which important elements of the Royal Australian and New Zealand Air Forces serve alongside the R.A.F., are:

- to support S.E.A.T.O.
- to assist the Federation of Malaya, at her request, both in external defence and in stamping out Communist terrorism (a long and arduous task in very difficult jungle conditions which is now nearing completion)
- to fulfil other defense commitments in South East Asia

The Command extends from Hong Kong round to the staging post at Gan in the Indian Ocean, which forms an important link in air communications with Europe.

The main base area is in Singapore, with "up-country" stations in the Federation of Malaya. The Venom operates in the day-fighter/ground-attack and fighter reconnaissance roles; Canberras provide the light-bomber strike elements. Photographic reconnaissance is carried out by Meteors and Pembrokes. The latter aircraft may be fitted with voice equipment to replace the worthy Dakotas which have proved so very useful in the type of operations peculiar to this most inhospitable territory. Last year some 84,000,000 leaflets were dropped and some 550 hours of air broadcasting were completed in the prosecution of the antiterrorist campaign.

Both short-range and longer range heavy-freight transport is essential to this theatre. The heavy-lift requirement is catered for by Hastings and Beverleys, while Sycamores, Whirlwinds, Pioneers, and Twin Pioneers provide the short-range component. The versatile Shackleton again supports these forces.

reinforcement of overseas theatres

The base areas throughout the world provide suitable logistic and mounting facilities for larger forces in an emergency, albeit under austere conditions. It would be an undesirable extravagance, however, to attempt to maintain large balanced forces in each theatre sufficient to undertake limited-war operations. Furthermore in the rapidly changing pattern of world events it is quite impossible to forecast with any degree of accuracy where or when trouble may arise.

This has led to the concept of a central strategic reserve of troops with the ability to deploy rapidly to any part of the world. Such rapid mobility calls for air transport, and for this purpose Transport Command in the United Kingdom is being built up.

The Command at present consists of Comets, Hastings, and Beverleys. Britannias have also recently been introduced, and these will very greatly increase the available strategic lift of personnel and freight and will release Hastings for the tactical and freight-carrying role. In the longer term the A.W.660 will largely replace the Beverley for the movement of heavy freight over the shorter ranges and the Britannia will be introduced for strategic freight movement. The A.W.660 will be capable of being refueled in flight.

Thus the rapidity with which Transport Command can move troops and their equipment to any trouble spot where they are needed is being greatly increased. In emergency the Command also provides support for the deployment of combat aircraft to reinforce overseas commands.

This overseas reinforcement is already regularly practised by

Bomber Command, with V-bombers and Canberras, to all theatres and by Fighter Command to the Mediterranean and Middle East. Both Javelins and Lightnings are to be given an in-flight refueling capability that will enable them rapidly to reinforce the Far East as well if necessary.

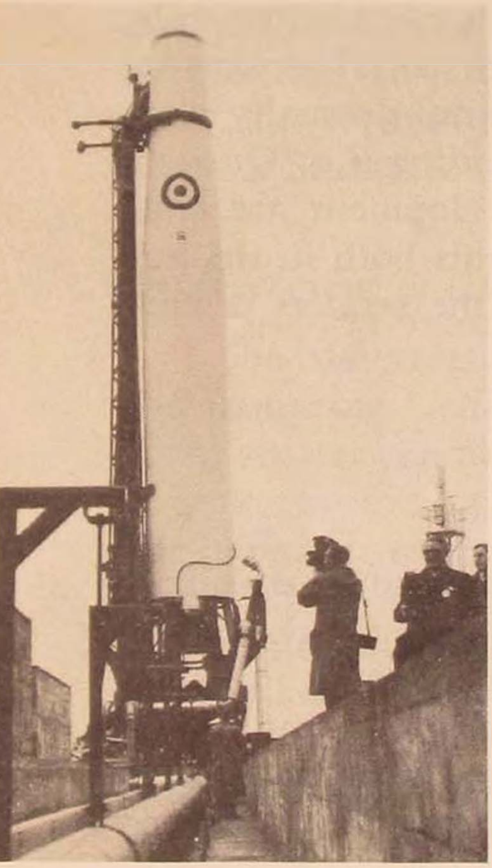
Pervading the defence capability to reinforce quickly is the versatility of Transport Command. It carries out day-to-day tasks to maintain the overseas base areas and to support weapons research and development programmes. In regard to the former, freight and passenger traffic is run on a 24-hour basis of shuttle service while the Command also retains the ability to mount special services to carry urgent freight, transport V.I.P.s, and undertake casualty evacuation missions. It also has the honour of providing the "Queen's Flight." As far as weapons research and development are concerned, the nuclear weapons trials establishments both in the Pacific and in Australia rely very heavily upon the services of this Command.

functions common to all roles

Communications and electronics are common to all roles and commands. Since these are becoming increasingly important, No. 90 Group, which was formerly responsible, has now been raised to the status of a full command. This new Signals Command is primarily concerned with the engineering and servicing of radio and radar installations and with the calibration and operation of navigational aids and telecommunications.

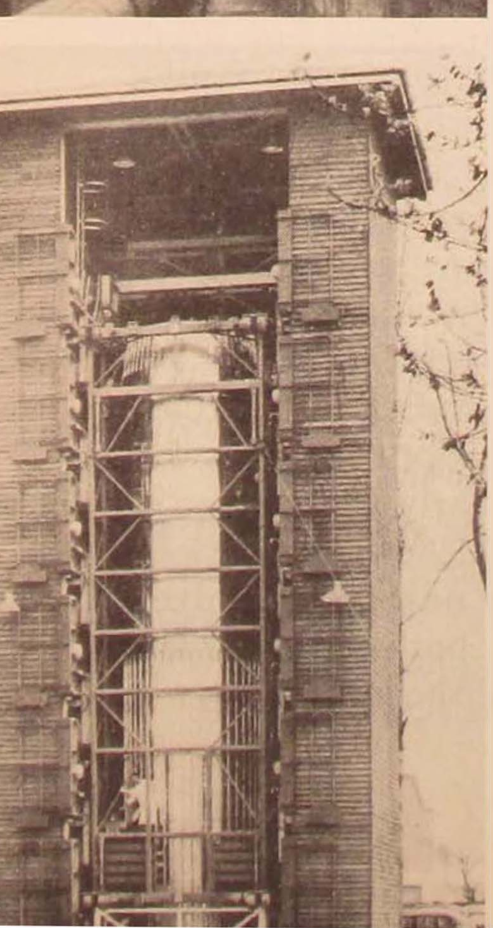
Commensurate with being the first air force to introduce pilot training exclusively on jets, basic flying schools are being equipped with Provost jets. The maintenance of a very high standard of training has resulted, in the last year, in the lowest fatal accident rates ever recorded for both jet and piston-engine aircraft.

The tendency for all weapons and equipment to become more complex demands greater maintenance and operating skills. Accordingly both flying and technical training standards and syllabi have been suitably modified. Higher qualifications are now becoming necessary to enter the R.A.F., particularly the college at Cranwell—the R.A.F. equivalent of the U.S.A.F. Academy at Colorado Springs. Furthermore technical cadets are now filling university vacancies for engineer degree courses, and both technical and general-duty weapons courses are firmly established.



The Offence

Britain's support of the Western nuclear deterrent rests on the three V-bombers (Victor, Vulcan, Valiant), which will be supplemented by the Thor and Blue Streak IRBMs. (1) The crescent-winged Handley Page Victor, the biggest and heaviest of the V-bombers, entered Bomber Command in April 1958. (2) The Avro Vulcan delta bomber (97 feet long, 99-foot wingspan) was added to Bomber Command in May 1956. The V-bombers will spearhead Allied nuclear retaliatory forces. (3) The Vickers Valiant, like all V-bombers, carries a 5-man crew: 2 pilots, 2 navigators, and an air electronics officer. It entered Bomber Command service in 1955. The tanker version shown is being developed to extend the range and flexibility of all V-bombers. (4) Bomber Command's first Thor IRBM was raised to firing position in November 1958 by No. 77 Strategic Missile Squadron, the first to receive Thor missiles. (5) The liquid-fueled Blue Streak IRBM, shown in development at de Havilland's, will be capable of carrying nuclear warheads over a 3000-mile range and impacting with extreme accuracy.



the R.A.F. over-all

From the foregoing the pattern of the R.A.F. begins to emerge. It is that of an air force which, perhaps not quite so big as it would like to be, is of sufficient size and quality to measure up to the country's defence requirements. Because of the austere economic atmosphere every single item of equipment must be essential to the performance of specific roles. Desirability alone is not a valid criterion. This has had a salutary effect, since the entire organisation is now trimmed of fat and down to bare essentials in which every component, human or otherwise, pulls its weight.

Because it is small—now 173,000 in all ranks but eventually reducing to 135,000 in 1962—it has to be of the highest quality and flexible to the utmost degree. That the basic training methods and standards produce men and arms of the right quality was established in the Battle of Britain. And since the R.A.F.'s standards have subsequently been set higher, it can justly claim to have the right quality.

As to flexibility, the R.A.F. adds the weight of its own deterrent to that of the West, maintains bases and forces throughout the world, is capable of providing fighter, bomber, coastal, and transport reinforcements to any of these bases in a very short time, and thus helps to fight the continuous cold war against Communism. It also gives help and encouragement to friends and allies and is prepared to make an effective contribution to allied limited-war operations. Should global war occur, the R.A.F. is able to deliver a formidable nuclear attack against any would-be aggressor.

In conclusion perhaps it might be said that the recent decision of the British Government to adopt a space research programme, although still tentative as regards military participation—i.e., the launching of satellites by British rockets (Blue Streak, Black Knight) —may eventually give the Royal Air Force the opportunity to break new barriers in the uncharted vastness of outer space.

Air Ministry

Tomorrow's Task

Colonel James S. Smith

THE TASK facing the United States Air Force today can be summed up in one phrase:

"To deter war on earth while developing a deterrent capability in space."

To fail in deterring war on earth or in space can well mean the end of the Free World.

Today, space is *the* magic word. It has completely captured man's imagination. That mysterious force which has always compelled man to uproot himself from his environment and lunge into the unknown has never been stronger, the challenge never greater. In space, for the first time in man's history, no boundaries exist. Always before, no matter how great his ships, his vehicles, his travels, man was bound to earth. Now a new vista has opened. In space he can literally travel to eternity.

This sort of scientific wonderment has permeated the Air Force. There has developed a peculiar fascination with space. It has been cited as a new environment, a new dimension—an entity within itself. But in actuality it is none of these. Admittedly it is strange and new, as yet unexplored and unused. But it is also merely the next step forward in the normal evolution of air forces.

What is needed today, in the Air Force and the entire Free World, is a cold, calculating look at space and its relationship to the conflict which exists on earth.

Each camp, the Free World and the Communist, is now poking an exploratory finger into the new arena. Each, with varying degrees of success, has made preliminary penetrations. The objectives of the Free World society in space are rather unclear. The objectives of Communism are disturbingly unknown. There is the frightening possibility, however, that if Communism can seize control of the earth's immediate space envelope, control of the world may be the reward.

These two societies have waged a relentless struggle for more than a decade. The struggle has taken all forms: economic, military, psychological, and political. It has run the gamut from friendliness to armed conflict. There is little possibility the struggle will end quickly, assuming that the deterrent power of the Free World air forces is kept at a level which will prevent unrestricted use of the military instrument. A cessation of the struggle could come from a change in the fundamental beliefs of either side or from some sort of internal economic convulsion. Neither of these events is likely. A sort of mutual containment will probably remain, with neither social order able to move into a position of marked advantage vis-à-vis the other. Each will exert tremendous effort to block moves by the other which might give an advantage. Substantial aid programs will be met by other large aid programs. Political blocs and alignments will be countered by other alignments. Military alliances will meet opposing alliances.

It is within the framework of this continuing conflict that the Air Force must decide upon its objectives in space.

Of primary concern is the realization that the struggle is only now beginning to project itself into space. It is in space that Communism may well bring into play the full weight of its military instrument. Only through the deterrent threat of Free World air forces has some restriction on that instrument's use been attained on earth. Certainly limited use has been made whenever Communism had the slightest opportunity. Korea, Indo-China, and Hungary are evidence enough. Greater exploitation of that military instrument will most certainly occur in space if the Free World is unable to prevent it. For by its basic creed, Communism will seek every opportunity and use every means to impose its political system on others.

The Air Force then—to go back to our opening statement—while deterring war on earth, must prepare for its deterrence in space.

The task on earth is fairly well spelled out and understood. The task in space is less definite. In examining this latter task, it might be well to sort out three main components: first, the probable arena; second, the possible pattern of conflict; and finally, some conclusions and steps needed to meet the task.

the arena

Since man first gained the capability of flight he has been steadily expanding the area in which to perform that flight. Space is but a further extension of the natural environment in which air forces operate; and air forces, under one organizational arrangement or another, have always been the expression of a nation's military instrument where flight was involved.

Until today the rate at which man has been expanding his frontiers of flight has been relatively mediocre. Now within the easily foreseeable future the frontier suddenly becomes limitless. In accommodating itself to this expansion the Air Force must center its concern primarily in the area of space that can be used in relation to the existing struggle. This area is logically the immediate space envelope around the earth. It is from within this space envelope that military threat—direct or implied—can be applied to earth. Both the Communists and the Free World are now moving into this space envelope. It may be pertinent that the Communists chose as their first space venture the placing of a sizable satellite in orbit around the earth. With such demonstrated capability, they might have first probed deep space. They chose otherwise.

Although the Free World may view the conquest of space as a pure scientific endeavor free from the encumbrances of the conflict on earth, it is highly improbable that the Communists share these sentiments. Rather their major space effort will be devoted to developments that can have a direct application to that conflict. There may be probes into deep space for scientific and propaganda purposes, but the main concentration will undoubtedly be within the immediate space envelope. It is here that the greatest return can come to Communism in its efforts to achieve ascendancy over the Free World.

the pattern of conflict

The first clash of the conflict is already under way. It is a combination scientific-psychological encounter, with each society straining to outperform the other. The launchings of satellites and outer space probes, for example, have as one objective the demonstration of technological achievement. They represent the first engagement. Until greater space capability is attained, this will probably remain the state of conflict. As capability is developed to exploit the immediate space envelope, the next stage of conflict will appear. This will be the legal or juridical encounter when nations attempt to project their sovereign rights into space.

Murmurings of this stage have already appeared. In December 1958 the House of Representatives Space Committee issued a report which, among other things, urged action now to develop a body of space laws. The world is operating in a "politico-legal void in space," the report said, and developments of greater capability in space "clearly signify the need for agreement on man's use of space." Some proposals have been developed to divide up space between nations, to provide boundaries within which national sovereignty remains. Others see space as an international domain where the prerogatives of individual nations must surrender to the desires of the whole.

History indicates, however, that the exercise of a nation's sovereignty usually depends on that nation's ability to defend that exercise or deny to other nations the capability to influence or restrict it. So it will be in space. Nations may proclaim certain legal rights or sovereignty regarding specific areas in space. They may well state, for example, that reconnaissance from space violates their national sovereignty. This is a reasonably well-established precept as far as present aerial reconnaissance is concerned—accepted, perhaps, because of the ability to generally enforce compliance. It may not be a precept that can be enlarged to include space, primarily because enforcement power will be lacking.

It is here that the succeeding stage of conflict will undoubtedly occur. Nations will gradually gain the capability of denying certain areas of space to vehicles whose mission violates one of their declared national rights or decisions. The first actual denial of access to certain areas of space will occur when one nation guides a vehicle into the path of another nation's orbiting satellite in an attempt to destroy it. Later, as technology permits, manned intercept vehicles may be launched to keep certain areas of space free from penetration. Still later may come encounters between the manned vehicles as they attempt to establish control within a specified portion of space.

So far, then, what we have examined is a pattern which may develop as the Free World and Communism move into space. First will be the technological encounter, next the legal, and perhaps finally actual conflict.

The nature of this final conflict will be new and strange, completely out of the sight and sound of the world. It can be an intensive, deadly struggle, with national survival at stake. Knowledge that the conflict even exists may be possessed by only a few. There may be no formal declaration or even official recognition. But both the Free World and the Communist world will be exerting great effort in the struggle. The outcome could mean the end of one system or the other.

what we must do

Communism will not willingly relinquish its use of space as a medium from which it can impose its system on others. The Free World, therefore, must prepare itself to resist Communist use of space for that purpose. And just as air forces have been the primary deterrent to full use of the military instrument on earth, so must they be in space. The United States Air Force as the major contributor to Free World air forces should assume leadership in this immense task, which must be done with no lessening of the deterrent capability. In fact the two efforts should share a common organizational base and be mutually supporting.

The first step for the USAF is task definition. Fundamental to this step is realization and acceptance that it is a military task, not purely scientific or exploratory. Essentially the task is to gain the capability to deter Communism from forcing its political, economic, and social order on other nations through the use of its military instrument in space. The immediate space envelope is where the threat will first develop. Of great importance are several things the task *must not* do. It must not deny to Communism its place in space. It must not deny the right of exploration or scientific endeavors. It must not presume that space is a Free World commodity closed to those who disagree with a particular political system.

In charting a course to accomplish this task, there are four important considerations:

- It is an inclusive task. That is, the two vital ingredients —deterrent posture on earth and the warmaking capability in space—cannot be separated.
- The inclusion of space is an evolutionary, not revolutionary, growth of air forces.
- The fundamental mission of the U.S. Air Force, as generally understood, will remain unchanged by the inclusion of space in the flight domain.
- The Air Force must develop its techniques for task accomplishment with full recognition of the proper role other agencies have been assigned in the over-all effort.

The Air Force, then, must develop the capability to deny access to certain areas in space, to fight in space if necessary, and all the while maintain the deterrent on earth. For that deterrent the ballistic missile, complemented by the manned bomber, may well remain the best method of weapon delivery.

The Air Force's research and development effort will undoubtedly continue to perfect the over-all reliability and capability of both the missile and the bomber. It is to this research effort that the Air Force must look in gaining the capability for manned space flight. Launching a man-in-a-capsule by means of a converted ballistic missile is a necessary and interesting experiment, but it is only a short step down the long path to manned military capability in the immediate space envelope. It is this capability which the research and development effort must ultimately provide the Air Force. Perhaps a more precise definition of Air Force objectives in space is needed to provide a clearer focus on the direction and emphasis of the research effort. Perhaps certain features of the existing program need to be modified to produce a clearer, more direct effort. Perhaps greater development attention is needed to speed the evolution of manned aircraft into the space environment. Perhaps certain organizational rearrangements are necessary to ensure proper balance in the application of the research effort to both manned space capability and further development of ballistic missiles. Whatever the direction of the research effort, its ultimate purpose must be to provide manned vehicles with which the Air Force can perform its military tasks in the immediate space envelope.

In the weapon area, the Air Force must develop techniques of applying modern weapons in space. Weapon effects need to be determined and employment tactics created. One interesting school of thought proposes that weapon capability has advanced with such fantastic speed that it has outgrown the environment to which military engagements are presently restricted. Therefore an expanded environment is essential for maximum employment of existing weapons. The physical extent of general wars, continues this proposition, has expanded to the point where the extension into space is inescapable. Modern weapons employed on earth may bring true "world" war. Nations not even directly involved in conflict would be threatened with extinction. Tomorrow, space is the arena. And here Communism can be expected to merge modern weapons capability with its credo of an imposed political and social order.

The uses of space vis-à-vis the deterrent effort on earth need to be examined more precisely. Target identification and location may be possible through spatial reconnaissance. The possibility of antiwarhead identification and defense against attack from space needs exploration.

The Air Force should start now to ensure that its command and control arrangements will meet the demands of space operations. A common organizational base for the task on earth and the task in space should be designed and gradually brought into being as space capability develops.

Air Force doctrine should reflect space operations as a normal evolution of flight and the natural environment of air forces as a part of a nation's military instrument. Doctrine should help lead the Air Force into its space-age responsibilities, not merely follow along.

The professional education effort needs examination to ensure that its contribution is toward tomorrow's Air Force as well as today's. The general service schools should be taking the lead in preparing commanders and staff officers for the changing complexion and composition of the Air Force as it expands its environment to include space. The minds of tomorrow's leaders must be kept open to acceptance of the weapons, vehicles, and environment of the future. The technical education effort, particularly of the younger officer, must relate itself more to the job that will need to be done, not so much to the job that is being done.

In short the Air Force must prepare itself to perform the same role tomorrow in space that it is performing today on earth; that is, to prevent Communism from using its military instrument to impose its order on others. Some of the things the Air Force should look to are sketched out here. There are, of course, many others. But essential to any hope of ever accomplishing the task is recognition and definition of the task itself, along with a blueprint of how it can be accomplished. This the Air Force needs to do now.

Headquarters United States Air Force

In My Opinion...

BASE SUPPLY MEETS AUTOMATION

Part I: What's Wrong with Supply?

SENIOR MASTER SERGEANT THOMAS W. DRAYTON

SUPPLY clerks contrast the thin chapters of Technical Manual 38-410 with the twenty-three volumes of Air Force Manual 67-1. Manpower and personnel people stress the nonavailability of essential skills at both organization and base supply level. Maintenance technicians point out that they cannot replace their black boxes with a back order. With the most adequate sort of justification, the burden of blame is tossed variously at the unit, at stockpiling, at the pipeline, at the inadequacy of airlift, at the shortage of funds, at the variety and complexity of supported equipment, at the machine procedures, at the instability of the personnel structure, at planning deficiencies, and at an infinite number of other targets. With isolated exceptions, almost nobody is happy with the supply system and almost everyone in a planning position is working—it seems almost continuously—to change it.

This article is directed to the object of explaining some of the things that seem wrong from the standpoint of the operator in the field. Too often the problems are not clear. The very serious burden of personal supply responsibility established in Air Force Regulation 67-10 is not equated with the enormous, staggering complications of the system. The painful nature of this defect is evident not only to the commander, who is generally getting excuses that he cannot evaluate, but also to the supply technician, who frequently is able to provide nothing but excuses. If nothing else, this article may establish that the problems are real ones and that the excuses are often valid.

evolution of the supply system

Until rather recently the question of why a multimillion-dollar inventory investment should be frozen at the base level has not appeared in serious discussions. Instead the recurrent economy drives appear to have been directed at isolated segments of the over-all investment.

Thus the single accounting system for all Air Force property of a decade ago has been replaced by separate accounting systems for Cost Category I, Cost Category II, and Cost Category III stocks as determined by dollar value. Again, these three accounting systems have been expanded with the development of various additional accounting systems for engines, stock fund items, and local-purchase property. These varying systems have in turn been enlarged to provide additional special systems within systems for supply support to maintenance, to war reserve material, to the installations engineer, to weapons, and to numerous specialized activities.

Concurrently, base supply's simple organizational structure of a decade ago has been modified beyond recognition. The accretions to base supply proper now may include a retail Category III central procurement outlet, a local-purchase outlet, an installation engineer supply point, outlets for one or more service units and one or more weapon systems—to the extent that the consumer must shop for his parts through a half dozen activities and that identical items may be stored in three or more different places.

As implemented at the command level, the changes to the base supply mission implied by the foregoing have caused it to pass far beyond the simple merchandising function originally contemplated. In a 400-degree revolution, the assumption that base supply should account for all end items on an installation has been modified, rejected, partially accepted in the plant account procedure, rejected again, and then to a degree brought back with elaborations in Volume XVIII, AFM 67-1. From another aspect the supply mission is now assumed at certain bases to include not only the provisioning of parts but also the job of telling the consumer the stock number and identification of the parts he presumably wants—this entailing an elaborate research activity. In still another logical extension of the accounting function, base supply is now being required to ensure the availability of the virtually endless IAM (inventory accounting monetary) data that is sought—presumably by comptroller personnel—to permit telling base supply what is wrong with it. In an extension of the issue function, at certain installations base supply is now required to manage elaborate communications and delivery networks to provide the ultimate maintenance service short of switching the black box.

This multiplicity of changes has occurred against the background of a virtually complete phase-out of the hardware used a decade ago, an entirely new system of nomenclature, and an almost total change-over from the solidly established, simple, manual accounting procedures to the Mycenaean maze of electrical accounting machines. At the organization level the impact of these changes has been exaggerated by the change from unit property book to unit property record and equipment authorization list (UPREAL), and from UPREAL to unit authorization list (UAL), and to the ultimate complexities of Volumes XVIII and XXI, AFM 67-1. At the disposition point the changes have been equally exaggerated by the implementation of the entirely new marketing and redistribution activity required by Volume XIII, AFM 67-1. The aggregate of the innovations is suggested by the fact that the supply career field has been rocked by an average of one procedural change a week for the past several years.

the effect on stock control

The latest attempt at introducing order into the supply scheme is contained in Volume XVIII, AFM 67-1. This procedure establishes a mandatory and standardized stock-control system utilizing punch-card accounting machine equipment. It includes the requisition, receipt, storage, stock control, issue, turn-in, shipment, reporting, document control, and item and monetary accounting for supplies at both the base and organization level. The possible existence of major variations and frequent changes in maintenance, personnel, cost accounting, and supply missions and the possible impact of any variations on the procedure remain largely irrelevant to the need for compliance, although major commands may seek relief from mechanization requirement.

As in the case of preceding changes, the goal of this innovation is beyond reproach. The need for a common general directive and a common supply language is implicit in the increasingly close interrelationships at all levels. The procedures involved are less gratifying.

In certain details the procedures suggest an extension of the system used n depots and in civilian merchandising operations without a thorough review of fundamental differences. In mechanized civilian-type operations the demand volume is very considerable for the majority of items stocked. In contrast the issue frequency of items stocked by the Air Force at the base supply evel is relatively so inconsiderable that a valid question can be raised at a number of bases as to whether the mission is one of resupply or one of inurance.

For example, the issue frequency of seventy per cent of the line items tocked at one of our bases did not exceed four issues annually. Of this seventy per cent the majority of items were required just once annually. Under circumstances of this nature the weakness of Volume XVIII procedures designed o establish stock levels by machine on the basis of consumption experience hardly requires comment. Adequate machine predictions cannot be made without adequate issue experience. This basic inability to predict exactly what we re going to need signifies that in a broad category of probably one third to ne half of the line items stocked the established level and, following this, the uantity due in on requisition have only an incidental relation to future conumer needs. At the particular base mentioned the great majority of stock evels fluctuated each ninety days and the majority of fluctuations exceeded fty per cent of the initial stock level.

This defect was exaggerated by the system in vogue for the accumulation f issue history. Volume XVIII procedures provided no means for determining whether a particular item had been stocked or handled for the entire year or or only a fraction thereof. This weakness had similarly been true of the preexisting machine procedure. Thus where only two issue history cards covering wo months were on file the machine inevitably faced a dilemma: the two ards could be considered to represent either a year's consumption or two months' consumption. The former case implied a level that might be only ne sixth of the actual requirement, if the item had actually been stocked nly two months; the latter a level that might be six times the actual requirement.

Again the machine procedures of Volume XVIII provided no satisfactory means for considering accumulated due-outs in the setting of a level. If they were not considered, the existing zero balance for fifty per cent of the items stocked suggested that the lag in awaiting the accumulation of issue experience would have a serious operational impact. If the due-outs were considered there were still certain difficulties in that so many back-orders had been canceled that the implication was that the units in the area of support did not normally know what they wanted.

Furthermore there exist broad categories of nonexpendable items that cannot be stocked at base level despite a predictable demand roughly proportionate to the population of these items times wear-out rates. In this and in other categories an item might properly be a nonconsumption issue item from the organization standpoint and, disregarding AFM 67-1, a consumption issue item from the base or depot standpoint.

The impossibility of correcting these situations under machine methods as contemplated in Volume XVIII is defined by the limitations in stock control data. Whether a solution could be reached by the costly process of superimposing a manual operation on top of the machine operation remains doubtful.

The reorder point of thirty per cent as stated in Section 11 of Volume XVIII had the effect that, even if adequate stock levels could be established, the stock position in Cost Category III segments of the account would inevitably be driven to a zero balance. The reorder point, translated into days of supply, was less than the pipeline. And this has happened.

In addition to the problem of data limitations, the procedures of Volume XVIII suggest a probable disregard of the difference in data input requirements between Air Force and civilian activities utilizing electronic computing or processing devices. Air Force input requirement is very heavy. The accomplishment of a transaction may involve the posting clerk and key-punch operator in five manual entries on AF Form 1517 and in additional key-punch entries, such as expense code, work order number, document number, aircraft or missile code, priority, IAM code, posting control code, date and card code on the transaction card. Fifteen pages in Volume XVIII are devoted to input codes, which generally must be shoved into the machine through a manual operation. This is true despite a degree of instability at base level, particularly in overseas areas, which virtually guarantees that historical accounting data, even if accurate, will be irrelevant to any future programing and will be dead weight to personnel not actively engaged in the comptroller function.

On one hand the civilian merchandisers do not have the mass of detail that the Air Force has. On the other they generally have a degree of consistency in the type of merchandise stocked. The continual introduction of new items into the AF system creates a situation that is profoundly dissimilar. The bulk of the detail introduced into the system generally centers around AF Form 159, the transaction card. Nearly every balance change involves a transaction card; every transaction card involves a sequence of manual and key-punch operations of varying complexity. This effectively precludes any continuity in the flow of paper. As tied in with the machine operation, the basic documents tend not to flow in a straight line but to oscillate from point to point and to ricochet from unit to unit with a frequency loosely proportional to the number of balance fields involved by the transactions. In line with established probability theory, these contortions make it mathematically certain that the procedure cannot work within acceptable error limits.

This is evident in following the back-order/back-order release procedure of approximately forty per cent of supply support. At one base it was found that, from initial receipt of the issue card to the ultimate release of the property, the essential documents went through this channel: editor – supervisor of stock record unit – key-punch operator – posting clerk – requisition clerk – key-punch operator – requisition clerk – distribution clerk – posting clerk – distribution clerk - analysis unit – machine room – posting clerk – night charge of quarters of the receiving and classification section – transportation in-checker – back-order release unit – driver – administration clerk of the receiving and classification section – stock record supervisor – requisition clerk – posting clerk – analysis unit – machine room – posting clerk. At the end of this channel the transaction was complete. It appeared that approximately seventy-six steps were involved, or about thirty separate operations. This presupposed a perfect work flow under the most typical conditions. The document in this case was a consumption-type request for a Cost Category II or III nonregulated, Air Force-centrally-procured item handled by that base. It was in a priority 6 through 15. It was back-ordered by base supply in entirety. The requisition was received by the supplying depot and shipment in entirety was made under the requested stock number. At the time of receipt no higher priority requirement existed, and the requesting activity still needed the item. The class was not in inventory at the time the original request was submitted or at the time the property was received. If any of these conditions had varied, the procedure as flowed would have trailed off into any one of a dozen major deviations of generally equal or greater complexity.

The foregoing underscores two additional points:

- First, the system is not mechanized. A costly manual operation precedes and follows the machine effort. In a review of Volume XVIII it may be seen that this holds true throughout the system. Even in the simple requisition process the manual specifically states that "a transaction card will be prepared and returned to base supply for filing behind the appropriate balance card for updating of due-in balance."
- Second, the system is not integrated. Independent base supply actions are not possible. The tie-in to an alien machine activity and the necessary complete reliance on it rob the base supply officer of any degree of control commensurate with his personal responsibility.

the effect on organization

From the organizational point of view the procedures of Volume XVIII appear almost equally dubious. On submitting a request to base supply the unit supply officer does not receive a copy indicating action taken. On turning in property he no longer automatically obtains a receipt. On the issue of property from base supply he no longer obtains a paper that enables him immediately to relate the issue to his original request. Even omitting from consideration the inherent invitation to fraud, the difficulties occasioned to an organization that processes several hundred requests weekly appear to make the procedure unworkable.

Theoretically the informational gap in this procedure is covered. A second copy of AF Form 154, the supply document register, is provided the organization from the base supply document control section after twenty-five transaction cards have been accumulated in a sequence for run-off by the machine room. In practice the delay in providing the document register and the resultant anguish at organization level have been inversely proportional to the probability that any complete sequence of twenty-five cards can be accumulated within a reasonable time. To date this probability has been small.

Stock numbers and nomenclature. Moving beyond Volume XVIII, we find the difficulties at both unit and base supply level immeasurably complicated by stock number and nomenclature problems. Catalog deficiencies within the units throw thousands of bad stock numbers into the system. The new Federal numbers and the incessant conversion programs require endless research and endless change. In certain classes the lag in developing stock numbers for new equipment has been such that up to thirty per cent of the items may not be stock-listed. Interchangeability and substitution data have been lost. Consequently research in each base supply has expanded into a major operation.

Priorities. The stock leveling and requisitioning problems have inevitably threatened the collapse of the priorities system. These problems are aggravated by inadequate preissue, inadequate bench stocks, inadequate time-change review, and invalid maintenance requests. Result: the volume of priority requisitions at some of our bases has boomed to nearly half the total submitted.

Maintenance and repair. The vital maintenance support and local repair phase has suffered from the implementation at command level of new concepts that direct the flow of reparable assemblies into the shop without prior reference to supply. This has resulted in continuing expenditures for the repair of assemblies that, from the base supply standpoint, are in an excess position. A related difficulty has been getting repaired other assemblies that are critical at base level. In reclamation the same thing holds true. The segmenting of related systems causes such failures as delay in establishing contracts for the recapping of tires, with a commensurate drain on base supply assets and base funds.

Local purchase. In striking contrast to the rest of the base supply picture, the Spartan austerity of the local-purchase store concept is, at a glance, refreshing. Section 25 of Volume I, AFM 67-1, prescribes that item accounting records will not be maintained on stocks acquired for distribution through local-purchase service stores. Apparently on the theory that people are honest, the manual slashes away at formerly mandatory controls. Even the possibility of audit is sacrificed in the drive for speed, simplicity, and an easy way.

In practice this goal has not always been reached. The civilian merchandising concept of relying on the judgment of department managers has fallen afoul of personnel turnover that can move department managers from their jobs before they can develop judgment. In the operation of million-dollar outlets, records have somehow crept back. Levels have been developed. Due-in entries have been found essential. Obligation and back-order systems have tended to return. These have favored the growth of requisition files, unit files, and office patterns extraordinarily reminiscent of the old manual procedures—but shorn of their merit as far as audit is concerned.

Manning. Throughout base supply the procedural difficulties here outlined have been multiplied by the inadequate manning, measured against current workloads, of essential skills in the supply career field. The disparity between the staggering cost of materiel on one hand and the comparatively low cost of payrolls on the other is not realized in manning actions. In an overseas installation the inventory turnover figure may range up to thirty or forty million dollars. Against this is a million-and-a-half-dollar payroll in which the difference between a reasonable operation and collapse may be a factor of two or three hundred thousand dollars. Aside from quantity of manning, there is the quality shortage. Sufficient seven-level skills are not available to man the system. Indeed, considering the complexity of supply and the rate of procedural change, a valid question could be raised as to whether enough people could be trained under any circumstance to make the system workable.

remedies

All these considerations inevitably suggest a return to basic concepts. To the large extent that base supply is an insurance rather than a merchandising function, as attested by issue infrequency, the freezing of a very large dollar investment at each installation may be questioned. Putting this concretely, if the resupply function worked perfectly the bulk of supplies stored at base level would not be necessary. The price tag on our ineffectiveness in this area, particularly our inability to predict and deliver requirements in time, will run anywhere from ten to thirty or forty million dollars per base. Whether this price and the system involved can be supported in a period of personnel retrenchment, of fiscal austerity, and of increasing procurement and transportation difficulty is a matter that invites very serious reconsideration.

- One immediate answer is modern computers with remote-sited input devices tied to an area communications system and allowing area-wide stock control. This would permit establishing levels on the basis of far greater and more consistent demand on the one hand and on the other would permit application of theater assets to the supply problems of each base.
- A second answer is consolidation. The maintenance of four separate

base supply operations on four bases within a twenty-mile radius would appear to be an unnecessary luxury. As an immediate measure it would seem desirable to settle on one base supply for all four, with possibly such modifications as informal (AFN) accounts under the tactical wings for the various weapon systems to ensure continuity of operational support.

- A third answer is stock control. At unit level this implies a hard second look at the established policy of focusing responsibility almost exclusively on the organization. At this level the deterioration of personnel both in skills and numbers is such that an inacceptable percentage of bad paper flows into the system. This generates intolerable overloads and translates into a continuing and unjustified drain on local and depot funds. If the ten to twenty per cent of bad paper could be eliminated, the savings would be immediate and enormous. As a practical matter this can only be accomplished through re-establishment of an editing function in base supply. This implies an acceptance of the hard fact that the machines cannot reason. Adequate skills must be provided for careful item-by-item analysis of machine products. Skill authorizations border on fantasy when one airman in AFSC 64152 (supply records specialist) must determine fundamental stock levels governing shipment of millions of dollars' worth of supplies.

- A fourth answer is simplicity. Accretions must be pared from the system until it can be understood and can be operated. The installation engineer supply point might well be turned over to the installation engineer. The local-purchase outlet could appropriately be given to the comptroller. The maintenance research function could be given back to maintenance units. The maintenance communications and delivery services could similarly be given back to the supporting unit supply activities. A line could be drawn between wholesale and retail functions. Such essentially extraneous and specialized functions as ammunition and POL could be moved from under the base supply officer's jurisdiction.

It is patently advisable to reconsider also the present back-order/back-order release system. This system does little but interpose an almost unworkable receiving and distribution complex between the shipping depot and the ultimate consumer. In a time of high-speed electronic computers, such complexity would appear unnecessary. The desirable system would include a routine base supply operation on a fill-or-kill basis and a priority-1-through-15 operation with direct requisitioning and direct depot-to-user shipment.

With this system it would be desirable to simplify IAM and accounting requirements and to streamline the flow of paper. As another phase, there is overriding merit in a self-contained unit, such as Cardatype, that relieves the base supply officer of his total dependence on an alien activity.

- A fifth answer, and an all-important one, is manning. Skills must be trained and assigned in numbers commensurate with the dollar value of each account and the tactical significance of the mission. And an approach must be made to such problems as the difficulty or impossibility of promotion, the continuing overload, the recurring manpower cuts, the increasingly technical and incessant procedural changes, and the gibes at supply as "soft core" service.

THIS article in its entirety might be taken to infer that somewhere somehow in the structure there has been some inadequacy in planning. This would be an unfair and generally unjustified inference, and it is not intended. There has been a surfeit of planning. AFM 67-1 is a magnificent intellectual edifice, and the volumes of this manual with the endless command implementations have planned us into the ground. Give us less planning. Tell us what to do and untie our hands so we can do it. . .

Headquarters 41st Air Division

Part II: Very Little Is Wrong with Supply—It Only Requires Some Understanding

MAJOR IRA M. KAY

I AM happy that *Air University Quarterly Review* has permitted me to read Senior Master Sergeant Drayton's article and given me the opportunity to express another's view. I feel it would be a tremendous injustice to the system we have and to the scores of dedicated and capable people planning and manning this system if we failed to complete the picture and show that supply can be pretty efficient and effective if it is completely understood by more of the people actively engaged in it.

Mark Twain once remarked that everybody complains about the weather but nobody does anything about it. Our supply system receives a different reaction: everybody complains about it, also, but each has a different solution for the inherent problems. Unfortunately too many of these solutions are applied on a local basis with inadequate knowledge of their effect on the entire system.

On one point we must be crystal clear. The 1959 Air Force and its support system are "mission oriented" and not "procedure oriented." Thus a 1945 system limited in scope to the mission of that time will not suffice to keep a deterrent Air Force in the air at all times and around the world. The garage we built with our house in 1946 was designed to give adequate space for the wife to get the car into it without taking off the fenders. Today we must park the car outside that garage because it is a fixed structure, not capable of accommodating today's car. Still we would not have the car any other way. We want the better riding qualities, the space, and the comfort. This, then, is progress, and we pay the penalty of leaving the car out in the weather.

Unlike the garage, our supply system must be able to change rapidly.

Those who complain of the complexity and constant changes to Air Force Manual 67-1 fail to realize the technical changes in our aircraft and the addition to our combat forces of missiles that require a support system responsive to their needs at all times.

Let's face it. The modern-day Air Force cannot live with the old methods of supply. Looking backward I remember with dismay that when I was supply sergeant for a squadron my requisitioning day was Wednesday and the items I requested were available on Friday. If the squadron ran out of toilet paper before Friday, it was "Out to the tall corn, boys." Can you imagine our ability to hold the U.S.S.R. in check if the airplane that needed a part on the wrong day had to wait on the line until the right day came? As we have gone from prop-driven aircraft to jets and then to missiles, the reaction time has also had to be geared to the operation.

Let us discuss for a moment this tremendous and so-called unwieldy AFM 67-1. All people being human, those in Air Materiel Command no less so, we make mistakes. Certainly we have published procedures that required change shortly after they were placed in effect in the field. But by and large they were errors of commission rather than omission. They have been made in the honest belief that the system announced would meet the mission requirements. We have but one purpose: our job is to place nuts and bolts on air vehicles. If in attempting to do this more expeditiously from day to day we take an occasional wrong path, we are the first to admit it and reverse our field. We certainly will never sit still to clip our coupons in the belief that we have the answers to all the problems. We will forever attempt to improve the systems in-being.

Prior to AFM 67-1 we had the much-talked-about Technical Manual 38-410. Sergeant Drayton has much company in those who remember the "good old days" of that manual. I have heard the cry again and again. TM 38-410, however, was a manual designed to depict, in general, base-level supply operations. It never attempted to provide detailed operating instructions that would be used by the base but rather gave the guidelines and the instructions for completing the forms to be used in accomplishing the local mission. It was supplementary to and supplemented by technical orders, Army regulations, War Department and Air Corps circulars. Everybody had a different version of how to accomplish the detailed work not specified by this station supply manual. The cry was raised everywhere, "Standardize our procedures. Give us *one* Air Force system in which we can train our personnel and transfer them from base to base without the necessity of retraining."

Along with this problem at base level, we had a problem at depot level too. Operational guidance came from the same varied mass of unrelated publications. Standard guidance was needed, and some method was required to bring together the multitudinous directive matter from various sources into one series of manuals that could be referred to at any level to determine the detailed procedures to be followed for any situation. This led to the birth of AFM 67-1. The size of this manual with its twenty-three volumes is the printed proof of the complexity of our system, not of the warped minds of our procedures writers. It has grown from its initial coverage to a tremendous scope, encompassing the many different directives that existed prior to its issuance.

It is said that AFM 67-1 promulgates new concepts. This is a half-truth. After all, the coverage of redistribution and marketing in Volume XIII does nothing more than bring the salvage yard and the salvage operation, which have existed from time immemorial in the Air Force, under the same roof as the rest of the logistics picture. Yet at the same time we do have new systems. Volume XVIII is a manual on base supply procedures, which some might say is already covered by Volume II. Nothing could be further from the facts or be more misunderstood. Our Air Force bases differ in size and mission all over the world. Some are located in places where we would not attempt to put mechanized equipment. Many are too small to justify the expenditure of funds for punch card equipment. Many have workloads requiring something more than the "good old days" of pushing a pencil. Their volume of business and their mission require the ability to react more frequently and more quickly. This puts us in the unenviable position of having one procedure for those bases that utilize mechanized equipment and another for those that cannot use such equipment because of their size or location. I think we do quite well to be able to describe two such systems, yet keep them in step with and understood by the depots that must support them.

Further, AFM 67-1 must, procedurally, cover the support of many more drastically different customers than Sergeant Drayton apparently has considered. We have picked up the responsibility for supplying our allies under the Mutual Assistance Program. We are supporting Dew Line, which calls for a most fantastic pipeline to remote places. We must be prepared to support a network of ballistic missile early-warning stations. We have mission-oriented our supply to support our first line of defense. We and the operational commanders know that we must have specialized support for each tactical weapon expected to be called upon in the event of war. If we failed to mission-orient our supply, we could not keep first-line aircraft in the air or our radar defenses on the air. The support for these users is so specialized that it must be handled on an individual basis for each. Yes, AFM 67-1 is a giant manual. But it is this way because of the job we must do.

Let us take a closer look at the base level, of which Sergeant Drayton speaks. Do we really have an unrealistic inventory investment at base level? We are demonstrating our combat readiness daily. The USAF is the world's most formidable combat force. It has a world-wide deployment and can strike world-wide in a matter of minutes. Despite our errors and despite our share of the less-than-perfect people who exist within all walks of life, we somehow manage to keep these aircraft in the air. These are complicated weapons. The cost of aircraft has risen so sharply in the last five years that the B-52 has been valued at more than its weight in silver. Within two years it was followed by the B-58, which is costed at almost its weight in gold. Notwithstanding the rising costs of aircraft, the value of the supporting base and depot inventory has remained relatively stable over the last seven years. This is true despite the fact that the number of items has increased from 300,000 in 1946 to 1,400,-

000 in today's inventory. The effectiveness of the Hi-Valu management introduced within the Air Force is indicated by the fact that, had we continued the level of materiel on the same basis as the 1952 management, the requirements for our current aircraft would have called for 6.8 billion dollars additional in this year's budget. This, then, is proof of the effectiveness of segregating the items of high cost into Category I.

If the Cost Category III procedures were followed by all concerned, adequate stocks would be on hand to prevent many of the shortages that exist world-wide. The Air Materiel Command does not claim that its depot system has done the job perfectly in all phases, but we are rapidly increasing our low-cost stockage and moving it as quickly as possible to those bases that forecast their proper needs. This brings up a serious disagreement I have with Sergeant Drayton. He is encountering a real problem in establishing levels for his materiel. This is not the fault of the procedures; it is a failure to understand the system. The most important thing he seems to have missed is that consumption is figured on each item month by month. Those items with zero consumption are recorded in the same manner as items with actual consumption. In any 12-month period the zero-issue periods must be computed along with the periods that had actual consumption. Therefore no dilemma should arise in finding the average issues of the year. If monthly figures are not maintained I agree that one would most certainly face a problem of not knowing whether the issues of record are for a year or for two months' consumption. I concede the point that the majority of the items stocked have so little movement that no level can be computed. AMC does not advocate that some of every item in the stock list should be stocked as insurance against a back order. The mathematical genius has not been born who can develop a formula to ensure prevention of a "stock out" in every last piece that could be replaced on an end item. This does not stop us from trying to do something about it. We are spending millions of dollars subsidizing research by such management analysts as the Rand Corporation and Harbridge House. We have changed AFM 67-1 recently to permit retention of stocks over much longer periods than were previously justified by consumption. If someone has the panacea for this problem, he is welcome in these hallowed halls.

I feel that there is inconsistency in Sergeant Drayton's article where on one hand he says, "Tell us what to do and untie our hands," and on the other hand he complains that AFM 67-1, which he feels is so big and cumbersome to use, is still not specific enough to tell him the steps to take.

Unfortunately we cannot make AFM 67-1 a substitute for common sense. The computed stock levels shown in Volumes II and XVIII are *recommended*. They still require judgment. Stock levels must be tempered by the due-outs that exist on the balance record as well as by the history of consumption. Due-outs plus issues equals demand. This is the rule and it will never change.

With regard to nonexpendable items, paragraph 2h, Section 11, Volume II provides for stock levels of some categories and on others extends the authority for local determination of stock levels if the base will just ask for the concurrence of the commodity class manager. Sometimes, perhaps, it is a problem to ask for authority to do something, but if the requirement is there and the action is not taken we cannot blame the system for this failure.

I hope that nothing said within these lines is construed to mean that Air Materiel Command believes it has a simple procedure. Were it possible to have such a thing, our work would be immeasurably easier. No, we know that the system is complex and we know that a tremendous workload has been placed on those who must operate it. Actually our visits to Air Force bases bring home to us that only the dedication and terribly long work days on the part of base supply officers and their personnel make possible the roar of aircraft we hear overhead. I can never conceive that any supply system outlined in AFM 67-1 calls for the confused flow of paper described by Sergeant Drayton! I suggest to the major command responsible for the base where this labyrinth of channels exists that quick remedial action is needed.

We are moving now toward lifting the burden of the detailed posting operation from the base supply officer. Since the specialized supply incident to first-line weapons necessitates individual accounts administered at base level, we are programing a small-scale computer which will automate the control of base supply inventory. Today he can only overcome this administrative workload at the cost of ignoring management improvements that may be badly needed. We foresee that by 1961 every base of sufficient size and volume of transactions, regardless of its location in the world, will have computer facilities. Under a prepared program it will accomplish for the base the errorless processing of the thousands of transactions taking place each week. The like items accounted for under the individual weapon accounts will be available on a cross-weapons servicing under priority conditions. The machine, however, will not replace the management required of the supply officer. It will permit him to divorce himself only from those transactions that are correct, not from the exceptions. Exceptional transactions will still require human judgment before the computer can handle them.

I sometimes feel that supply personnel lose sight of the mission to which they are assigned. They are trained as specialists for one purpose—service to the customer. Maintenance research is one such service that we feel properly belongs with supply. Once upon a time we demanded that the maintenance officer correctly prepare the paper work and accurately describe by stock number the item desired. If he failed to do this, the supply officer had his excuse to the commander that the maintenance officer was not spelling out his needs. That day is gone. Supply's function to the commander is to supply his specialists with their requirements as long as they can state a description of the items, how many items they need, and where the items go. We have built up a large research section, but only by consolidating many research sections that existed at each base. We acknowledge that the public law calling for Federal cataloguing of all the old Air Force stock has resulted in a mountain of manuals, stock lists, and stock list changes describing our items of stock. It would be fantasy to think that we can afford a wide distribution of these manuals. The personnel required just to maintain them would prevent this. Rather we have realistically placed the burden of research on the base supply officer, since he is the most qualified man on the base to accomplish this job. Where would we be if we returned this task to the initiator of requests? We would be back in the days of the refusal of the supply officer to process a piece of paper unless the t's were crossed and the i's dotted. We cannot afford to stand on ceremony. To repeat, we are mission-oriented. We must do the job necessary to secure the parts and select the material to enable the mechanic to maintain his aircraft and get that aircraft in the air. The motto "Without Supply, Nobody Flies" is the keynote of supply operation. We must do the job.

The AMC depots are faced with every problem imaginable in dealing with these complex systems. We, as well as the rest of the supply world, have our share of people who do not understand the system or comply with the directives. We too commit our share of mistakes, and these mistakes are felt by the customers as we fail to fulfill our part of the mission. This, however, is the exception, not the rule. People are inconsistent. If they feel well, they perform well. If they are annoyed, sick, or lack the desire to do the job, then certainly it is reflected in their output. Since we cannot have robots, we must search for a better way to accomplish the mission of the wholesale movement of property to our retail consumers. We too are turning to computers as the answer to the volume and complexity of our administrative job. We have just started to have operational systems on some of these giant computers and are beginning to get startling results. Unfortunately these results are diluted at the moment in the massive size of our establishment. For us, as at base level, the year 1960 will be an amazing one. The computer will take over the stock control and distribution of our weapon systems and our commodity classes. Our intentions are to have every request processed within twelve hours after it is received. The automation is designed to eliminate the confusing "status" information we are currently transmitting. I wish that there were space and time to explain the automatic features and the service we expect to furnish.

In summing up the answer to Sergeant Drayton's question, I can say that there are problems with supply, but it does work. We are being imaginative and forward-looking and are solving our problems as rapidly as we can in the face of the dynamic structure of our Air Force. We count as blessings the unsung heroes who, without reward, use their God-given intelligence and all their energies in the performance of our service mission.

Headquarters Air Materiel Command

THE USAF SCHOOL COUNSELOR NOTES

LIEUTENANT COLONEL RUSSELL N. CASSEL

A SERIES of United States Air Force School Counselor Notes on Space Age Critical Problem Areas are currently being planned, developed, and disseminated under the monitorship of the Commander, Orientation Group, USAF, Wright-Patterson AFB, Ohio. The notes are designed to provide the school guidance counselor with a quasi-technical summary of current progress and future plans in select critical problem areas of the aerospace age, with emphasis on implications to the educational and career guidance and planning of our youth. Through this medium it is hoped to open a "lateral" channel of communication between the task scientist concerned with the solution of these critical problems and the school counselor concerned with advising select youth of the specialized career needs of the aerospace age.

total aerospace power as a using agency of the schools

It is common knowledge to those of us who have spent many years both in the Air Force and in our public schools that the training programs of the Air Force are considerably ahead of those in private or public schools in such areas as airplane and engine mechanics, pilot training, electronics, and leadership, to name but a few. The great masses of these specialists currently working in any phase of aviation have received their basic and advanced training in the Air Force.

In the field of aviation in our military services there are about 850,000 military personnel on active duty in the Air Force, another 300,000 in Civil Service, about 200,000 in Navy aviation, and about 100,000 in Army aviation. There are about 800,000 in aircraft industry, with the number sometimes being as high as 900,000; and there are about 125,000 in commercial aviation. About 1 out of every 3 of these employees is an airplane and engine mechanic, and about 1 out of every 4 is an electronics or radio trained technician. Thus, about 2½ million of the nation's total labor force of 70 million persons are involved in aviation and related careers. Each year a staggering number of replacements is required, and most of them come directly from the public schools of our country.

In proportionate numbers the career preparation requisites of these individuals range from the basic clerk or airman to the highly trained task scientist. The higher the degree or level of competence required of the individual, the more essential it is that he be oriented with respect to the current critical problems of the aerospace age. Such orientation involves a threefold approach: (1) selection, (2) classification, and (3) training. It is to all three of these activities that the present USAF School Counselor Notes are directed.

need for a lateral channel to schools

In the November–December 1958 issue of *Harvard Business Review*, Margaret Mead described why our present education is obsolete:

> Although the educational system remains basically unchanged, we are no longer dealing primarily with the *vertical* transmission of the tried and true by the old, mature, and experienced teacher to the young, immature, and inexperienced pupil. This was the system of education developed in a stable, slowly changing culture. In a world of rapid change, vertical transmission of knowledge alone no longer serves the purpose of education.
>
> What is needed and what we are already moving toward is the inclusion of another whole dimension of learning: the *lateral* transmission, to every sentient member of society, of what has just been discovered, invented, created, manufactured, or marketed. This need for lateral transmission exists no less in the physics or genetics laboratory than it does on the assembly line with its working force of experienced and raw workmen. The man who teaches another individual the new mathematics or the use of a newly invented tool is not sharing knowledge he acquired years ago. He learned what was new yesterday, and his pupil must learn it today.

The USAF School Counselor Notes on Space Age Critical Problem Areas are intended to serve as a lateral channel of communication between the select task scientists and the schools.

objectives of Counselor Notes

The USAF School Counselor Notes have mutual and reciprocal objectives related to both the Air Force and the nation's schools, and these two agencies must play a continuing supportive role to each other.

The USAF's objectives are:

- to identify those critical problem areas of the aerospace age that have important implications for the education and career training of our youth
- to summarize the current progress and future proposed plans in the select critical problem areas, emphasizing the implications for education and career preparation of youths and adults alike
- to disseminate such summaries of the select critical problem areas to appropriate persons, both within and outside the Air Force, who might be responsible for the guidance of education and career training of youths and adults
- to evaluate the School Counselor Notes on a continuing basis, with a view toward facilitating their general effectiveness

The schools' objectives are:

- to indoctrinate school guidance personnel and counselors on the appropriate and effective use of USAF School Counselor Notes as lateral channels of communication with select task scientists

- to identify those individuals in the various school and training programs for whom information relative to the select critical problem areas will have important education and training implications in terms of student-expressed or counselor-recommended interest, consistent with their present capability and experience
- to provide meaningful interpretation of certain of the quasi-technical summaries contained in the appropriate selected USAF School Counselor Notes relative to the proposed training of individuals involved
- to facilitate the inclusion of such areas of instruction and courses of study in local school curriculum offerings as are essential for the sound and effective educational and career training of youth and adult alike and as might be indicated by the USAF School Counselor Notes

aerospace-age critical problem areas

During the past year responsible representatives from many Air Force and related activities participated in the identification of the initial select critical problem areas to be covered in Counselor Notes. Some of these agencies were Headquarters USAF, all Air Force major commands, Aircraft Industries Association, Air Force Association, National Aviation Education Council, Civil Air Patrol, and many task scientists. Fifteen subject areas were identified and USAF School Counselor Notes on each are now in various stages of planning and progress toward publication:

Note 1 – Manpower and Education

Dr. Eli Ginsberg, National Manpower Adviser to President Eisenhower, and Dr. Frank Sievers, Chief of Guidance Department, U.S. Office of Education, are to be invited to provide the materials for this note. Presently in planning stage.

Note 2 – Leadership Development

This note is intended to include a summary of our present knowledge relative to the identification of leadership attributes and their assessment. Also it will summarize work in the leadership development and training areas. Presently in planning stage.

Note 3 – Space Age Education

This note is planned to include a description of approximately a dozen currently operating model aviation programs and to emphasize the wisdom of expanding such programs wherever possible, making use of the experience gained by them. It is to include such programs as Civil Air Patrol, National Aviation Education Council, National Air Museum, United States Air Force Museum, University of Illinois Institute of Aviation, Phoenix Union High Schools and Phoenix College System Flying School, University of Miami Aviation Education Program, University of Hawaii Aviation Education Program, and others. Initial drafts have been prepared for many of these programs, and it is hoped to complete the major portion during the coming summer.

Note 4 – Mastery of Stress

This note was the first one written and compiled and was first distributed in July 1958. It was a summary of referenced materials by Dr. E. Paul Torrance, now Director of Educational Research, University of Minnesota, previously chief task scientist at the USAF Survival School, Stead AFB, Nevada. A second printing of this note should be available before this article reaches print.

Note 5 – Living in Space

This note is intended to include a summary of the work relative to aviation medicine currently being accomplished under the immediate direction of Dr. Hubertus Strughold, sometimes referred to as "the father of aviation medicine." Dr. Strughold has been invited to present this material.

Note 6 – Cosmic Radiation

This note is to convey information relative to cosmic radiation in currently proposed research including exposure factors relative to both animals and man as well as conditions of outer space.

Note 7 – Radiation-Biological Effects

This note was compiled and distributed in August 1958. It is a slight modification of a report made by RCA Service Company, Inc., under contract with the Aero Medical Laboratory, Wright Air Development Center. In essence it is a summary of all nonclassified publications in the subject area, and it serves as a reference and resource aid for school and other personnel. This note is available only in very limited quantities, but it will probably be reprinted if the need indicates.

Note 8 – Weightlessness—Zero Gravitation

This is a summary of work done largely by Dr. Siegfried Gerathewohl at the School of Aviation Medicine, Randolph Air Force Base, Texas. It should be available for distribution about the middle of July 1959.

Note 9 – Acceleration

This note is planned as a summary of the combined projects of the Air Force and Navy, to be compiled largely by Dr. Edwin Hiatt, Aero Medical Laboratory. It should be available for distribution in late summer 1959.

Note 10 – The Struggle for Men's Minds

This note has been compiled by Dr. E. Paul Torrance, author of *Mastery of Stress*. He was invited because of his intimacy in the area and because of his experience with the training and functions of the school counselor role. The material has had initial clearance through Hq USAF, and the completed Counselor Note should be available for distribution during late July 1959.

Note 11 – Man's Fitness for Space

This note was added to the original list at the request of Colonel John P. Stapp, Director, Aero Medical Laboratory, and is intended to provide a summary of the work being done in the subject area by that laboratory. It should be available in late fall 1959.

Note 12 – Ballistic Missiles

It is planned to develop this note when the program relative to the Minuteman System (SM-80) is cleared for release to the public, probably in summer 1960.

Note 13 – Electronics—Human Engineering

This note is to be compiled by representatives of related industries and is still in the planning stages.

Note 14 – Human Happiness and Mental Health

This note is intended to include a summary review of such psychological and sociological problems as divorce, delinquency, crime, and mental health, as well as our present provisions for dealing with such problems. It is still in the early planning stages.

Note 15 – Language Training

This note is to be compiled by the staff of the USAF Language School, Lackland AFB, Texas. It is still in the planning stage.

Detachment #1, Orientation Group, USAF

The Quarterly Review Contributors

Major General Henry Viccellio has been Commander of the Nineteenth Air Force since its activation 1 July 1955. He attended the College of William and Mary, then completed flying training in 1936. He served at Barksdale Field and as Commander, 70th Fighter Squadron, Hamilton Field. He was Chief of Staff, 13th Fighter Command, Guadalcanal, 1942–43. After 30 combat missions he was assigned to Air Force Hq as Tactics and Plans Officer, A-3 Division, later as Chief of the Fighter and Air Defense Branch. He was Chief, Testing Bureau, Air Proving Ground Command, from 1945 to 1947; then attended the Armed Forces Staff College; commanded the 82d Fighter Wing, Grenier AFB; became Deputy for Plans, Hq TAC, 1949, and Director of Operations, Eastern Air Defense Force, 1950. From 1951 until his present assignment he served in Europe, first as Director of Operations, Twelfth Air Force; then as Chief, Special Air Staff, Allied Air Forces Central Europe; and as Director of Operations, Office of the Air Deputy, SHAPE.

Colonel Edward N. Hall (M.S., California Institute of Technology) is currently engaged in technical activity associated with the IRBM in Europe. Previously he was Director of the Minuteman Weapon System and prior to that the Thor Weapon System at the Air Force Ballistic Missile Division, Headquarters ARDC. He got his start with missiles at the end of the war when he led an Air Force Propulsion Group through German rocket plants and later assisted in the division of captured missile equipment between the United States and Great Britain. He then became Assistant Chief, Non-Rotating Engine Branch, Power Plant Laboratory, Wright-Patterson AFB, where he helped in the development of solid and liquid rocket power plants. In 1954 he joined Western Development Division as Chief, Propulsion Development, with responsibility for the programs leading to engines for the Atlas, Titan, and Thor missiles.

Lieutenant Colonel S. E. Singer (Ph.D., Ohio State University) was a Command and Staff School student when his article was written. Commissioned in the Air Force through the aviation cadet meteorology program in 1943, he served as AACS Detachment Commander and Squadron Operations Officer in Alaska and Canada during the war. He was a radio engineer with Trans World Airlines at Saint Renan, France, 1946-47, then returned to active duty as Weather Communications Officer, Continental Weather Wing, Tinker AFB. He was Special Projects Officer, Hq Air Weather Service, from 1948 to 1951. After receiving his doctorate in nuclear chemistry in 1953 under AFIT, he served as Chief, Radiation Branch, Effects Division, Air Force Special Weapons Center, ARDC, Kirtland AFB, until his attendance at Command and Staff School, 1958-59. His present assignment is as Physicist, Defense Atomic Support Agency, Washington, D. C.

Colonel Richard C. Harris is Chief, Plans and Requirements Division, DCS/O, Hq Air University. After completing two years at Glendale College, California, he enlisted in the West Point Preparatory School at Schofield Barracks, Hawaii, in 1937. When World War II broke out he joined the RCAF, and transferred to the USAF shortly after Pearl Harbor. He flew heavy bombers from England and later from Italy, where he commanded the 343d Squadron, 98th Bomb Group. After the war he was Assistant Military Air Attaché in Argentina and later served in the Directorate of Intelligence, Hq USAF. In 1951 he went to Spain and assisted in negotiating a Mutual Defense Agreement, signed in 1953. He then commanded the first USAF squadron at Madrid and laid the groundwork for the first U.S. operational air base at Zaragoza. After attending the Command and Staff School in 1956-57, he was assigned to Hq Air University. Colonel Harris is the author of *Highlights of Spanish History*.

Major Charles F. Roberts (M.S., Massachusetts Institute of Technology) is presently assigned to Scientific Services, Hq Air Weather Service. During World War II he served as a weather officer in the ZI and in the Pacific Theater. He was with the 30th Weather Squadron on Guam and Iwo Jima in 1947 and 1948. After attending M.I.T. in 1953-54, he served in the Directorate of Climatology 1954-55 and as Chief of Weather Projects Branch, 2d Weather Wing, in Germany from 1955 to 1958.

Major Alvan Bruch (M.S., New York University) is currently doing doctoral work in meteorology at New York University, under the Air Force Institute of Technology. He was called to active duty in 1943, trained in meteorology, and commissioned in 1944. He served with the Air Transport Command in the China-Burma-India Theater in 1945. After a service break in 1946, he served with the 30th Weather Squadron in the Pacific from 1947 to 1949. He was assigned to the WBAN Analysis Center, Washington, D. C., 1950-51; to the USAF Weather Central, 1952-53; and to the Directorate of Climatology, Hq Air Weather Service, 1954-55.

Colonel Harry F. Cruver (M.B.S., Harvard University) was a student at the Air War College when his article was written. During World War II he served with the 100th Bombardment Group in squadron and group assignments. After the war he was assigned in Personnel Plans, Headquarters USAF. He next served as Director of Budget at Headquarters United States Air Forces Europe, and later as Comptroller, Western Air Defense Force. His present assignment is Chief of the Programs Branch, Directorate of Personnel Planning, Headquarters USAF.

Major General Dale O. Smith (USMA; Ed.D., Stanford University) is Commander, 313th Air Division, Okinawa. During World War II he commanded a B-17 group in England. After graduating from Air War College in 1947 and receiving his doctorate in 1951, he was assigned to the Air War College faculty. In 1952 he became Director of Education, Hq Air University, and in 1954 was assigned to the staff of the Operations Coordinating Board of the National Security Council in Washington. During 1956 he was Chief of the Policy Division, DCS/O, Plans, Hq USAF. In early 1957 he was sent to Saudi Arabia as Chief, U.S. Military Training Mission, and Commander, Second Air Division, serving there until assigned to his present position in December 1957.

Wing Commander C. W. Hayes entered the Royal Air Force in 1940 and served throughout the war in Coastal Command, first on Beaufort torpedo-bombers and then on Leigh-light Wellingtons. From 1947 to 1949 he was on the directing staff of the Empire Air Armament School at Manby, Lincolnshire. After a tour of duty at Headquarters Bomber Command, he took the course at the R.A.F. Staff College. Next he was assigned to Air Ministry on intelligence duties, then to Allied Forces, Mediterranean. Since 1958 Wing Commander Hayes has been with the Air Ministry in London on duty in the Directorate of Air Staff Briefing. He was awarded the Order of the British Empire in July 1958.

Colonel James S. Smith (M.A., Columbia University) is assigned to the Directorate of Personnel Procurement and Training, Headquarters USAF. A troop-carrier pilot from 1942 to 1944 and squadron commander from 1944 to 1945, he left the service in 1946 to return to school. He re-entered the Air Force in 1951 and served as Director of Plans, Hq Tenth Air Force, until 1953. Colonel Smith graduated from the Command and Staff School in 1956, then served as Chief of Personnel Planning Division, Hq Air University, until his present assignment.

Senior Master Sergeant Thomas W. Drayton is Supply Inspector, Inspector General's Office, Hq 41st Air Division, Japan. He served as a supply officer in the Pacific Theater during the war. Afterward reverting to enlisted status, he served as Editor, Base Supply, Biggs AFB, then as Operations Analyst, 13th Supply Group, Depot, Tachikawa, Japan, from 1947 to 1951. He was awarded the Bronze Star in recognition of Korean War logistical studies and later the Commendation Ribbon for similar achievements.

Major Ira M. Kay is Assistant for Electronic Data Processing Equipment, Industrial Engineering and Systems Division, Supply Directorate, Air Materiel Command. Ever since his enlistment in the Army Air Corps in 1936 his duties have been in the Supply field. During the war he was a Base Supply Officer and Director of Supply on the Materiel Staff of the Antilles Air Command. In 1947 he was assigned as Dep. Director of Supply, Warner-Robins AMA.

Lieutenant Colonel Russell N. Cassel, USAFR (M.Ed., Pennsylvania State University; Ed.D., University of Southern California) is Chief Clinical Psychologist, Phoenix Union High Schools and Phoenix College System, Phoenix, Arizona. Presently on reserve status he is serving as Aviation Education Specialist, Orientation Group, USAF, Detachment #1, Norton AFB. He was a school teacher and counselor, 1935 to 1940, and an assistant professor, San Diego State College, 1949 to 1951. In the service from 1940 to 1944 he was in personnel work, and he has been a research psychologist with Hq Air Training Command, 1951 to 1955, and with Hq AF Personnel and Training Research Center, 1955 to 1957.

ATTENTION

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