UNITED STATES AIR FORCE
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REVIEW

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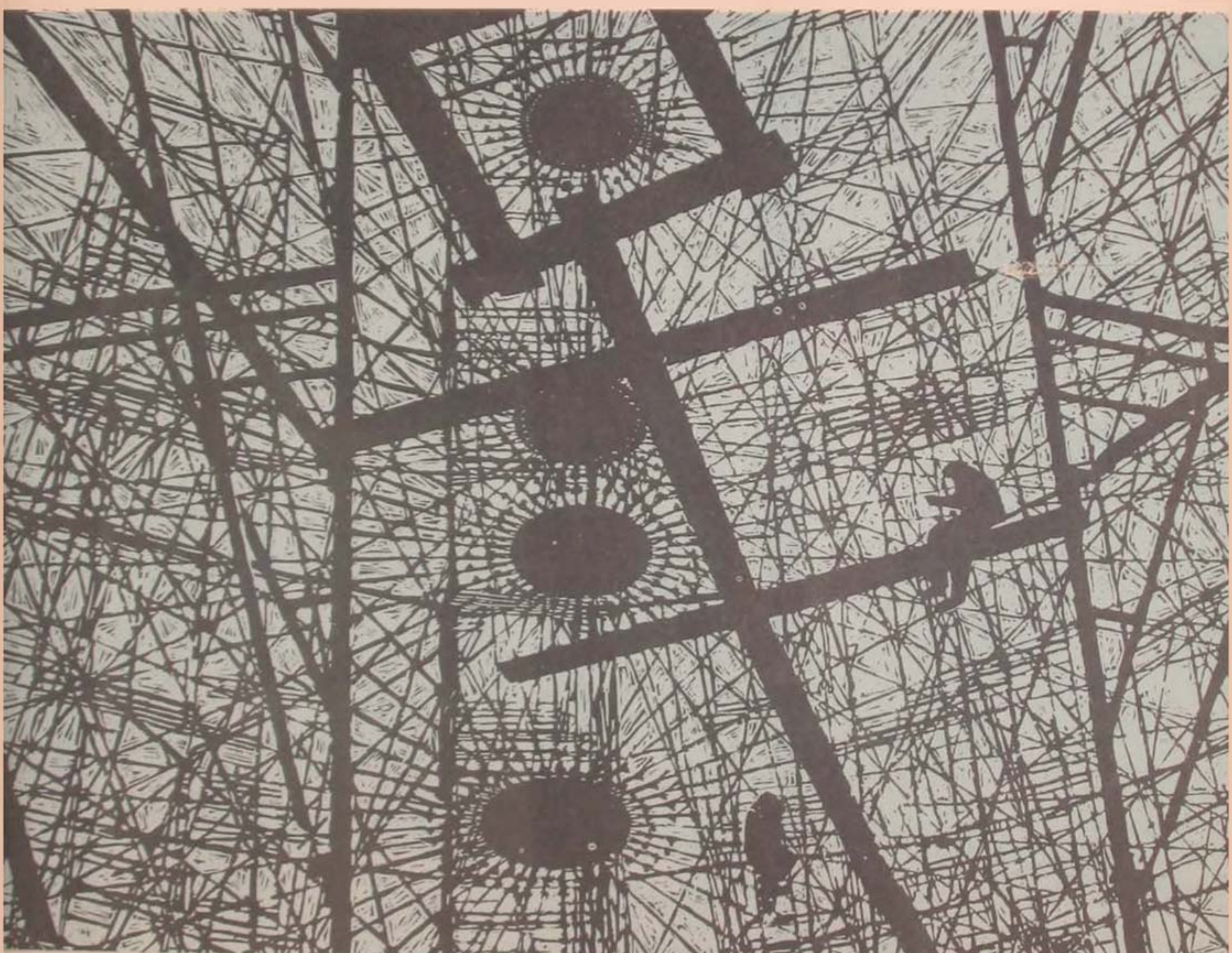

SATELLITES, SENSORS, AND SPACE SPECIALISTS...
PROJECT MANAGEMENT...PRESSURE SUIT DEVELOPMENT

JANUARY-FEBRUARY 1965

AIR UNIVERSITY REVIEW

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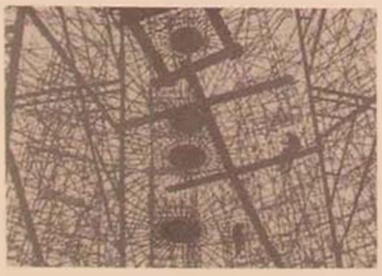


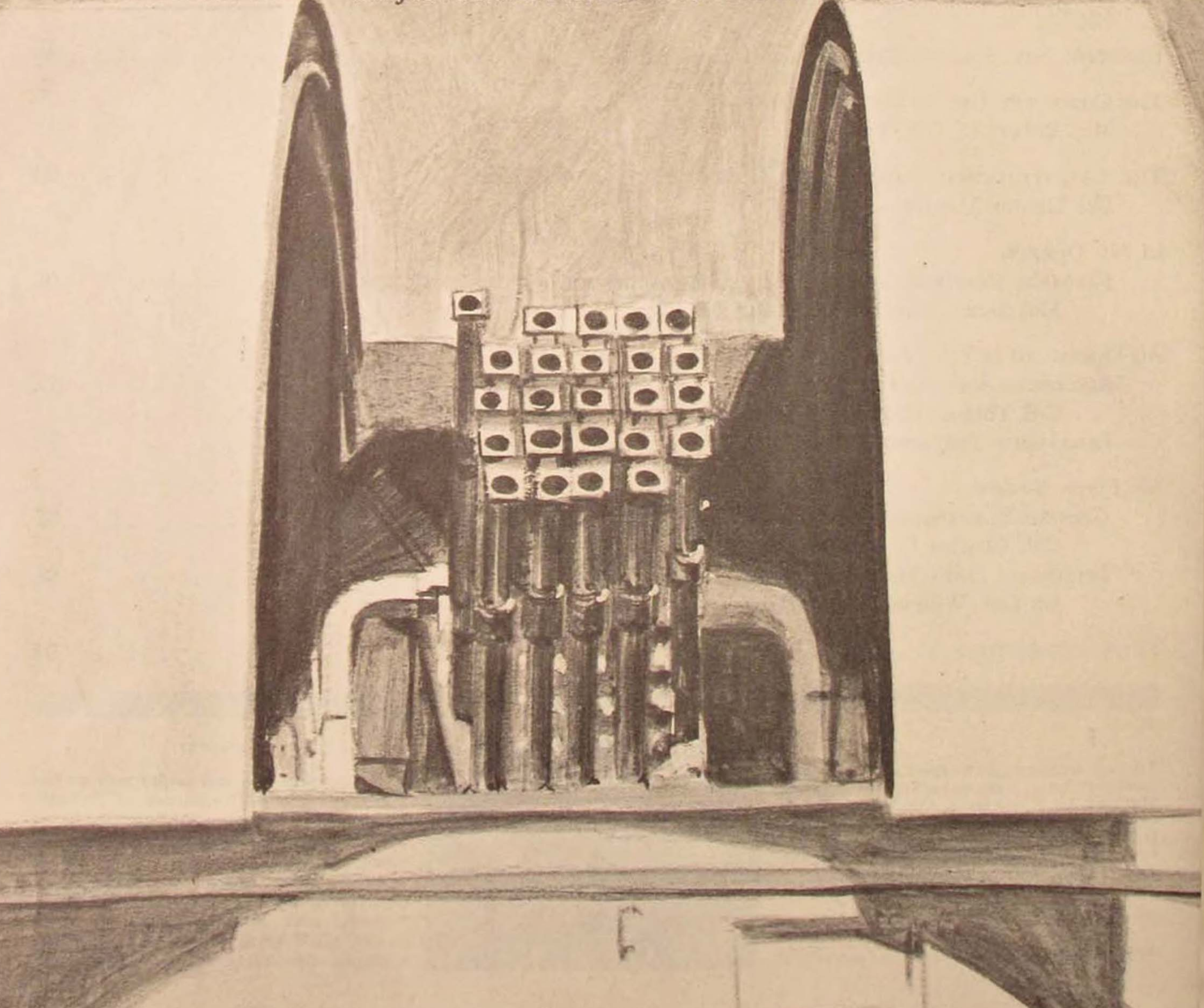
the cover

When construction was under way on the 140-foot "golfball" radomes of Ballistic Missile Early Warning System Site III at Fylingdales Moor, England, the maze of wires and girders formed an intricate tracery against North Sea skies. Major General Horace A. Hanes, in "Satellites, Sensors, and Space Specialists," tells about BMEWS and more recent space surveillance developments and techniques.

SATELLITES, SENSORS, AND SPACE SPECIALISTS

USAF's Space Surveillance Story

Major General Horace A. Hanes



THROUGH the ages storytellers who set themselves down to recite strange and wondrous tales have commenced with the classic phrase, "Once upon a time. . . ." Only a short time ago the subject of this story would have made an excellent plot for an adventure comic strip. Since the chain of events which have taken place may significantly change our lives, it is fitting and proper that we employ the time-honored opening. So, "once upon a time" the habitual study of the heavenly bodies in the universe around us was confined largely to astronomers, navigators, and young lovers. Then in October 1957 the Soviets abruptly upset this comfortable state of affairs. With the explosive hurling of Sputnik I into orbit around the earth, the infinite ocean of space above was no longer the exclusive preserve of theorists and poets. It had been successfully invaded by the twentieth century scientist and engineer.

In the roughly 90 minutes required for Sputnik I to make a complete circuit of the earth, a new frontier for human conquest and competition opened up. Around the globe, people who had heretofore looked skyward for comfort or a hint of tomorrow's weather now did so with a sense of uncertainty, even alarm. This spectacular achievement by a foreign power did produce one immediate result. It made the entry of the United States into space, and in particular the aerospace defense business, inevitable.

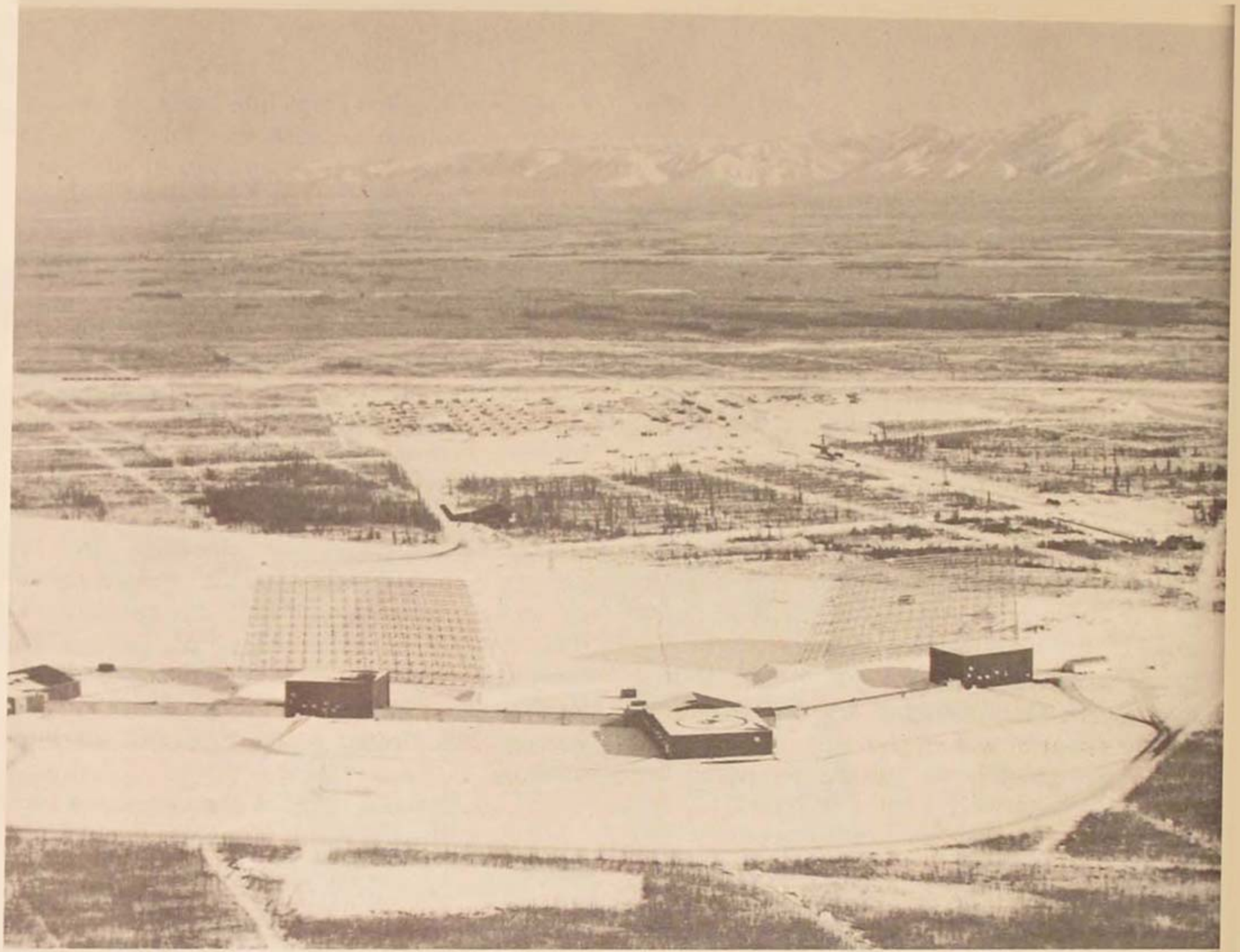
Among the first to recognize the vast military potential of man-made earth-orbiting satellites was General Thomas D. White, then Chief of Staff of the United States Air Force. The launching of the 184-pound Sputnik I package clearly demonstrated the inadequacy of existing detection and surveillance equipment. As a counter to this new threat, General White ordered the establishment of a system which would provide for the detection and continuous surveillance of all man-made objects in space. What followed was one of the most intensive and compressed joint Department of Defense and civilian industry scientific and engineering efforts in our peacetime history.

One of the first steps into this new dimension in aerospace defense was taken in 1958 with the establishment of an interim filter center called "SPACETRACK" at Laurence G. Hanscom Field, Massachusetts. The facility was placed under the control of the Geophysics Research Directorate of the Air Force Cambridge Research Center. To provide military/civilian program coordination and continuity, several special agencies were created. The Department of Defense established the Advanced Research Projects Agency (ARPA) and assigned it the responsibility for conducting a research and development program. The National Aeronautics and Space Administration (NASA) was given responsibility for the civilian scientific space efforts. Operation of the SPACETRACK filter center was handed to the Air Force. The Army and Navy were directed to establish portions of an electronic radar fence across the southern United States to detect satellite crossings.

The heart and brain of the aerospace surveillance system was the Hanscom Field filter center. Cooperative arrangements with other agencies, both military and civilian, brought all sensor detection data to SPACETRACK. A central data-processing unit was installed in 1958 to receive, process, and store satellite observation information. High-speed electronic computer systems, beginning with the IBM 650 and progressing through the Philco 2000, were used for data processing.

In October 1960, three years to the month after Sputnik I was launched, operation of what was to be known as the Space Detection and Tracking System (SPADATS) was assigned to the North American Air Defense Command. An initial cadre of twelve hand-picked USAF/ADC air defense specialists was dispatched to Hanscom Field to attend what was then scheduled to be a two-year training program. The curriculum included celestial mechanics, radar, radiometric and optical sensor devices, high-speed computer operations and maintenance, satellite tracking procedures, and orbital computation techniques. An order also went out to the Air Force to construct a permanent SPADATS/SPACETRACK Center for CINC-

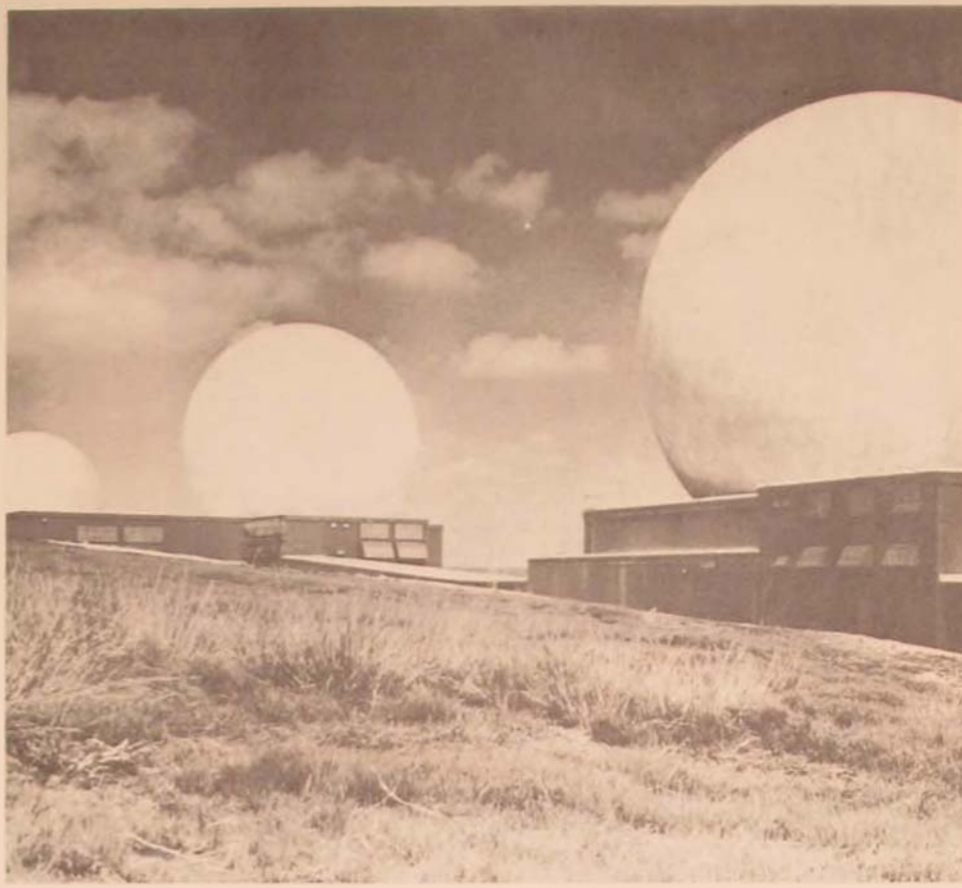
Eye camera, Holloman AFB, New Mexico



NORAD at Ent Air Force Base, Colorado Springs, Colorado.

Astonishing progress by both the U.S.S.R. and U.S. space programs by this time prompted a swift change in our aerospace defense operations and planning requirements. In January 1961 there were 35 man-made satellites in orbit around the earth, and the celestial population was doubling every ten months. Top defense officials in the Pentagon directed that the new center under construction in Colorado Springs be completed and ready for full operation by 1 July. The already compressed two-year training course for the original twelve students in training at Hanscom Field was accelerated. By attending classes ten to twelve hours a day, they completed the course in the incredibly short period of five months.

At the same time that General White took the actions which resulted in the establishment of our present USAF SPACETRACK System, he also added impetus to the Ballistic Missile Early Warning System (BMEWS), which was steadily approaching operational capability. It was to be comprised of very long-range, ultra high-speed radars capable of providing the brief but vital warning time necessary to take defensive and offensive measures in the event of a hostile missile attack launched against the North American Continent by way of the polar approaches. Thule, Greenland, and Clear, Alaska, were selected as the first two site locations in the system. The Thule site became operational late in 1960 and the Clear site in early 1961. Although not specifically designed as a satellite sensor, it was quickly discovered that BMEWS was an extremely effective and reliable source of space satellite observations. Thus an unexpected and entirely welcome supplement to the SPACETRACK net



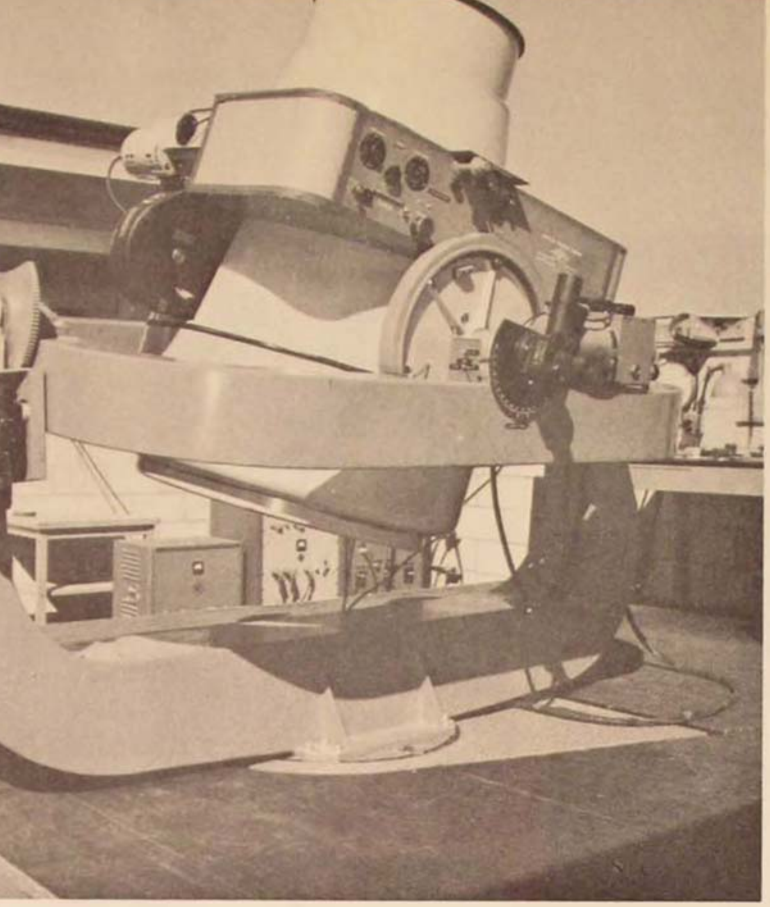
The Ballistic Missile Early Warning System station at Clear, Alaska, has been operating since 1961. It is in the interior, along the broad Nenanna River valley between Anchorage and Fairbanks, just northeast of Mount McKinley. . . . The final link, Site III, in the warning net blanketing the top of the world became operational in 1963 at Fylingdales Moor, England. It is operated and maintained by the Royal Air Force Fighter Command. USAF personnel of the 71st Surveillance Wing (BMEWS) work side by side with their RAF counterparts to provide inputs to the NORAD Combat Operations Center at Colorado Springs.

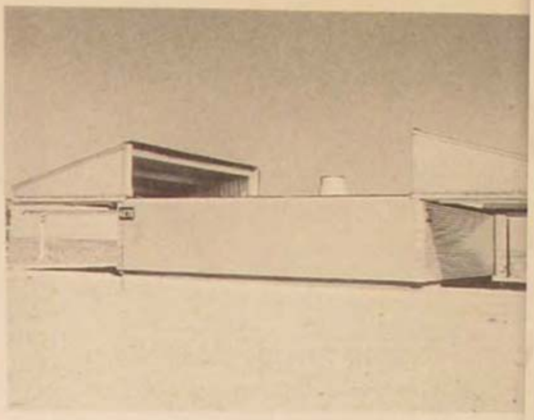
presented itself at a most opportune time.

From the beginning it was obvious that an "aerospace" defense operation must be worldwide in scope. To directly supervise the operations of an already far-flung and rapidly expanding space surveillance network, the 9th Aerospace Defense Division was activated under the Air Defense Command in mid-July 1961. Its headquarters was collocated with that of ADC in Colorado Springs. The mission of this, the first and only military organization of its kind in the free world, is to detect, identify, track, catalogue, and predict the future orbits of all man-made objects in space, including ICBM's and deep-space probes. These tasks are being accomplished in response to and under the operational control of CINCNORAD, whose responsibility it is to provide warning of any hostile ICBM attack against the North American Continent.

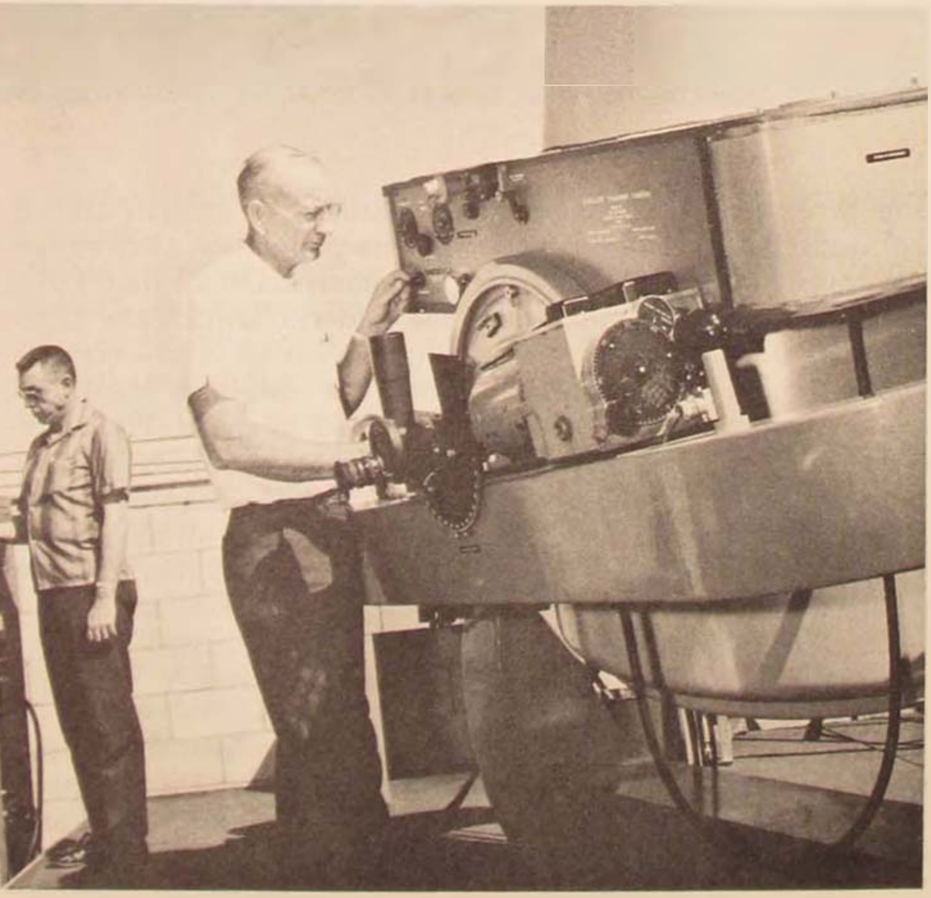
As mentioned earlier, the growth rate in the man-made satellite population circling the earth has been phenomenal. On 29 June 1961, the day before the SPADATS/SPACETRACK Center was officially scheduled to commence operations, one of our U.S. satellites known as "1961 OMICRON" exploded in space. The satellite inventory of some 30-odd objects literally doubled with a bang. For the sake of clarity and definition, the center views all man-made objects in space as satellites whether they be payloads, booster packages, or bits and pieces of vehicles which have disintegrated in orbit. The latter particles are referred to as space debris or space junk.

During the training months of our space surveillance operations, about 12,000 space satellite observations were being received and processed. Compare this with the current rate, which fluctuates between 190,000 and 215,000





Space Camera



The Baker-Nunn camera is one of the optical sensors providing the SPADATS/SPACETRACK Center with precision data on orbiting objects. In its shelter with sliding roof, this prodigy of "box Brownies" can pick up a six-inch sphere at 2400 nautical miles. By identification and correlation of the star background in the photographs, an object's geographical position can be determined with great precision and its future orbital path predicted. Twelve Baker-Nunns are operated by the Smithsonian Astrophysical Observatory and five by the USAF, this one at Edwards AFB.

observations received, processed, and catalogued each month. This averages out to one every twelve seconds around the clock, seven days a week.

To further illustrate the population explosion in outer space and the effect it has on aerospace defense operations, on 1 October 1964 there were 477 man-made objects circling the earth. As of that date there had been a total of 887 such objects under surveillance at one time or another. The difference in these two figures is accounted for by objects which were in orbit but which decayed, fell back into the earth's atmosphere, and destroyed themselves. In this day and age when everything from budgets to bosoms assumes seemingly astronomical proportions, the statisticians in the 1st Aerospace Control Squadron, which operates the SPADATS/SPACETRACK Center, can come up with some startling figures of their own. Since commencing operations, these space-age sentinels have processed nearly 7,000,000 observations through the center.

It is estimated that by 1970 there will be between five and seven thousand man-made space objects in earth orbit. All of them will have to be continuously identified, tracked, and catalogued. It is readily apparent that the task of our aerospace defense system will become increasingly complex.

The question might well be posed here as to why we must keep constant tabs not only on payloads but on all the bits and pieces of junk in space. The answer is that if we did not we would be unable to detect and identify new additions to the space inventory.

How is this huge task being accomplished now? The basic elements of our space surveillance system include a string of sensors serving as the eyes. These feed data through a vast web of communications lines to the terminal facility and keystone of the system, the SPADATS/SPACETRACK Center at Ent AFB.

Since this network of space sensors, which at the present time number more than 650 sprinkled around the world, includes facilities owned and operated by other U.S. military services and foreign countries, establishment of a joint command-type organization to govern it was necessary. It is through SPADATS that NORAD exercises operational control over the complete and integrated military aerospace defense operations on the North American Continent.

Pursuant to a DOD memorandum of October 1960, the terminal facility of this system was officially designated the "SPADATS/SPACETRACK Center." The USAF serves the center in two ways. First, when receiving and processing data provided by the USAF portion of the sensor system, the 1st Aerospace Control Squadron functions as the SPACETRACK Center and is the control element for the USAF/ADC Spacetrack System. Second, when receiving and processing data from non-USAF sensors, which is accomplished by the same personnel and employs the same computers, the 1st Aerospace Control Squadron and a NORAD command representative constitute the SPADATS Center. This defines an arrangement which, although difficult to explain, works well in practice.

The non-USAF space surveillance elements and systems over which SPADATS exercises operational control include U.S. Army, Navy, civilian, and Royal Canadian Air Force sensor facilities. The best known of these is the U.S. Navy space surveillance fence (SPASUR) situated east and west across the southern U.S.

These observations reach the center by all types of communications methods, ranging from electronic impulses fed directly into the central computer facility at millionths of a second to postcards and photographs delivered by regular mail.

The sensor devices used in aerospace surveillance operations are highly diverse. The goliaths of them all are the parabolic fixed-beam BMEWS radars at Thule, Greenland and Clear, Alaska. These huge, curved screens are over 400 feet long and 165 feet high and weigh over 1500 tons. They are held upright by nickel-steel pipes twelve inches in diameter, stressed to withstand 185-mile-per-hour winds and a six-inch coating of ice. Officially designated the AN/FPS-50, this super surveillance radar includes 290 king-sized black boxes full of electronic equipment, ten monitoring consoles, 704 feedhorns, and 440 miles of connecting cables and wave guides. All of this is installed in four scanner buildings, two transmitter buildings, and a combination transmitter-computer building. Four of the reflectors, each the size of a 40-story building laid on its side, are used at Thule, and three at Clear.

The BMEWS radar system is capable of scanning space to ranges in the neighborhood of 3000 miles. In terms of target resolution, it could pick up and track an ordinary house door at this range over Siberia.

Another type of long-range radar used in both the BMEWS and SPACETRACK systems is a dish-shaped rotating antenna approximately 85 feet in diameter, with a 360-degree azimuth scan capability and from ground level through the vertical. It has a range of more than 2000 nautical miles. The dish assembly or moving portion of the equipment weighs 106 tons. It can operate either in an automatic search mode or be directed at and locked onto one specific target. The switch from automatic search to single target lock-on is accomplished in a fraction of a second.

The Thule BMEWS site is equipped with both the tracker and fixed-beam types of equipment. This combination provides a maximum degree of satellite-tracking flexibility and efficiency.

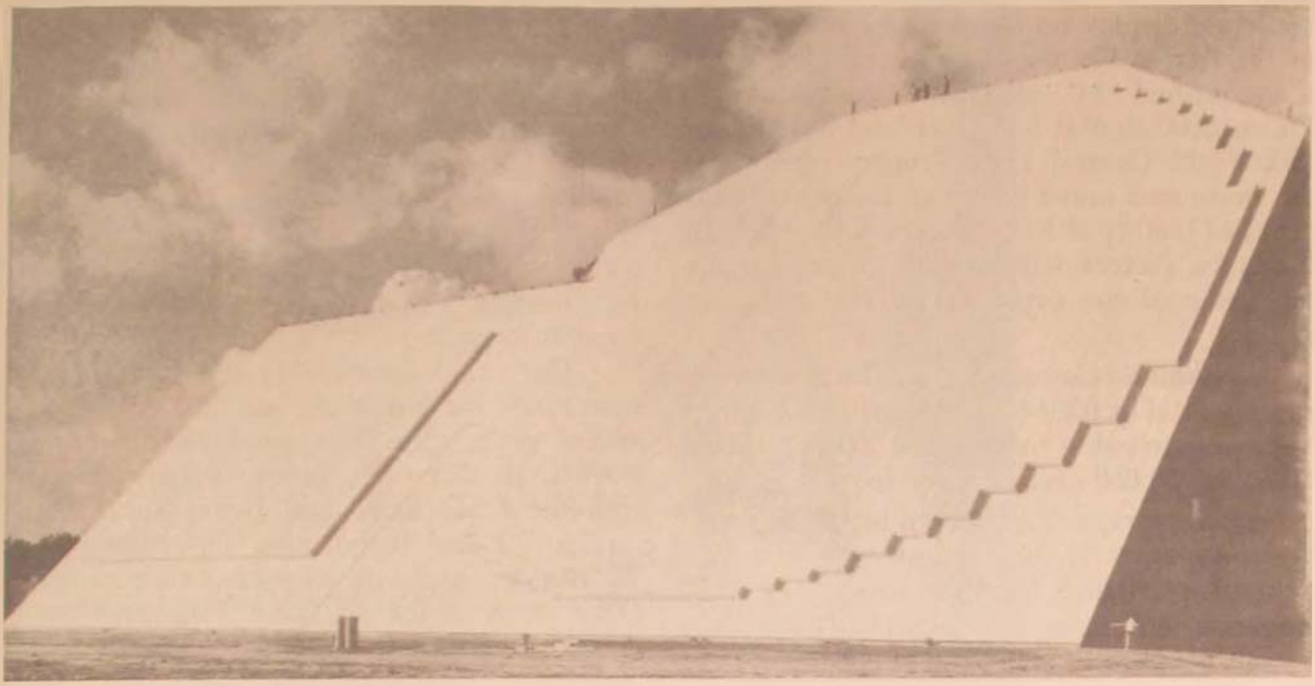
Another member of the electronic-type sensor family which feeds a large volume of data into the SPACETRACK system is a radiometric device. This type requires a cooperative satellite, one which emits signals of one kind or another from a transmitter installed within the space vehicle itself. Chains of these radiometric devices, which are highly accurate, are located along both the Atlantic and Pacific missile ranges. Radiometric devices are employed to track our manned space capsules.

Finally, the SPACETRACK system makes extensive use of optical sensor equipment. One of these devices is the Baker-Nunn camera. Standing ten feet high and weighing three tons, these great gran'daddies of all the box Brownies are not only superbly accurate instruments but provide truly remarkable target resolution at extreme ranges. For example, this camera picked up the U.S. Vanguard I space package at a range of approximately 2400 nautical miles. This doesn't sound too impressive until one recalls that Vanguard I is a six-inch sphere. Comparatively speaking, this feat is equivalent to photographing a .30-caliber bullet at 200 miles. The Baker-Nunn, by photographing orbiting vehicles against a star background, makes possible pinpoint positioning of the vehicle. Through star identification and correlation, it is now possible to determine the geographical position of a man-made satellite in space within two-thousandths of a degree in azimuth and two-thousandths of a second in time. Accuracy of this nature also makes possible the prediction of the exact future orbital path of the object.

Other optical sensors in use are the Boston University and Facet Eye cameras. The former unit, designed and built at Boston University, is the only mobile sensor in the system. It is mounted on an antiaircraft gun mount. It was designed for taking configuration-type photographs and has been used with marked success in missile photography. The unit is air-transportable and is carried around the world for use on special spacetrack projects.

The Facet Eye camera at first glance tends to resemble either a bank of rocket launchers or the wildest dreams of a TV addict. It is comprised of 24 long-barrel telescopes, each of which is connected to its own television receiver. The specific advantage of this particular instrument is the extension of aerospace photography into the daylight hours. Data are thus acquired which are not normally obtainable from other systems. Most space photographic devices require the sun's reflection on the object to be effective. As this reflection occurs only at dawn and dusk, the usable time intervals for instruments such as the Baker-Nunn camera are restricted.

In addition to the military-owned and -operated optical devices mentioned, civilian and educational astronomical observatories feed much valuable data into the system. Cooperating agreements are in effect with many internationally recognized organizations. Among them are the Mount Palomar Observatory in California, the Smithsonian Astrophysical Observatory, and similar organ-



First of a new generation of space sensors, AN/FPS-85 being built near Eglin AFB, Florida, will be completed and incorporated into the USAF SPACETRACK System by January 1966.

izations in Norway, Canada, South Africa, Australia, and the Middle East. Some of the observations from these sources received in the SPADATS/SPACETRACK Center read and view like science fiction. One which was certainly in this "way out" category was a picture taken by the Mount Palomar Observatory in the summer of 1962. It was a photo of the U.S. Mariner II, a deep-space probe, on its third day of travel, or at a range in excess of 350,000 miles.

As mentioned earlier, the optical sensor is an invaluable asset not only in the detection and tracking phases of spacetrack operations but equally so in the decay phases of man-made satellites. A vitally important part of the job of the SPADATS/SPACETRACK Center is the accurate prediction of the time and place at which an artificial satellite will fall back into the earth's atmosphere and be destroyed.

The state of the art in decay predictions has progressed to the point where imminent casualties in the space satellite population are forecast regularly and accurately. Some of these events produce unusual and dramatic results. In the summer of 1962 orbital analysts in the 1st Aerospace Control Squadron predicted that the Russian vehicle Sputnik IV, launched in May 1960, was reaching the end of its life span. They estimated that it would decay in the month of September and re-enter the atmosphere and that surviving pieces, if any, would land in the general vicinity of the state of Wisconsin. This information was forwarded to a team of astronomers in Wisconsin, who did in fact witness the re-entry and fiery destruction of Sputnik IV.

Connecting the space surveillance sensor network with the center in Colorado Springs is a communications net with full backup systems. The major communications channels are redundant or have a memory capability which provides for the storage and rapid transfer of data from a primary channel, if it has failed, to its backup circuit without loss of any of the information in transit.

An input of data on some 5600 space satellite observations per day precludes any possibility of processing this information manually. Both the correlation of incoming data and their display on the great plotting boards in the NORAD Combat Operations Center are accomplished by electronic computers. A Philco 2000 digital computer and a matching Philco 212 Central Data Processor make up the brain and nerve center of the SPACETRACK terminal facility at Ent AFB. The following performance factors will provide a general appreciation of the capability of this computer system.

Arithmetic Computations. The system can make a total of 626,950 additions and subtractions per second, a total of 199,400 multiplications and 79,680 divisions per second.

Data Storage. The system has a core storage capacity of 32,768 computer words with a total of 48 binary bits per word. It has 19 magnetic tape units, each of which can record a total of 19 million alphanumeric characters per 3600-foot reel of tape. These tapes are used for program storage and record files.

Data Processing and Output. The magnetic tapes are capable of reading or writing 90,000 alphanumeric characters per second; the high-speed printer reproduces data at a rate of 900 lines per minute with up to 120 characters per line.

Access Time. The access time for information stored in the Philco 212 is one and a half microseconds.

The end product of this nearly unbelievable maze of electronic gear takes several forms. The first is a current catalogue of all man-made objects in space, including deep-space probes. This list, as mentioned previously, includes debris such as rocket motors and aluminum panels. The catalogue contains the object number, official designation or name given it, national origin, and launch date.

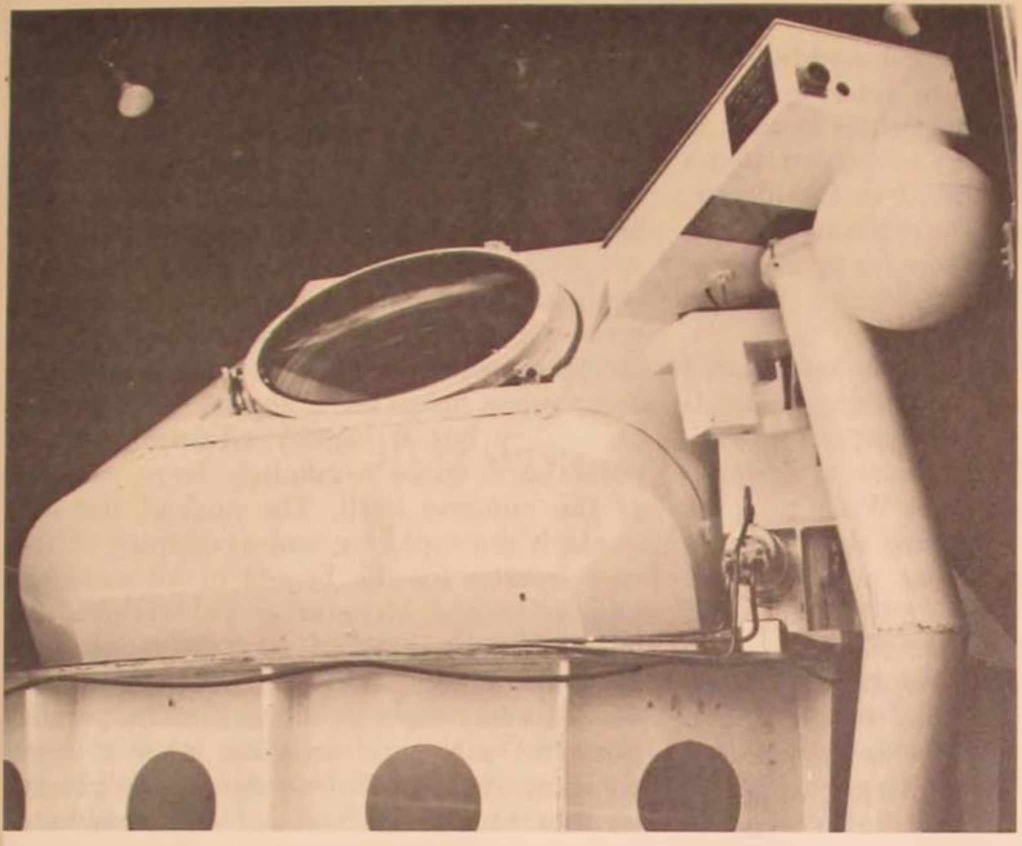
A space object bulletin is also produced. This document provides current and predicted orbital data on all space objects. The information is in the form of the geographical point on the globe at which each space object crosses the equator and the precise time of its crossing.

From the space object bulletin a further refinement is made which is called the Sensor Look Angle list. This document is tailored for specific sensor sites around the world. In other words, space surveillance personnel at any given site can consult this guide and obtain the exact position in space of a given satellite relative to their site location in terms of range, azimuth, elevation, and time. More simply, this procedure is not unlike a gunnery instructor on a firing range telling a shooter on the line exactly where and when to point his weapon in order to hit the bull's-eye.

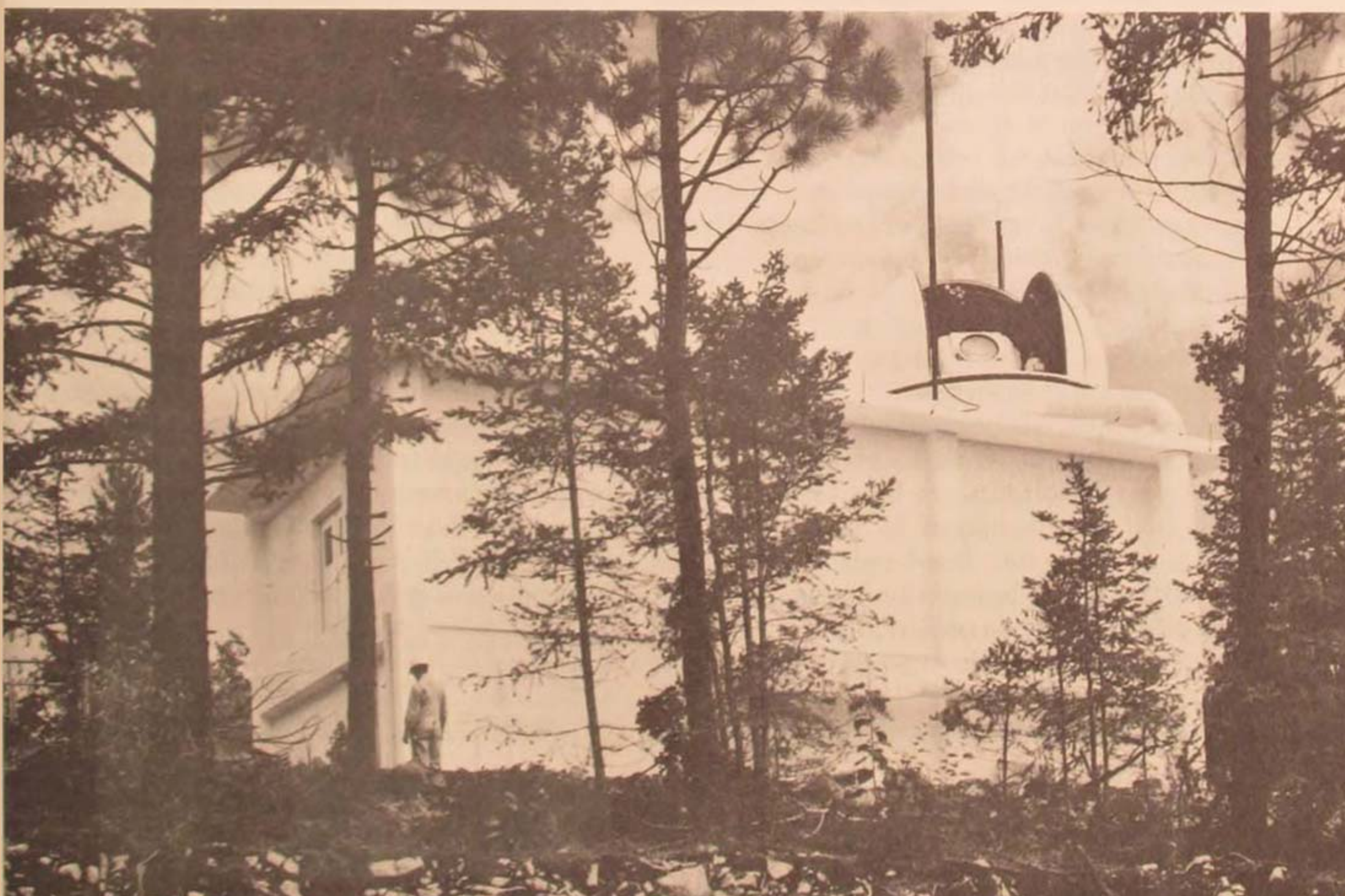
The rapid increase in the inventory of man-made earth-orbiting satellites in the past seven years, plus the predicted continued growth in this area, poses a continuing requirement for more and better surveillance equipment and techniques. The most recent addition to the family of BMEWS aerospace defense units is the site at Fylingdales Moor, England. Perched on the heather-covered Yorkshire moors near the North Sea coast, this installation serves as the eastern anchor and final link in the BMEWS system. Unlike its sister sites in Greenland and Alaska, the Fylingdales facility does not employ the huge fixed-antenna type of radar. Rather three FPS-49 tracker radars provide aerospace surveillance. This site is owned, operated, and maintained by the Royal Air Force Fighter Command. A contingent of USAF personnel from the 71st Surveillance Wing works side by side with their RAF counterparts to provide inputs into the NORAD Combat Operations Center at Colorado Springs. The 71st Surveillance Wing is the subordinate unit of the 9th Aerospace Defense Division charged with the management of the BMEWS activity.

Although the primary missions of the Fylingdales site are to provide IRBM warning for the British Isles and ICBM warning for the North American Continent, this installation is a prolific source of space satellite observations, as are those at Thule and Clear.

Future additions to our spacetrack system scheduled to become operational in 1964 will greatly increase our ability to observe and differentiate space traffic. A new and unprecedented phased-array radar to be known as the FPS-85 is nearing completion at Eglin AFB, Florida. This is the first radar system



The first Air Force sensor specifically designed for wide-angle space surveillance is the electro-optical AN/FSR-2. It will detect satellites at ranges of 20,000 miles or more, well beyond the normal range of radar equipment. Under construction at a site near Cloudcroft, New Mexico, it is to be operational by July 1965.



specifically designed, developed, and built for the surveillance of objects in outer space.

Also scheduled for completion in 1964 is an electro-optical system to be known as the AN/FSR-2. It will be located in Cloudcroft, New Mexico, and will be capable of probing space to distances of 20,000 miles or more.

We have in-being today a fully operational space satellite detection, surveillance, and cataloguing system. We have attempted to indicate on an unclassified basis some of its capability and scope of operations. While progress in this area of activity in three short years is noteworthy, the skyrocketing population of man-made objects in space and the advent of maneuvering space vehicles will place much greater demands upon the SPACETRACK system.

The average layman may well ask, and logically so, Why must we be so deeply concerned with the rapidly increasing space population? Why is such extreme accuracy required in our space surveillance operations? Extrapolation from the pages of history provides the answers to such questions. At given times in the past, the physical mediums of land, water, and air have offered opportunity for national expansion and conquest. Ambitious nations historically have recognized and taken full advantage of a new medium at the proper time to gain pre-eminence in world affairs. For recent examples, both the airplane and submarine were invented in peacetime but were first exploited in war. The missile and nuclear weapon were "born" during World War II and have now reached a state of maturity.

Once again the nations of the world are confronted with a medium which presents a great opportunity for economic, scientific, political, and military growth. That medium is outer space. Space technology is still in a state of infancy but is rapidly advancing. Man's potential in space is infinitely large, as large as the universe itself. The goal of the free world is the exploring and developing of this new frontier for the benefit of all mankind. Our ambitions in outer space are peaceful ones. To ensure these good intentions, we must maintain a position of perpetual awareness of every element in the satellite population. Not only must we know what is there, we must also have knowledge of the characteristics, function, behavior, and intended use. International competition for outer space requires not only a mutually agreed-upon set of rules but also—equally important to us—the means to enforce them effectively. Space surveillance is an essential element of such an enforcement capability.

The means of enforcement is another story, which may well begin, "Once upon a time . . ."

9th Aerospace Defense Division, ADC

PROJECT MANAGEMENT

An Innovation in Managerial Thought and Theory

Major David I. Cleland

ULTIMATE authority within the Department of Defense rests with the Office of the Secretary of Defense. This authority has its origin from Title II, The Department of Defense, the National Security Act of 1947 (Public Law, 80th Congress). This act reflects the intent of Congress to centralize and strengthen the management of the military, economic, and social aspects of national defense. Subsequent legislation in 1958, under stimulus of President Eisenhower's defense reorganization message, clearly portended subsequent recentralization of authority within the Office of the Secretary of Defense. This increasing centralization has been accomplished in an environment of:

(1) Changing roles and missions of the military establishments with respect to the traditional separation of areas of operation; beginning erosion and merging of parochial divisions of military operations into land, sea, and air employment; continuing unification of certain functions of the armed forces, with indications of a single national system of defense evolving.

(2) Increasing and dynamic acceleration in the conception and development of weaponry.* Technical breakthroughs, incremental and protracted development cycles, and increasing costs stimulated the need for a distinct type of managerial innovation in the management of large development and production programs.

Within the national military establishment certain weapon acquisitions became so vast and demanding that it was impossible to assign to one single organization total responsibility for successful accomplishment of the objective. The increasing demands for more advanced weaponry and the increasing propensity of the Department of Defense to depend on the private industrial complex for research and development efforts intensified the requirement for a management philosophy that went beyond the traditional management theories.

Unfortunately expertise in the science and art of management lagged the state of the art in development and engineering. The military manager, engaged in the development and acquisition of weapons, was confronted with the coordination and integration of large aggregations of human and nonhuman resources, the greater part of which were outside the traditional concept of *line* command. Traditionally, management practitioners and scholars have approached the management function through the medium of the *line* and the *staff*. Line functions are thought of as those activities which have a direct and constitutional role in the accomplishment of organizational objectives. Staff, on the other hand, refers to the specialized assistance and counsel provided the line manager. Traditional management philosophy is pervaded with vertical flow of authority and responsibility relationships. Whatever horizontal relationships did exist were of a collateral

*Weaponry, a general term, connotes the varied instruments intended to inflict damage to an enemy through the destruction of physical or mental capabilities. The term *weapon system* means a highly sophisticated weapon composed of a combination of equipment, skills, and managerial know-how, which as an integrated entity is capable of effectively destroying an enemy.

and coordinating nature and did not violate the principle of unity of command. Traditional military and business organizations have functioned for the most part on a vertical basis and depend almost exclusively on a strong and inviolate superior/subordinate relationship to ensure unanimity of objective. The existing management theory was found lacking when it was realized that certain management relationships were evolving in the development and acquisition of large single-purpose projects whose development and production cut across interior organizational flows of authority and responsibility and radiated outside to other organizations that were managed as autonomous units. In particular, traditional management theory failed to provide a contemporary philosophy required for the manager to use in defense/industry ventures involved in the inception and development of advanced weapon systems. Singular elements of risk and uncertainty, extensive involvement of resources, and changing concepts in the employment of weaponry forced a management posture calling for a blending and unifying of many defense and industrial organizations directed toward a common objective. An existing multilayered and diffused management structure within the industrial and defense organizations concerned complicated the management function.

The basic objectives involved in the development and acquisition of a weapon system include divergent activities such as research, engineering, test, production, operational support, etc., all of which are time-phased over the life of the project. The result is an interlaced sequential managerial activity encompassing broad spectrums of personnel and resources extending over several years of time. The intimate superior/subordinate relationships found in recurring activities still exist, but the main focus of the task involves the unification and integration of complex input factors into a meaningful pattern of accomplishment. The functional approach, or traditional departmentation based on homogeneity of duties or geographical location, becomes meaningless when the task involves the coordinated single-goal effort of hundreds of organizations and people. Individual managers have a general affinity for identifying boundaries of responsibilities and specializing in these areas. When organizations were relatively small this provided no great problem, since the functional manager could maintain lateral staff contact to ensure mutual support and understanding of interfunctional goals. Traditional management thinking is built on these ideas; the emergence of multiorganizational objectives has shown the provincial management theory of Fayol and Taylor to be lacking.*

Since World War II there has been unprecedented acceleration in the advancement of technology in all phases of industrial and military management. Radical changes have occurred in the design and employment of weaponry. These profound changes have forced innovation in Government- and Defense-oriented industrial organizations. In many cases weapons and strategy have evolved which do not fit the functional organization, and the result has been the emergence of new theories concerning management and organization. Attention is being given to molding the organization around the task. New terms have come into use, such as "systems management" and "systems engineering," which portend the need for a new type of managerial surveillance that has no organizational or functional constraints.

The size and complexity of contemporary and expected future programs discourage the development of a single *autonomous* element of the defense establishment to manage a program successfully. Rather what is required is a blending of the technical know-how of many functionally oriented organizations under one centralized coordinating and managing agency whose prime role is to synchronize and integrate an aggregation of resources. The *project management* philosophy has been developed by the military/industrial complex as a means to satisfy the requirement for the management

*Henri Fayol, a French industrialist, wrote a book titled *General and Industrial Management*, which appeared in 1916. No English translation was published in the United States until 1949 (New York: Pitman Publishing Corporation). Fayol is called by many scholars the father of modern management theory. His writings describe the job of the manager from the viewpoint of a single firm rather than from the unifying requirement demanded of a project manager in today's defense/industry environment. Frederick Taylor's writings appeared around the turn of the present century and described management at the shop level; he was concerned with the efficiency of workers and managers in actual production-line activities.

of defense resources from inception to operational employment. How did this concept develop? Is it a further refinement of traditional management thought and theory, or is it a revolutionary new development which portends radical changes in organizational theory and in the management of activities by the functional approach?

In the aerospace industry/Government relationship there has developed a tendency towards greater and greater use of ad hoc offices concerned exclusively with the managerial integration of a single weapon system or subsystem. The increasing use of this managerial innovation indicates that it is becoming sufficiently ingrained in management thought and theory so that serious questions are being raised about the ability of the pure functionally oriented organization to manage more than one major project successfully. This is particularly so where nonrepetitive production programs are being conducted and in those military and industrial organizations where basic and applied research programs are undertaken. The establishment of a project manager in a functional organization permits managerial concentration of attention on the major considerations in the project or program. This concentration is particularly valuable when the producer is competing in a market system where the product price is largely determined by reimbursement of costs actually incurred or where the contract involves, on the part of the producer, a total commitment of company resources over an extended period of time and, on the part of the buyer, a monopsonistic situation where an intimate dependence upon the producer to fulfill the contract commitment increases the risk and uncertainty factors. It is a market where the financial and managerial risks of the business center around only one or a few ventures. Consequently there is a much greater propensity on the part of the buyer to enter into the active management of the program in the seller's facility.

characteristics of project management

In a sense project management is compatible with the traditional and functional approach to management, yet it has provided *a way of thinking* with respect to the management of highly technical and costly weapon systems, the development and acquisition of which have spread across several large autonomous organizations. The project manager within Department of Defense organizations has been established to manage across functional lines in order to bring together at one focal point the management activities required to accomplish project objectives. The project manager has certain characteristics which tend to differentiate him from the traditional manager:

(1) As project manager, he is concerned with specific projects whose accomplishment requires a great amount of participation by organizations and agencies outside his direct control.

(2) Since the project manager's authority cuts through superior/subordinate lines of authority, there is a deliberate conflict involved with the functional managers. The functional manager no longer has the complete authority with respect to the function; he must share the authority relative to a particular project with the project manager.

(3) As a focal point for project activities, the project manager enters into, on an exception basis, those project matters which are significant to the successful accomplishment of the project. He determines the *when* and *what* of the project activities, whereas the functional manager, who supports many different projects in the organization, determines *how* the support will be given.

(4) The project manager's task is finite in duration; after the project is completed the personnel directly supporting it can be assigned to other activities.

(5) The project manager manages a higher proportion of professional personnel; consequently he must use different management techniques than one would expect to find in the simple superior/subordinate relationship. His attitude regarding the traditional functions of management must of necessity be tempered by increased factors of motivation, persuasion, and control techniques. For many professionals the leadership must include explanations of the

rationale of the effort as well as the more obvious functions of planning, organizing, directing, and controlling.

(6) The project manager is involved in managing diverse and extraorganizational activities which require unification and integration directed toward the objective of the project. He becomes a unifying agent with respect to the total management function. In effecting this unifying action he has no line authority to act per se but rather depends on other manifestations of authority to bring about the attainment of the objective. Thus the *directing* function is of somewhat less importance from the perspective of the project manager. What direction he does effect is accomplished through the functional managers who support him in the project endeavor.

(7) The project manager does not normally possess any traditional line authority over the line organizations involved in creating the goods or services. His motivational tools become different than those available in the more prevalent superior/subordinate vertical relationship.

evolution of the project manager

One major difficulty in adjusting to the concept of project management is caused by a failure on the part of management to understand this new and evolving role. The concept of project management is still evolving. Its evolution has gone through stages where different titles and degrees of responsibility have been associated with the position. The construction industry early recognized the need for a management process which permitted the introduction of a unifying agent into the ad hoc activities involved in the construction of single, costly projects such as dams, turnpikes, and large factories and buildings.

During World War II when large aircraft contracts came to the airframe industry, a new method of management arose which integrated the many and diverse activities involved in the development and production of large numbers of aircraft. In the military establishment one sees evidence of the project manager in such endeavors as the Manhattan Project, the ballistic missile program, and the Polaris program.

The need for a unifying agent in these large projects motivated the development of a project-type organization superimposed on the traditional and functional organizational structure. This unifying agent idea reflects contemporary thinking about project management. The forerunners of project managers, designated project expediters, did not perform line functions but instead informally motivated those persons involved in doing the work. The project expediter was mainly concerned with schedules and depended upon his personal diplomacy and persuasive abilities to remove bottlenecks in the management process. The project expediter was perhaps the earliest kind of project manager. Slightly above him in terms of time and responsibility appeared the project coordinator, who had a more formal role in the organization and was concerned with the synchronization of organizational activities directed toward a specific objective in the overall functional activities. This type of coordinator had some independence, reflected by his freedom to make decisions within the framework of the overall project objectives, but he did not actively enter into the performance of the management functions outside his own particular organization. The project coordinator had specific functional authority in certain areas, such as in budgeting, release of funds, and release of authority to act as in the dispatching function in the production control environment.

Today's project manager is in every sense a manager. He actively participates in the organic functions of planning, organizing, and controlling those major organizational activities involved in the specific project. He accomplishes the management process through other managers. Many of the people that feel the force of his leadership are in other departments or organizations separate and apart from the project manager's parent unit. Since these people are not subject to his operating supervision and owe their fidelity to a superior line manager, unique conflicts of purpose and tenure present themselves. The project manager has real and explicit authority but only over those major considerations involved in the project plan. One of the project manager's biggest problems is how to get full support in the project effort when the functional people are responsible to someone else for pay raises, promotion, and the other expected line superior/subordinate relationships.

authority and responsibility of the project manager

Since the project manager acts as the focal point within the organization through which major decisions and considerations flow, he must be given a special kind of recognition with respect to the authority and responsibility involved in his relationships with other managers in the organization. Authority is the legal or rightful power to command, to act, or to direct. Ultimate authority derives from the society in which the organized effort exists. Authority is *de jure* in the sense that it exists by rightful title, i.e., specific delineations of the authority of an organizational position are contained in the unit's documents such as policy and procedural instruments, job descriptions, and organizational charters.* Not to be neglected is the *de facto* authority that can be exercised by the project manager, i.e., the implied authority reflected in the organizational position. It is the intrinsic and necessary power to discharge fully the responsibilities inherent in the task or job. Thus an organization receiving public funds has *de facto* authority to create administrative policy stipulating how the funds will be maintained, to appoint a custodian to assume pecuniary responsibility for the safeguarding and legal obligation of the funds, and to take other necessary measures to adequately control the expenditure of the funds within the specific authority granted when they were accepted. Other aspects of the *de facto* authority include the project manager's persuasive ability, his rapport with extraorganizational units, and his reputation in resolving opposing viewpoints within the parent unit and between the external organizations. Other factors that influence the degree of authority which the project manager can exercise include:

(1) Influence inherent in the rank, organizational position, or specialized knowledge of the incumbent.

(2) The status or prestige enjoyed by the project manager within the *informal* organizational relationships.

(3) The priority and obligation existing within the organization for the timely and efficient accomplishment of the project goals.

(4) The existence of a bilateral agreement with a contracting party for the completion of the project within the terms of the contract in such areas as cost, performance (quality, reliability, technology), and schedule.

(5) The integrative requirements of the project manager's job in the sense that he has the sole responsibility within the organization to pull together the separate functional activities and direct these diverse functions to a coordinated project goal.

The project manager's authority and responsibility flow horizontally across the vertical superior/subordinate relationships existing within the functional organizational elements. Within this environment the authority of the project manager may often come under serious question, particularly in cases involving the allocation of scarce resources to several projects. Generally the project manager has no explicit authority to resolve interfunctional disputes through the issuance of orders to functional groups outside his office. However, since the project manager is the central point through which program information flows and total project executive control is effected, this individual comes to exercise additional authority over and above that which has been specifically delegated. His superior knowledge of the relative roles and functions of the individual parts of the project places him in a logical position

*Within the Air Force specific and forceful authority has been delegated to the project manager, or in Air Force parlance the system program director. Air Force Regulation 375-3, dated 25 November 1963, states:

> An SPD (System Program Director) is appointed by AFSC (Air Force Systems Command) for each system program not later than receipt of the formal document requiring application of system management techniques.
>
> He manages the collective efforts of participating field organizations in preparing system program documentation, and revisions as requested.
>
> His mission with respect to an approved system program is to:
>
> (1) Manage (plan, organize, coordinate, control and direct) the collective actions of participating organizations in planning and executing the system program.
>
> (2) Propose and/or prepare modifications of, or changes to, the system program within the limits of guidance received from participating organizations or higher authority.
>
> (3) Make changes to the system program consistent with his authority, as required to maintain internal balance of the system program.

to become intimately involved in the major organizational decisions that might affect the outcome of his project. As the focal point through which major project decisions flow, the project manager's input into the decision process cannot be ignored or relegated to a subordinate role. The unique position of the project manager inherently gives him knowledge superior to that of the personnel responsible for any subsystem or subactivity functioning as part of the integrated whole. (But this superior knowledge does not exist as the single authority within the total organization but only as the single authority with respect to the particular project involved.)

Organizational rank carries both explicit and implied authority. The project manager should have sufficient executive rank within the organization relationship to enable him to exercise a subtle and pervasive authority by virtue of his position or the trappings of his office. He should have sufficient rank (through evidence of seniority, title, status, prestige, etc.) to provide general administrative leverage in dealing with other line officials, with supporting staff personages, and with those in authority but external to the parent unit. This implies that there should be some correlation between the rank of the project manager and the cost and complexity of the project he manages. The more costly the project, the greater the degree of risk involved; and the more complex the internal and external organizational structures involved, the higher the rank of the project manager should be. Within the military services there has been a tendency to increase the authority of a project manager's position by assigning higher ranking officers to it. A brigadier general would be expected to exercise more influence (and thus authority) over his subordinates, his peers, and extraorganizational elements than would a lieutenant colonel or major occupying a similar position.

Management literature has neglected any real definition or discussion of the authority of the project manager. This is to be expected because of the near universality of the functional approach to management education and practice. Until contemporary management thinking has fully conceptualized the unique nature of the project manager's role, extraordinary manifestations of authority will be required. It will be an uphill struggle because of the threat that project management poses to ingrained functional management practices and thinking.

The project manager requires a clear delineation of authority and responsibility in order to balance the considerations involved in the proper development and successful conclusion of the project objective. He is frequently faced with major and minor "trade-offs" involving factors of cost, schedule, and performance of the product. Many times these trade-offs lack clear-cut lines of demarcation and foster internal and extraorganizational conflicts of purpose. Referral of the problem for resolution to the proper functional managers may not resolve it in the best interests of the project, since the functional manager tends to be parochial (and rightly so) in his view and less concerned with individual project objectives than with providing the services of his particular function across all the projects.

The creation of the position of project manager in an organization requires careful planning to prepare existing management groups. Certain criteria are offered for delineating the authority and responsibility of project managers:

(1) The charter of the project manager should be sufficiently broad to enable his active participation in the major managerial and technical activities involved in the project. He should be given sufficient policy-making authority to integrate the functional contributions to the project goals.

(2) The project manager must have the necessary executive rank to ensure responsiveness to his requirements within the parent organization and to be accepted as the unquestioned agent of the parent organization in dealing with contractors and other external entities.

(3) He should be provided with a staff that is sufficiently qualified to provide administrative and technical support. He should have sufficient authority to vary the staffing of his office as necessary throughout the life of the project. This authorization should include selective augmentation for varying periods of time from the supporting functional agencies.

(4) He should participate in making technical, engineering, and functional decisions within the bounds of his project.

(5) The project manager must have sufficient authority and capability to exercise control of funds, budgeting, and scheduling involved in the project accomplishment.

(6) Where the project management task involves the use of contractors supporting the project effort, the project manager should have the maximum authority possible in the selection of these contractors. After the contractors are selected, the project manager should have direct involvement in the direction and control of the major contractors involved in his particular project. His should be the only authority recognized by the official in the contractor's organization who is charged with contractual actions.

focal position of the project manager

The typical relationship that would be desirable for a situation involving two organizations having a mutuality of interest in a large project is shown in Figure 1. The establishment of a special project office in both the buyer's organization (e.g., the Government) and the seller's organization (e.g., an aerospace company) permits a focal point for concentration of attention on the major problems of the project or program. This point of concentration forces the channeling of major program considerations through a project manager who has the perspective to integrate relative matters of cost, time, technology, and system compatibility.

This managerial model is not meant to stifle the interfunctional lines of communication or the necessary and frequent lateral staff contacts between the functional organizations of the defense contractor and the military organization. Rather, what is intended is the establishment of a focal point for critical decisions, policy-making, and key managerial prerogatives relating to the project manager when trade-offs between the key elements of the research or production activity are involved. By being in a face-to-face relationship the two project managers can control and resolve both interfunctional and interorganizational problems arising during the course of the project.

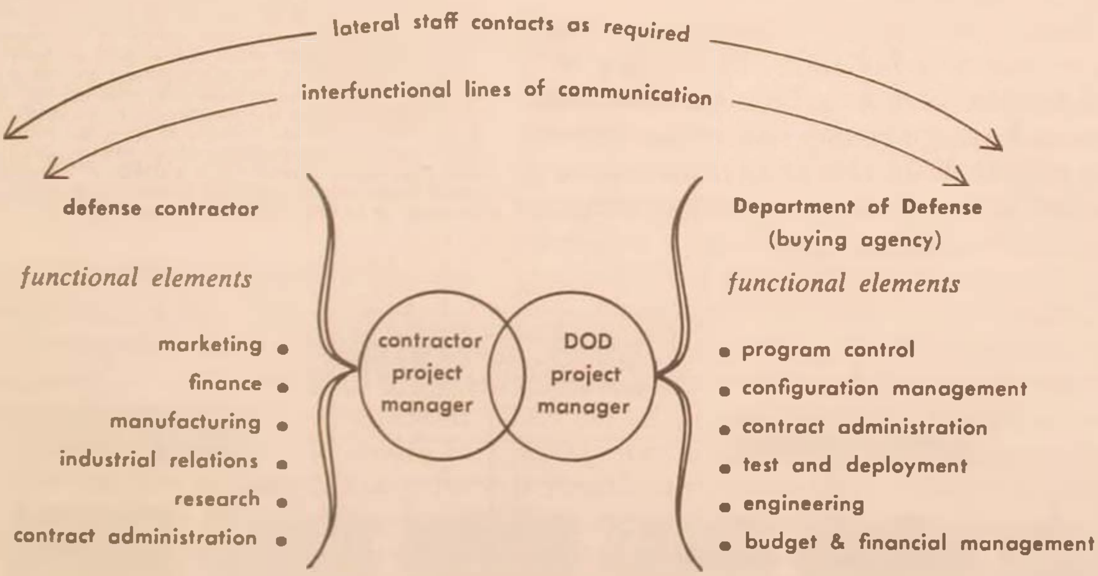


Figure 1. Interorganizational project manager relationships. Critical decisions involving policy and managerial prerogatives are directed through the central focal point. Decisions involve cost and cost estimating, schedules, product performance (quality, reliability, maintainability), resource commitment, project tasking, trade-offs, contract performance, and total system integration.

This organizational relationship precludes any one functional manager from overemphasizing his area of interest in the project to the neglect of other considerations.

organizational arrangements for project managers

The organizational arrangements for management of industrial projects can vary considerably. One example is the functional organization with the project manager reporting to the company president or general manager in a staff capacity (Figure 2). Under this concept the project manager functions as an "assistant to" the chief executive officer in matters involving the project, relieving him of some of the burdensome detail of the project. As a staff official the "assistant to" type of project manager investigates, researches, analyzes, recommends, and coordinates relative to the project. Major decisions are made by the chief executive officer. Although the project manager does not function in a line capacity in this arrangement, he usually has wide use of functional authority and by being in close proximity to the chief executive wields significant influence with respect to the project.

Placing the project manager in a staff capacity degrades his ability to function as a true integrator and as a decision-maker with respect to the major factors involved in the work of the project. With this arrangement there is the risk of having the project manager's responsibilities exceed his authority. If he is relegated to a staff position, his ability to act decisively depends almost solely upon his grant of functional authority, his personal persuasive abilities, or some specialized knowledge he has.

A functional organization exists in which the project manager reports to the chief executive officer in a line capacity (Figure 3). In this organizational and authority relationship the project manager's immediate office staff may vary from a single manager to several hundred people, depending upon the degree of centralization of the project activities. As the project manager's responsibilities increase and more and more of the operating facets of the project are centralized under his control, the organization may seem to have a new company or organizational division formed to manage each major program or project independently. The project manager has authority over the functional managers with respect to the *when* and *what* of the project activities. Functional managers in turn are responsible to both their functional supervisors and the project manager for adequate support of the project.* The authority

*This appears to violate the scalar principle described by Henri Fayol in *General and Industrial Administration*. Fayol envisions the scalar chain as the chain of superiors ranging from the ultimate authority to the lowest rank with the line of authority following every link in the chain. He also discusses the unity of command principle, i.e., an employee should receive orders from one superior only. The author of this article believes that these principles can easily be upheld in small organizational arrangements where the management process operates through the vertical superior/subordinate relationship. In today's large organizations where the management of a single project may cut across many internal functional lines of authority and extend into outside organizations, these management principles lack ubiquity. What is required is a discrete differentiation of managerial functions between the functional manager and the project manager as to respective spheres of influence.

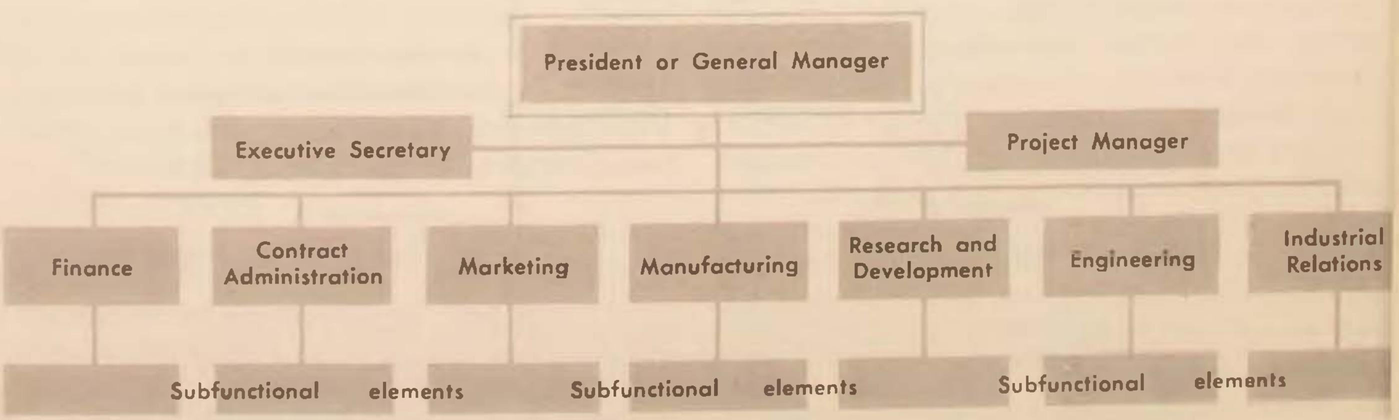


Figure 2. Functional organization with project manager in a staff capacity

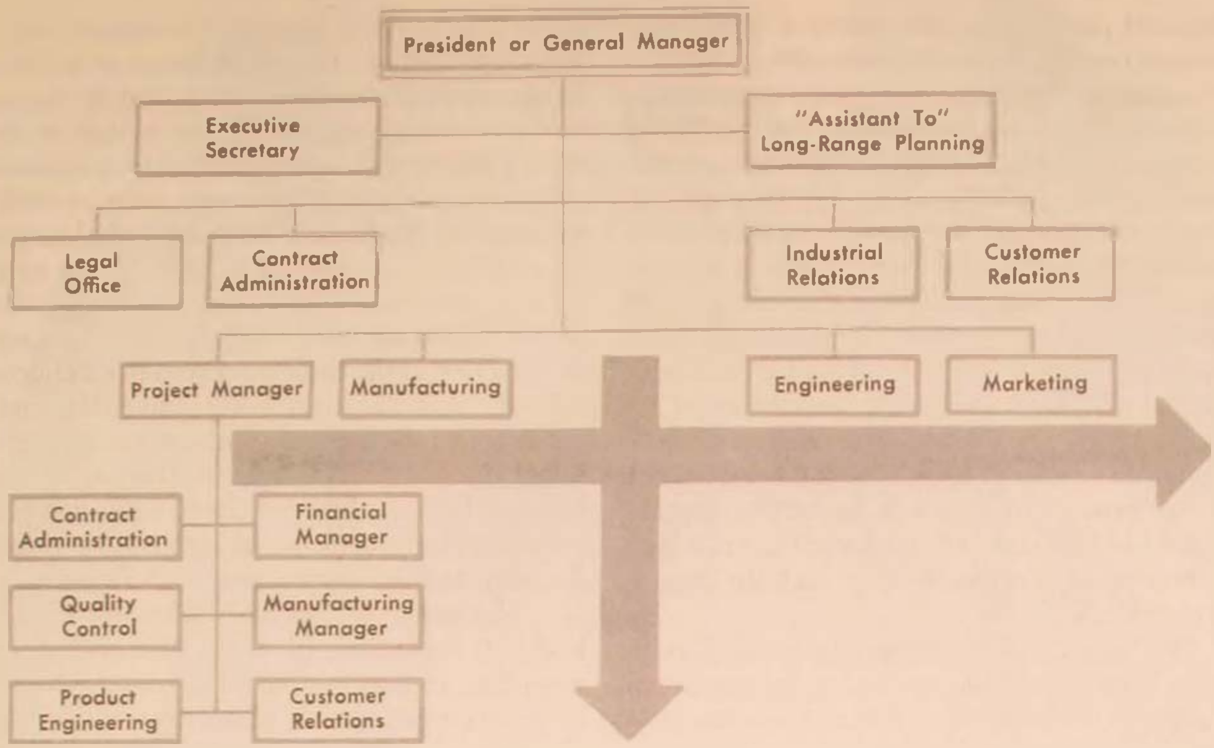


Figure 3. Functional organization with project manager in a line capacity. This organizational structure allows for vertical flow of functional authority and responsibility as well as horizontal flow of project authority and responsibility.

of the project manager in this organizational relationship flows horizontally throughout the organization. It is tempered, however, by direction from the functional managers, who are concerned with the *how accomplished* portion of the project.

The type of functional organization, the size and complexity of the project, and the philosophy of management held by the chief executives of the firm will affect the type of project management to follow. The proponents of total project management would desire to have all project people working directly for the project manager. The choice of organizational arrangement, whether pure functional, completely projectized, or an organizational form in between these extremes, should be made after the effects of the unique environment on the particular project are evaluated as to basic advantages and disadvantages.

project management in DOD

The Department of Defense has something over 100 weapon and support systems managed by project managers. Practically all these project managers are officers with the rank of colonel or lower, though in some of the larger programs (e.g., the F-111 System Program) the project manager has the rank of brigadier general. As military officers, these project managers are subject to permanent change of station in and out of the system program offices. Usually their tenure in any one project manager position is considerably shorter than the four to eight years required for the development and acquisition of a major weapon system. Ostensibly, these project managers plan, organize, and control the activities involved in the development and acquisition of weaponry. They are supported by subsystem managers and other project managers throughout the research, development, and production complexes of both Governmental and industrial organizations. Within the Governmental structure, project managers are identified as the symbol of leadership of the project. Unfortunately, in some cases this leadership is symbolic only, because of the active participation in upper organizational echelons of advisers, delayers, debaters, inspectors, and coordinators. These specialized staff personnel become involved in providing such support as budget, audit, contract surveillance, technical advice, programing, procurement review, facilities control, etc. The proliferation of these special support agencies leads one to fear that the project manager is becoming merely a symbol of leadership for whom there is a lack of authority and responsibility, in both degree and clarification.

The project manager may be located in an organizational position several echelons down the managerial hierarchy of the Department of Defense. In this position he finds it difficult to be selective in the acceptance of the abundant special staff assistance that is made available—and in some cases directed—to him. The increasing trend toward centralization in the Department of Defense and the establishment of certain thresholds in the expenditure of Defense funds have placed constraints on the project manager. The delegations of authority to the project manager vary widely in their charters and perhaps even more widely in practice. One could not reasonably expect the project manager to have complete control of his funds or the final decision on technical problems when his project is part of an overall defense development effort. Logically, a superior organizational unit that has a greater perspective of the total resources to be allocated should retain sufficient control over the project manager to ensure unanimity of national goals. What does become suspect is the use of multilayers of line managers and staff specialists between the project manager and the point of decision in the Department of Defense.

The use of project management techniques had its inception in the military/industrial complex. It has enabled the management of large aggregations of resources across functional and organizational lines directed toward unifying all effort to the common objective. Project management is a relatively recent phenomenon; as business and military organizations continue to become larger and more interdependent, the role of the project manager will come into clearer focus.

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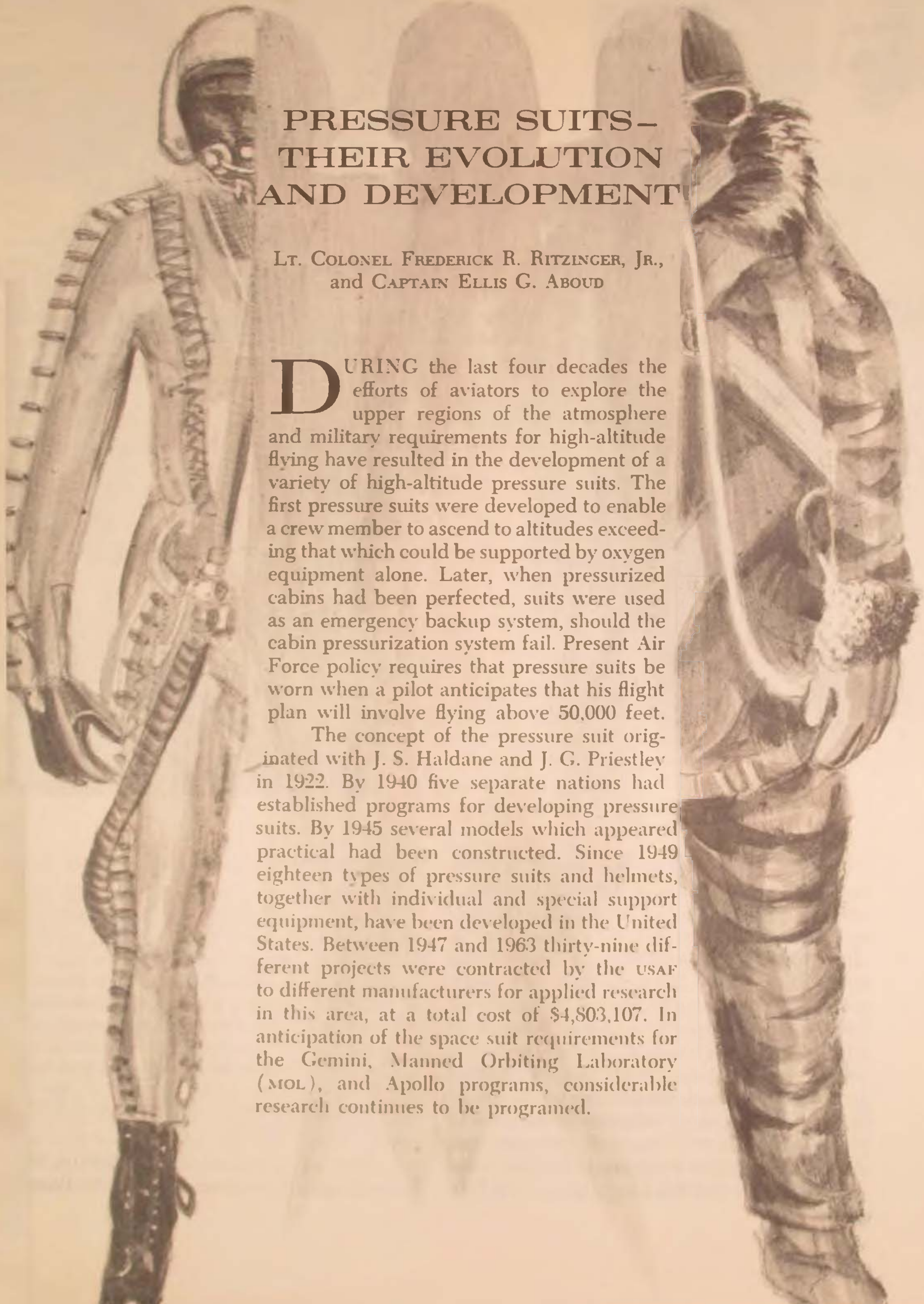
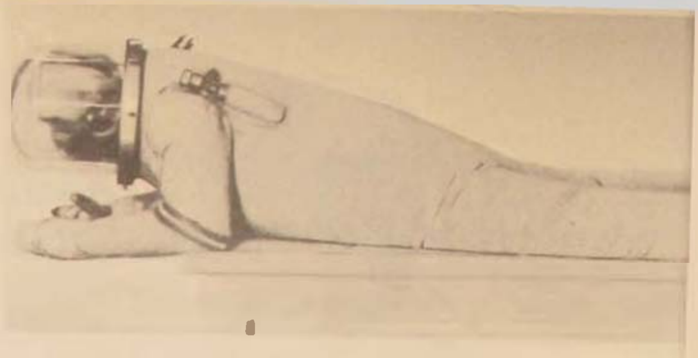


PRESSURE SUITS–THEIR EVOLUTION AND DEVELOPMENT

Lt. Colonel Frederick R. Ritzinger, Jr.,
and Captain Ellis G. Aboud

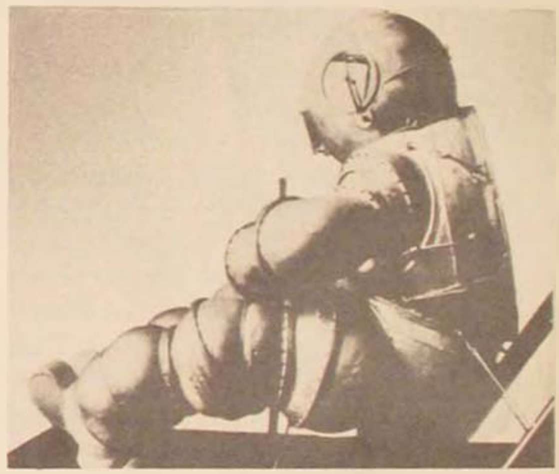
During the last four decades the efforts of aviators to explore the upper regions of the atmosphere and military requirements for high-altitude flying have resulted in the development of a variety of high-altitude pressure suits. The first pressure suits were developed to enable a crew member to ascend to altitudes exceeding that which could be supported by oxygen equipment alone. Later, when pressurized cabins had been perfected, suits were used as an emergency backup system, should the cabin pressurization system fail. Present Air Force policy requires that pressure suits be worn when a pilot anticipates that his flight plan will involve flying above 50,000 feet.

The concept of the pressure suit originated with J. S. Haldane and J. G. Priestley in 1922. By 1940 five separate nations had established programs for developing pressure suits. By 1945 several models which appeared practical had been constructed. Since 1949 eighteen types of pressure suits and helmets, together with individual and special support equipment, have been developed in the United States. Between 1947 and 1963 thirty-nine different projects were contracted by the USAF to different manufacturers for applied research in this area, at a total cost of $4,803,107. In anticipation of the space suit requirements for the Gemini, Manned Orbiting Laboratory (MOL), and Apollo programs, considerable research continues to be programed.



Early Pressure Suits

In 1934 Wiley Post, in a suit made for him by the B. F. Goodrich Company, became the first man to fly an airplane wearing a pressure suit. He made at least ten high-altitude flights in it before his death in 1935. . . . German developments included an airtight coverall for wear in a pressurized cabin in case of pressure failure. . . . An Italian pressure suit, with back aperture, proved impractical because of weight and immobility.



In the early 1930's, man's critical altitude limitation was 40,000 feet. Although flights exceeding this altitude had been achieved, they stretched man's physiological ceiling beyond safe limits. This physiological ceiling is based on the utilization of 100 per cent oxygen, which is required at this altitude, and is directly related to the reduced barometric pressure in ambient air at 40,000 feet. To enable man to venture safely above 40,000 feet, he needed some form of counterpressure device that could maintain his pressure environment within safe physiological limits. The full pressure suit, which is essentially a miniaturized cabin, was developed to serve this purpose. In 1922 Haldane and Priestley pointed out:

> If it were required to go much above 40,000 feet, to a barometric pressure below 130 mms of mercury, it would be necessary to enclose the airman in an airtight dress somewhat similar to a self-contained diving dress, but capable of resisting perfectly safely an internal pressure of about 130 mms of mercury. This dress could be so arranged that even in a complete vacuum the contained oxygen would still have a pressure of 133 mms of mercury. There would then be no physiological limit to the height obtainable.

The first pressure suit was built in 1933 by an English firm for an American balloonist,

The initial German pressure suit for use in un-pressurized cabins was made of laminated silk and rubber with reinforcing silk webbing. Ballooning and rigidity caused abandonment of this idea. . . . A German pressure suit of World War II featured a metallic covering over a cloth suit, with movable, airtight joints, but its weight was excessive.

Mark Ridge, who wanted to use the "diving dress" method for high-altitude balloon flights. Experiments were conducted in a low-pressure chamber with Mr. Ridge in the suit until a pressure of 17 mm Hg was reached. This pressure is equivalent to 84,000 feet. In these experiments Ridge experienced no abnormal symptoms, for owing to the added pressure within the suit he was actually never exposed to a simulated altitude above 36,500 feet.

In 1934 Wiley Post, either independently or by reading of Ridge's suit, conceived the idea of a high-altitude pressure suit. From his successful 1930 Bendix race, Post had gained experience and technical insight into the values of high-altitude flying. He believed that the altitudes at which the pressure suit would permit him to fly would give him a decided advantage in his attempt to break the world altitude record and also in a series of races he was planning to enter. Post had in mind a suit similar to a diver's suit that could be pressurized. Working with him, B. F. Goodrich engineers constructed a model suit using double-ply rubberized parachute fabric, to which pigskin gloves, rubber boots, and an aluminum helmet were joined. During tests at Wright Field this model proved unsatisfactory because of its extreme rigidity when inflated, leakage at the waist joint, and rupture of a reinforcing piece.

A second suit was modified to correct the deficiencies of the first. Post's experience with the second suit is classical, as indicated by a historian's account of the episode.

> On an especially hot and humid day late in July 1934, Wiley attempted to try on the revised suit and helmet. It was a tight squeeze and he got stuck. It was strikingly hot and exceedingly uncomfortable for him, immobilized as he was with his arms, shoulders and neck tightly bound by the suit. Understandably, he was very anxious to get out of the garment as quickly as possible. He expressed this feeling loudly and distinctly. Despite the help of several strong assistants, Wiley, who was an unusually powerful man, remained incarcerated in it. He grew restless, expressed at least a low anxiety, and directed that he be extricated at all costs. The project team led Post from the main building to another containing a refrigerated golf ball storage room where they could all be more comfortable and work with more leisure. Even then, they were only able to remove the upper suit by cutting it off.

Before another suit was made, the previous suit designs were restudied. The first and second ones had been essentially a one-layer fabric suit which was joined at the waist. The one layer had to serve a dual task: when inflated under pressure it had to conform to a particular shape and simultaneously prevent the gas from leaking through the fabric pores. This approach had not been sufficiently successful. When inflated, both suits had been voluminous, and the joints in the first one were observed to be too stiff and restrictive during a static test. It was therefore decided to design a suit with two separate layers, each designed to fulfill different functions. Post would enter the suit through a large neck opening in lieu of the waist entrance. The suit was to have an inner rubber bag that would contain the gas and an outer cloth fabric to retain its anthropomorphic shape under a pressure of at least 7 psi (564 mm Hg). This suit was fabricated in a sitting position with arms fashioned to reach the stick and throttle. No movable joints were incorporated, although limited leg movement to operate the rudder pedals was attained by bunching the material between metal bands above and below the knee. After extensive tests, Post made his first flight in this suit in late August 1934. This was the first time any man had flown in an aircraft using a pressure suit. He made at least ten documented flights in this suit before his death in 1935.

Within a year following Post's untimely death, interest in pressure suit development was apparent in several European countries. In England, the RAF continued the development of Ridge's suit and with its help twice succeeded in breaking the world's airplane altitude record. In France in 1935, Dr. M. Rosenstiel, a naval surgeon, and Dr. Paul A. Garsaux of the French Air Ministry, with the backing of the Potex Airplane Co., introduced a full pressure suit. Like Wiley Post's first suit, Dr. Rosenstiel's creation ballooned when pressurized. Also, the designers were plagued by joint leakage, inflexibility of the suit material at low temperatures, and valve malfunction due to icing. Continued efforts to perfect this suit were made during the years which followed, but they were terminated by the outbreak of World War II. The Italians also developed a pressure suit and flew it to 51,000 feet in 1937, but they discontinued their research in favor of a pressurized cabin development program.

Germany's first efforts in high-altitude research were concentrated on pressurized cabins. This program was initiated in 1928 and continued throughout World War II. In 1935 the German Air Ministry, paralleling Great Britain's course, entrusted to a manufacturer of diving suits and oxygen equipment the task of designing a pressure suit for use in unpressurized aircraft. Its initial model was fabricated of laminations of silk and rubber, reinforced with an external net of silk cord. The same ballooning and rigidity encountered by the other countries in their early suit designs also confronted the Germans. After several unsuccessful attempts to improve their initial model, they abandoned this idea and developed a model with a metallic outer covering over a cloth suit. The metallic covering would eliminate the fishnet characteristics of the earlier designs and provide an anti-elongation feature. This suit required easily movable, airtight joints at the various hinge points of the body and extremities. After many difficulties were resolved, the suit was finally built. It could maintain 11 psi pressure without sacrificing mobility, but even though the metal was of light weight, the weight penalty was too great to be practical.

The Germans developed also a lightweight one-piece coverall pressure suit to be worn in pressurized cabins and serve as an emergency or escape apparatus in the event of cabin pressure failure. Entrance was gained by means of a fold in the back, which was laced to provide an airtight closure. In contrast to the full pressure suits of other countries, this design supplied breathing oxygen by means of a standard mask and regulator. The suit was designed for short periods of inflation and consequently did not incorporate many of the features of the true full pressure suit. The joints that facilitated movement of the limbs in the metallic suit were not used in the escape suit, nor was the shape retained as well. Consequently, when inflated the suit ballooned considerably, restricting limb movement to an unacceptable level. Development of this escape suit never reached that of the pressure suit, and the war ended before an acceptable model had been produced. Nevertheless Germany was far ahead of its time in pressure suit development. She had introduced the concept of using pressure suits as a secondary or backup system for pressurized cabins should loss of cabin pressure occur at high altitude. She also introduced a suit design which separated the breathing gases from the suit-pressurizing gases, a feature which considerably reduced the oxygen consumption of pressure suits.

In the United States work in this field lagged from Post's death in 1935 until 1941. With the advent of World War II, high-altitude flying became an operational requirement, and interest in improving high-altitude support equipment was renewed. In 1941 the technique of positive-pressure breathing was discovered and led in 1942 to the development of the pressure vest. Testing of the pressure vest showed the value of a mechanical counterpressure device. It demonstrated that mechanical counterpressure applied directly to the body provided the same physiological effect as gas pressure. In 1943 investigation at the University of Southern California resulted in the use of inflatable tubes or capstans to supply mechanical counterpressure to the extremities. This principle, originally designed for use in anti-G suits, when applied to the design of pressure suits permitted successful use of an emergency garment in altitude chamber tests to 80,000 feet.

The mechanical counterpressure principle was an entirely new approach to pressure suit development. In the ensuing years these suits were improved, as were associated items such as helmets, resulting in the partial pressure suits now in our inventory.

Theoretically, the full pressure suit is the ideal type of protective garment for high-altitude use. A number of technical difficulties in design would have to be overcome, however, before such a garment could be perfected. Of prime importance was the problem of providing adequate internal ventilation to dissipate excessive perspiration and body heat that collects within the gastight suit. In addition, the problem of preventing the inflated suit from becoming unduly rigid and virtually immobilizing the wearer had to be solved. A considerable amount of work and technical ingenuity was clearly needed in the design of a full pressure suit and helmet that would remain flexible when pressurized to the necessary 2 to 5 psi and yet permit enough mobility and dexterity for the flyer to complete his mission. Because the solution of these difficulties was not anticipated in the near future, it was necessary to take an alternative though less desirable approach to pressure suit development and exploit the possibilities of a partial pressure suit design.

In 1947 the U.S. Air Force and Navy combined their efforts in a pressure suit development program. The Air Force undertook the task of developing the partial pressure suit. The Navy concentrated on full pressure suit development.

Although the partial pressure suit was an interim compromise toward the development of the ideal garment, it has served and continues to serve a useful purpose. Certain problems had to be overcome, however, before the mechanical counterpressure principle could be utilized. Breathing oxygen under increased pressure appreciably increases man's tolerance to altitudes above that which is achieved by breathing oxygen at ambient pressures. Overdistention of the lungs and thorax by positive breathing pressures can be prevented by mechanical counterpressure about the chest. But without counterpressure to the rest of the body, a breathing pressure of 50 mm Hg can be tolerated for only a few minutes (150 mm Hg is desirable). This limited tolerance to pressure breathing when only the chest is protected is caused by the shunting of blood into the distended veins and capillary beds of the arms and legs, sufficient so as to reduce the effective blood volume almost immediately by as much as 500 milliliters. If pressure breathing is continued, an additional quantity of blood and body fluids would be gradually lost from the effective circulation by the accumulation of fluid within the tissue spaces in the unprotected parts of the body. For this reason the partial pressure suit was designed to cover the arms and legs as well as the trunk, even though some mobility is sacrificed.

The basic components of the partial pressure suit are a helmet and neck seal, a pneumatic bladder seal covering the chest and abdomen under a close-fitting fabric suit, and pneumatic tubes or capstans which run down the sides and along the arms and legs. This system is arranged in such a manner that when the helmet and lungs are pressurized, the capstan tubes also inflate and tend to draw the material tightly over the surface of the body. The higher the helmet pressure the tighter the suit becomes, so that the pressure within the body is more or less perfectly counterbalanced by the mechanical pressure of the suit. In the event of decompression above 40,000 feet, the partial pressure suit would be automatically activated by an aneroid-controlled regulator designed to maintain an altitude equivalent of 40,000 feet in the pressurized suit.

The first partial pressure suit was standardized in 1948. This suit was a form-fitting garment made of nylon-cotton twill. It was furnished with a full-head helmet containing earphones, a microphone, and a removable faceplate. A small hose attached to the faceplate delivered oxygen under pressure from the regulator. In altitude chamber tests it was flown to a simulated altitude of 106,000 feet. In actual flight it was worn in all high-altitude flights of the X-1 series and the Douglas D-55811 aircraft. In one of Lieutenant Colonel Charles E. Yeager's Bell X-1 flights, cabin pressure was lost at peak altitude. His suit inflated automatically, preventing the loss of his life and a multimillion-dollar aircraft. As a "get-me-down" garment, it served a useful purpose. However, the suit when inflated restricted mobility, produced breathing fatigue, and provided protection for only six minutes. Since the Air Force wanted a "mission completion" suit, i.e., one that would be capable of providing adequate protection for an entire mission flight profile, efforts were continued to improve this suit for increased comfort, mobility, and time tolerance.

In 1954 a second model, the MC-1 partial pressure suit, was introduced, but it was never more than a limited standard item. This design had a cloth-covered chest bladder and smaller capstans. The chest bladder was incorporated to minimize breathing fatigue by equalizing the internal and external thoracic pressures. It provided adequate counterpressure to equalize the mask pressure but caused blood pooling and loss of fluid from the vascular system in other parts of the body, and therefore it had a limited time tolerance.

A third model was constructed in which the thoracic bladder was extended to the groin. This modification considerably improved the suit's performance but still did not fully compensate for the pressure effects on the circulation. Finally, when the "torso" bladder was extended to cover the thighs nearly to the knees, the suit's performance was considerably improved, allowing some subjects who had poor time tolerance in the MC-1 suit to remain without difficulty at 100,000 feet for several hours. Protection to 198,770 feet for extended periods was also demonstrated. With the exception of minor improvements, this suit, the MC-3, is essentially the same partial pressure suit in use today.

Although this suit serves a useful purpose, it continues to have some operational deficiencies. These center around the problems of comfort, mobility, ventilation, donning, fitting, and integration with other flight equipment. To overcome these problems, a new concept in partial pressure suit design was developed in 1959. The resultant suit is a cloth-covered bladder that covers the torso and extremities. It is designed to accommodate many types of helmets. It can be donned in two minutes and provides protection for two hours or more at simulated altitudes in excess of 100,000 feet while delivering a maximum helmet and bladder pressure of 150 mm Hg. It is called the "get-me-down" altitude suit or CSU 4/P Quick Donning Suit. The CSU 5/P is an improvement of the same design with added insulation for exposure and immersion protection. This equipment has not yet gained complete acceptance for operational use by the Air Force because full pressure suits were proved superior in mission-completion and survival capabilities.

During the period the Air Force was perfecting the partial pressure suit, the Navy was making remarkable progress in its full pressure suit development program. By the mid-1950's a host of suit systems designed by Navy engineers and civilian manufacturers had been evaluated and, for the most part, rejected. By the end of 1955, however, a full pressure suit design had emerged which had operational possibilities. This model had two layers. The inner layer was formed with a nylon fabric coated with natural rubber to provide an envelope impermeable to gas and water. The outer layer of nylon fabric provided a restraint cover to minimize ballooning of the inner bladder under pressure. The torso section was formed in a sitting position and extended from the neck to the wrists and below the knees. Insulated boots were cemented to the inner bladder at the leg endings, and gloves were attached to the wrists by watertight joints. A series of pressure-sealing zippers was incorporated in the suit to facilitate donning and doffing. Ventilation gases were distributed over the body by tri-loc tubes that were not integrated in the suit proper but were affixed to an undergarment. The helmet was attached to the neck ring of the torso. A face seal, fitting across the pilot's forehead, over his cheeks, and under his chin, was installed to separate the breathing gases from the suit gases. Oxygen was supplied to the breathing cavity by a demand-type regulator. The breathing regulator was controlled by the suit pressure to allow the pilot at any altitude to breathe with a normal pressure relationship between the chest and the oral/nasal cavity. The exhaust gases were discharged into the suit and vented overboard by the controller. The control valve, which was altitude-sensitive, monitored the discharge of exhaust gases to maintain that increment of pressure in the suit which, when added to the atmospheric pressure, would provide an absolute pressure of 3.4 psi at any altitude above 35,000 feet. Also, the control valve was equipped to supply oxygen to the suit to maintain the required pressure if at any time ventilation air was absent and leakage from the suit could not be replaced by the gases expired during breathing.

This suit went through a series of modifications between 1955 and 1957. The most important change was the incorporation of an external tie-down system for the helmet which allowed the suit to be constructed in a semistanding position. After limited issue of this system, it was apparent that the equipment was too heavy and bulky for operational use. In fact some of the pilots objected so vehemently that the entire development program was endangered. To accomplish a reduction in weight, a new approach to suit construction and an extensive materials study were needed. But the Navy wanted a lightweight suit immediately, meaning a development program in terms of a few months rather than years. Material studies and suit structure studies had been in progress for years, and no unusual breakthrough appeared imminent. Therefore the Navy decided that the mission-completion concept would be discarded for the time being and an emergency-type pressure suit would be developed.

In a little over six months the emergency-type suit was completed. Its performance was far better than had been anticipated. The torso weight had been reduced more than ten pounds, and the form fit of the torso greatly reduced much of the objectionable bulk. Elimination of the rotatable bearings had not sacrificed mobility as much as had been expected. Almost before initial evaluation of the suit had been completed, the emergency-only concept had lost its meaning because the system met the requirements for a mission-completion full pressure suit.

The construction of this suit was quite different from that of its predecessors. The inner or gas-impermeable layer was made of nylon fabric spread-coated with neoprene. The outer restraint layer was made of nylon fabric. It was attached to the inner layer at the neck ring, wrists, entrance closure, etc., but otherwise the inner and outer layers were free from each other. An arrangement like this allowed the outer layer to be adjusted to fit the individual and the inner layer to bunch into the desired envelope. The torso was built to allow for full standing position. Neoprene-coated fabric socks were permanently affixed to the leg endings. Standard leather boots were worn over the socks. Only one rotatable bearing remained in the suit. This was located in the neck ring, to which the helmet was attached. The helmet pressure control and ventilation systems were unchanged.

Since 1957 this system has undergone eight modifications, to become the full pressure suit now being used by the Navy. These changes included a ventilation system for distributing vent air over the pilot's body, an improved helmet tie-down system, adjustment lacings to improve sizing and fitting, and numerous minor modifications. Otherwise, the system remains essentially the same. In keeping but not quite in step with the lightweight torso development, the helmet had undergone an evolution. The basic design was retained, but a weight decrease was gained by reducing the overall configuration and the number of laminae of fiber glass in the hard shell. The weight now normally carried by the pilot in the lightweight full pressure suit is 25 pounds, cutting in half the weight of the original Mark IV system. This had been accomplished with little or no loss in performance or protection provided by the heavyweight system.

In 1959 the Air Force adopted the Navy Mark IV lightweight full pressure suit, designating it the A/P22S-3 Full Pressure Suit, and in 1962 standardized a more advanced model, the A/P22S-2 Full Pressure Suit. Both suits are essentially the same design except that the A/P22S-2 contains four functional layers instead of two, lending greater mobility and comfort when the suit is inflated. These improved features were achieved by using a restraint layer of link net mesh of nonstretchable dacron cord, to minimize ballooning. The A/P22S-2 suit was used in the X-15 Project and now is slowly replacing the A/P22S-3 suit in our inventory.

Although present-day operational pressure suits still leave something to be desired in terms of comfort, ventilation, and mobility, they are fully reliable and physiologically compatible with our current operational flight profiles. The concept of pressure suit design has emerged from that of a futuristic curiosity to an important backup life-support system for high-altitude flying and earth orbital flights. Throughout the years the technology in suit design has kept pace with the advancements in aviation technology. When the Mercury program was inaugurated, the basic Navy Mark IV full pressure suit could be modified to meet the requirements of the Mercury space suit.

Future space programs, however, are generating new requirements for pressure suit design. Since the Gemini, MOL, and Apollo flight profiles include extravehicular excursions, the requirements imposed on pressure suits for these programs are considerably advanced over those imposed on the suits we have in our inventory. Unlike the Mercury suit, which was sheltered from the space environment within a pressurized capsule, these suits will be directly exposed to the vacuum of space and to thermal, ultraviolet, and corpuscular radiation from the sun. They will have to be ruptureproof and impervious to micrometeorite strikes. They will have to provide for greater mobility and tactile dexterity than current models. These and other technical design problems will have to be solved before the goals of these space programs can be realized.

Considerable effort is being exerted in the United States to meet this challenge. The National Aeronautics and Space Administration developed a suit for Gemini which is an advanced modification of the Air Force's A/P22S-2 suit, and NASA's Apollo extravehicular suit program has been in operation since 1962. The Air Force's Advanced Extravehicular Protective Technology Program (ADEPT) is a "crash" project to identify and study the most up-to-date techniques and principles that can be applied to the design of operational extravehicular protective assemblies.

Today the least understood and most difficult aspect of suit design is mobility. The conventional fabric full pressure suits now available when pressurized do not provide the desired mobility for extravehicular operations. Several techniques are being studied which may solve this problem. One is the development of a pressure-retaining homoform, which is a close-fitting net garment designed not to deform according to lines of nonextension over the surface of a body. ("Lines of nonextension" are those lines over the surface of the body that do not deform as the joints of the body perform.) This concept may help minimize the interference from ballooning of the suit when pressurized. Another approach to solving the mobility problem is the cord restraint principle. This concept involves utilization of the scissors effect and pulley action of restraining cords when they are anchored through eyelets at strategic points about a joint. This principle provides the unique quality of permitting movement of the joint in any plane and holding the selected position without continued effort.

Concurrent with fabric or "soft suit" developments, design study and construction of experimental "hard assemblies" are being undertaken. The hard-shell concept may be attractive as a protective cocoon to establish a less

In 1962 the A/P22S-2, adapted from the Navy's Mark IV, became the Air Force's most advanced full pressure suit. Easy to put on and off, it ensures survival in water as well as at high altitudes.

severe environment in which the soft suit may function. This would permit a dual-purpose suit, i.e., intravehicular as well as extravehicular protection with a greater margin of safety, and eliminate the need for spectral coatings on cloth for extravehicular exposures. If the mobility problems of the soft suit cannot be solved, it may be necessary to use rigid protective assemblies for extravehicular activities. An all-metal suit has been devised, utilizing welded metal bellows to provide flexibility for limbs and torso. Mobility is achieved through the geometric properties of a restraint leakage system which permit the pneumatic forces of the gases contained within the suit to contract the spring forces of the metal bellows. When these forces are balanced, the joints move without restraint.

What the final configuration of the MOL and Apollo suits will be has not yet been determined. The original Apollo suit, which has been undergoing testing, is a fabric anthropomorphic pressure garment including a back-mounted, portable, life-support system and a thermal protective garment that isolates the entire assembly from the external environment. This suit has not yet met and may not meet all the design criteria required to provide a reliable, habitable environment for extravehicular excursions, nor does it have the required mobility for extravehicular tasks. More work and perhaps a new design are necessary before the Apollo suit will be ready for operational use. The MOL garment, on the other hand, will be selected at some future point in time from the latest design developments at that particular time. What its configuration will be is anyone's guess, but when the MOL vehicle is launched its crew members will have the most advanced, the most sophisticated, and the most reliable life-support system that the vast resources of the United States can provide.

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AIR HOSTILITIES IN THE PHILIPPINES

8 December 1941

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THE PURPOSE of the historian," stated Professor Homer Carey Hockett, "is to ascertain *facts*, which become the basis of all generalizations or conclusions (these being also facts of a higher order, serving to give history its meaning and value). But the raw materials with which the historian works are *statements*, and the first lesson which he must learn is that statements must not be mistaken for facts. . . . His task is, if possible, to make such a use of statements that he will through them arrive at facts."[1] Who fired the first shots of the American Revolution at Lexington, the reasons for Pickett's charge at Gettysburg, the purpose of President Lincoln in deciding to begin battle at Fort Sumter are problems in historiography that have long defied a determination of precise historical fact.

Much closer at hand and still within the memory of living witnesses, the story of the initiation of air hostilities in the Philippines on 8 December 1941 and of the handling of the U.S. Far East Air Force on this first day of Japanese attack there provides another case study in the difficulty of determining precise historical truth. With the publication of the late General of the Army Douglas MacArthur's *Reminiscenses*,[2] these events are once again described, but, unfortunately, the questions surrounding them remain unanswered. Now that the case has been reopened there is ample justification for a new attempt to place these events in their historical setting and to seek to settle at least a part of the misunderstanding that has surrounded them.

With the emergence of Japan as a major world power, defense of the Philippines became an increasingly difficult task for the military planners of the United States. Separated from the coast of California by 6000 miles of Pacific waters, studded in their central reaches by Japanese bases in the Caroline and Marshall Islands, the Philippine Islands were a badly exposed American possession. From 1928 to 1938 the basic U.S. war plan for the defeat of Japan—the ORANGE Plan—visualized a long and costly war in which a Philippine garrison of Army troops would attempt to deny Manila and other key defenses to the enemy until the U.S. Fleet could force through the Japanese mandates and establish a secure line of communications to the Far East. As such, the Philippines were no longer an element of American strength but rather a liability. In 1935, the Chief of the Army War Plans Division suggested the desirability of undertaking some negotiation by which the Philippines would remain neutral in case of a war with Japan, thus freeing American forces to fight along the line Alaska-Hawaii-Panama.[3] The immediate prewar RAINBOW 5 plan, approved by the Joint Board on 14 May 1941, did not appreciably change the mission of U.S. forces in the Far East: the Army was assigned the mission of protecting the territory of the associated powers, preventing the extension of Axis influence, and supporting naval forces. The U.S. Navy would advance through the Carolines and Marshalls to the western Pacific.[4]

Although the Army mission in the Philippines remained defensive, the German attack against Russia in June 1941 and the mounting evidences of Japan's warlike intentions demanded a strengthening of American forces in the Philippines. General Douglas MacArthur was recalled to active duty on 26 July 1941 and given command of the United States Army Forces in the Far East (USAFFE). The Philippine Department Air Force gave way to an enlarged Far East Air Force (FEAF) on 16 November 1941 under the command of Maj. Gen. Lewis H. Brereton, who had arrived in Manila thirteen days earlier. Modern planes were dispatched as they became available: P-40B's and P-40E's were allocated to the pursuit force, the latter being shipped directly from the factories. Given priority in the assignment of the few B-17 Flying Fortresses available in the Army Air Corps, the 19th Bombardment Group managed a pioneer Pacific flight to Luzon's Clark Field in October and November. As soon as they could be equipped from current production, four heavy bomber groups were projected for the Philippines. The second of the scheduled groups—the 7th Bombardment—began leaving California on 6 December 1941. The men of an A-24 dive bomber group—the 27th Bombardment—reached the Philippines on 20 November, but the group's planes were following in a slow convoy. Of modern combat aircraft the FEAF possessed on 1 December 1941 a total of 35 B-17's and about 105 P-40B's and -E's.[5]

Arrival of modern heavy bombers in the Philippines gave the Army forces an ability to participate in strategic offensive operations.[6] On 14 October 1941, General Henry H. Arnold, Chief of the Army Air Forces, emphasized to General MacArthur that an offensive employment was to be expected from the new B-17's. "By utilizing Singapore, Darwin, Rockhampton, Rabaul, Davao, and Aparri for operating bases for B-17 types of airplanes," Arnold wrote, "it is our opinion that the sea routes between Japan and Singapore, and Japan and the Dutch East Indies can be very well covered. . . . Furthermore, B-24's operating out of Aparri can cover the south section of the Japanese Islands as far north as Nagasaki."[7] In Washington, Army and Navy planners undertook the necessary revision of RAINBOW 5, and General Brereton carried a copy of the new tasks assigned to USAFFE to MacArthur. Changes in the revision of the basic war plan were officially mailed to MacArthur on 21 November 1941, with an additional word of advice from U.S. Chief of Staff George C. Marshall. "Heretofore," Marshall wrote, "contemplated Army action in the Far East Area has been purely of a defensive nature. The augmentation of the Army Air Forces in the Philippines has modified that conception of Army action in this area to include offensive air operations in the furtherance of the strategic defensive, combined with the defense of the Philippine Islands as an air and naval base."[8] In the event of hostilities, MacArthur was now directed by RAINBOW 5 to execute "air raids against Japanese forces and installations within tactical operating radius of available bases."[9]

The new concept of the defense of the Far East involved exploitation of the strategic mobility of air power from Philippine, Malay, Netherlands East Indies, and Australian bases, and General Brereton's immediate duty was to coordinate the preparation of air facilities at these places. While Brereton was in Australia negotiating for base accommodations, his staff busied itself with the preparation of additional air facilities in the Philippines, where until then Clark Field had been the only available heavy bomber base. Colonel Francis M. Brady, FEAF chief of staff, Colonel Harold H. George of the V Interceptor Command, and Captain Harold Eads, the FEAF engineer, drew up a plan for the relocation of air units. At the Del Monte plantation on Mindanao they found a site where a temporary heavy bomber base could be speedily prepared.[10] According to

General Brereton, the USAFFE staff met these plans for a Mindanao base with some reluctance: Brig. Gen. Richard K. Sutherland, MacArthur's chief of staff, pointed out that the war plan for the Philippines included no American ground troops for the defense of Mindanao.[11] On 29 November, MacArthur reiterated this same thinking in a letter to Marshall: "The definitive location of the Bomber Command base in Mindanao is not acceptable because that island is strategically a salient and its defense a difficult problem with the force now in contemplation." MacArthur favored the building of a bomber base in the Visayan Islands, at the center of the archipelago, which would be well protected by coast artillery guns and troops. But to provide immediate relief for the congested air facilities on Luzon, MacArthur permitted the construction of a bomber strip at Del Monte.[12]

While the scheduled defenses of the Philippines were marching toward a readiness date in the spring of 1942, worsening relations with Japan necessitated intensified war preparations for the force at hand. On 10 November 1941, Brereton ordered all air units on the alert, re-

On 8 December 1941, Clark Field—the major air base in the Philippines—looked much as it appears in this photograph taken in December 1937. The field was still turf-surfaced, the ground around it too wet to permit any extensive dispersal of aircraft.

quiring the 19th Bombardment Group to maintain one squadron at all times on two-hour readiness for reconnaissance and bombing missions.[13] On 27 November, General Marshall warned MacArthur that hostile action might occur at any moment, but cautioned "If it is impossible to avoid hostilities, the United States desires that Japan commit the first overt act." This policy, however, was not to be interpreted so as to jeopardize a successful defense of the Philippines, and MacArthur was specifically authorized to take such reconnaissance and other measures as might seem necessary prior to Japanese hostilities. In case of war, General MacArthur was directed to carry out the tasks assigned in the revised RAINBOW 5 plan, which had been delivered to him by Brereton.[14] MacArthur immediately replied that air reconnaissance had been extended and intensified and that within the limitations of deployment in the theater everything was in readiness for a successful defense.[15] In reply to a message from Arnold cautioning against sabotage, MacArthur on 6 December replied that all Air Corps stations were alerted, airplanes dispersed and each under guard, airdrome defense stations manned, and counter-subversive measures had started functioning.[16]

In order to obtain greater dispersal, General Brereton sent two squadrons of B-17's to Del Monte airfield on the evening of 5 December 1941. Under command of Major Emmett O'Donnell, Jr., the 16 Fortresses of the 93d and 14th Squadrons departed Clark Field after dark in a secret movement. Here begins the first of the controversies regarding the handling of the Far East Air Force in the initial days of hostilities. "To the best of my memory," O'Donnell wrote in February 1946, "it was never intended to send more than two squadrons of heavy bombers from Clark Field to Del Monte prior to 7 December 1941."[17] In *The Brereton Diaries*, published in 1946, General Brereton recorded that he was able to send no more than two squadrons southward because the B-17's of the 7th Bombardment Group were leaving the United States early in December with orders to push through as rapidly as possible and they would need to use the field at Del Monte. Brereton further stated that permission to move the 16 Fortresses to Del Monte "was obtained from General Sutherland only with the understanding that they would be returned to the airfields to be constructed on Cebu and Luzon as soon as the necessary operating facilities could be prepared."[18] According to Colonel Eugene L. Eubank, commander of the 19th Group, when interrogated on 2 July 1942: "We were planning to keep six squadrons on Del Monte and two in Luzon."[19]

The USAFFE version of these events was first published in 1944 when Mr. Frazier Hunt, a press correspondent who had visited MacArthur's headquarters to gather material for a popular biography, asserted that General Sutherland on three occasions before 8 December had ordered Brereton to send all B-17's to Mindanao and that only after a last and peremptory order had Brereton finally dispatched two of the squadrons. When it was published, Hunt's biography of MacArthur carried an introduction by Brig. Gen. C. A. Willoughby, Chief of Military Intelligence, GHQ Southwest Pacific Area.[20] In an interview with Mr. Walter D. Edmonds on 4 June 1945, General Sutherland repeated the same account:

> Gen. Sutherland began by saying all the B-17s had been ordered to Del Monte some days before [8 December 1941]. On a check it was found that only half had been sent. GHQ wanted the planes in Del Monte because they would there have been safe from initial Jap attacks—they could not have been reached at all—and they could themselves have staged out of Clark Field to bomb Formosa. This direct order had *not been obeyed*. And it must be remembered that GHQ gave out general orders and that the AFHQ were supposed to execute them.[21]

In September 1946, after *The Brereton Diaries* appeared in print, General MacArthur broke his silence: "I had given orders several days before to withdraw the heavy bombers from Clark Field to Mindanao . . . to get them out of range of enemy land-based air."[22] In his *Reminiscences*, General MacArthur spoke more kindly of General Brereton:

> A number of statements have been made criticizing General Brereton, the implication being that through neglect or faulty judgment he failed to take proper security measures, result-

ing in the destruction of part of his air force on the ground. While it is true that the tactical handling of his command, including all necessaries for its protection against air attack of his planes on the ground, was entirely in his own hands, such statements do an injustice to this officer.[23]

Examination of related contemporary written evidence permits some evaluation of these recollections. Brereton's account of Sutherland's reluctance to permit the movement of B-17's to Del Monte is partially reinforced by MacArthur's statement on 29 November 1941 that the Mindanao base "will give immediate relief from the congested conditions on Luzon . . . [but] is not acceptable because that island is strategically a salient. . . ." In another letter on 1 December, MacArthur requested antiaircraft artillery to protect Del Monte, presumably against carrier-based air attack.[24] In neither letter did MacArthur mention any immediate intention to move all B-17's to Del Monte, and in his message of 6 December he merely noted that all airplanes were dispersed and each under guard.

There are also some inconsistencies in the recollection of the air officers. In his book, *They Fought With What They Had*, Edmonds does not find Brereton's explanation of why he sent only half of the B-17's southward to be "too convincing." Edmonds reasoned that the arrival of the new group of Fortresses from the United States would be stretched out over several days.[25] As a matter of fact, back in Washington on 1 December, General Arnold planned that a total of 48 heavy bombers would have departed for the Philippines between 3 and 10 December and that the first 19 of these planes would arrive at Del Monte on 12-13 December.[26] The initial movement would actually be delayed, and the first flights would not begin to depart for Hawaii until 6 December. It is similarly difficult to reconcile Sutherland's supposed reluctance to allow two squadrons to move to Del Monte with the inevitability that the whole 7th Group would soon have to be based there. And while MacArthur was not satisfied with the Del Monte base, he apparently visualized it as the main bomber base—at least until a new Visayan airfield could be built —with Clark Field to be used as a staging base for combat missions. It is possible that Sutherland's reluctance as described by Brereton was merely designed to establish the point that Del Monte was not to become the permanent bomber base. Brereton noted that Sutherland exacted the provision that the planes would be returned either to Clark Field or to a base constructed on Cebu in the Visayas.

While none of the Air Force officers have emphasized the fact, establishment of the entire B-17 force at Del Monte would have been hazardous. At Clark the bombers could be defended by aircraft warning radar, fighters, and antiaircraft artillery. Del Monte was completely lacking in airdrome defense, and the bombers had to be protected by dispersal and camouflage. The new airfield at Del Monte was supposedly a secret base and was believed to be outside the range of Japanese land-based bombers, but neither of these possibilities could be guaranteed, for there was a large settlement of dissident Japanese on Mindanao and the enemy was expected to use carrier aircraft in his initial assault against the Philippines. In retrospect, it would appear that Brereton's disposition of his heavy bombers was sound: two squadrons at Clark under protection of fighters and artillery and two squadrons camouflaged and dispersed at Del Monte. A historian finds here, however, two opposing statements, and he must accept or reject one or the other of them in the light of his own best judgment. The Army historian Professor Louis Morton found it impossible to determine where "the responsibility lies for failing to move all the B-17's south." Morton thereby assumes that an order to move the Fortresses had been issued.[27] In the absence of definitive contemporary evidence, the best judgment on the matter appears to be the statement of Colonel Eubank, made in July 1942 before the events became controversial, when he said: "We were planning to keep six squadrons on Del Monte and two in Luzon."

The beginning of hostilities in the Pacific found the Philippine garrison alerted and, within limits, ready for a successful defense. The timing of the Japanese attack at Pearl Harbor, shortly after dawn on 7 December 1941, fa-

Del Monte airfield was hurriedly laid out in flat meadowland at the left of this prewar photograph of the Del Monte plantations. The Agusan River flows through the ravine.

vored the American defenses in the Philippines, since H-hour in Hawaii coincided with the very early morning hours of 8 December in the Far East. Japanese aircraft on Formosa, moreover, would be weathered in during the morning and would not be able to manage an assault against Clark Field until shortly after noon. The Far East Air Force was thus permitted an opportunity to strike a first blow. Why it did not do so is the subject of the second and major controversy regarding the employment of the U.S. heavy bomber force in the Philippines on the first day of the war.

General Brereton has written that a telephone call awakened him early on the morning of 8 December, and he recalled that Lt. Col. Charles H. Caldwell, FEAF operations officer, answered and received the news from General Sutherland that Pearl Harbor had been bombed. Sutherland then told Brereton that the Japanese had attacked Hawaii at 2:35 A.M. Manila time and that a state of war existed.[28] Caldwell's later recollection of what then transpired is as follows: "I . . . was standing right beside the General when he told General Sutherland to tell General MacArthur that the 19th Group would be ready to bomb Formosa at daylight; Sutherland said that he would have to contact General MacArthur before such a mission could be authorized. He later called back and said that the mission would not be flown."[29] After completing his telephone conversation with Sutherland, Brereton immediately ordered all air units notified of the Japanese attack and directed Colonel Eubank to come down to FEAF Headquarters. He recalled that it was then around 4 A.M. and still dark.[30]

Brereton recorded that at about 5 A.M. he reported to USAFFE Headquarters in Manila, where he found that General MacArthur was in conference. Sutherland briefed him on all available information, and Brereton told Sutherland that he wished to mount all the B-17's at Clark for missions to Formosa and to prepare the Fortresses at Del Monte for similar missions to be staged through Clark Field. He requested permission to begin offensive action immediately after daylight. According to Brereton, Sutherland agreed with the plans, authorized preparations, and said he would obtain General MacArthur's authority for the attacks.[31] At this point begins a series of entries in a typescript document, titled "Office of Commanding General, FEAF, Summary of Activities," the authenticity of which as a historical source will be subsequently examined. The first entry at 7:15 A.M. in this document records that General Brereton visited No. 1 Victoria (USAFFE Headquarters) where he was "informed that for the time being our role was defensive but to stand by for orders."[32]

In the meanwhile the FEAF staff had been gathering in General Brereton's office at Nielson Field on the southern outskirts of Manila, and the staff had been joined by Colonel Eubank and his operations officer from Clark. Captain Allison Ind, FEAF intelligence officer, was assembling target folders on Formosa. As to the state of the target information he would observe: "We were as ready as we would be for a long time to come."[33] According to the recollection of Captain Harold Eads, all those present were of the opinion that the Air Force should "strike at the Japs in Formosa with everything we had without delay." The FEAF staff was preparing to proceed on that basis.[34]

When he arrived at Nielson Field, Brereton brought the news (as Eads expressed it) that "we couldn't attack until we were attacked."[35] While war planning continued, Sutherland was again contacted at 9 A.M., and, according to the FEAF Summary, he again advised "planes not authorized to carry bombs at this time."[36] Colonel Francis M. Brady, the FEAF chief of staff, who may well have made this call (although he remembered it as having been put through at about 9:30 A.M.), later stated that Sutherland told him that FEAF would be properly informed of any new decision and that he was not to call again.[37] At 10 A.M. Brereton again telephoned Sutherland who repeated that "all aircraft would be held in reserve and that the present attitude is strictly defensive." Brereton said that he remonstrated that if Clark Field were "taken out" by the enemy the Air Force could not operate offensively.[38]

Apparently at about this time Sutherland did authorize a reconnaissance mission to Formosa, and at 10:10 A.M. Colonel Eubank left for Clark Field to send out these planes. According to the FEAF Summary, Brereton received a telephone call from General MacArthur at 10:14 A.M. authorizing him to take offensive action (in his diaries Brereton records this call as having been received at "about 11 A.M." and as having been from Sutherland). By this time, Brereton had changed his plans. Since no attack had been made against Clark, he wished to hold the B-17's there in readiness until the reconnaissance missions could return, but, with or without photographic reconnaissance, the B-17's would attack Formosa late that afternoon.[39] To follow the plan of operation outlined in the FEAF Summary, General Brereton had by 10:45 A.M. matured the following schedule: two squadrons of B-17's would attack known airdromes in southern Formosa at the latest daylight hour permitting visibility; the two squadrons at Del Monte would move to a dry-weather strip at San Marcelino at dusk and then to Clark after dark, where they would prepare for raids against Formosa at dawn the next day. At 11:56 A.M. this plan was communicated to General Sutherland.[40]

The recollections of the Air Force officers—while differing as to exact details—are remarkably consistent in regard to the events on the morning of 8 December. Even Colonel Eubank, who said that he did not wish to discuss the matter when interrogated in July 1942, commented that it was General Brereton's plan to bomb Formosa and that such had been firmly recommended by him.[41] But the delay had been too long, and as the result of a series of unfortunate circumstances a Japanese air attack at Clark Field shortly after noon destroyed most of the two squadrons of B-17's based there. Half of the B-17's in the Far East having been eliminated, offensive action against Formosa was no longer practicable.

The recollections of General MacArthur and General Sutherland as to the events on the morning of 8 December 1941 are at sharp variance with those of the air officers. In June 1945, Sutherland told Edmonds that "there was some plan to bomb Formosa but Brereton said that he had to have photos first. That there was no sense in going up there to bomb without knowing what they were going after. There were some 25 fields on Formosa." Sutherland closed the subject with a positive assertion: "Holding the bombers at Clark Field that first day was entirely due to Brereton."[42] In an official release issued after the publication of *The Brereton Diaries*, General MacArthur stated that he knew nothing of a Brereton recommendation to bomb Formosa:

> I wish to state that General Brereton never recommended an attack on Formosa to me and I know nothing of such a recommendation having been made; that my first knowledge of it was contained in yesterday's press statement.
>
> That it must have been of a most nebulous and superficial character, as no official record exists of it in headquarters.
>
> That such a proposal, if intended seriously, should have been made to me in person by him; that he never has spoken of the matter to me either before or after the Clark Field attack.
>
> That an attack on Formosa with its heavy air concentrations by his small bomber force without fighter support, which, because of the great distance involved, was impossible, would have had no chance of success.[43]

MacArthur concluded this September 1946 release with the observation: "The over-all strategic mission of the Philippines command was to defend the Philippines, not to initiate outside attack." In his *Reminiscences*, General MacArthur wrote:

> Sometime in the morning of December 8th, before the Clark Field attack, General Brereton suggested to General Sutherland a foray against Formosa. I know nothing of any interview with Sutherland, and Brereton never at any time recommended or suggested an attack on Formosa to me. My first knowledge of it was in a newspaper dispatch months later. Such a suggestion to the Chief of Staff must have been of a most nebulous and superficial character, as there was no record of it at headquarters. The proposal, if intended seriously, should certainly have been made to me in person. He has never spoken of the matter to me either before or after the Clark Field attack.[44]

These categorical statements made by Generals MacArthur and Sutherland necessarily give the historian some pause, especially those parts of General MacArthur's statements that refer to official records in his headquarters. It appears, however, that both MacArthur and Sutherland must have been speaking from memory rather than from recourse to records. In May 1944, the Fifth Air Force chief of staff originated a letter to MacArthur's headquarters asking for information regarding the employment of the FEAF bomber force on 8 December 1941 and received this reply: "There is no official information in this headquarters bearing upon the questions propounded in basic communication."[45] It is entirely possible that General MacArthur may not have been informed of General Brereton's early-morning requests for authority to attack Formosa; the recollections of the air officers and the FEAF Summary attest that these requests were directed to General Sutherland.

MacArthur's reasoning that unescorted B-17 attacks against Formosa would have been "impossible" does not coincide with then-current thinking or with other events that happened on 8 December. In the prewar period, the B-17 Flying Fortresses were believed to have great defensive capabilities. General Arnold envisioned that long-range B-17 missions would be conducted without fighter escort. This was further borne out by the fact that the radius of action of the P-40's sent to the Philippines was only 285 miles.[46] MacArthur, moreover, apparently authorized the B-17 attack that was supposed to have been sent to Formosa late on the afternoon of 8 December. At any rate, on 9 December he signaled the War Department that "the intended attack on Formosa had to be canceled in view of damage reported at Clark Field."[47] MacArthur's statement that the strategic mission of the Philippine command was "to defend . . . not to initiate outside attack," was at variance with the amended RAINBOW 5 plan which directed "air raids against Japanese forces and installations within tactical operating radius of available bases."

When he published his *Diaries* in 1946, General Brereton surmised that he might have been unable to get authority for the early-morning attacks against Formosa because MacArthur had been instructed not to attack unless attacked first and that the Pearl Harbor attack "might not have been construed as an overt act against the Philippines."[48] Although MacArthur had been officially directed to implement the revised RAINBOW 5 plan by the Chief of Staff's letter of 21 November 1941, the month or less permitted to change from defense to offense was a short time in which to reorient planning and thinking, especially since MacArthur (as he wrote Marshall on 29 November) had not previously planned to include heavy bombers in the Philippine Army because of their cost.[49] Hard on the heels of the revised RAINBOW 5 came the 27 November directive that "the United States desires that Japan commit the first overt act." Literal interpretation of this order led USAFFE to refuse Brereton's request for a few high-level reconnaissance flights over southern Formosa on 1 December,[50] and Sutherland later cited this order when he explained the exceedingly circumscribed authority granted the commander of the V Interceptor Command against Japanese planes reconnoitering Luzon: "We told him he could effect it," Sutherland recollected, "but that he must act defensively; but if the Japs came in near enough he could go to it."[51]

Based upon personal interviews with General Sutherland in November 1946 and June 1951, Professor Morton concludes that Brereton's surmise that the Pearl Harbor attack was not considered an overt act against the Philippines "must be dismissed." In support of this position, Morton further cites the fact that MacArthur received a message from Washington at 5:30 A.M. on 8 December informing him that hostilities had begun, and that he was to execute RAINBOW 5.[52] In drawing his conclusion, Morton ignored MacArthur's statement that his mission had been "to defend . . . not to initiate outside attack." MacArthur's *Reminiscences* now reveal that USAFFE was thinking defensively. MacArthur states that initial reports of the Pearl Harbor attack left him with the impression that the Japanese had suffered a setback and that the failure of the Japanese to close against Luzon during the morning of 8 December supported this erroneous belief. "I therefore contemplated," MacArthur wrote, "an air reconnaissance to the north, using bombers with fighter protection, to ascertain a true estimate of the situation and to exploit any possible weaknesses that might develop on the enemy's front."[53] This statement adds weight to the conclusion that the incubus of a long period of defensive thinking, unfamiliarity with strategic air capabilities, and the hesitation arising from the directive that the Japanese should attack first may well have contributed to the fatal delay in launching the heavy bomber attack against Formosa, although more than one Air Force officer has since observed that "the bombing of Pearl Harbor was a first-class overt act."[54]

Under normal circumstances the existence of contemporary documentary evidence enables a historian to evaluate the statements of interested participants in the events they describe. Unfortunately, only a limited amount of documentary evidence bearing upon the employment of the FEAF bomber force in the Philippines can be found. With surrender imminent, Lt. Gen. Jonathan M. Wainwright, commanding on Corregidor, used two small aircraft on the night of 12 April 1942 to transport some 150 pounds of what he described as "General Staff Section Journals, documents, and my diaries" to Mindanao, whence they were taken by special courier to General Sutherland in Australia. "These papers when they arrive," Sutherland directed, "are to be delivered to me—not to staff sections." Another notation on Wainwright's message stated that the documents described were received on 19 April 1942 and placed in a vault in the Chief of Staff's office.[55] In September 1942, General Marshall sent a message to Brisbane stating that it was understood that the staff journals of the Headquarters Forces in the Philippines from the beginning of the war to 1 April were in GHQ, Southwest Pacific Area, and that they should be forwarded to the War Department without delay. The Brisbane headquarters replied that complete staff journals from the Philippines were "not available."[56] Although virtually complete G-4 records ultimately arrived in Washington, the location of USAFFE-USFIP G-2 and G-3 journals was never discovered by Professor Morton, who wrote: "A careful search . . . has failed to produce them, and the principals, Generals Wainwright and Sutherland, assert they have no knowledge of their whereabouts."[57]

Very few Far East Air Force records survived the retreat from the Philippines. Generals Brereton and Brady have pointed out that two official reports were made to General Arnold, one before FEAF Headquarters left the Philippines and the other shortly after the evacuation of Java. Diligent search of official records collections failed to disclose the original of either report. General Arnold, moreover, made no apparent use of the reports when he wrote his *Global Mission,* but instead remarked that he had never been able to get "the real story of what happened in the Philippines."[58]

That the two FEAF reports were made is nevertheless fairly certain. General Brady recalled that the first report was carried out of the Philippines by Brig. Gen. Henry B. Clagett, the commander of the V Interceptor Command, who was ordered to Australia to establish a rear base.[59] The FEAF Summary of Activities notes that a memorandum was prepared for General Arnold on 18 December 1941, giving a chronological statement of events between 3 November and 8 December 1941.[60] General Clagett departed the Philippines on the following day, and it is to be assumed that he later forwarded the report to General Arnold from Australia. If it could be located, this document might well clear up the dispute about the basing of the B-17's at Del Monte. General Clagett died before replying to a request for information regarding his knowledge of this historical source.

The second report must have covered FEAF activities from 8 December 1941 through 24 February 1942. While the original of this report has never been located, the USAF Historical Division Archives contains a typescript document which is either a carbon copy of the report or the working data from which the report was prepared. This document—entitled "Office of Commanding General, FEAF, Summary of Activities"—was discovered in the retired files of the Tenth Air Force (Brereton's next command after leaving Java) in India, and it was routinely transmitted to the Archives in October 1945.[61] Buried in a bulk shipment of documents, this FEAF Summary of Activities was not noticed until the first volume of *The Army Air Forces in World War II* was nearing publication. The summary was of such importance that the editors of the Air Force historical series immediately undertook to incorporate its information wherever possible.[62]

In its form, this FEAF Summary of Activities appears to be a detailed daily diary of FEAF Headquarters, with time entries for the events of each day between 8 December 1941 and 24 February 1942. General Brereton has recalled that he instituted the practice of keeping a detailed daily diary at FEAF: "It was my invariable habit," he stated, "to report for the record the substance of personal conferences outside headquarters immediately upon my return."[63] Lt. Col. Keith P. Siegfried, who as a warrant officer joined FEAF Headquarters in Java, recalled that the format of the Summary was that generally employed in the Headquarters diary. "At that time," Siegfried recollected, "the minute-by-minute recording of incidents, conversations, phone calls, and the receipt or dispatch of messages as they occurred was an established SOP."[64] Internal evidence points to Major Norman J. Lewellyn (Brereton's aide who was killed in India in 1943) as the keeper of the portion of the Summary through 29 January 1942, and General Brady remembers that Lewellyn went about FEAF Headquarters each day collecting information. General Brereton has also stated that Lewellyn was the custodian of the FEAF War Diary.

While the FEAF Summary appears to be a

day-by-day report of events, internal evidence makes it apparent that it was transcribed in its present form somewhat later than the events it describes. The most certain evidence of this is the erroneous dating of many of the earlier entries as "1942" rather than "1941." One rarely if ever makes an advance error in setting down a date, and it is likely that these misdated entries were transcribed early in 1942, when the harassed typist was overly conscious that a new year was at hand. Misspelled place names scattered throughout the Summary (not an unusual feature in military records) indicate that the typist was transcribing unfamiliar material. Additional internal analysis also indicates that the FEAF Summary is a compilation of several different diaries: (1) General Brereton is "positive that the entries from 8 December to 23 December are accurate transcriptions taken from . . . the Headquarters War Diary." (2) From 24 December 1941 through 29 January 1942, the Summary's entries follow the travels of Brereton's headquarters to Australia and Java, and this portion of the document unquestionably represents the work of Major Lewellyn. (3) The portion of the Summary for 30 January through 22 February 1942 is a carbon copy identical to a similar portion of the FEAF Headquarters diary in the Kansas City Records Center. (4) The last page of the Summary covers events on 24 February 1942, the date that General Brereton gave up command of FEAF, and does not appear in the Kansas City file copy of the FEAF Headquarters diary.

Two significant questions emerge from this internal criticism: When was the FEAF Summary transcribed in its existing form? Were the sources edited before their transcription? Watermarks of a Javanese bank on a portion of the paper used in the Summary point to the time and place of the assembly of the information as late January or early February 1942 in Java. When asked about the matter, Generals Brereton and Caldwell were certain that the Summary was carried by Lewellyn when they departed from Java for India on 25 February 1942. After what appears to have been a cursory examination of the Summary, Walter D. Edmonds commented that he felt "fairly sure that it has been re-edited." Reports of pursuit activity, Edmonds claimed, coincided more closely with statements in the 24th Pursuit Group's history than did the recollections of the various personnel he interviewed.[65] As a matter of record, however, the 24th Group's history was written in Australia during October 1942, and by this time the FEAF Summary was already resting in the files of the Tenth Air Force in India. It may be noted, moreover, that the details in the FEAF Summary coincide generally but not exactly with the recollections of the Air Force officers regarding the happenings of December 1941. The Summary thus possesses the precision and definition which usually characterize the difference between a contemporary document and the memories of participants in events. Finally, both Generals Brereton and Caldwell accepted the authenticity of the Summary after they had examined it in 1952. "There is no doubt in my mind of the authenticity of the diary," General Caldwell stated,[66] while General Brereton wrote: "I am absolutely certain that the Diary is an authentic record of the facts as they were recorded at that time."[67] Additional criticism thus buttressed the initial conclusion of the Air Force historical editors that the FEAF Summary "represents a valuable record compiled closer to the events described than any other known source of comparable scope."[68]

It is not really within the province of proper historical reporting to speculate on what might have been the result of a heavy bomber attack against Japanese bases on Formosa in the opening hours of American participation in World War II. "As a matter of fact," General MacArthur suggested, "an attack on Formosa, with its heavy air concentrations, by our small bomber force without fighter cover, which because of the great distance involved and the limited range of the fighters was impossible, would have been suicidal."[69] On the other hand, Japanese officers interrogated after World War II were less certain as to what the effect of such an attack might have been. With 150 Army and 300 Navy aircraft crowded into Formosa's limited air facilities, depending on overhead fighter cover for protection, Japanese commanders knew many anxious moments during the morning of 8 December. Only the Navy planes had range enough to reach Manila, and the delicately adjusted attack plan called for the launching of a strike from Formosa at sunrise. When ground fog delayed the take-off, the Japanese greatly feared that American aircraft would initiate the first strike. This fear was increased at 8 A.M. when an American radio message was intercepted indicating that an attack was being considered and that the B-17's would arrive over Formosa at 10:10. At this hour, a Japanese Army plane falsely reported the approach of the B-17's, and, expecting the worst, the Japanese donned gas masks and otherwise prepared for the American attack that never came.[70]

Actually, however, the facts that must be gathered about the initial phase of American air operations in the Philippines involve not what might have been but what actually happened. Acceptance of the FEAF Summary of Activities as a nearly contemporary and almost certainly authentic source permits little doubt to remain that General Brereton did request and was denied authority to send a B-17 strike against Formosa early in the morning of 8 December. Complete resolution of the question as to whether Brereton had been ordered to move all the B-17's back to Mindanao well before the war's beginning must await the location of additional documentary evidence. One may hope that as the passing of time diminishes the keenness of the controversy the appearance of additional source material will allow historians to tear away the "conspiracy of silence" that has so long surrounded the beginning of the war in the Philippines.

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Notes

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13. Ltr, Brereton to All Post, Group, and Separate Squadron Commanders, 10 November 1941, in AAF AG 381.
14. Msg, Marshall to CG USAFFE, No. 624, 27 November 1941, in AAFRH-11: Army Air Action in the Philippines & Netherlands East Indies, 1941-1942, p. 249.
15. Msg, MacArthur to Marshall, No. 1004, 28 November 1941, in AAFRH-11, p. 249.
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38. FEAF Summary of Activities, 10:00, 8 December 1941; *The Brereton Diaries*, p. 40.

39. FEAF Summary of Activities, 10:14, 8 December 1941; *The Brereton Diaries*, p. 41.

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41. Eubank interview, 2 July 1942.

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56. Msgs, Washington to Brisbane, No. 1874, 17 September 1942, and GHQ SWPA to AGWAR, C-671, 10 October 1942, in AG File 313, GHQ SWPA, Kansas City Records Center, SWPA Collection, BX-50756.

57. Morton, *The Fall of the Philippines*, p. 586.

58. General of the Air Force H. H. Arnold, *Global Mission* (New York: Harper & Brothers, 1949), p. 272.

59. Ltr, Brig. Gen. Francis M. Brady to Air Force Historian, 2 July 1952.

60. FEAF Summary of Activities, 18 December 1941.

61. Ltr, Dr. H. L. Bowen, former member of Historical Section, Hq AAF India-Burma Theater, to author, 20 November 1952.

62. Craven and Cate (eds.), *The Army Air Forces in World War II*, I, 206n.

63. Ltr, Lt. Gen. Lewis H. Brereton to Chief, USAF Historical Division, 3 April 1952.

64. Ltr, Lt. Col. Keith P. Siegfried to Chief, USAF Historical Division, 24 October 1952.

65. See ltr, William F. Walsh, Jr., Boston, Mass., to Historical Officer, USAF, 28 March 1950, in ASI HA 730.01 (4469-1); Edmonds, *They Fought With What They Had*, p. 92.

66. Memo for Air Force Historian from Caldwell, 25 April 1952.

67. Ltr, Brereton to Chief, USAF Historical Division, 3 April 1952.

68. Craven and Cate (eds.), *The Army Air Forces in World War II*, I, 206n.

69. MacArthur, *Reminiscences*, p. 120.

70. U.S. Strategic Bombing Survey, Interrogations No. 601, Comdr. Ryosuke Nomura, 28 November 1945 and No. 74, Capt. Chihaya Takahashi, 20 October 1945.

EXERCISE SKY SOLDIER
TIEN BING VI

In early October 1964, the Republic of China (R.O.C.) forces noted increased reconnaissance activities by aggressor aircraft and also an increase in enemy ship sightings in the Taiwan Bay area. On 20 October an estimated 100 aggressor troops were observed landing in small boats on the coast near the mouth of the Ta Tu River. After coming ashore they deployed in a southwesterly direction toward Chaung Hau.

The steadily improving economy and standard of living in Taiwan and the existence of the antiaggressor government are believed to have caused the "aggressorland" to become more hostile toward the Republic of China.

In the final days of October, an aggressor force, having made other successful landings on the coast, directed its forces north and south, to turn the friendly positions. The R.O.C. field armies contained the aggressor forces and prepared to execute a counterattack plan to drive the enemy back into the sea. At the same time, the R.O.C. requested immediate assistance from the United States under existing treaties and security arrangements, in order to eliminate the international security threat. As a result of this request, planning was initiated for the employment of U.S. and R.O.C. airborne forces.

THIS was the hypothetical military/political situation on the island of Taiwan and the setting for joint United States–Republic of China Exercise Sky Soldier/Tien Bing VI from 27 October to 5 November 1964.

Sky Soldier VI Troop Carrier Command Post was activated at 1600 hours 25 October on Naha Air Base, Okinawa, by Brigadier General Richard H. Ellis, Commander, 315th Air Division, and Troop Carrier commander for the exercise. Over seventy United States Air Force transport aircraft, under the operational control of the USAF 315th Air Division, had been assembled on Okinawa, along with more than 3800 personnel and over 3,800,000 pounds of cargo to be airlifted into the exercise area to join their allied R.O.C. forces in repelling the simulated aggressor.

Three Command Airlift Support Units (CALSU's) were established to execute the orders issued by the Troop Carrier Command Post. The CALSU at Naha Air Base controlled 315th Air Division flying units of the 6315th Operations Group, which is equipped with three C-130 troop carrier squadrons. At Kadena Air Base, Okinawa, the CALSU supported the aircraft from the 22d Troop Carrier Squadron, 1502d Air Transport Wing (MATS), and crews from the Naval Air Transport Wing, Pacific, flying Air Force C-130's. The third CALSU was located in west central Taiwan to monitor and control Sky Soldier airlift operations.

Organizations directly involved in airlift operations were the 315th Air Division and its subordinate units: the 5th Communications Squadron, 7th Aerial Port Squadron, 9th Aeromedical Evacuation Squadron, and 815th Troop Carrier Squadron; also the 6315th Operations Group and its assigned troop carrier squadrons, the 21st, 35th, and 817th.

Military Air Transport Service (MATS) units under the operational control of the 315th Air Division were the 1503d Air Transport Group and its assigned 22d Troop Carrier Squadron, the 1502d Air Transport Wing augmentation aircraft and crews, and U.S. Navy crews from VR 7 Naval Air Transport Wing, Pacific, flying Air Force C-130's.

Exercise Sky Soldier/Tien Bing VI brought together a total of over 40 units and supporting elements of the U.S. and Chinese Army, Navy, and Air Force. In addition to the 315th Air Division and subordinate units mentioned above, other U.S. Air Force units in-

An informal conference is held during the joint United States–Republic of China Exercise Sky Soldier/Tien Bing VI. Conferees are Brig. Gen. Richard H. Ellis, Troop Carrier and 315th Air Division commander; Col. L. M. Tannenbaum, 315th deputy chief of staff for operations; and Brig. Gen. Ellis W. Williamson, 173d Airborne Brigade commander.

cluded Fifth Air Force, Thirteenth Air Force, and 313th Air Division, all part of the Pacific Air Forces. The U.S. Army units participating were the 173d Airborne Brigade (Sep), Headquarters IX Corps, 999th Signal Company, and elements of the 97th Civil Affairs Group, 549th Quartermaster Company, and U.S. Army Broadcasting and Visual Activity, Pacific.

Sky Soldier/Tien Bing VI had several objectives, the more important of which were to improve the combat readiness of participating units; exercise the airborne capabilities of the U.S. airborne brigades; evaluate the effectiveness of marshaling plans, procedures, and techniques; and provide training in all phases of combat airlift and tactical air operations.

Initial activity began early Monday morning, 26 October, with briefings on the exercise for all personnel involved in the operations. Loading of the aircraft started at 0800 with members of the 173d Airborne Brigade (Sep), Camp Sukiran, Okinawa, rolling their trucks of cargo up to the aircraft. Thirty-six 315th Air Division and ten Naval Air Transport Wing C-130 Hercules were loaded with 600,000 pounds of cargo for airdrop on D-day, Tuesday, 27 October.

For the paratroopers of the U.S. Army's 173d Airborne Brigade (Sep), Tuesday began at 0500 when 2000 of them were loaded on 24 C-124 Globemasters of the 1502d Air Transport Wing and the 1503d Air Transport Group (MATS), for the flight of some 500 miles along the Ryukyu island chain to the airdrop site in the west central Taiwan area.

The Republic of China forces were the first into the assault area, completing their airdrop of Chinese paratroopers at 1000 hours. Next in C-130's came a 14-man combat control team from the 7th Aerial Port Squadron and a 50-man Army assault team from the 173d Airborne Brigade. The C-124's followed at 1100 hours, dropping 1000 paratroopers before high surface winds prevented further drops for the day.

On Wednesday winds in the drop zone had diminished, and the paratroop and cargo drops were completed. Airlanding of assault cargo started Wednesday afternoon, and C-124's and C-130's delivered over a million pounds of cargo daily on Thursday, Friday, and Saturday.

The C-130 aircraft were equipped with the 463L roller rail conveyer system, here used for the first time in any exercise of this magnitude. With this system, aircraft needed less than 10 minutes to offload airlanded cargo at their destination, while combat assault rolling stock was offloaded in a matter of seconds during the airland assault phase. Airdropped cargo utilizing the same system exited the aircraft in less than 10 seconds.

Aircraft-movement and weather information, vital in all exercises of this type, was under the control of the 5th Communications Squadron. A 12-man team at a fixed site at Naha Air Base and a 12-man mobile communications team set up in Taiwan handled up to 150 weather, aircraft-movement, and administrative messages each day during the assault phase, 27–31 October. Starting on D-day, 27 October, and during all aircraft movements, squadron weather reports were broadcast over the objective area every 15 minutes. The mobile communications team can be air-moved to any site and be fully operational two hours after landing. It can then tie into existing networks or operate alone and communicate over long distances.

Division-size airborne exercises such as this have constantly improved the defense posture and the combat and operational readiness of the armed forces of the United States and its allies in the Pacific in recent years.

Office of Information,
Hq 315th Air Division

The Work on the Ground

The hub of airlift operations during the joint United States–Republic of China Exercise Sky Soldier/Tien Bing VI was the Troop Carrier Command Post at Naha Air Base, Okinawa. Staff officers worked around the clock to see that operations went according to plan.

Planning cargo- and troop-loading schedules

Navigators of the 35th Troop Carrier Squadron do their preflight work. Navigators were responsible for getting their aircraft over the drop zone at the exact second called for in the operation plan.

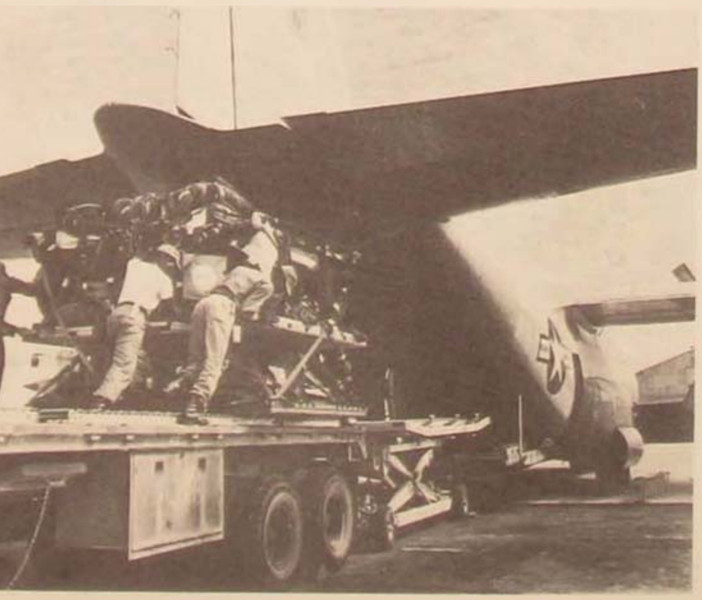
A 51st Organizational Maintenance Squadron crew refuels a 315th Air Division C-130. The 51st was kept busy throughout the exercise maintaining the division's four squadrons of C-130's at Naha Air Base.

Aircraft movement information was transmitted by the 315th Air Division's 5th Communications Squadron. Communicating between this fixed station and a mobile station in Taiwan, the squadron handled up to 150 messages each day on aircraft moves.

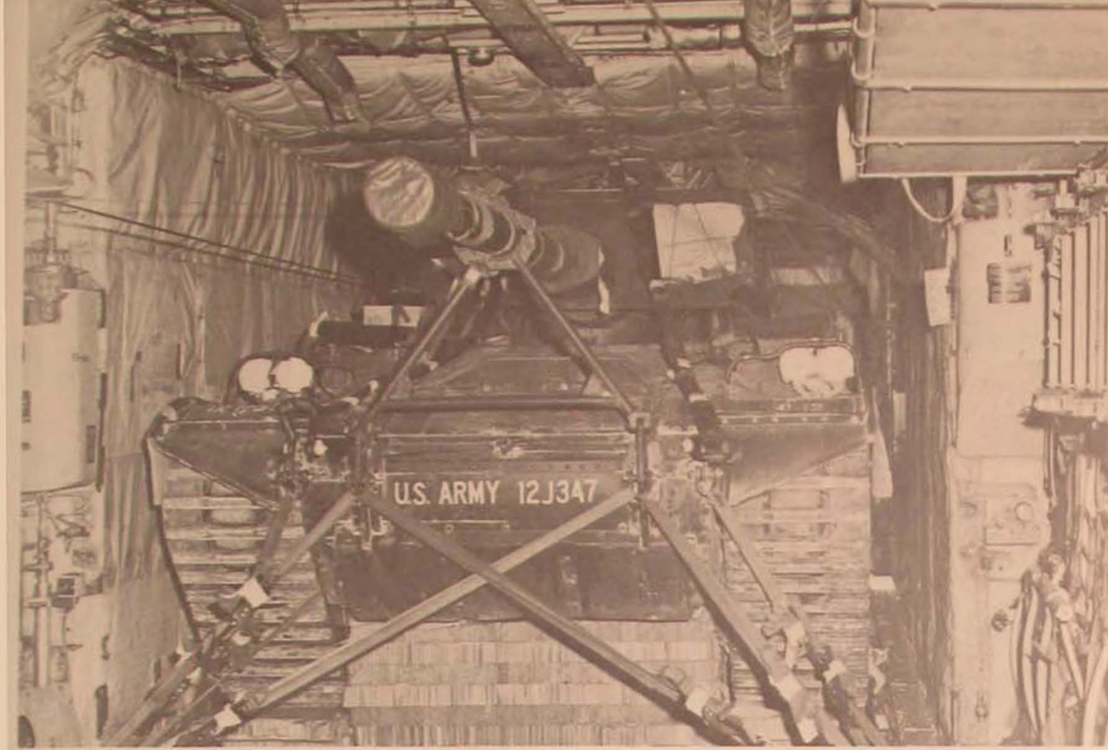
Proper loading of cargo by the 315th Air Division loadmasters pays off as the crew quickly offloads this huge C-124 Globemaster in Taiwan. In just five days of the joint exercise, over 3,800,000 pounds of combat cargo was airlifted from Okinawa to Taiwan.

The Loading Phase

Combat cargo loading at Naha Air Base. USAF C-130 aircraft airdropped more than 600,000 pounds of assault cargo during the exercise.

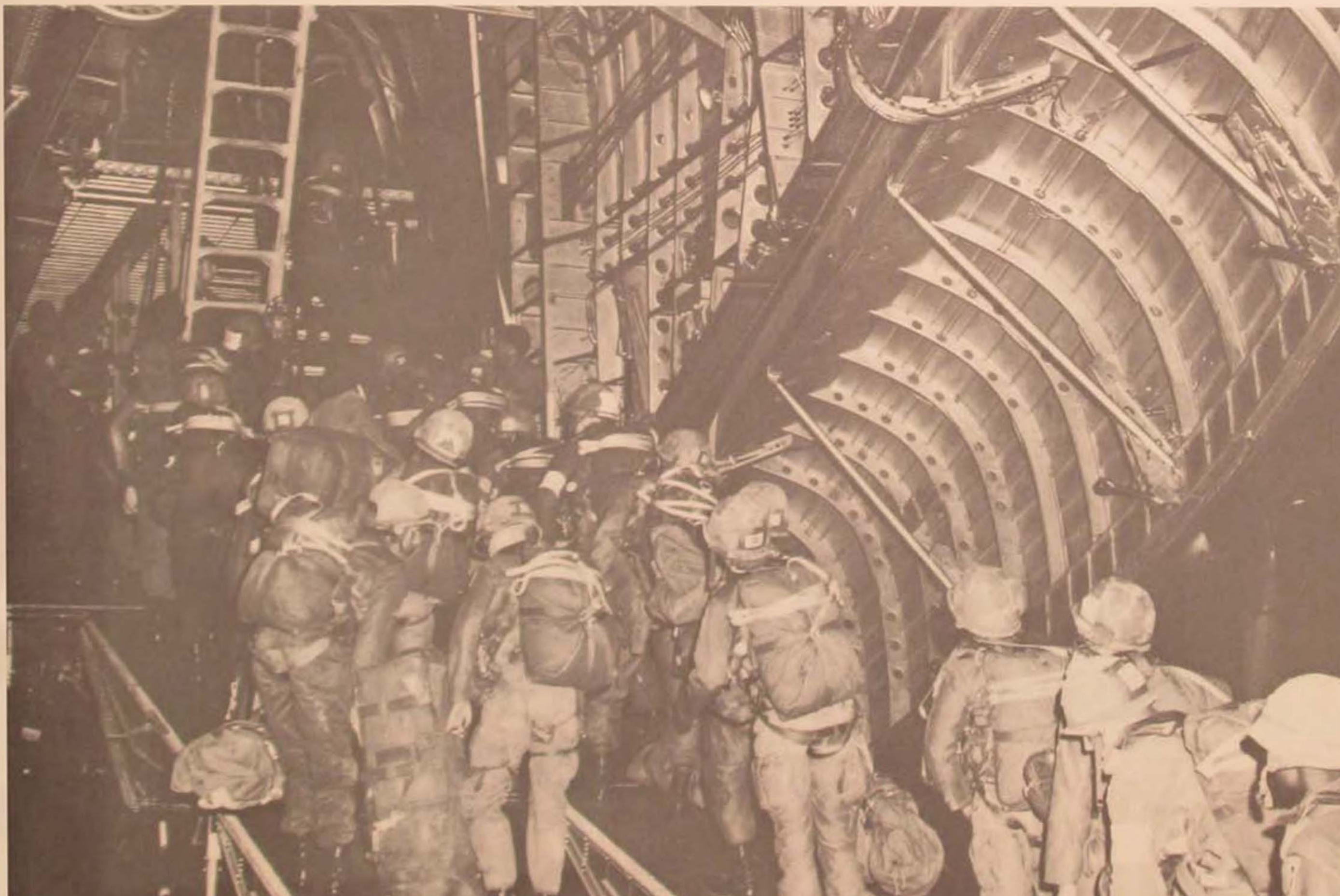


Army members of the 173d Airborne Brigade (Sep) and Air Force loadmasters of the 315th Air Division push a double pallet of Army "mules" into a C-130 Hercules during the assault phase. Using the 463L roller conveyer system for the first time in a Pacific area exercise, crews were able to onload palletized cargo in minutes, offload in 10 minutes, and airdrop cargo in less than 10 seconds.



An Army self-propelled antitank (SPAT) is loaded into a C-130 for aerial delivery. This weapon, along with thousands of pounds of other combat cargo, was airdropped in west central Taiwan.

'Airborne All The Way"—Troops of the 173d Airborne Brigade (Sep) narch aboard a 1503d Air Transport Group (MATS) C-124 Globemaster of he 22d Troop Carrier Squadron at Kadena Air Base, Okinawa. These air-orne troopers were dropped in west central Taiwan during the exercise.



The Aircraft Begin To Roll

The C-130's. An 815th Troop Carrier Squadron crew is briefed prior to flight by the aircraft commander. Other crew members are the [illegible] *flight mechanic, and two loadmasters.*

The C-124's. Globemasters of the 1502d Air Transport Wing and 1503d Air Transport Group (MATS) are readied for early morning take-off at Kadena Air Base. These aircraft flew over 2000 paratroopers of the 173d Airborne Brigade (Sep) in support of Sky Soldier VI. The MATS airlift augmentation units were under the operational control of 315th Air Division.

ty-six C-130 Hercules of the 315th Air Di-on move out for the runway at Naha Air for a formation take-off. The 315th Air sion's flying units include the 21st, 35th, h, and 817th Troop Carrier Squadrons.

This formation helped deliver over 3,800,000 pounds of combat cargo to west central Taiwan in support of Sky Soldier/Tien Bing VI.

Airborne—and Down

C-130 Hercules of the 315th Air Division move into a close tactical formation on the way to the drop zone during Sky Soldier VI. C-130's from the 21st, 35th, 815th, and 817th Troop Carrier Squadrons air-delivered over 600,000 pounds of combat cargo to the drop zone.

315th Air Division's combat control team and the 173d Army assault team caught a few winks prior to jumping, after which they set up a drop zone for over 2000 173d Airborne Brigade troopers who jumped thirty minutes later.

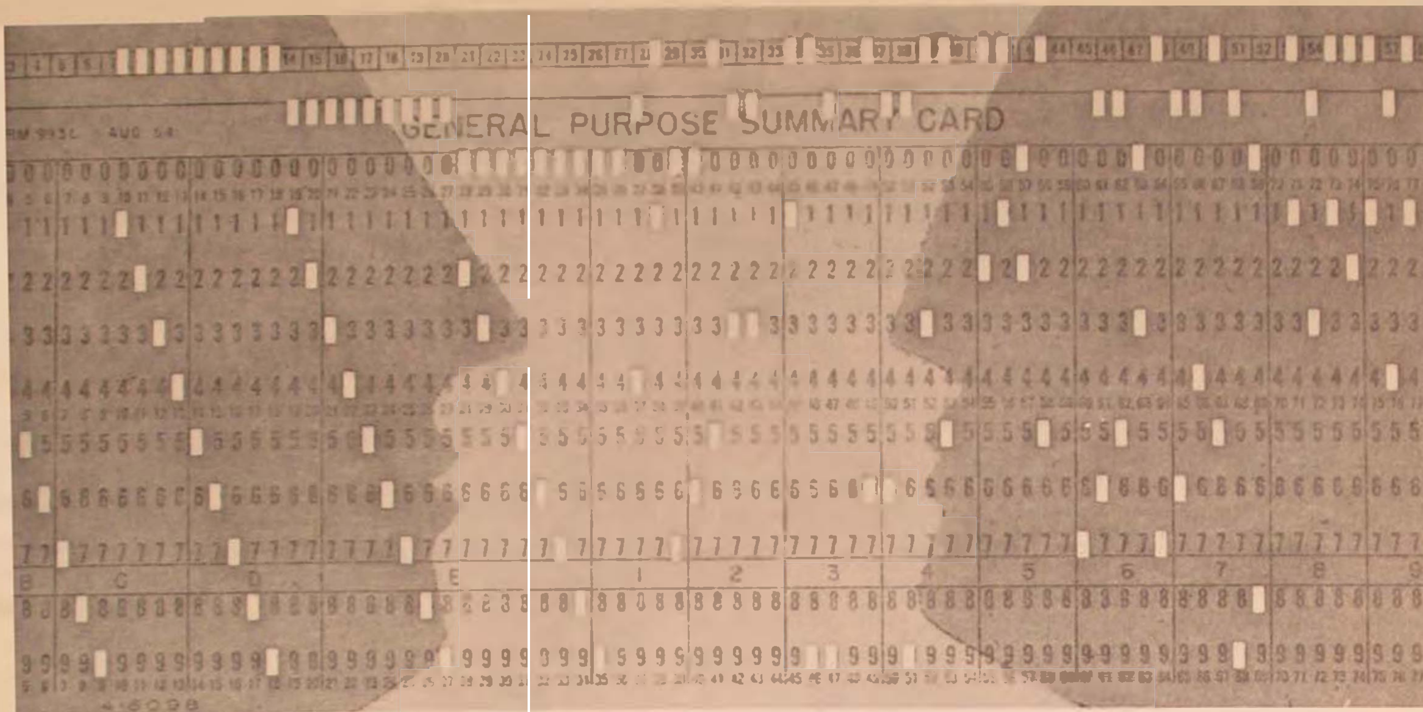
Thousands of tons of combat cargo pour from the C-130's during the D-day assault phase. All cargo hit the ground within the objective area.

sing parachutes of the 173d Airborne Brigade (Sep) were seen almost uring the joint United States–Republic of China Exercise Sky Soldier/ I. The regular paratroopers were preceded into the drop zone by the 5th Air Division combat control team and a 50-member Army assault team.

THE COMPUTE

MOST OF us in the Air Fo to look very far to see computers on almost al lives. Our national defense structur by a computer complex beyond the the layman. The Strategic Air Co crewman depends upon computer s for the accomplishment of his job his very life. A recent innovation h computer home to us in a most cr paycheck. Air Force finance offic consolidating their activities and a paycheck-producing activity.

With all this shifting from manu operations, it is surprising to see on so completely and consciously man is personnel management. We ma chines, our strategies, and even our m puter; but when it comes to our car that the process remain manual. T most often heard in defense of this p the computer is too impersonal, that sent having their destiny placed in a machine." The purpose of this artic



THE COMPUTER USE OF HUMAN BEINGS

MAJOR ROBERT L. ABLE

MOST OF us in the Air Force do not have to look very far to see the impact of computers on almost all aspects of our lives. Our national defense structure is integrated by a computer complex beyond the imagination of the layman. The Strategic Air Command combat crewman depends upon computer systems not only for the accomplishment of his job but in fact for his very life. A recent innovation has brought the computer home to us in a most critical area, the paycheck. Air Force finance offices are rapidly consolidating their activities and automating the paycheck-producing activity.

With all this shifting from manual to computer operations, it is surprising to see one area remain so completely and consciously manual. That area is personnel management. We manage our machines, our strategies, and even our money by computer; but when it comes to our careers, we insist that the process remain manual. The argument most often heard in defense of this position is that the computer is too impersonal, that people would resent having their destiny placed in the hands of a machine.[1] The purpose of this article is to take issue with the reasoning that supports this "too impersonal" position and advance in its place the thesis that the computerization of the officer promotion and assignment activities will provide the fairest and therefore most truly impersonal system we can attain. This thesis, with supporting arguments, will be organized around the principal objections cited for computerizing personnel management. It is intended not as a conclusive contribution but rather as a thought stimulant and should raise far more questions than it answers.

the "too impersonal" objection

The "impersonal" objection to computerization of officer promotions centers around the position that there is no substitute for human judgment and that only another officer, with considerably more experience than the one being evaluated, can properly and equitably weigh the many factors necessary for so important a decision. The real question here is: What is judgment? There are many definitions, of course, but they all essentially describe judgment as a process of reasoning, of comparing one alternative against another, considering and weighing the identified criteria, so as to reach a conclusion. Isn't this, in effect, a conditioned choice based upon experience?

If judgment really is a process of comparing and weighing relevant factors, can't a computer weigh many more factors than a man? There is practically no limit for the computer, but the man sitting on a promotion board certainly is limited in his capacity. He can only consider those factors he thinks of as he picks up each folder. As the number of folders mounts, it should be apparent that a narrowing process takes place until he gives *actual* consideration to only a few factors. At the same time his colleagues are also narrowing the span of their consideration, but each settles on a different set of factors. Which is the fairer system: all contestants computer-compared according to the same criteria, or the remote chance that this process will be duplicated by a three-man group?

The significant question to ask of the "too impersonal" proponent is, What is so magic about human consideration? Does it guarantee or even imply fairness? When compared with automated consideration, just the reverse occurs. If unfairness could enter the evaluation, it could do so *only* through human consideration. The computer has no biases, personal or professional. It can consider only what it is told to consider and apply only the relative weights it is told to apply. These criteria are the ones the Air Force would identify as most supportive to its requirements. If they seem to be unfair to some group, e.g., those with too little formal education or without combat crew experience, that group is aware of its deficiency and must make the choice of remaining or leaving the organization. If their departure hurts the Air Force, then the Air Force must reconsider its criteria. Fairness is thus properly oriented to the organization rather than the individual.

Under the present system, what assurance does the candidate have that he was actually considered on the basis of criteria he believes the Air Force esteems? Promotion board chairmen make every effort to achieve a common ground among board members, but how successful *can* they be? When each member retires to the privacy of his own thoughts, he cannot suddenly cleanse himself of biases which have evolved from years of experience, no matter how conscientiously he tries. If he lacks degrees, can he really believe formal education is vital? If he is nonrated, can he esteem combat crew experience above all else? If he was commissioned from AFROTC or the aviation cadet program, can he consider Academy graduation a criterion? The three-man review system is certainly an effort to reduce these biases, but few would argue that is does a perfect job. The computer is immune to bias.

Even if one conceded a perfect job of eliminating biases and establishing a perfectly homogeneous set of criteria, couldn't the fatigue factor alone preclude equal consideration? For example, the 36-man board that recently completed the FY 64 temporary majors selections was reported to have reviewed the folders of over 24,000 officers.[2] After the board was broken into twelve 3-man groups, each man reviewed over 2000 folders. Is it physically possible for a reviewer to be the same man, with the same dedication to fairness, on folder number 2000 as he was on folder number one? And if he isn't exactly the same man, haven't we introduced another factor into the considerations: In what order did one's folder happen to fall? The Air Force makes every effort possible to reduce the impact of this factor, but can it be eliminated completely? The answer is yes, by computerizing the process.

Perhaps an argument even more supportive to the thesis here advanced is one centering about the intended role of the Officer Effectiveness Report (OER).[3] The current OER structure is obviously intended to personalize the performance-evaluation process as much as possible. This is apparent from the policy of having an officer evaluated by the two supervisors (rater and indorser) who work most closely with him. They know him best and more personally than anyone else in the hierarchy, and so they complete the OER. But what happens then? Someone else, who has never known the officer, the rater, or the indorser, must attempt to interpose his judgment of what the raters meant as compared with what all other raters meant. Doesn't this rather substantially shift the locus of responsibility for meaningful performance evaluation away from "those who know him best" to "those who don't know him at all"? On the other hand, if the process were automated the total performance-evaluation process would shift back to the rater and indorser. Their evaluation would be the sole input for this key portion of the overall promotion-selection process. Again, only through computerization can we achieve a truly impersonal system.

the "criteria weighting" objection

One of the objections against automating the process stems from the fact that the Air Force tried and abandoned a system of assigning points for correspondingly weighted criteria. A similar system would of course be necessary with a computer process. When the point system was rejected, the process was shifted to a "whole man" concept. Under this system, the board member examines the entire file and awards a single composite score. In the final analysis, however, this does not effect any real change. What process does the board member actually go through when he makes this examination? Doesn't he very quickly, though unconsciously, set up his own little informal weighting system by which he reaches his composite score? And if he does, which is the fairer system, one in which candidates are compared against as many weighting systems as there are reviewers, or one in which all candidates are compared against the same criteria with the same weights? And what if some of the board members are influenced by criteria contrary to Air Force personnel requirements? Will this system elevate the kind of skills the organization needs? Why leave so vital a need to chance?

This argument breaks down when one realizes that what we are now doing singly we could do collectively more effectively. We now brief board members on the kinds of factors the Air Force needs and hope that each will use these as the basis for his evaluation. Why couldn't the function of future promotion boards be to evaluate all the possible criteria, compare them with Air Force needs, select the most significant, and assign the appropriate weights?—leaving the rest of the process to computers. In such a system the board's task would be just as vital as it is now. It would require the same depth and breadth of experience on the part of board members.

This automated process would be even more flexible than the current system because the weighted criteria could in fact be changed for each board or each time Air Force requirements changed. There is serious question as to how fast the manual system can change. It is one thing for personnel staffers to brief the board members concerning the desired weighting of criteria, but it is quite another thing for them to change a long adopted sense of values. For example, in the 1950's when the Air Force gave strong support to formal education as a significant promotion criterion, did all of the subsequent promotion board members really accept this as a vital criterion? Can we expect senior officers who did not have the opportunity for formal education to suddenly change their views? Could they stop reasoning that since they made it to the top without education, so also could others?

In the final analysis, the "flexibility" issue is really a sterile argument. If changes in Air Force requirements dictate criterion changes, those changes must be communicated to the board. Such changes could just as easily, and far more effectively, be communicated to a computer.

One of the experiments that USAF Personnel staffers have already conducted is the mechanical simulation of a promotion board's actions. To do this, the computer men carefully observed each step in the review process, noting the factors considered and the weights assigned. This information was then fed to the computer, and it was asked to perform the same process. The idea, of course, was that if a large enough sample could be studied, eventually the computer would be taught all the relevant factors and therefore do the job. The process was apparently rejected because the machine did not produce exactly the same selections as did the board, although they were very close. The implication was that the computer could not be taught perfectly and any imperfection—or deviation really—would be unfair to those not selected. The real question is, Which list was the more correct? Isn't it entirely possible that the human board was wrong, with wrongness defined as the degree of deviation from the established criteria? Maybe the computer choices adhered more closely and were to that extent fairer. Perhaps the experiment serves as proof of the "human frailty" arguments.

This issue could be tested, of course, by selecting and carefully weighting a number of criteria, thoroughly briefing the board members, letting the board and the computer make the selections, and then evaluating the deviations. Careful analysis of the results should locate and measure the deviations from the weighted criteria.

computer potential in officer assignments

Besides the promotion system, the other major personnel management function of greatest interest to most of us is the assignment process. The thesis advanced here is that computerizing this process is even more beneficial to the officer and the Air Force than conversion of the promotion system to computers. Many of the objections and counterarguments would closely parallel those previously advanced. For example, it is argued that computerizing the assignment process is too impersonal and human consideration is preferred. Again the real question is, What is actually taking place in this process? Obviously it is a matching process by which the myriad weighted details of Air Force requirements are matched against the details of qualifications, preferences, equity, etc. How can it be argued that a human being can actually consider the relevant detail that the computer can? And if he cannot, who is the loser? The answer—both parties to the transaction.

If the assignment system were automated, the key function of USAF Personnel staffers would be the selection and weighting of criteria. This function is obviously the most important in the process and is also a continuous one if changing requirements are to be met.

Consider for a moment the kinds of factors which could be considered from the officer's standpoint. Obviously a more refined system of expressing the officer's personal preference could be developed, weighted as USAF felt appropriate, and incorporated into every selection. Such facts as last assignment, foreign service vulnerability, rotation between isolated and desirable locations, preferences as to location, progress made toward career development (i.e., command-staff or rated-nonrated rotation), and so on ad infinitum. Evidence that consideration of career development through job rotation has not been incorporated into the majority of assignments was amply demonstrated in a research study conducted by the author.[4] In that study a statistically significant sample of officers representing every major command was asked to compare their career progress with that specified as desirable for their rank in Air Force Regulation 36-23. Some 60 per cent of the respondents, second lieutenant through lieutenant colonel, reported that they had not received the desirable rotation. The reason would seem to be that there are simply too many variables for the staffer to give proper consideration to them all. The solution would seem to be: automate the process and eliminate the human limitation now apparent.

THE CENTRAL THESIS advanced here is that if the officer promotion and assignment processes were automated, great benefits would accrue to both the individual and the Air Force. The principal objection to such a proposal seems to center around the "too impersonal" nature of such a procedure. The argument advanced here is that an automated system would provide a substantially fairer—yet truly and wisely impersonal—system than could ever be achieved with the manual human process.

There is some evidence that USAF Personnel staffers would support the thesis advanced here but are reluctant to install such a system out of concern for the impact upon officer morale.[5] Certainly this is indicated by the shift toward central control of the two systems. Though I have no affiliation or experience with USAF Personnel activities, it is apparent that some degree of automation is already being incorporated into these systems, particularly the assignment process.

The purpose of this article has been to stimulate the thinking of all its readers regarding this question. Hopefully, it will encourage inputs from many people: from computer people regarding the technical feasibility of my proposal, rebutting arguments from dissenters, practical considerations from those engaged in the two processes, and others who share an interest. If we can achieve such a debate, we will be doing our fellow officers at the Pentagon (or Randolph) a great service.

United States Air Force Academy

Notes

1. For a summary of the "impersonal" argument see Colonel Lonnie E. Martin, " 'Instant' Personnel Management," *Air University Review*, XIV, 4 (September-October 1963), 56-63.
2. *Air Force Times*, 26 February 1964, p. 10.
3. The author is indebted to his colleague, Captain Orin C. Patton of the Air Force Academy faculty, for the key points of this argument.
4. Robert L. Able, "An Analysis of the Use of Selected Methods of Executive Development in the U.S. Air Force" (unpublished Ph.D. dissertation, Graduate School, University of Kentucky, 1962).
5. Martin, *op. cit.*, p. 58.

THE CONSTITUTIONAL BASIS OF THE UNITED STATES AIR FORCE

Dr. Maurer Maurer

IN A desperate effort to prevent establishment of the United States Air Force in 1947, opponents of an autonomous air service resorted to the Constitution of the United States. Arguments based on strategic, tactical, and administrative considerations had been exhausted in the organizational controversy that had been going on for more than three decades. Now Congress was considering legislation that would separate the Army Air Forces from the Army and create an independent United States Air Force equal to the Army and Navy in a unified military establishment.[1] This bill not only pleased the airmen but also had the approval of the War and Navy Departments and the support of the President. But there were a few die-hard opponents who tried to prevent the passage of the National Security Act of 1947 by labeling the bill "unconstitutional."

The Preamble to the Constitution states that one of the reasons for establishing the Government of the United States was to "provide for the common defense." Toward this end, Section 8 of Article I says:

> The Congress shall have power
>
> To lay and collect taxes . . . to pay the debts and provide for the common defense and general welfare of the United States; . . .

> To declare war . . .
> To raise and support armies . . .
> To provide and maintain a navy.
> To make rules for the government and regulation of the land and naval forces. . . . And
> To make all laws which shall be necessary and proper for carrying into execution the foregoing powers . . .

Elsewhere, in Article II, Section 2, the President is designated "Commander-in-Chief of the Army and Navy."

The Constitution thus speaks of an army and a navy, of land and naval forces, but nowhere does it mention an air force. It does not say that Congress shall have power to create one, or that the President shall command any such force. Therefore, opponents of air force autonomy maintained, there is no constitutional sanction for an independent air service.

Advocates of air force independence had to admit that the Constitution does not expressly provide for an air force. But they insisted that Congress has authority to create one and make it a separate branch of the military establishment. The power is there—not specifically stated but implied from various other powers.

The argument, then, was really over the way in which the Constitution is to be interpreted. Is it to be construed strictly or loosely? The question is as old as the Nation itself. From the very beginning the people of the United States have lined up on one side or the other, invoking the supreme law of the land to support or oppose policies and programs of the national Government. There has been no permanent alignment, however, for people have never hesitated to switch from one position to the other as issues have changed.[2]

In the matter of air force independence, Rear Admiral Ellis M. Zacharias, USN (Retired), was one of the persons who gave the Constitution a narrow interpretation. Reading the proposed National Security Act of 1947, he found "many sections . . . which violate the spirit and letter of the Constitution and make it inadvisable to pass this legislation." The Admiral told a committee of the House of Representatives that the necessity or desirability of establishing the United States Air Force was immaterial. The question, he said, was "whether or not there is any basis in law or any power of Congress to enact legislation creating a separate military department." Confessing a "limited knowledge of constitutional law," Zacharias asserted that the powers bestowed upon Congress by the Constitution are "precise and specific." He found "nothing in the Constitution . . . which will permit the creation of an entirely new military establishment outside the present constitutionally authorized Army and Navy." Nor could he find any "provision for a commander-in-chief of an air force as there is specifically provided for the Army and Navy." This did not mean that air power could not be used, but to be constitutional, the Admiral maintained, the air forces of the Nation must be "integral parts of the Army and Navy."[3]

When Representative W. Sterling Cole (R., N.Y.) testified before the committee, he took the same line and borrowed some of the Admiral's words. Advocating retention of the air force within the War Department, Cole said this was "the only method sanctioned by the Constitution." He pointed out, however, that the Constitution could be amended to provide for an independent air force and to make the President its commander in chief. Without such an amendment the bill before Congress was, in Cole's opinion, clearly unconstitutional.[4] Cole may have realized that he was fighting a lost battle. At any rate, when he took the floor of the House to express his "conviction that the creation of a separate department of air and a separate air force as a part of the Military Establishment is without authority under the Constitution," he did not attempt to present any argument in support of his views.[5]

Representative Melvin Price (D., Ill.) rejected Cole's narrow interpretation of the Constitution. The bill, Price said, "seeks to give us an Air Force worthy to employ the great air power that we have developed." He would not blame the framers of the Constitution "for lack of prophetic vision," but he felt that later generations should not be penalized because the Founding Fathers did not have enough foresight to make specific provision for an air force when they wrote the Constitution in 1787.[6]

Representative J. Edgar Chenoweth (R., Colo.), who wanted it known that he favored a powerful air force, was not sure that Congress was doing the right thing in setting up an independent air service. Without specific authorization by the Constitution, he said, appropriations for the United States Air Force might not be legal. When Carl Spaatz, Commanding General of the Army Air Forces, appeared before the House committee, Chenoweth asked him if his attorneys had looked into the constitutional question. The four-star General replied that in the opinion of his Judge Advocate the bill was constitutional and Congress could legally appropriate money for a separate air force.[7]

Spaatz's answer was based upon a lengthy memorandum prepared by Colonel Desmond O'Keefe, the Air Judge Advocate.[8] As might be expected, O'Keefe had no doubts about the significance of air power, which, he said, was "utilized by practically every country in the world as a most potent offensive and defensive weapon, as formidable in itself as any ground army." He was sure that the power to create an air force to employ this weapon must exist somewhere within the framework of government. It did not reside with the states because the Constitution says that without the consent of Congress no state may keep troops or warships in time of peace or engage in war unless the state has been invaded or is in imminent danger of being invaded.[9] O'Keefe concluded, therefore, that whatever authority may exist for the establishment of an air force must belong to the Federal Government. The logical place to seek such authority is, of course, in the so-called "war powers."

It was not necessary to discuss the extent of these powers in time of war because, the Air Judge Advocate said, "No one disputes that during an emergency they are practically unlimited."[10] But the question at hand concerned legislation in peacetime. The Colonel found that the power "to declare war presupposes the ability to wage it successfully, and as a consequence this requires the exercise by Congress of its war powers in time of peace to the extent that Congress deems it necessary to provide for . . . the common defense." To postpone preparations until after a declaration of war "would lead to most grave consequences." Therefore, O'Keefe maintained, the war power must be interpreted to cover whatever actions Congress may deem necessary in order for the Nation to be prepared.[11]

True, the Constitution does not state that Congress shall have authority to create an air force, but neither does it contain specific provisions for establishing a national bank or constructing Wilson Dam. Yet, as O'Keefe pointed out, these and many other actions not specifically provided for by the Constitution had been sustained by the Supreme Court through a broad interpretation of the Constitution.[12] Justice Joseph Story had explained that the Founding Fathers, being unable to anticipate all the exigencies of the future, had left the legislature free "to adopt its own means to effectuate legitimate objects and to mould and model the exercise of its power as its own wisdom and the public interest should require."[13] Urging a broad interpretation of the powers relating to the creation of military forces, the Air Judge Advocate quoted a memorable passage from Chief Justice John Marshall's decision in McCulloch *v.* Maryland: "Let the end be legitimate, let it be within the scope of the Constitution, and all means which are appropriate, which are plainly adapted to that end, which are not prohibited, but consist with the letter and spirit of the Constitution, are constitutional."[14]

One of the legitimate functions of the national Government is the common defense, as the Constitution says in its Preamble. O'Keefe noted, however, that congressional authority for the creation of an independent air force cannot be based on this common defense clause because, as the Supreme Court has held, the Preamble does not confer any power on any department of the Government. However, as Story said in commenting on the Preamble, "No one can doubt that this does not enlarge the powers of Congress to pass any measure which they deem useful for the common defense." Further, the Supreme Court has held that the Constitution is not to be interpreted in a manner that would defeat its avowed objectives.[15]

No specific grant of power is required to enable Congress to provide for the defense of the Nation because defense is an inherent responsibility of the government of a sovereign nation.[16] Instead Section 8 of Article I of the Constitution makes provisions for declaring war and for raising, maintaining, and governing the forces required for defense. The first clause of that section supplies the financial means for defense by authorizing Congress to lay and collect taxes for that purpose.

Clause 1 of Section 8 is often misread by skipping over the words about taxes, thus converting the clause into a specific authorization for Congress to provide for the common defense.[17] Admiral Zacharias evidently realized that, misconstrued in this way and coupled with the later clause authorizing Congress to make all laws necessary and proper for carrying out the other powers, Clause 1 of Section 8 could be used to support the legality of the National Security Act of 1947. Giving Clause 1 its generally accepted interpretation, the Admiral explained that this "related to the raising and expenditures of money" for defense. But he went on to assert that this clause does not give Congress power "to provide physically for the elements having the duty of defense of the United States."[18] Colonel O'Keefe read Clause 1 in the same way as the Admiral but arrived at a different conclusion, thereby supplying an answer to Representative Chenoweth's question concerning the legality of appropriations for the United States Air Force: "As a necessary attribute to the present day common defense of this nation Congress, both in peace and war, has the undoubted power to authorize the expenditure of money for the means of carrying on aerial warfare and may create whatever 'agency' or 'instrumentality' it deems best suited and expedient to perform this function."

If the Founding Fathers had spoken in terms of "armed forces," the question concerning the constitutionality of the National Security Act of 1947 might not have been raised because "armed forces" could easily be interpreted to include an air force. Instead they mentioned an army and a navy as the only instruments they knew in an age when wars were fought on land and sea.[19] As O'Keefe pointed out, "at the time of the adoption of the Constitution, an 'air force' was unknown, and, therefore, could not have been expressly included as such." He was sure, however, that the "clear intent and purpose" of the Founding Fathers "was to vest complete power in Congress over the national armed forces," and that the names applied to these forces are of no significance. In the Constitution the Air Judge Advocate found "equally as much authority for an *Air Force* as . . . for an *air component of the land forces*."

Thus the Air Judge Advocate defended the National Security Act of 1947 against the attack that had been launched by opponents of an autonomous air force. The House did not rally to Cole's cry of "unconstitutional"; the Senate considered it unnecessary to argue the constitutional question. Having cleared Congress, the act was signed by President Harry S Truman on 26 July 1947. That same day the President prescribed the functions of the three services in an executive order which contained an interesting reflection of the Constitution's silence on the subject of an air force. In state papers of this kind the President had traditionally been styled "Commander in Chief of the Army and Navy." Now he became "Commander in Chief of the Armed Forces."[20]

About six months later, on 19 January 1948, Representative Claude I. Bakewell (R., Mo.) introduced a joint resolution to amend the Constitution to give Congress specific power to create and maintain an air force and make rules for its government, and to designate the President its commander in chief.[21] Bakewell's objective was to remove any doubt that might exist concerning the constitutionality of the new United States Air Force. W. Stuart Symington, who had become the first Secretary of the Air Force, thought that Bakewell's proposal might have the opposite effect, that it might jeopardize procurement of materiel by raising a question as to the legality of ppropriations for Air Force operations. After ymington made known his concern, Bakewell id not press for action. The resolution was ever reported out of the Committee on the idiciary, and consequently Congress never oted on it.[22]

The question of the constitutionality of ne Air Force came up again in 1950 during ne trial of an Air Force private by the name f Ingle, who was accused of being absent ithout leave and of escaping from the guard-ouse. When the court-martial was convened : MacDill Air Force Base, defense entered a otion for dismissal on the ground that the ourt lacked jurisdiction. Contending that ongress has power to make rules and regu-tions for the government of only land and aval forces, defense argued that to try this ase in a court appointed by an Air Force com-ander would violate that part of the Fifth mendment which says that "No person shall . . be deprived of life, liberty, or property, ithout due process of law." The motion hav-g been denied, the private was tried, found uilty, and sentenced. The record eventually ent to the Air Force Board of Review, which refully considered the motion that had chal-nged the jurisdiction of the court-martial.[23]

Noting the Supreme Court's decision that nilitary law is due process" so far as persons n the military or naval service" are con-rned,[24] the board reasoned that if Congress s power to create the Air Force it must also ve power to bring Air Force personnel under ilitary law in order to maintain order and scipline in the service.[25] Consequently the ajor issue, the board believed, was "whether e Congress had authority to create the Air rce within the military in the first place." lying heavily on Colonel O'Keefe's memo-ndum of 1947, the board held that the nited States Air Force is the legitimate sister the Army and Navy.

Later the same year the board received a se in which the constitutionality of the Air rce had been challenged directly. In this stance a private named Bainbridge had been arged with desertion and had been convicted a court-martial at Lackland Air Force Base. the outset of the trial, counsel for the defense had moved for dismissal because of lack of jurisdiction. The court could not agree with counsel's contention that, "since the Air Force is not an Army, is not a land or naval force, therefore there is no provision in the United States Constitution for the Air Force." After the motion had been overruled, the prosecu-tion offered in evidence a paper authenticated by the seal of the Department of the Air Force. Defense counsel objected: "It purports to be an official document of an unconstitutional agency." The objection was overruled. Other papers bearing the seal were presented. Each time defense objected and each time he was overruled. The Board of Review quickly dis-posed of the motion and the objections by cit-ing its finding in the Ingle case.[26]

The following year a lieutenant, Naar, asked the District Court for the District of Columbia to prohibit the Air Force from bringing him to trial at Bolling Air Force Base.[27] The lieutenant's attorney maintained that trial by court-martial for larceny would be a violation of the Fifth Amendment, which states: "No person shall be held to answer for a capital or other infamous crime unless on a presentment or indictment of a grand jury, ex-cept in cases arising in the land or naval forces . . ." Counsel for the accused argued that, since the United States Air Force is neither a land nor a naval force, the exception to the Fifth Amendment does not apply to members of the Air Force. By using the approach taken by the Board of Review in *Ingle*, the District Court could have considered the broader question of the constitutionality of the Air Force. With ap-peals, the question might eventually have been answered by the Supreme Court. The District Court, however, found that the lieutenant had failed to "state a cause of action upon which relief may be granted." The judge therefore denied the application for a restraining order and dismissed the complaint. No appeal of this decision was taken.[28]

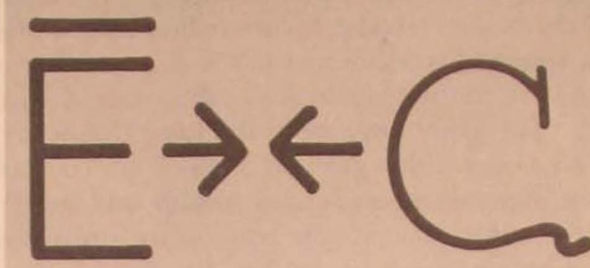
The District Court had, in effect, upheld the constitutionality of the United States Air Force. The arguments that had been advanced in 1947 by opponents of a separate air force, and later by military personnel seeking a way to avoid punishment for offenses with which they had been charged, had been countered so effectively and decisively that since 1951 the question of the legality of the United States Air Force has not reappeared in Congress or before any court, civil or military.[29]

Aerospace Studies Institute

Notes

1. National Security Act of 1947, 61 Stat. 495.
2. If an example is required, one might mention Thomas Jefferson, who was a strict constructionist when he was opposing Hamilton's plan for a national bank in 1791 but who shifted to a broader interpretation when he was trying to justify his own action in purchasing Louisiana in 1803.
3. House of Representatives, Committee on Expenditures in the Executive Departments, *Hearings . . . on H.R. 2319*, 80th Cong., 1st Sess. (Washington: USGPO, 1947), 491-92, hereafter cited as *Hearings*. At Headquarters Army Air Forces, the Office of Legislative Services dismissed Zacharias' testimony with the following comment: "As to the lack of constitutional authority for an independent Air Force, an examination of the enumerated powers of Congress will indicate that such power exists in the Congress to establish and provide for the armed forces and separation of Air and Ground is merely a compartmentization."
4. *Hearings*, 672-73.
5. 93 *Cong. Rec.*, 9420 (1947).
6. *Ibid.*, 9422.
7. *Hearings*, 340-41.
8. Memorandum for Director, Plans and Operations Division, War Department General Staff, by Col. Desmond O'Keefe, The Air Judge Advocate, 10 April 1947. All subsequent O'Keefe quotations and references are from the Memorandum.
9. Art. I, Sec. 10, Cl. 3.
10. O'Keefe quoted United States v. Stephens, 245 Fed. 956, 960 (1917), affirmed in 247 U.S. 504 (1918), and United States v. Tarble, 13 Wall. 297, 408 (1872).
11. O'Keefe quoted Ashwander v. Tennessee Valley Authority, 297 U.S. 288, 326, 327 (1936).
12. O'Keefe quoted or cited a number of cases, including the following: Legal Tender Cases, 12 Wall. 457 (1871), McCulloch v. Maryland, 4 Wheat. 316 (1819); Ashwander v. Tennessee Valley Authority, *supra*.
13. Martin v. Hunter's Lessee, 1 Wheat. 304, 326 (1816).
14. 4 Wheat. 316, 421 (1819). The word "consist" appears in the original report; in O'Keefe's Memorandum, as in numerous secondary sources, this is changed to "consistent."
15. United States v. Boyer, 85 Fed. 425, 430 (1898), quoting Story, *Commentaries on the Constitution of the United States* (1833), Sec. 462.
16. Penhallow v. Doane, 3 Dall. 54 (1795); United States v. Curtiss-Wright Export Corp., 299 U.S. 304, 315 (1936); cf., Alexander Hamilton in *The Federalist*, No. 23 (1787). O'Keefe, however, did not consider the origins of the war power.
17. See, for example, Cole's testimony in *Hearings*, 672. For interpretation of this clause, see Edward S. Corwin (ed.), *The Constitution of the United States of America, Analysis and Interpretation*, Sen. Doc. 170, 83d Cong., 2d Sess. (Washington: USGPO, 1953), 112-13.
18. *Hearings*, 491-92.
19. It may be noted, however, that Benjamin Franklin, who was a member of the Constitutional Convention, had witnessed the balloon experiments that J.A.C. Charles and Joseph Montgolfier had conducted in France in 1783 and had immediately seen the possibility of using such instruments in warfare. (Franklin to Ingenhousz, 16 Jan. 1784, in John Bigelow [ed.], *The Works of Benjamin Franklin* [New York: Federal Edition, 1904], X, 266-69.) Before the Convention met in 1787, other Americans, including Washington, Jefferson, and Francis Hopkinson, had shown an interest in balloons. (Jeremiah Milbank, Jr., *The First Century of Flight in America* [Princeton: Princeton University Press, 1943], 4-23.) The fact remains, however, that many years were to elapse before air power would acquire any great significance in warfare.
20. Executive Order 9877, 26 July 1947.
21. H. J. Res. 298, 80th Cong., 2d Sess. (1948); 94 *Cong. Rec.*, 322; cf. Edward S. Corwin, *The Constitution and What It Means Today* (Princeton: Princeton University Press, 1958), 71.
22. Bakewell to Maurer, 19 Oct. 1959. As Professor Corwin has suggested, Congress evidently believed that the Constitution already provided sufficient authority for the creation of the Air Force and that consequently no amendment was required. (Corwin, *The Constitution and What It Means Today*, 71; Corwin, *The Constitution . . . Analysis and Interpretation*, 284.)
23. ACM 2631, Ingle, 3 CMR (AF) 353 (1950).
24. Reaves v. Ainsworth, 219 U.S. 296, 304 (1911).
25. The Board quoted John Paul Jones O'Brien, *A Treatise on American Military Law* (1846), 25, and cited Kahn v. Anderson, 255 U.S. 1 (1921).
26. ACM 3191, Bainbridge, 4 CMR (AF) 102 (1950); also see ACM 2771, Austin, 4 CMR (AF) 978 (1950).
27. The question whether military courts are acting within their special and limited jurisdiction may be inquired into by Federal courts.
28. Naar v. Lee, Civil Action No. 2061-51 (D.D.C., 1951). When the lieutenant was brought to trial at Bolling Air Force Base, his attorney asked for dismissal on essentially the same grounds that the case had been taken to the District Court. The motion was rejected and became a matter for consideration by the Board of Review, which found that the principles of construction set forth in *Ingle* were also applicable in this case. (ACM 4215, Naar, 2 CMR 739 [1951].)
29. The writer has been unable to find any reference to this subject in published congressional documents or any case mentioned in any of the court reports. This does not necessarily mean, of course, that the question is dead and will never be revived. In fact, the first draft of this article was written in 1959 as the result of a query from an Air University student who had some doubts about the legality of the President's serving as commander in chief of the Air Force.

In My Opinion



FLEXIBLE RESPONSE vs. DETERMINED RETALIATION

MAJOR GENERAL DALE O. SMITH, USAF, Ret.

IT MAY SEEM that I am beating a dead horse by even mentioning the term "massive retalia-ion." It has been discredited, butchered, and uried by its detractors, and the seemingly more easonable new terms "graduated deterrence" and flexible response" have been substituted in its lace. But if one tries to avoid the bias and emo-ion associated with "massive retaliation," it might ust possibly represent a philosophy of persuasion which is the direct opposite from that of the "flexi-le response." To purge ourselves of the bias ound in a discredited term, let us talk instead of determined retaliation."

Next, let us begin with a homely example in rder to examine and compare these two philoso-hies of persuasion free from the emotion which ight be generated by relating them to war and nuclear weapons. Let us consider a Western nge conflict common to the last century and to odern fiction.

Determined retaliation means simply to make counter moves with superior force at places of our own selection. Now suppose our ranch, the Bar E, has a serious grievance against a neighboring spread, the Lazy C. The Lazy C has been using some of our pastureland and polluting our water supply. We have tried negotiations and threats, but to no avail. It is time for us to act.

In following a "determined retaliation" policy, we move in and take over the Lazy C reservoir and divert it to our own use, making it clear that we will remain there in force until the Lazy C gets off our pastureland.

It happened that the Lazy C reservoir was unprotected and it was easy to take. Once there we found ourselves in a strong defensive position; it would be hard to dislodge us by force. Besides, we have moved in several full-time guards. Now we can sit tight. No one has been killed, our action was swift, determined, and decisive. The next move is up to the Lazy C.

Suppose, however, we followed the other

policy of "flexible response." The philosophy behind this style of persuasion is that when the time comes to act we act very cautiously at the point of contact and that we gradually increase our pressure until the other side gives in. In this way it is hoped we shall never use more force than is necessary to achieve our ends, while the chances of the Lazy C overreacting and increasing the intensity of the conflict (escalating) are reduced. So we send an unarmed cowhand out to the disputed pastureland and instruct him to drive off the Lazy C cattle.

The likely response of the Lazy C ranch is to send a man with a gun and drive off our cowhand. Our superior strength and wealth will avail us little in this event simply because we attempted a half-hearted measure. In fact, the Lazy C people will no doubt figure we're scared to take adequate action. Similarly, we ourselves lose some self-confidence by this rebuff.

So next time we, too, send a man with a gun. The Lazy C people respond with two men with two guns. Stepping up our response in a graduated manner, we retaliate with three men and order them this time to shoot. The Lazy C men fire back with four guns. We have encouraged escalation to limited war.

Still our superior strength has not helped us resolve the conflict. We are playing the game by the rules established by the Lazy C, and in permitting them the initiative, we are letting them raise our ante on each exchange.

Eventually, of course, the flexible response tactics could give us victory, but in the meantime there will have been a long-drawn-out small war with a rising tide of hate on each side. Many people on both sides will have been killed. We might even settle for a truce, considering the expense involved in this graduated range war. In which case the weaker ranch would win the contest.

Now the question is, which kind of strategy will better persuade the Lazy C to pull back from our pastureland? It can be assumed that either strategy will work if pursued to its ultimate end simply because we have the greater strength and wealth. But there are other considerations.

First, we do not want this minor altercation to escalate into a feud which would cause all Bar E and all Lazy C folk to be at each other's throats incessantly. Ranching would take second place to the feud, and we would probably fail economically, regardless of our superior strength. Our aim should be to persuade the Lazy C owners as *soon* as possible with as *little conflict* as possible. Which strategy would most likely do this?

The first situation of "determined retaliation" puts us in a favorable tactical position at the Lazy C reservoir and takes advantage of our superior strength. If the Lazy C accepts the challenge we present, the range will burst into a rather large-scale war (not necessarily nuclear), which we wish to avoid. However, if the Lazy C people are *well aware* of our superior strength and wealth, and if our demands do not threaten their *existence* or *prestige*, then only madness would lead the Lazy C to pursue the fight.

Three conditions can be met by following a policy of "determined retaliation." First, our move must be in force—nothing half-hearted—which demonstrates our superior strength and our confidence in that superiority. Second, we must not threaten the existence of our enemy, for then he will fight to the end. Instead we must make it abundantly clear that we wish him simply to get off our land. Third, we must not threaten his prestige. In fact, by moving back from the Lazy C reservoir, in exchange for his getting off our pastureland, we have allowed him to save face.

How are these three criteria for effective persuasion met for the other situation in which we employed a "flexible response"? First, our true strength was not demonstrated. If the Lazy C had been aware of our superiority, our graduated actions would have led them to believe that we didn't have the will to use our strength. Second, we did not threaten their existence so this criterion was adequately met. But third, we did, by prolonging the conflict, threaten their prestige. The longer the shooting goes on, the greater the emotional commitment. Prestige becomes a vital issue and there is no obvious *quid pro quo* to pave the way for an honorable retreat.

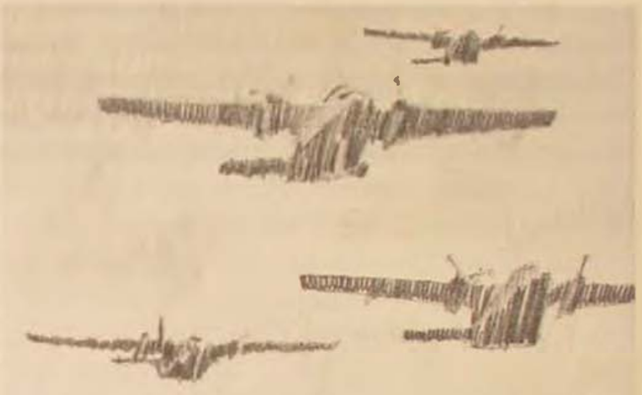
From this analysis it would appear that two of the criteria for successful persuasion, those of awareness of superior strength and preservation of the opponent's prestige (the "golden bridge for retreat" suggested by the ancient Romans), are not served as well by the "flexible response" strategy as by the "determined retaliation" strategy.

In the beginnings of World War II and Korea there was often voiced a self-condemnation: "too little and too late." The "flexible response" strategy inevitably results in using "too little too late." This is a strategy that has been fashioned not for the purpose of persuasion but for the purpose of confining war to conventional (nonnuclear) weapons and to the earth's surface. The major reasons behind this are three: (1) general fear of nuclear war, (2) Communist measures to reduce our superior nuclear strength, and (3) the desire to perpetuate traditional surface strategies.

It is suggested that our national strategy be re-examined on the basis of the three criteria cited. Which strategy gives us the best chance of *persuading* our opponent to do our bidding? And which strategy leaves us in the most favorable military disposition should our effort at persuasion fail?

Arlington, Virginia

Air Operations in Viet Nam



AIRLIFT IN SOUTHEAST ASIA

Colonel Thomas B. Kennedy

IN THESE days of highly sophisticated modern weapon systems operating in supersonic environment, computerized control of personnel and equipment, and an expanding aerospace effort directed toward the use of the most complicated systems yet known to military man, there is a contradiction that exists in terms of the places where the U.S. Air Force today is actually engaged in or supporting combat operations.

In Southeast Asia, particularly Viet Nam, the environment, the operating conditions, the nature of the conflict itself, the terrain, the weather, the facilities—all dictate that the historical knowledge of operations in less complicated environment be brought to bear to cope with the situation.

Today man is talking in terms of mach 3 for transport aircraft of the future, and our forces are geared to aircraft such as the C-135, C-141 (soon to be operational), and the C-130 as the primary airlift element of U.S. Air Force commands throughout the world. Modern terminals are being built with mechanized cargo-handling systems geared to data punch control of the flow of cargo and personnel. In Viet Nam, however, the airlift job rests on the strong wings and landing gear of the somewhat ancient C-123, with backup support from the appropriately manned CV-2A Caribou of the U.S. Army. The airlift mission also depends on the willing, dedicated people using imagination, initiative, and physical effort to accomplish tasks that are vital to the conduct of all military operations in Viet Nam.

Much has been written and said about the environment of Viet Nam, its effect on military operations and hence on the requirements for particular types of equipment to solve problems peculiar to this environment. Environment here is usually spoken of in terms of jungle canopy 200 to 300 feet high, the marshy delta lands covered by rain during much of the year, the plateau area of central Viet Nam with its highlands, and the rugged mountains in the northern part of Viet Nam. All these make up the geographical environment.

However, the environment that makes airlift so vital to the conduct of operations is the underdeveloped state of transportation in this area. With the very limited road and railroad network that exists in this part of the world, any significant movement of equipment and supplies is basically a job for the airplane. The French had long recognized this, and over the years they built numerous small airstrips throughout Viet Nam to support their plantation type of economy. These airstrips, designed for light aircraft to move small cargo loads and small groups of people basic to a plantation economy, are serving a vital purpose today and form the basis of the network of airports used in moving equipment and troops throughout Viet Nam.

It was recognition of the necessity for logistics and tactical airlift support that established the Air Force approach to building an airlift capability in Southeast Asia. This capability had to be responsive to and appropriate for the environment that exists. As the U.S. national policy evolved, which indicated an obvious buildup in U.S. support to the government of the Republic of Viet Nam, one of the first things that military planners recognized as a requirement was the need for improving both the capacity and the quality of airlift support for Southeast Asia. This led to the early introduction, in January of 1962, of the first squadron of C-123's designated as "Mule Train." This squadron, deployed on TDY from Pope AFB, North Carolina, formed the nucleus of the buildup that was to follow.

The unit was injected into a truly rustic situation. Parking and maintenance facilities did not exist. No control organization for either the shipper or the operator was available, little or no communications were functioning, and airfield information was at a premium. Aircraft and other parts were limited in numbers. Equipment, facilities, and overall vehicle transportation were unbelievably critical.

Here, perhaps, a little ought to be said about the C-123 and its capabilities to perform the kinds of missions that need to be performed in Viet Nam. While old and relatively obsolete in terms of modern aircraft, it was designed specifically for assault airlift. Operating in an environment where many of the airports are unimproved dirt strips 2000 feet or less in length, the C-123 for the first time really came into its own and did the job for which it was designed. Capable of operating into 1500-foot unimproved strips at gross weights of approximately 54,000 pounds and hauling up to 12,000 pounds, depending upon fuel requirements, it became the backbone of all future airlift operations in Southeast Asia. Rugged, relatively easy to maintain, and possessing a high degree of reliability, it proved itself capable of living up to its name, "The Provider."

But airlift is more than just aircraft and crews. Airlift is a system. It consists of the trained aircrew, an appropriate aircraft, the people who maintain that aircraft, the organization that controls loading and unloading of aircraft throughout the system, and a control mechanism that ties all these elements together and makes the system responsive to the requirement of the user.

As it became evident that this airlift effort would increase, the resources available to the air force component commander were increased. An aerial port function was established. A centralized control system, including the necessary communications, was devised. This control system was linked as an inherent part of the Air Operations Center (AOC) to the rest of the tactical air operations being conducted in Viet Nam, to provide an integrated air effort under the control of the air force component commander. As time progressed it became evident that this was a long-haul job. The war would not be won in a relatively short period of time, so units that had been put in Southeast Asia to perform these airlift functions on a TDY basis were gradually phased into a PCS-type unit. By July 1963 the prime Air Force airlift element was put on a firm footing which permitted orderly inputs of trained personnel on a PCS basis and the establishment of necessary support channels for logistics basic to any sustained operation.

The evolution of this unit followed classic pattern: CINCPACAF has assigned to him the 315th Air Division with headquarters at Tachikawa, Japan. This unit is responsible for providing intratheater airlift to the theater commander. CINCPAC, charged with operations throughout all of the Far East, has available to him through the air force component commander this centralized-control airlift system.

This pattern was followed in setting up the airlift system in Southeast Asia. Here the elements were assigned to the 315th Air Division but were assigned under the operational control of the air force component commander in Viet Nam. This component commander is responsible for providing to the Commander, U.S. Military Assistance Command, Vietnam (COMUSMACV) airlift responsive to the needs of the users in Viet Nam. The U,S. Air Force airlift organization in Viet Nam is the 315th Troop Carrier Group comprised of three squadrons of C-123's and the 8th Aerial Port Squadron. These elements are tied together through the communications system basic to an air operations center and a tactical air control system. The airlift control element known as Transport Movement Control (TMC) is located in the Air Operations Center and uses the communications of the Tactical Air Control System (TACS) to perform its central control function.

As in any joint operation, the air force alone, of course, does not make the determination as to what or who moves on its aircraft. Instead it is necessary to control the use of airlift through some central board or mechanism which determines relative priority of the requirements for airlift to prevent its abuse and to ensure that the airlift effort is applied to the highest relative priority, depending upon the tactical situation. In South Viet Nam this priority control function is monitored by COMUSMACV and is exercised on a combined basis with the Vietnamese forces through a Combined Movement Allocations Board (CMAB). The CMAB is responsible for determining allocations of airlift on a bulk basis to the various users based on the capability of the airlift system and the relative urgency of each user's requirements.

In general, the airlift system must be responsible for satisfying requirements in four main categories and in four relative priorities. The first category, of course, is emergency tactical airlift. The second category is preplanned tactical airlift. The third is on-call or emergency logistics airlift, and the fourth is routine logistics. The categories and priorities are easily understood, but the relative amount of effort devoted to these categories is unusual when compared to classic airlift operations in the past. During Korea, for example, the number of tactical airlift operations conducted was relatively small as compared to the total airlift effort, the bulk of the Korean airlift being logistical in nature. In Viet Nam, by contrast, as high as 30 per cent of the airlift sorties flown in any month are considered tactical, and because of the fluid nature of the conflict in Viet Nam almost all sorties are exposed to potential enemy fire whether they be of a logistics, training, or tactical nature.

The operational environment in which the airlift elements function is probably the reason for describing airlift activity in Viet Nam as different from any previous airlift operations which U.S. forces have conducted. In Viet Nam today there are approximately 176 airfields, fewer than 15 of which have control tower facilities. The rest are, in essence, uncontrolled airfields where the final determination as to wind direction and velocity and the condition and security of the runway must be made by the aircrew, by correlating the best intelligence information that can be provided and actual visual observations over the airfield. In addition to the airfields that must be serviced, there are numerous drop zones where outlying elements are resupplied by air. But numbers alone do not describe the whole story. It is the nature and condition in which these airfields exist and in which these drop zones are found that make the airlift task difficult. Many of the runways are less than 2000 feet long, and only a very few have hard surface. They are located in jungle terrain, in mountains, and in the flat delta country where approaches from any direction expose the aircraft to a sustained period of vulnerability to ground fire.

The pace of the operation also is unusual and has a definite bearing on the functioning of the system. On an average day approximately 100 airlift sorties of various kinds are flown. Around 10,000 tons of cargo and personnel are airlifted every month. The 8th Aerial Port Squadron, handling not only the in-country terminal function but also the intertheater terminal function, processes and handles some 13,000 tons of cargo and people per month. These terminal functions are not performed under conditions which equate to terminals at Travis or McGuire or any modern Air Force installation. They are performed from hangars or open storage on difficult surfaces, including pierced steel planking (PSP), dirt, laterite, and in a few cases hard surface. This all compounds the problem of expeditious loading and safety in loading.

Historically also in large-scale operations, various types of transport aircraft have been used to perform specialized functions. Here in Viet Nam the C-123 is called upon to perform all these functions and several others that have not been performed by transport aircraft in the past. In addition to providing normal logistic support throughout the country on a routine basis, the airlift system is responsible for providing in-country medical air evacuation, airdrop resupply to Special Forces elements throughout the country, and airdrop of troops. Many of these missions take on hazardous aspects and require the highest degree of professional pilot skills to counter the hazards not only from enemy ground fire but also from the terrain and weather or a combination of all three.

As the unit evolved from TDY status of highly trained troop-carrier assault-oriented aircrews to PCS units, it was obviously necessary to train crews that had not previously been trained in troop-carrier operations to perform the missions required in Southeast Asia. The crews selected to perform the operation on a PCS basis came from all walks of life—Strategic Air Command B-47 and B-52 crews, Air Defense Command C-121 crews, Air Training Command T-29 crews, and Military Air Transport Service C-124, C-133, and C-135 crews. Crews were trained at Pope AFB and sent to Viet Nam with a sound background in the aircraft but relatively little actual experience in the type of operations basic to the environment. Consequently, it was necessary to establish extensive time-phased orientation and training programs to build the experience level of the aircrews in the environment in which they were flying. The crews responded remarkably, and rapidly assumed the highest degree of professional ability, individual resourcefulness, and a dedication to getting the job done that was basic to the successful accomplishment of the mission.

In the aerial port area also people were taken from all walks of life because the Air Force did not have a base of resources large enough to pro-

Tan Son Nhut Air Base near Saigon, Viet Nam, has progressed since its tent days of 1962.

A C-123 is loaded by forklift under truck lights at Eighth Aerial Port Squadron, Tan Son Nhut AB, to permit take-off at first light.

vide a rotation of highly qualified and skilled people in this particular job skill. Supply personnel were given the job of becoming experts in the air freight business in a relatively short period of time. Here, again, by comprehensive training programs it was possible, because of the ability and dedication of the individuals, to form a highly professional organization with a remarkable *esprit de corps* and a degree of imagination and ingenuity unusual any place in the world. The locally developed traffic-handling systems are an outstanding tribute to American "can do" spirit. For example, by use of simple skate-type rollers and homemade pallets, 78 aircraft landed, offloaded, and were airborne with an average touchdown-to-takeoff time of 11 minutes—on a dirt runway in mountainous terrain.

Perhaps a discussion of one day's operation, which may or may not be typical, would clearly illustrate the operation of the system and the various kinds of missions that might be flown on a given day.

First let us look at the overall posture of the forces on any given day. The hub of the activity is at Tan Son Nhut Air Base. Here two squadrons of C-123's are based. Another squadron is located at Da Nang. Elements of these squadrons are deployed to Nha Trang in support of Special Forces and to Bangkok, Thailand, for the intra-Thailand airlift mission in support of the U.S. forces deployed in that part of Southeast Asia. Aerial ports are operating in Can Tho, Vung Tau, Tan Son Nhut, Bien Hoa, Nha Trang, Qui Nhon, Pleiku, and

ARVN troops unload bags of rice from a C-123 at Cam-Duc for resupply of a strategic hamlet.

At the jungle airstrip of Aloui, Vietnamese troops prepare to unload pierced steel planking.

Da Nang in Viet Nam and at Bangkok. Each morning at 1030 there is a meeting of the Transport Movement Control, Maintenance, and Aerial Port personnel to determine the next day's activities. The maintenance status is weighed against the operational commitments and workload, the terminal backlog is measured, special airlift requests are evaluated, and of course any tactical operations are considered in the planning session. At this time agreement is reached on the number of airplanes that will be furnished and the various categories or priorities of airlift in response to the requirements. Flight orders are then published, fighter escort and rendezvous are called for, and helicopter support for any operations that may require air rescue coverage is arranged for with the Vietnamese Air Force. As the day progresses and changes to requirements are received, based upon priority of effort, the morning's planning session is the basis for decisions made as to commitment of forces for the next day's operation.

Since most operations are conducted during daylight hours because of the environment, takeoff times and routings of aircraft are established so that they can depart and return to their home station during daylight hours or at least leave the last remote air base toward home station prior to darkness.

These departures and arrivals have to be integrated with weather, the ability of airfields to absorb a particular flow of aircraft, and the timing of other tactical air operations that affect the availability of escort fighters. Terminal cargo loads are preplanned, and loading starts at midnight. Aircrews arrive from 0430 on, depending upon their planned departure time. They are briefed on the weather and the intelligence situation, draw weapons, and flight-plan their mission for the day.

Logistics flights take off early in the morning from Tan Son Nhut and Da Nang for the day's delivery of rations and munitions. At Nha Trang, Special Forces personnel have loaded the airdrop resupplies for Special Forces units in the mountainous and jungle terrain. These supplies consist of ammunition, rations, barbed wire, and in general all kinds of essentials that make living in the jungle possible. These aircraft normally fly two sorties a day, turning around as soon as the first sortie is completed to deliver another load at a different drop zone. Here again these missions are escorted by fighter aircraft, and fighter rendezvous point must be established. After picking up its fighter escort, the C-123 flies to the target area and clearly identifies the drop zone by smoke signals from the Special Forces on the ground before beginning the airdrop. Multiple passes at the drop zones are made necessary by the size of the drop zones, the kinds of loads, and the volume limits on delivery capability of the C-123.

The drop zones, frequently located in mountainous terrain and sometimes almost like a box canyon, require that the pilot do a little of the old-fashioned seat-of-the-pants type of flying. In some extreme cases, the pilot has approximately three seconds to start his turn after delivering a load before he finds himself boxed into a position from which he would not be able to maneuver himself. After completing his series of airdrops, he returns to his home station, gets reloaded, and perhaps for his afternoon mission delivers a load of Special Forces supplies, airlanding them on a remote jungle strip.

Many of these strips have to be seen to be believed—1500 to 2000 feet in length, in mountainous terrain surrounded by jungle with trees as high as 200 feet. These dirt and laterite strips tax a pilot's ability and the performance limitations of the aircraft to an unusual degree.

Back at Tan Son Nhut an emergency requirement has come in to deliver ammunition to troops engaged in conflict down in the delta. Alert aircraft are maintained in constant readiness with crews to perform emergency missions. Whether it be the delivery of elements of the airborne brigade, referred to as the fire brigade, air evacuation, or the airdrop or airlanding of supplies, the alert aircraft are geared to be responsive to the wide variety of airlift tasks that can be imposed.

Meanwhile throughout all of Viet Nam other C-123's are being loaded and dispatched on the many preplanned and on-call missions that are basic to this continually changing situation. Throughout the day it is necessary to divert and reroute aircraft through the centrally controlled system to satisfy requirements that have generated since the previous morning's planning conference. This is done almost routinely by the controllers on duty in the transport movement control section.

If an aircraft breaks down anywhere in the system, maintenance teams must be dispatched,

An airstrip that formerly served an old French plantation near Minh Thang is surrounded by rubber trees 200 feet high. Only 35 feet of the width of the strip can bear the load.

On approach for landing at a remote airstrip, logistics plane has dropped a smoke bomb to indicate by color the type of load it carries and to help indicate wind direction.

Vietnamese paratroopers drop from C-123's into small clearing in Viet Cong-infested area.

perhaps to a remote area, to attempt to get the aircraft out before nightfall. Substitute aircraft must be provided to take care of mechanical difficulties so that the supplies and equipment can be delivered as planned. Delays in delivery not only affect the logistics posture of whatever unit is being supported but frequently involve such problems as securing an airfield for a specific period of time while the aircraft is on the ground. The ground forces must go out and secure the approaches and the perimeter of the airfield for a limited period, and should the logistics aircraft fail to arrive on time, this work would have been for nought.

Meanwhile the aerial ports are continuing to load and unload the in-country airlift elements and are also handling all the MATS and 315th Air Division aircraft performing intertheater airlift at bases such as Bien Hoa, Tan Son Nhut, Nha Trang, Da Nang, or Bangkok.

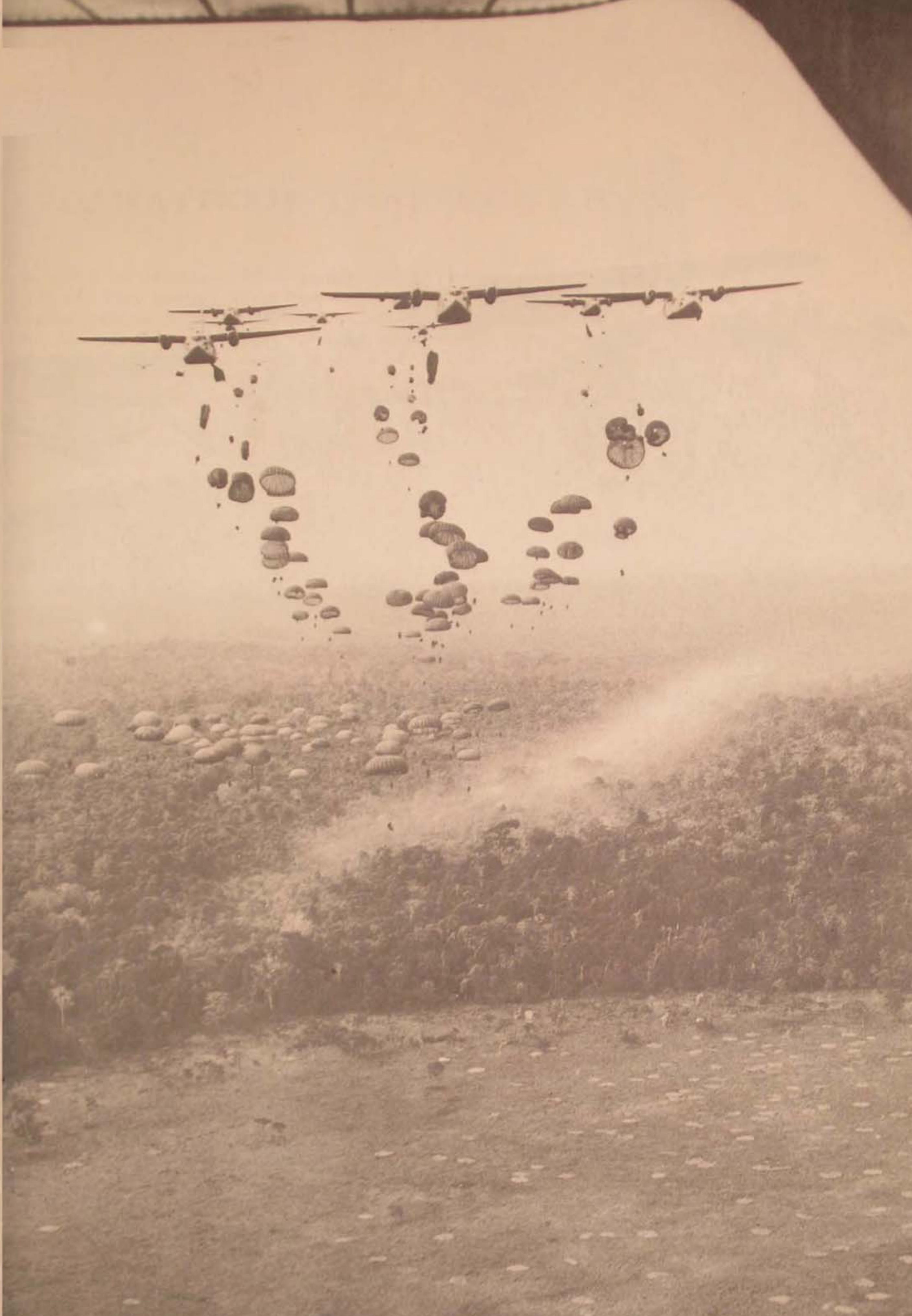
What I have just described may be considered a typical day. But besides all this, in the midst of one of these typical days it may be necessary to airdrop the selected battalion of an airborne brigade in support of an emergency tactical mission. Since this is the highest-priority mission to which the airlift force must respond, all resources are immediately applied to this type of activity. Aircraft are quickly recalled, and the alert aircraft standing by on the ground are immediately reconfigured for airdrop mission, as are the day's spare aircraft and those that are recalled to perform the mission.

These missions are run with very little opportunity for preplanning. Frequently the take-off time for such a formation mission is within two hours after first notification that the mission may occur. This leaves little time for briefing and the fine, detailed coordination normally expected of airborne operations.

It can be anticipated that each day will be different in terms of the kinds of missions that must be performed, the emergency requirements levied, the weather, and the mechanical problems faced. But it can be guaranteed that each day will be a rapidly phased, pressure-packed operation in which the ingenuity and the professionalism of the aircrews, the maintenance personnel, the aerial port operators, and the controllers will be brought to bear to solve the varying problems.

The key to effective airlift operations in this environment is responsiveness. And this responsiveness must be geared to whatever task and whatever geographical location is most critical. It can only be achieved by the centralized control resources and adequate communications systems and the dedication and professionalism of all the people involved. The constantly changing nature of the situation in

Language difficulties must be surmounted by the copilot of a C-123 who briefs passengers in Vietnamese before take-off for Cam-Duc from Bien Hoa AB.



Vietnamese Rangers and Army personnel waiting to board C-123 on dirt strip in Mekong Delta area for transfer to another camp site

Viet Nam requires that new techniques, improved methods, be continually introduced. There is no resting on our laurels. Although the laurels received have been well deserved in the past and will be in the future, they will come from the ability to adapt and respond to whatever variety of tasks can be imposed.

To illustrate this point: With the increasing tempo of activity, an Australian airlift unit has been integrated into the system and an additional C-123 squadron and Army Caribou company are being deployed to cope with the increasing requirements. But regardless of forces committed or the extent of the operation, it is axiomatic that airlift forces must operate in the framework of a system established—even if under the most difficult environment—to control the total effort constantly so as to apply it to priority tasks.

Hq Pacific Air Forces

PARATROOP TRAINING, ARVN

Every month the Republic of Viet Nam Army (ARVN) conducts the final practice drop of its airborne troop training. These troops are trained in the vicinity of Vung Tav, about 30 miles south of Saigon. The training division for the paratroopers is part of the 100th Airborne Division, ARVN. The drop zone is about 10 miles from Vung Tav. The troops are dropped fully combat loaded. When they hit the ground they are deployed into their field problem, which takes two weeks to complete. They are then redeployed to a different airborne division, and from there they go into combat. C-123's of the 315th Troop Carrier Group, 2d Air Division, Tan Son Nhut AB, furnish the airlift.

Three C-123's of the 315th Troop Carrier Group flying over the coastal city of Vung Tav, Republic of Viet Nam, en route to the Vung Tav drop area. Vung Tav is located on the South China Sea in the Mekong Delta area of Viet Nam.

Combat-loaded paratroopers in C-123

Approaching the Vung Tav drop zone. Vung Tav Bay, a part of the China Sea, is in the background behind delta marshland.

Ready for the jump

The C-123's unload over the delta area drop zone.

Postgraduate combat operational troops jump into Viet Cong-infested jungle clearing or over wide-open rice country of the Mekong Delta with its water-drenched paddies.

Air Force Review

GROUND ELECTRONICS ENGINEERING AND INSTALLATION

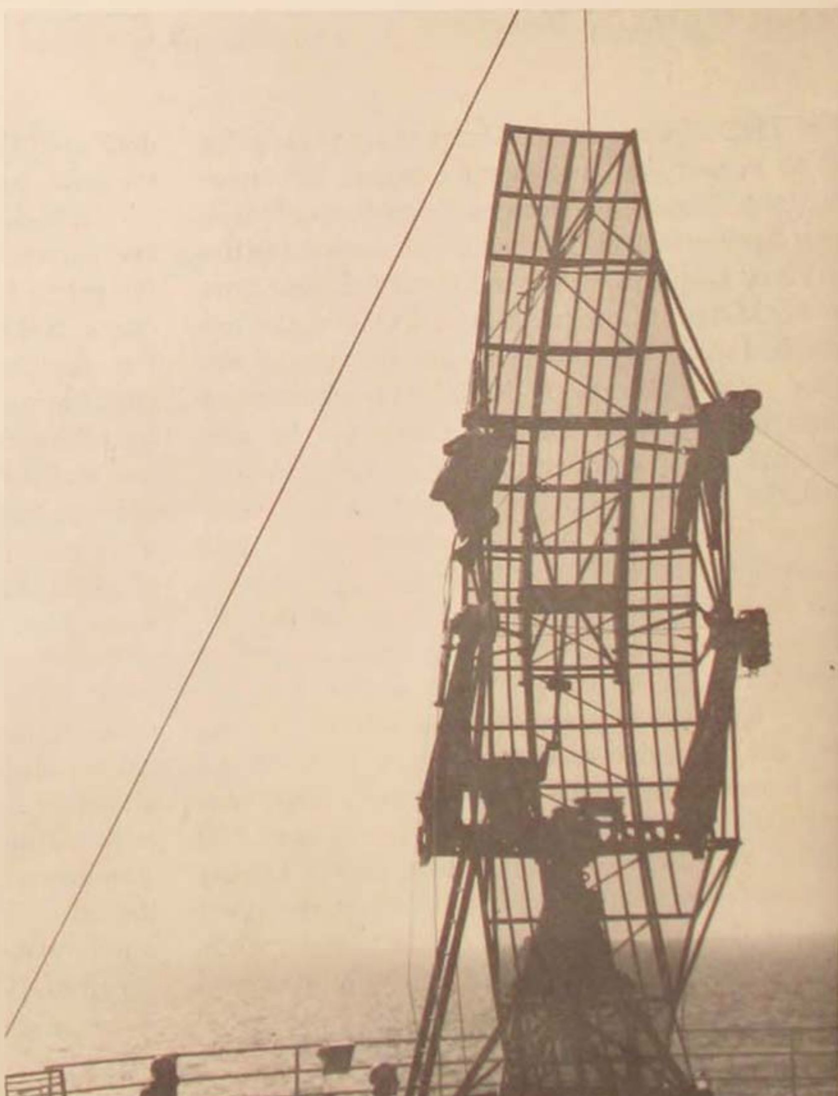
Colonel Charles U. Brombach

IN THE summer of 1958, almost six years prior to Project ICE (Increased Combat Effectiveness), the Ground Electronics Engineering-Installation Agency (GEEIA) was born and assigned to the Air Force Logistics Command (AFLC), at that time the Air Materiel Command (AMC). One of the criteria laid down by the Pentagon framers of the GEEIA constitution (AFR 20-17) was that GEEIA would be mission oriented. It would not be self-sufficient and thereby duplicate services already available. It would rely on support such as Civil Service processing, fiscal accounting, and data processing from the "host" of any base it occupied. This early frugal environment influenced the development of GEEIA into a "lean," fast-on-its-feet organization. For example, GEEIA has approximately 1300 vehicles—cable plows, ditchers, trucks—but not one sedan or station wagon. When GEEIA was founded there were approximately 5700 persons assigned. Its budget (P437 funds) was $50 million, and 2400 jobs were accomplished. During the next few years the personnel strength remained roughly the same, as did the allotted funds, while the number of job completions steadily increased until in 1963 it reached a dramatic 5800—still with the same basic resources as existed in 1959.

Although significant savings in men, money, and materiel have been realized, economy was not the prime factor behind the USAF decision to form GEEIA. Actually, top USAF officials were faced with the obvious need to "shore up" the installation-engineering of ground electronics. During the formative years of the new Air Force—late Forties and early Fifties—this work, which had formerly been accomplished by the Army Signal Corps, was delegated to many low-level activities in almost all of the major air commands. All in all, there were some 24 activities engaged in the business of engineering and installing ground electronics equipment. As a consequence there were technical and schedule incompatibilities and inefficient communications-electronics (C-E) facilities. Coordination channels were lengthy and cumbersome. It was only natural that each activity looked out for its own interests and attempted to "corner" the limited available resources—trained personnel and C-E equipment—without regard to the relative priorities involved. This competition for resources resulted, many times, in their being applied to low-priority use at the expense of high-priority needs in another command.

Probably the most severe effect was that by 1958, although we were in the jet age and fast approaching the space age, we could not provide, in a timely fashion, the modern C-E facilities needed for our global and fast-changing operations. Modern strategic bombing, nuclear weapon, and missile concepts dictated centralized decision-making and control of our dispersed forces. Strategic and tactical intelligence had to be communicated to command and control centers in Washington, Omaha, and Colorado Springs. Data were continuous and voluminous and had to be relayed quickly and accurately. After being analyzed, resultant decisions had to be transmitted, in some cases to individual bombers flying over the arctic or desert near the perimeter of the free world. Intelligence from the BMEWS and other Air Defense sensors was useless unless it could be flashed rearward for evaluation and decision-making. The resulting action commands again had to be sent instantaneously to combat elements. For, as General Power once said. in effect, "Without communications I don't command or control anything except my desk."

During the late Fifties the United States Air Force faced up to the difficulties it was encountering in its attempt to provide these critical communications-electronics facilities. It realized also the greatly expanding quantity and complexity of C-E requirements. It therefore decided it needed a worldwide organization that would be a repository of organic technical know-how and installation engineering capability. Thus GEEIA was born and, along with it, AFR 20-17, which delineates the mission and responsibilities of GEEIA. Simply stated, the mission is to "manage the implementa-



GEEIA personnel dismantle and remove Texas Tower radar equipment.

H-19 simplifies installation of tactical air navigation antenna.

tion of the USAF Ground Communications-Electronics Program as it pertains to engineering and installation." This one sentence involves so many things that it would be almost impossible to name an Air Force operation or activity with which GEEIA does not in some way become involved. Some of the major responsibilities of GEEIA are to

—develop and publish technical standards

—provide technical assistance to Air Force commands to develop C-E requirements and state these requirements in what are known as C-E Implementation Plans (CEIP's)

—engineer and install ground C-E facilities

—control and manage C-E materiel resources needed to accomplish installation of C-E facilities

—accomplish systems implementation testing, and test and acceptance of facilities and systems installed

—prepare base telephone development plans and keep them current

—train a reserve force of seventeen Air National Guard squadrons for use during national emergencies or wartime

—participate, as required, in the Military Assistance Program.

GEEIA does all these things with approximately 100 military and civilian personnel (including Mobile Depot Activity) deployed around the free world, responsive to all the needs of the United States Air Force. There are fourteen squadrons, five region headquarters, and a command headquarters located as shown on the accompanying chart from T. O. 31-1-8. Flexibility is a keynote of this organization, which routinely sends engineers and installation teams across region borders to meet the peak workloads of a Berlin crisis, an Alaskan earthquake, a Cuban "buildup," a Guam typhoon, or a Viet Nam operation.

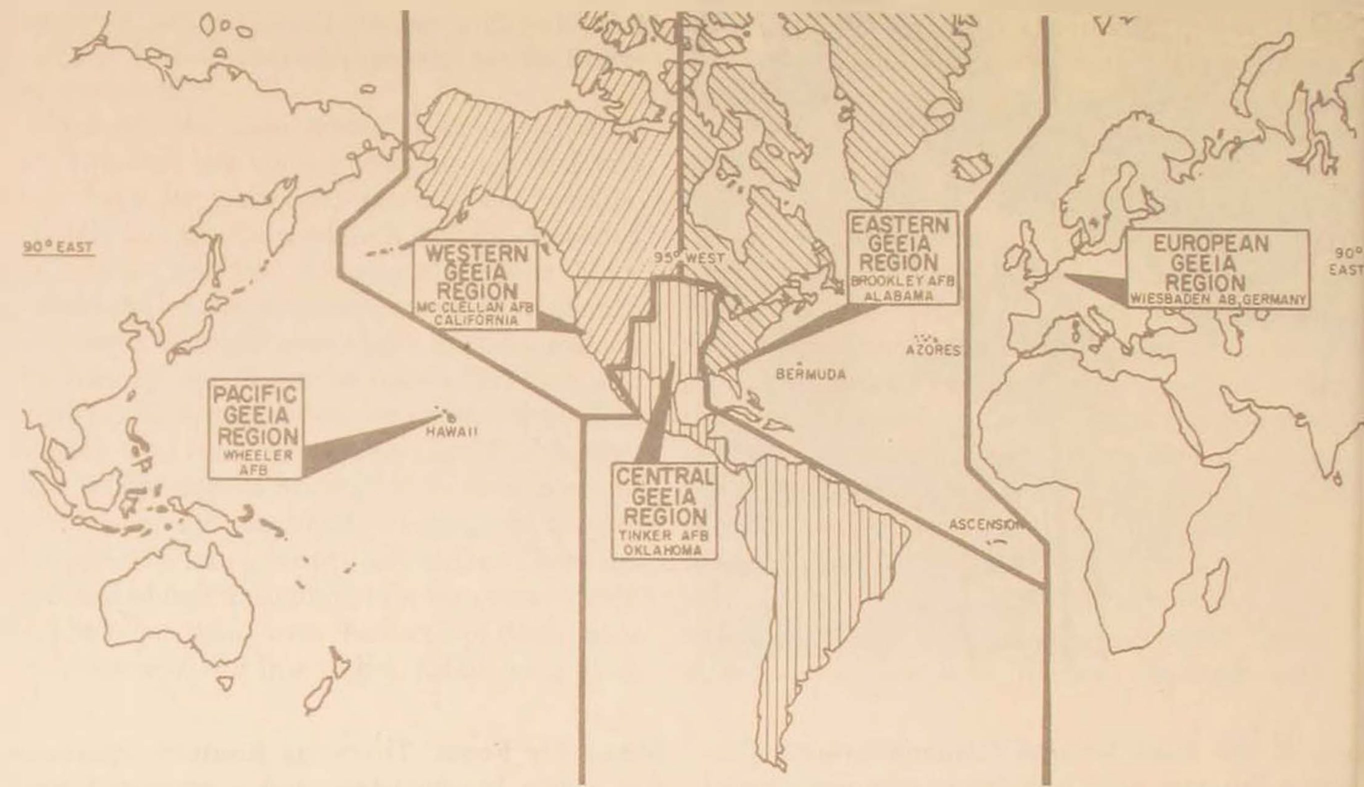
A sampling of the communications-electronics jobs that GEEIA is involved with discloses such projects as:

(1) Installation of radars and associated communications in the vast Air Defense Command complex.

(2) Multimillion-dollar "hook-up" of the ICBM sites as part of the Site Activation Task Forces (SATAF). Just one ICBM wing includes up to 150 sites and as much as 2100 miles of missile control and communications cable, which has a reliability requirement of 99.9 per cent.

(3) Communications for the Atlantic Missile Range, the John F. Kennedy Space Center, and NASA's Merritt Island Launch Area.

(4) Administrative communications, long-haul and on-base, including Autovon and Autodin. GEEIA also contracts and negotiates with commercial telephone companies for many stateside communications facilities.



Worldwide regional boundaries of Ground Electronics Engineering-Installation Agency

(5) Navigational aids such as ground-controlled approach (GCA), tactical air navigation (TACAN), control towers, and instrument landing systems.

(6) Meteorological facilities such as weather radars and ceilometers.

(7) Closed-circuit color TV for Pentagon and other command centers and educational TV systems.

(8) Strategic and tactical communications such as tropo and microwave systems, from Thule, Greenland, to Turkey and southeast Asia.

(9) Under radio-interference and hazards-reduction responsibility, lectures and workshops whereby GEEIA indoctrinates local radio and TV repairmen in the methods of correcting interference from new high-power radars.

(10) Tropospheric path-loss measuring, using highly specialized equipment and teams.

Effective 1 July 1964 the function of on-site depot-level repair of ground electronics equipment was incorporated in GEEIA's mission, and the associated Mobile Depot Activity personnel and other resources were transferred concurrently. This is another ICE move, since sizable savings are anticipated by this reorganization. Overhead will be reduced and productivity increased by this consolidation of similar specialists and their test and tool equipment.

THE RAPID operational deployment of intercontinental ballistic missiles demanded a fast-reacting, flexible, professional C-E organization such as GEEIA. What the next technological breakthrough will be is difficult to forecast, but whatever it is there will certainly be an even greater requirement for communications-electronics—that is to say, command and control. As costs continue to rise with each succeeding weapon system, the need for cost consciousness becomes more acute. GEEIA, with its hard core of engineering and technical know-how and its mission-oriented, quick-reacting organization, provides the United States Air Force with a professional force that is capable of fulfilling, at a minimum cost, the emergency war and postwar needs of the United States Air Force.

Eastern GEEIA Region, Brookley AFB, Al

TECHNCIAL DATA MANAGEMENT

Lieutenant Colonel William O. Rennhack

A CHRONIC problem plaguing the Air Force for many years has been the generation of staggering amounts of data by contractors to assuage our insatiable appetite. The lack of control over contractor-furnished data and reports has been a major concern to the Government.

While there is considerable evidence daily in the newspapers and other media of the billions of dollars expended to procure missiles, aerospace vehicles, electronic components, and similar end-item hardware, it is less obvious that the cost of data makes up 10 to 20 per cent of the average hardware contract. It has been estimated that close to $2.6 billion was spent in FY 64 by the Department of Defense for data.* It is no wonder, then, that a major emphasis has been placed by the Air Force on the management of this costly acquisition.

For the past two years the Air Force Systems Command, the organization charged with the responsibility for procurement of all new system/program acquisitions, has spearheaded an exhaustive effort to "get a handle" on the data problem. This Herculean undertaking involved the restructuring of the entire process of buying data from contractors. In a concerted effort to ensure the ready availability of timely and accurate data at minimum cost, the Data Management Working Group was created within AFSC. The group was directed to take a fresh new approach to data management—to push back the horizons and make drastic inroads into the peripheries of the data spectrum. Specifically, the group had two basic objectives: to challenge the existing structure for acquiring data and to develop a standard authorized data list for uniform application to contracts.

In the past, requirements for data were interspersed throughout the contract and referenced documents. The first basic concept was to establish a data requirement form (DD 1423) to list all data items. A clause in the contract states that the only data to be paid for will be listed on the 1423 notwithstanding other statements to the contrary. This imposes a discipline upon the Air Force to analyze the data and distinguish the essential from the nice-to-have.

The second basic concept was to consolidate all requirements for contractor data into one loose-leaf binder. Specific discrete data items were of a standardized format. Only items contained in this Authorized Data List (Vol. II of AFSC/AFLC Manual 310-1) can be listed on the DD Form 1423. These ironclad procedures forged the cornerstone of the new approach to data management.

The two basic objectives have been described as the MIN/MAX theory. The minimum essential data would be listed on a DD Form 1423. These would be selected from the maximum allowable data list. The policies and procedures for acquiring the minimum essential are published in Volume I and the maximum allowable is published in Volume II of joint Systems/Logistics Command Manual 310-1. New Air Force Regulation 310-1 makes these policies mandatory for all users of contractor data.

These new concepts of data management did not come easily. Their formulation required almost

*Defense industries have an abhorrence for unnecessary paper work. At the Monterey conference in May 1962 the Aerospace Industries recommended strong action to reduce the ordering of data by the Air Force. The House Appropriations Committee annually has reminded the Department of Defense to buy hardware and not paper. It has been estimated that the number of hours expended annually to prepare reports has risen 400 per cent since the Korean War.

two years of concentrated effort, about 75,000 man-hours and dogged determination to accomplish the following:

• Vested interests and parochial vision had to be sacrificed.

• Approximately 9000 documents had to be intensively reviewed.

• A logic flow chart showing milestones in the life cycle of a new system had to be prepared.

• Coordination between commands, divisions, staff, and industry had to be continuing and aggressive.

Positive direction from the Air Staff has been the key to successful implementation. The Data Management and Advisory Committee of the Air Staff focuses attention on problems which affect the major commands. The Air Force Logistics and Systems Commands have a Joint Data Management Review Board which makes revisions to the Authorized Data List (Vol. II, 310-1). In addition, data reviews are made by the data management officers of the Air Materiel Areas and the AFSC Divisions. Each new contract is thoroughly screened to ensure minimum essential data requirements.

The establishment of data requirements should be a joint Air Force/industry effort. Contractors are encouraged to establish data management control points. Whenever possible, contractors' recommendations for substitution, consolidation, or elimination of data are requested when planning for or reviewing data requirements.

The cost of unnecessary data is not our only concern. We are even more concerned about providing our system program directors and their teams with the proper information to make decisions. In order to control his program the director must plan ahead to get the necessary status reports, financial progress reports, PERT networks, and so forth. If he encounters design deficiencies, overexpenditures, or schedule slippages, it is probable that his data are inadequate for management control.

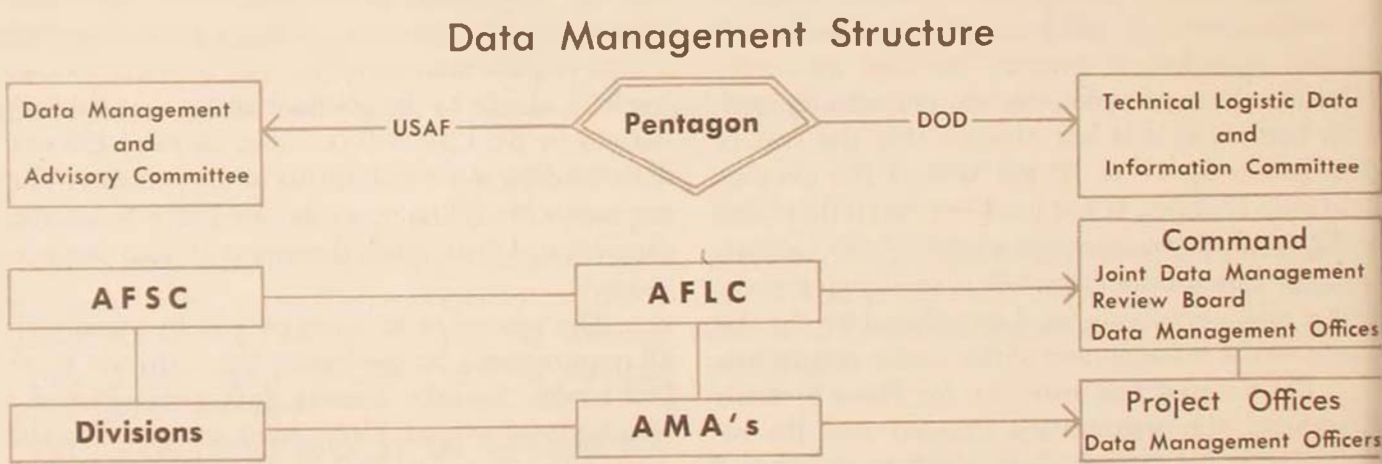
Steps taken to improve data management include the following:

• All system program offices have data managers who are responsible to the director. Every data item requirement must be approved by the director. Data items must be justified by cost estimates when available. These are the day-to-day procedures which force timely decisions for data management.

• Instead of buying engineeering drawings to support all missions, we now order drawings only when they are required to support a mission.

• If we need a reprocurement package for competitive purposes, we order it only on the items which have a reasonable chance of being procured competitively. The contractor must identify which items on the DD Form 1423 are proprietary. This enhances the Air Force's bargaining position early in the acquisition process.

General Schriever has stated that manage-



ment and not technology is the pacing factor of our progress. The reason we are insistent in our demands for better data management is that data handling is a common denominator for all our other management techniques. We are on the hreshold of entirely new disciplines in configuraion management, engineering management, and vstem program management. A long needed critial evaluation is being made of our existing tech rder system. User needs are being analyzed, and he best method of presenting this information is eing determined. New manuals are being preared in these areas as well as in the 310-1 data ries.

In summary, the new approach to data mangement has attempted to take a fresh look at all he old data problems. The five main advantages of is approach can be stated as follows:

(1) It will save system acquisition dollars.

(2) It will save Government resources by eliminating unnecessary storage and retrieval of data.

(3) It will force timely decisions.

(4) It will free the decision-making process from excess detail and masses of unwanted information.

(5) It will eliminate burdensome reporting requirements imposed on contractors.

We are just beginning to reap measurable benefits, but already the amounts of data have been greatly reduced. A savings of $36 million was reported in FY 1964. Our data managers report that reviews and concentration on buying only the minimum essential are now a way of life.

Data constitute the nervous system of a program. The most significant benefit of data management is our ability to have better data for decision-making by the system program director.

Hq Air Force Systems Command

The Contributors

Major General Horace A. Hanes (B.E., Illinois State Normal University) is Commander, 9th Aerospace Defense Division, ADC, Ent AFB, Colorado. After completing flying training in 1939 and receiving his regular commission in 1940, he served with the 18th Pursuit Group in Hawaii, with the Air Training Command, and with the 312th Pursuit Squadron before being transferred to the First Fighter Group, Mediterranean Theater of Operations, in 1943. He commanded the 71st Squadron and later served as group operations officer and deputy commanding officer. Other assignments have been as Commanding Officer, Fighter Station, Punta Gorda, Florida, 1944-46; Commander, 31st Fighter Group, Germany, to November 1947; Commanding Officer, 67th Tactical Reconnaissance Group, March AFB, California, to 1949; Chief, Air Defense Division, Directorate of Requirements, Headquarters USAF, 1950-52; Director of Flight Test, Air Force Flight Test Center, Edwards AFB, California, 1953-57; Commander, 58th Fighter Bomber Wing, Korea, 1957-58; Deputy Chief of Staff/Operations, Fifth Air Force, Japan, 1958-61; Deputy Chief of Staff/Plans, Headquarters Air Defense Command, from 1961 until his present assignment in July 1964. General Hanes is a graduate of the Armed Forces Staff College and Air War College. He set the world's first official supersonic speed record over the Mojave Desert on 20 August 1955, flying an F-100C Super Sabre at an average speed of 822.135 mph. He was awarded the Thompson Trophy for his record runs at 40,000 feet and in 1956 received the Mackay Trophy.

Lieutenant Colonel Frederick R. Ritzinger, Jr., USAF, MC, is Chief, Aeromedical Indoctrination Department, USAF School of Aerospace Medicine, Aerospace Medical Division, ASFC, Brooks AFB, Texas. After graduation from the University of Illinois College of Medicine in 1948 and two years' general practice, he entered the Air Force in 1952 and was assigned to the 62d Tactical Hospital, Larson AFB, Washington. He completed the Aviation Medical Examiners' Course at Randolph AFB in 1953, the Harvard School of Public Health in 1955, and the Advanced Course in Aviation Medicine at Randolph in 1956. He was Commander, Wiesbaden Air Base Dispensary, Hq USAFE, 1958-60, and Chief of Professional Division, Hq MATS, from 1960 until his present assignment in 1963.

Captain Ellis G. Aboud, USAF, MSC, (B.S., Wake Forest College) is an instructor in Aviation Physiology, Aeromedical Indoctrination Department, USAF School of Aerospace Medicine, Aerospace Medical Division, AFSC, Brooks AFB, Texas. During World War II he served in the U.S. Army, South West Pacific Theater, 1943-45. He was recalled to active duty during the Korean War, 1951-53. He attended the University of North Carolina School of Medicine for two years and the University of Michigan until he again entered on active duty in 1957. He served as Physiological Training Officer at Carswell AFB until his current assignment in 1959.

Dr. Maurer Maurer (Ph.D., Ohio State University) is Chief, Historical Studies Branch, USAF Historical Division, Aerospace Studies Institute. He was formerly a historian at Air Force Logistics Command and a member of the faculty of Wittenberg College. He edited *Air Force Combat Units of World War II* (1961) and is the author of numerous monographs on Air Force history. He also has contributed articles to various journals, including *Air University Review*, *Military Affairs*, and the U.S. Naval Institute *Proceedings*.

MAJOR DAVID I. CLELAND (M.S., University of Pittsburgh; Ph.D., Ohio State University) is assistant head of the Systems Management Department and Assistant Professor of Management, School of Engineering, Air Force Institute of Technology. He teaches courses in Systems Management, Management Thought and Theory, and Corporation Finance. His several years of systems management experience in the Air Force Systems Command included duty as Program Manager for the KC-135B command post aircraft.

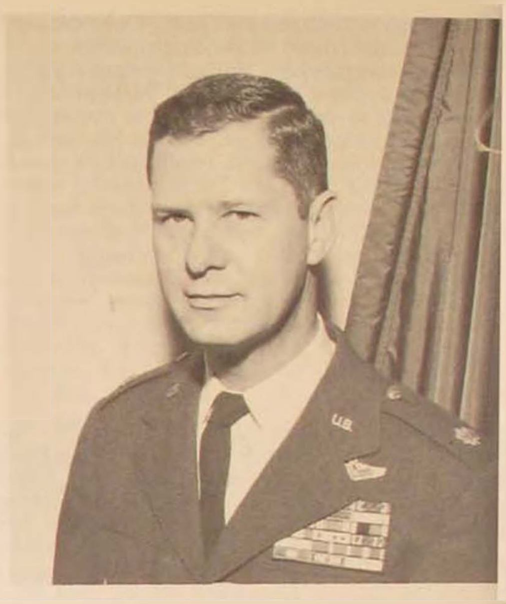
DR. ROBERT F. FUTRELL (Ph.D., Vanderbilt University) is Professor of Military History, USAF Historical Division, Aerospace Studies Institute, Air University. He is also Professorial Lecturer in International Affairs at the George Washington University Center, Maxwell AFB. He is author of *The United States Air Force in Korea, 1950-1953* and was a contributor to *The Army Air Forces in World War II*. Dr. Futrell has been a frequent contributor to the *Air University Review* and other military and historical journals.

MAJOR ROBERT L. ABLE (Ph.D., University of Kentucky) is Associate Professor of Economics, Air Force Academy. He served with the Fifteenth Air Force in Italy during World War II, flying B-24's, and in the Korean War, flying B-26's. He has also served as a B-47 pilot in the Strategic Air Command. Most of the rest of his career has been in education, including an AFROTC tour at the University of Kentucky. He has published several articles on management development and related topics, including one in the November-December 1964 issue of the *Air University Review*.

MAJOR GENERAL DALE O. SMITH, USAF Retired, (USMA; Ed.D., Stanford University) was last assigned as Air Force Member, Joint Strategic Survey Council, Joint Chiefs of Staff. During World War II he commanded the 384th Bombardment Group (B-17) in the European Theater. After graduating from the Air War College in 1948 and receiving his doctorate in 1951, he served on the Air War College faculty and in 1952 became Director of Education, Hq Air University. In 1954 he was assigned to the staff of the Operations Coordinating Board. During 1956 he was Chief, Policy Division, Plans Directorate, DCS/O, Hq USAF, and in 1957 he was sent to Saudi Arabia as Chief, U.S. Military Training Mission, and Commander, 2d Air Division (USAFE). In 1958 he was assigned as Commander, 313th Air Division, Okinawa, and in 1960 as Commander, 64th Air Division (ADC), Stewart AFB, N.Y. He was Special Assistant to the Joint Chiefs of Staff for Arms Control from 1961 until 1963. General Smith is the author of *U.S. Military Doctrine* (1955), and his articles have been published in numerous magazines and in *Impact of Air Power* edited by Eugene Emme and *The Wild Blue* edited by John F. Loosbrock and Richard M. Skinner. General Smith retired 1 August 1964 and has since devoted his time to writing and consultant work.

COLONEL CHARLES U. BROMBACH (USMA; M.B.A., University of Chicago) is Commander, Eastern Region, Ground Electronics Engineering-Installation Agency (GEEIA), Brookley AFB, Alabama. Before World War II he served in the Signal Corps and was Signal Officer of the Hawaiian Air Depot at Hickam Field on 7 December 1941. He later served as Communications Officer, 7th Air Force Service Command, and subsequently as Signal Officer of Headquarters Army Air Forces, Pacific Ocean Area (AAFPOA). Postwar assignments have been as Chief of Communications Maintenance, Headquarters AFLC; Chief of Communications Maintenance Engineering, Headquarters USAF; Chief of the Communications and Navigation Laboratory, Wright Field, and communications staff officer in Headquarters USAFE, Germany. In the summer of 1958 he was named the first commander of GEEIA. Prior to his present assignment he served for three and a half years as Deputy Commander, GEEIA. Colonel Brombach is a graduate of the Industrial College of the Armed Forces.

Colonel Thomas B. Kennedy (B.S., University of Maryland) is Assistant for Requirements and Systems Programs, Headquarters PACAF. After completing flying training in 1943, he flew B-26 and B-24 missions in World War II. Shot down over France, he worked with the French Underground, ultimately returning to Italy with the help of British "A" Force personnel. Postwar assignments have been in the Air Training Command, 1945-46; with MATS (including the Berlin Airlift), 1947-51; as Director of Operations, 374th Troop Carrier Wing, FEAF, 1951-53; in the Directorate of Requirements, Hq USAF, 1954-58; as Chief of Programs and Policy, Hq MATS, 1959-61; and as Commander, 315th Troop Carrier Group, Republic of Viet Nam, until his present assignment. Colonel Kennedy is a graduate of the Air Tactical School, Air Command and Staff College, and Air War College.



Lieutenant Colonel William O. Rennhack (B.S., Northwestern University; M.B.A., Air Force Institute of Technology) is Data Management Officer, Headquarters Air Force Systems Command. He served overseas during both World War II and the Korean War. He was Director of Management Analysis, Headquarters Flying Training Air Force, 1955-58, and Division Chief, Guidance and Control Procurement Division, Wright-Patterson Air Force Base, from 1959 until his present assignment in 1963.

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