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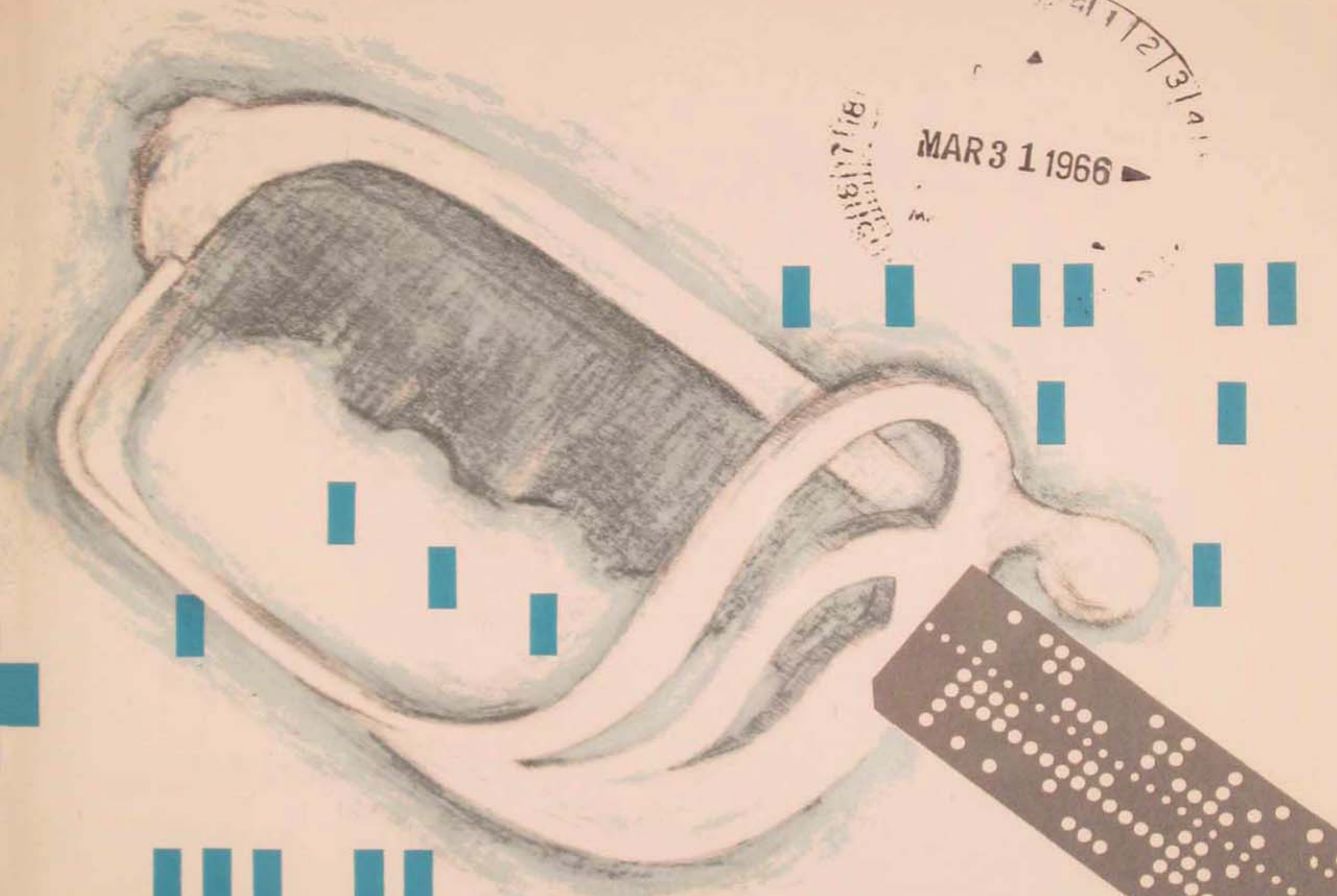

sharp edge of analysis

STRATEGY AND ANALYSIS . . . NEW AIR WAR COLLEGE . . .
DIRIGIBLES RECONSIDERED . . . NORTH COUNTRY RESUPPLY

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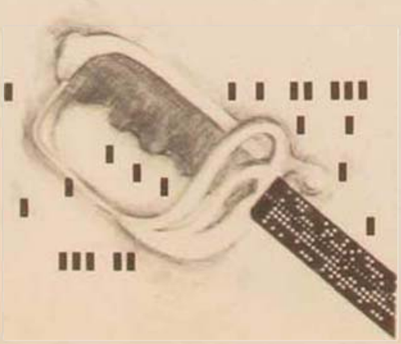
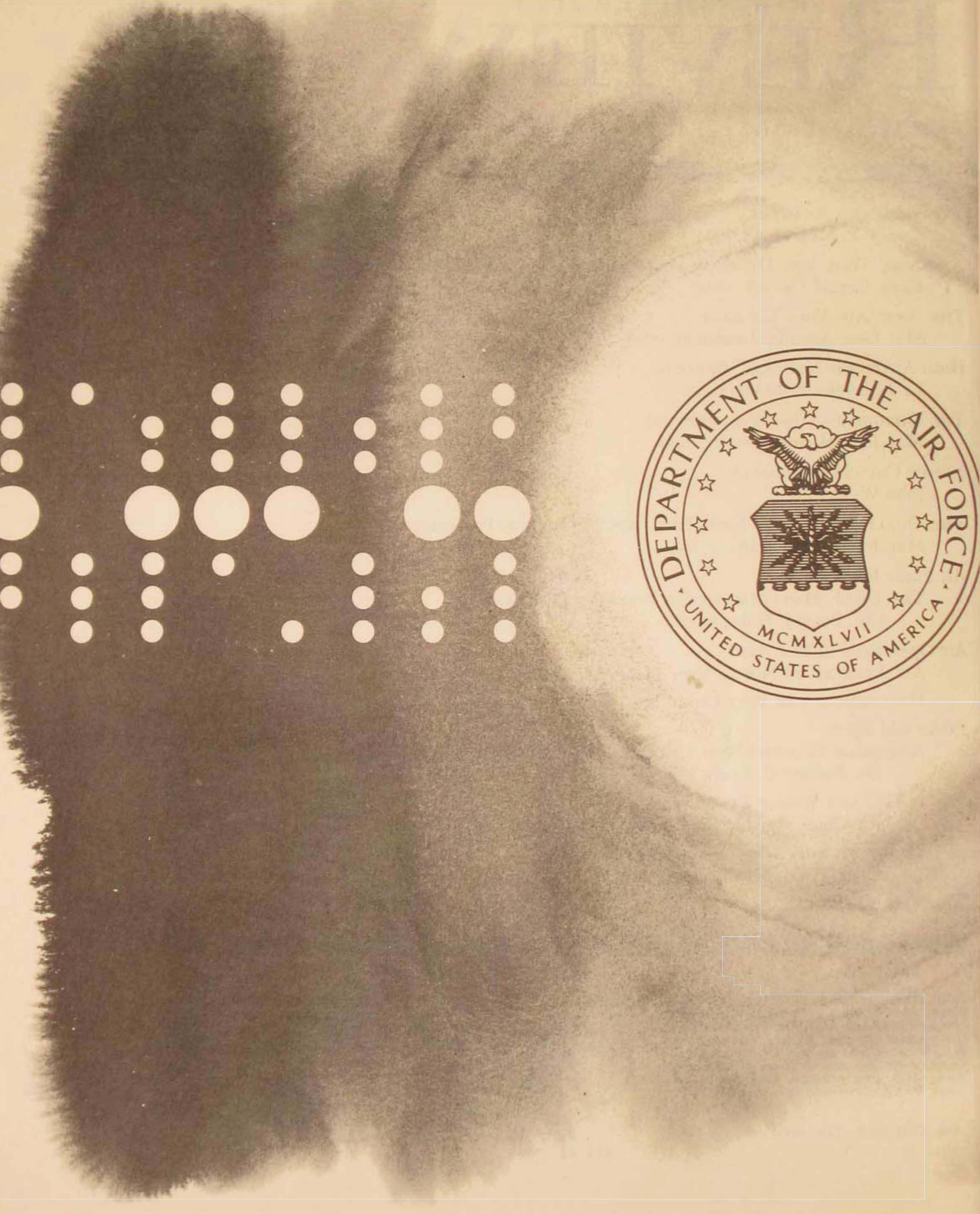


the cover

The Gordian knot of today's complex military planning and decision-making no longer yields to traditional ways, yet the well-honed edge of operations analysis and systems analysis slices through the maze of possible solutions to the best choice. In this issue of the *Review*, General J. P. McConnell introduces a series of articles on Air Force techniques of analysis.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STRATEGY AND ANALYSIS

GENERAL J. P. MCCONNELL

Chief of Staff,
United States Air Force

THE increasing application of technically oriented analytical techniques to the task of updating and refining our national strategy has become a matter of searching concern and study for everyone involved in the planning of military operations. To gain maximum benefit from our examination of that subject requires, first of all, that we recognize one primary indication of its growing importance to our profession. That indication is supplied by the fact that recent improvements in our methodology for analysis, as an aid to decision-makers, have greatly increased both our opportunity and responsibility to participate in the formulation of national strategy.

This does not mean that the military, as only one of many interrelated instruments of national policy, will decide its own task. It does mean, however, that we now can bring to light more effectively in advance of our commitment to a task those technical and functional alternatives that are required as a sound basis for decisions at all levels of authority.

The importance of insuring that full advantage is obtained from this before-the-fact presentation of choices is especially apparent to me in dealing with the two major areas of my responsibility—one involving resource management in the fields of personnel and logistics and the other having to do with my position on proposed force levels and joint operations as a member of the Joint Chiefs of Staff.

My daily concern with this range of problems has convinced me of the necessity for improving our understanding and mastery of the analytical techniques that have a useful application to strategic planning.

In pursuing that goal we should keep in mind that strategic planning at the highest level addresses the political, economic, and military ways and means of achieving national objectives, while military strategy prescribes the force levels and operational doctrines that can be employed toward those ends. Thus the objectives of economic and military strategy can be regarded as the means of national strategy.

These broad aspects of the problem have remained reasonably constant. The past two centuries, however, have brought drastic increases in the scope and complexity of strategic planning at all levels, a trend that has called for corresponding increases in our efforts to refine and improve the planning techniques that we employ.

I am convinced that some fundamental appreciation of events that produced this altered planning environment will facilitate our adjustment to it now and for the future.

Before the latter part of the eighteenth century, strategy was influenced largely by judgments based on a straightforward appraisal of given conditions with regard to the size, cohesiveness, and state of culture of the enemy society. Additionally, there were such clear-cut planning factors as geographic location and natural barriers, all of which exerted a readily apparent effect on the employment of forces. Apart from the vagaries of leadership it can be said that power, victory, and strategic success during this phase of history were primarily a function of numbers in a situation normally marked by the use of rudimentary weapons of known capability.

As well as being limited in complexity by these conditions, the problems of strategic planning were also limited in scope by a political aspect of the dynastic wars that occurred

With this issue, *Air University Review* begins a series of articles concerning the military application of analysis techniques. Of course analysis is virtually as old as warmaking itself, but since specialists from other disciplines—physics, chemistry, mathematics, the biological and social sciences—were called upon in great numbers during World War II to assist in the war effort, first operations analysis and more recently systems analysis have become disciplines in their own right.

The development and adoption of analysis techniques during the past decade have become so general and so dynamic that a broad survey of the whole subject seems in order. General J. P. McConnell begins the series by viewing analysis in historical perspective, with a look at both the past and the future in his provocative introduction, "Strategy and Analysis." Captain Gerald Garvey follows with a more detailed account of analysis as it is presently applied, in "Analysis, Tool for Decision-Making" on page 7.

Subsequent issues of the *Review* will continue the series, examining analysis methods and techniques as applied to specific subject areas such as JCS and AF war planning, technology, operations, and reliability; support for analysis afforded by the vital skilled human analyst, the essential computer, and the inevitable man/machine interface; the future of analysis as refinements are made in the machinery and methodology of the discipline; and Soviet cybernetics and other foreign developments in the field.

We gratefully acknowledge our indebtedness to Colonel Francis X. Kane, not only for conceiving the idea of an analysis series but also for material assistance in developing the syllabus and negotiating with others who have prepared articles covering these various phases of analysis. To all the authors we extend our thanks.

before the emergence of the modern nation-state. Generally those wars were fought with far less than nationwide support to achieve objectives that had a greater bearing on royal prestige than national survival.

That set of conditions was supplanted about the time of the American Revolution by an era still prevailing in which strategy became a device for expressing not just the will of dynasties but the purposes, angers, and fears of entire populations. Strategy then began taking a form that made heavy claims on resources and required broad national support. Accompanied by rapid improvements in transportation, communications, and firepower, this trend has increased tremendously the complexity of strategic problems and the scope of strategic planning.

Only after a slow, faltering, but eventually correct analysis of this new situation did our country succeed in pushing through, before our entry into World War I, some of the essential improvements in the management of manpower and material resources and the direction of military operations.

It took the technological revolution of World War II, however, to overcome the inertia of custom and tradition which for years had geared the analytical aspect of strategic planning to an expanded timetable that included (1) holding actions to protect our country over the full period of mobilization, (2) a buildup phase for concentrating power against overseas objectives, (3) a decisive phase for the defeat of enemy forces, and (4) an exploitation phase to establish control of the enemy.

With the advent of air nuclear forces, the first two steps in this classic sequence were forced into permanent discard—a development that compelled the acceleration and refinement of analytical processes to evaluate alternative force levels, doctrines, and operational concepts that would be needed to uphold our national policy.

Another spur toward greater emphasis on the computer-aided, quantitative approach to analysis has been the identification of a growing number of potentially profitable opportunities for exploiting progress across a broad field of scientific interest. These alternatives—all of them costly—must be thoroughly evaluated at a series of decision points as the basis for justifying support from the research stage through the production stage. Included in this process are examinations of all development proposals and programs from the standpoint of military requirements, technical feasibility, design approach, and cost effectiveness.

The growing quantity of data to be sifted in dealing with these problems is illustrated by the fact that we studied 5000 design aspects last year for a proposed Advanced Manned Strategic Aircraft (AMSA), compared to 360 for the B-58 ten years ago.

After the technical solutions are reached, we still have ahead of us the questions of force levels, doctrines, and operational concepts.

There is an interesting point to be made in this respect about our strategic offense and defense forces, which, as objects of deepest concern, have undergone prolonged and elaborate war-gaming tests throughout the period since World War II. Over the interval from the late forties through the mid fifties, when long-range nuclear-armed bombers and manned interceptors filled roles as dominant strategic offense and defense systems, these evaluations were relatively simple and straightforward.

By contrast, our evaluations today must encompass an expanding mix of systems employed in these roles. Last year, for example, the Air Force, along with the Army and Navy, conducted a study of strategic problems to determine the gross trends that will influence the allocation of funds over the time period of the 1970's. One of the main purposes of that exercise was to measure the utility of certain weapon systems that are being considered from the standpoint of their individual contribution to a mixed force.

As a primary criterion for this measurement, the mixed force was postulated as one that could destroy a desired portion of an enemy's target systems and at the same time protect our own society from unacceptable damage. The exercise included not only a study of missiles and bombers projected for that period but also an appraisal of antisubmarine warfare and civil defense.

Even more complex today are the war-gaming analyses of tactical forces, which present a far greater number of variables with respect to environment and kill probabilities.

In addressing those questions, we are placed at some disadvantage by the fact that the period during which strategic planners could rely on their knowledge of battle-tested weapons has been replaced by a period in which the weapons are coming along faster than the battles.

This does not mean that all military experience is irrelevant; but it does require that experience be reinforced by intensive analysis of data supplied by weapons effectiveness testing that simulates as closely as possible the expected future combat environment.

The military's positive and vital contribution to this analytical effort is indicated by the fact that our people in uniform, through the operating levels, are called upon to apply their experience extensively in establishing the test objectives and criteria and in designing the test models. Skillful completion of those steps is essential in obtaining valid input data for analyses of weapon systems capabilities in terms of reaction, penetration, survivability, and accuracy.

Through studies in the logistics area, we have improved our basis for determining munitions requirements in the European theater and for making the choice between rearward and forward maintenance for the many types of equipment in our inventory.

To meet increased requirements for quality and speed in preparing these aids for decision-makers, we recently have brought many of our top analysts together in a Directorate of Studies and Analysis under the Deputy Chief of Staff, Plans and Operations. We also have established under the Deputy Chief of Staff, Plans and Operations, a Deputy Director for Operational Tests and Evaluation, to provide a better arrangement for assigning test priorities and distributing test results on the basis of overall needs. As a source of expert advice on these and other activities in this area of interest, I have a Chief Operations Analyst on my personal staff.

With regard to this entire range of effort, I cannot overemphasize the important degree in which the technical or quantitative approach to analysis has vitalized the interaction between decision-makers at the highest levels of the government and the operating elements of the military. Reflecting this interaction is the increasing flow of data, in the form of proposals and directed studies, up through the channels linking the military departments with the Office of the Secretary of Defense and the Executive agencies. On a daily, routine basis, military judgment is being brought to bear on these questions at meetings between our people who are doing the studies and representatives of OSD.

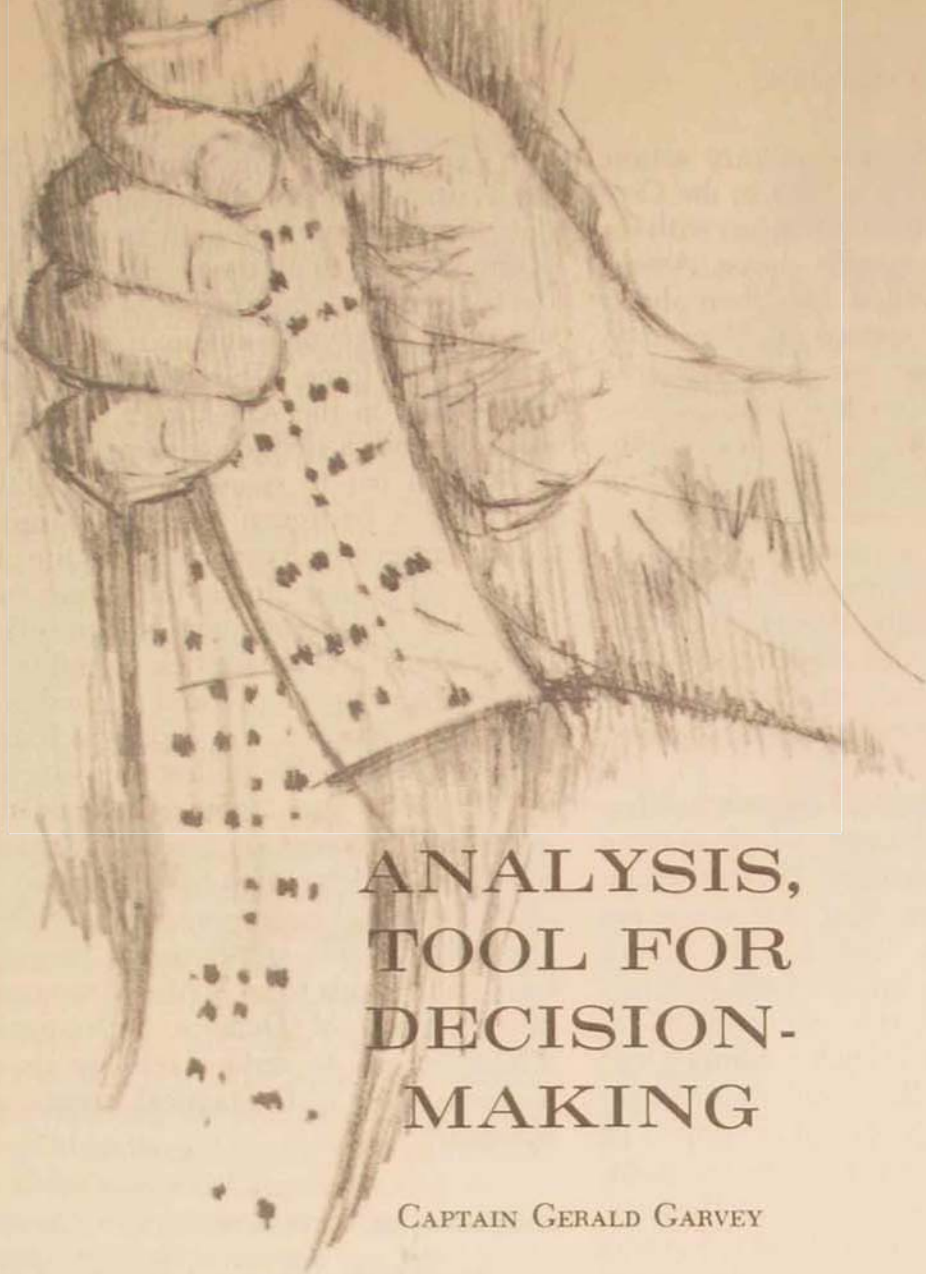
Finally, we must not lose sight of the fact that strategic problems of national scope require the evaluation of myriad factors in political, economic, and social areas as well as in the fields of technology and military doctrine. It is also true that no one can be an expert in more than one or two of the subfields in each of these areas.

Consequently, it is our clear responsibility to support the judgments that are made at that essentially higher level of abstraction by helping to present alternatives that are based on thorough quantitative analyses of all the hard data relevant to technical approaches, systems, tactics, and doctrine.

To the credit of the Air Force, it can be shown that as early as World War II the work of our operations analysts in evaluating tactics and concepts of operations produced major improvements in the effectiveness of our forces. Later, through the continuing refinement of these analytical techniques in the Air Staff and the RAND Corporation, we helped produce a tool of management that the Department of Defense has adapted to illuminate the uncertainties relating to many aspects of defense.

This technically oriented analytical approach, in contrast with "blue sky" speculation, provides a basis for rational and effective action on all of the grave strategic issues that require a decision. There is still far more work to be done, however, and we must improve our analytical methods continually in order to cope with the increasingly complex problems of the future.

Headquarters United States Air Force



ANALYSIS, TOOL FOR DECISION-MAKING

CAPTAIN GERALD GARVEY

THE USE of modern analytical techniques as decision-making tools has enjoyed increasing currency in recent years throughout the American defense establishment. This discussion will approach the subject from three directions: first, to outline in general terms the imperatives of nuclear-age defense planning which have given rise to new patterns of strategic thinking under the Kennedy and Johnson Administrations; second, to touch briefly on the relationship between these modern defense imperatives and the emergence of "analysis" as an institutionalized method of doing business in the Pentagon; and third, to summarize some of the principal goals and uses of systematic analysis as a defense decision-making tool.

requirements of strategic analysis

The principal problems of nuclear-age strategy arise from a need to develop patterns of thinking that complicate, and even contradict, traditional military ideas. Nuclear weapons threaten the traditional tendency of Americans to think of war—when they think of it at all—as involving a total commitment to total victory. Today the "unconditional surrender" mentality is necessarily giving way to a deepened intellectual and emotional conviction that modern war makes sense only if it is fought for limited objectives and limited ends—if indeed it ever makes sense.

As a corollary, war must be waged with limited means and in a limited manner. The classical criterion of effective military action, perhaps most colorfully expressed in the Civil War axiom about "getting there fustest with the mostest," appears increasingly naive. Americans have traditionally relied upon their ability to outdo and outlast an enemy as the primary means of winning wars. American victories have most frequently been logistical, not tactical, in origin. The natural resources of the United States, coupled with the Yankee gift for tinkering and productive know-how, endowed the United States with a comparative advantage over just about any opponent, so long as "getting there fustest with the mostest" was decisive in war. Rarely did the United States have to operate under the same constraint of economy that enforced itself against her less wealthy opponents.

But in the modern nuclear context, a different kind of constraint emerges which limits a nation's war-waging capability. This constraint is even more compelling than that stemming from limited resources. The fact that both major world powers are approaching "nuclear plenty" enjoins on each the constraint of rationality. They must act in such a manner that the costs—political as well as economic—of their military activities will not exceed the gains. To do otherwise in the short run might be tantamount to inviting national disaster in the long.

Historically, the infeasibility of delivering virtually unlimited destruction on an enemy capable of annihilating oneself, too, set an automatic upper limit on the costs of war to the human race. This historical limit began to vanish when nuclear weapons in relatively invulnerable delivery systems threatened to make unlimited violence a feasible possibility. The limitations formerly inherent in weaponry could no longer be relied upon to save mankind from prodigality or stupidity when waging war. Consequently, prodigality and stupidity in defense planning become intolerable as never before.

The United States can never again equate what is "effective" in a narrow military sense with what is "rational" as a national policy. The feasible cannot again be regarded as necessarily the most economical course of action. We must outthink, not just outlast, an enemy.

The so-called "McNamara revolution" in the Pentagon reflects an attempt to accommodate the imperatives of modern defense. There is one keynote to all the recent changes in the doctrines underlying the use of American military force, a keynote summarized by the term "economy of force." This notion is perhaps best exemplified in the well-known caveat: "Don't kill a fly with a sledgehammer." You don't use a baseball bat to spank a willful child. You don't use a hydrogen bomb to punish every minor aggression. At each stage in the planning and use of military force, the nature and magnitude of the threat must be carefully measured. Kinds and quantities of military force must then be developed and applied in a manner proportioned to the ends which are to be achieved. From this philosophy we can trace the Kennedy and Johnson Administrations' aversion to reliance on threats of "massive retaliation" to deter Sino-Soviet limited aggression of the kind experienced in Southeast Asia. Similarly, to this emphasis on proportioning force to the ends to be achieved we can attribute Secretary of Defense McNamara's continuing efforts to reduce reliance on nuclear weapons, even of the tactical variety, in NATO defense.

analysis as an institution

The McNamara revolution has been characterized by an extraordinary emphasis on formal analysis, technically known by such terms as "systems analysis" and "operations research." Today analysis is consciously used as a tool to assist the decision-maker in evolving plans for the development and use of force. This brings up the first, and in some ways the most interesting, perspective from which to look at the subject of analysis: the emphasis on analysis as a more or less permanent institutional part of the modern decision-making apparatus.

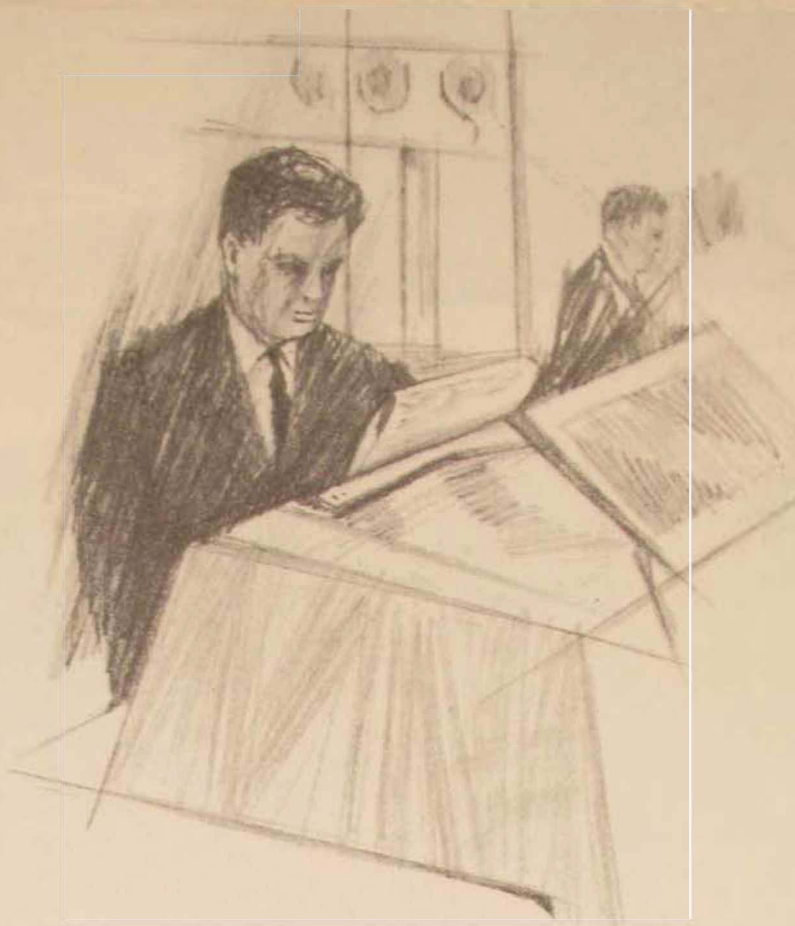
Why has formal analysis come to the fore to such an unprecedented degree in recent years? Is there any clear (not to say inevitable) relationship between the ascendancy of analysis as an accepted *method* of defense decision-making and the new emphasis on economy of force and rationality as principles underlying the *substance* of modern defense decisions?

The eminent military historian Bernard Brodie, in the April 1965 issue of *World Politics,* addressed himself to this question. After noting the prominent role played by certain named economists in the evolution of what has come to be known as the "McNamara strategy," Mr. Brodie concluded that the new modes of thinking in American strategy have resulted in part from the coincidence that the analysts surrounding Secretary McNamara happened to share certain strategic doctrines which have since come to be identified with him.

Can so much really be charged off to "coincidence"? Cannot a more plausible explanation be found in the fact that economists are by training and inclination highly sensitive to relationships between gains and costs, between means and ends?

The relationship between analysis and modern defense imperatives is natural, not fortuitous. Analysis means, above all, rational decision-making. As was pointed out, the constraint of rationality looms to unprecedented importance in nuclear-age war planning. Moreover, analysis puts a premium on solving problems in the abstract or through experimental means, by reducing the problems to their basic elements. "Muddling through" to a solution is foreign to the analytical approach, just as it is inappropriate to nuclear-age decision-making. It is obvious that, with nuclear weapons, theories of war cannot be tested by actually having a war; therefore military planners necessarily must resort to hypotheses and carefully controlled simulations of war. In short, they must resort to analysis.

A general, logical pattern begins to emerge, explaining the increasing reliance of military planning on theories borrowed from the intellectual disciplines, all of which are woven into a comprehensive, useful whole, assisted by the unifying of analytical frameworks. Among the "academic invaders" of the Pentagon, none are more important than the foreign policy experts and international relations theorists. This development reflects, in part, America's turning away from her traditional isolationism, coupled with the growing view of military power as a tool of foreign policy rather than as an



end in itself. The ascendancy of the economists bears witness to the rising costs of defense and to the role of the military establishment as an integral component—both user and supplier—in the nation's flow of goods and resources. Complementing such contributions from economists and mathematicians as game theory, linear programing, and classical consumer demand theory (from which, incidentally, the famous "program package" budget technique gets its intellectual pedigree) are various simulation techniques now in use, including war gaming and carefully controlled field exercises such as Big Lift and Gold Fire.

A jargon has developed to distinguish two types of analysis according to the level of generality at which they are performed. "Operations research" refers primarily to the analysis of specific weapon systems; that is, it refers to the problem of designing optimum characteristics into the various component parts of our defense posture. On the other hand "systems analysis" has through usage come to refer more generally to the top-level problem of designing, or at least of defining, the optimum characteristics of the defense system as a whole, of which the objects of operations research are the parts.

What is analysis?

Behind the mystery of terms such as "operations research" and "systems analysis," the term *analysis* simply refers to the process by which a problem is broken down into its component parts. What distinguishes analysis, in the sense of a formal tool for decision-making, from the type of commonsense analysis that anyone performs in solving any type of problem is the fact that this "breaking down" process is carried out in a highly formal, highly rigorous manner. Each step in the analytical process can be justified; each step can be reproduced. Any desired series of steps can be retraced, in order to provide a test on the validity of the analysis.

When we say "rigorous" we mean that the elements into which the problem is broken down satisfy two requirements:

(1) The elements, or more precisely, the variables and relationships among variables, are expressed in terms which permit them to be looked at from the standpoint of certain more or less *standard theoretical frameworks*. For example, if we are studying the phenomenon known as escalation and want to develop insights into the conditions under which a given conflict situation will be stable (i.e., non-escalation-prone), we might want to express the variables in the problem—such variables as "enemy intent," "enemy capabilities," "U.S. interest," "U.S. capabilities," etc.—in such a way that they can be treated with theoretical frameworks that have been developed in the discipline of economics for the purpose of analyzing stability or equilibrium in supply-and-demand or bargaining situations.

(2) We generally require in operations analysis that the variables in a problem be expressed in such a way that they are amenable to *mathematical treatment*.

On the subject of "mathematization" of social phenomena, one important footnote should be added at this point. To say that a subject will be analyzed mathematically is *not* necessarily to say that all, or even that any, of the

The data of operations research and systems analysis may sometimes seem far removed from the world of practical military reality, yet from them have derived such large-scale joint exercises as Big Lift in 1963 (left) and Gold Fire I in the fall of 1964.

elements in that problem can be quantified. It is not even to say that numbers or measurements will be used in developing a solution. Mathematics can be applied in various ways and at several different levels of generality. It is often possible to define the important variables of a problem with sufficient clarity that they can be expressed in mathematical terms and in a way which permits the relationships among these variables to be expressed as mathematical relationships. It is then possible, without ever once "quantifying" the variables, to follow through the logical implications of one's assumptions. Used in this general way, mathematics becomes a tool of logic rather than a means of numerical analysis.

Frequently a layman, when confronted with a page covered with forbidding mathematical symbols and notations, denies the validity of the analysis out of hand, on the *a priori* ground that problems of human choice are not susceptible to mathematical treatment. In fact such *a priori* rejection of the usefulness of mathematics is often doggedly held to even though the analysis does not pretend to be a "quantification of human nature" but is rather a rigorous mathematical presentation of the logic of the problem.

The aim of breaking a problem down into its component elements is to provide a simplified model of reality. The word "model" in this context means nothing more involved or abstruse than a representation of reality.

A model in its formal sense is composed of two elements: first, the working elements of the problem, known as variables; and second, the relationships among these variables. For example, the famous Einstein equation $e = mc^2$ is a model and represents reality. It tells us something about the real world, namely, that energy equals mass times the speed of light squared. And it communicates this information in terms of variables (e, m, and c) which bear definite relationships to one another, as expressed by the equality sign and by the implied multiplication sign between m and c^2.

Why do analysis?

Broadly speaking, there are two reasons why a decision-maker desires to take a systematic approach to problem solving. First of all, he realizes that the quality of his decision will depend on the quality of the information upon which he bases it. Accordingly, the decision-maker needs some framework to assist him in organizing and interpreting his knowledge. At the same time most prudent decision-makers realize that they frequently will need more information than is available at the precise moment when a difficult problem arises. Hence they desire to know what additional information is necessary to arrive at a satisfactory solution. A formal, analytical model is helpful in this respect too. It assists a decision-maker not only in organizing his knowledge but also in organizing his ignorance.

To say that a decision-maker desires to organize his knowledge is to say very little. Knowledge must be organized in accordance with some design in order to ensure that it will serve clearly defined purposes. Generally these purposes can be grouped under four headings:

Criteria of Relevance. A model must assist a decision-maker in determining what data are relevant to the problem and what data, however interesting, are really not needed to solve the difficulty at hand. This requirement is especially important in the analysis of social phenomena, where the data are frequently so rich, so diverse, and so numerous that the decision-maker will tend to get lost in disorganized heaps of information unless he can quickly and reliably sort out and limit his attention to the information directly pertinent to his problem.

Sensitivity Analysis. Even within the range of data that may be deemed relevant to a given problem, it is nevertheless frequently true that certain variables exert a far more significant effect on the solution than do others. To take an example from a military situation: Few commanders would deny that weather considerations are generally relevant to the choosing of an optimum strategy. Yet it is equally obvious that in many combat situations accurate knowledge of the comparative capability of one's own and the enemy's military forces is more important to the decision-maker than is precise knowledge of the weather prognosis. Thus weather is a relevant variable, but comparative capability is a far more sensitive one.

Control Variables. In most circumstances we do analysis not simply for the sake of doing analysis but rather to provide a tool for effective practical decision-making. That is to say, we are not only interested in knowing about the real world; we are also interested in affecting or influencing the real world. In order to influence the environment, it is necessary to manipulate certain variables, which will in turn produce effects on other variables. A model, by revealing the relationships between dependent and independent variables, helps us to do this. Given a description of a situation in terms of these relationships, we can carefully manipulate the independent variables with a reasonably high expectation of predicting the changes that will be produced in the dependent variables.

Generation of Hypotheses. Finally, the foresighted analyst is interested in learning. He wants to get the maximum payoff from any analysis by searching for additional hypotheses that may be suggested by his model, because they may be useful later in solving a related or even a different kind of problem.

what analysis won't do

It is perhaps unfortunate that "analysis" has become in recent years unduly glamorized —something more than a mode and only slightly less than an intellectual cult. It is important, therefore, to bear in mind that analysis is no panacea. Like any other tool, it can be misused. And when misused, analysis is as likely as any other tool to be as dangerous as it is helpful.

The practical value of any theory or analytical model depends not only on its abstract appeal or formal neatness. The value of analysis for a decision-maker concerned with practical problems depends quite as much on the art and skill of the analyst as it does on the intellectual credentials of the body of theory from which a particular model is derived. Any theory is based on certain assumptions and, to be useful, requires data that have been interpreted in an appropriate manner. If proper regard is not paid to the assumptions of a model, or if inappropriate or incomplete data are used when applying the model, invalid conclusions will result.

Is the human factor neglected?

The strongest and frequently the most persuasive charge leveled against the use of mathematical analytical techniques is that they tend to ignore something known as the "human factor." It is often alleged by critics of analysis that human nature can never be quantified; that the logic of human events is never so inexorable as mathematical formulas imply; that life is shot full of uncertainties and statistical hazards which tend to be simplified away in abstract conceptualism of the type made famous (or infamous) by modern defense analysts.

Perhaps the best way to demonstrate the respects in which these objections are valid, and at the same time to highlight those respects in which such criticisms are misguided, would be to give a brief discussion of one of today's most popular analytical tools, game theory.

The theory of games was developed in the 1940's by two Princeton professors, the mathematician John von Neumann and the economist Oskar Morgenstern. These two superbly creative theorists sought to develop a mathematical model of the kind of conflict situation known technically as a "strategic game." It is important at the outset to note that Von Neumann and Morgenstern did not presume to develop a theory that would predict the outcome of *every* conflict situation. The first step for these, as for any analyst, was to define and limit the problem.

What, then, is a "game of strategy" in the sense used by Von Neumann and Morgenstern? How is a "game of strategy" distinguished from other types of games, such as games of skill and games of chance?

Swimming is a game of skill in which an individual pits his ability (in this case a physical ability) against a foe (in this case nature herself). Swimming is a "game" in the sense that it involves a conflict in which one participant wins and one participant loses. If the swimmer's skill and endurance are not equal to the task which he has set for himself, he will drown—clearly a loss of the game. On the other hand, if the swimmer's skill is of a reasonably high order, he will successfully move from one point to another across the water within some reasonable period of time, and his successful negotiation of this task can be termed a "win."

Contrast the problem confronting the swimmer with that facing a crapshooter. Assuming that the dice are not loaded and that the crapshooter is not possessed of an unusual ability to put an unusual type of spin on the dice, his success or failure will depend altogether on the statistical probability that a fair roll of the dice will turn up the number he has called. No element of physical skill—no extraordinary element of physical coordination or practice in throwing dice—plays any role in a game of craps. Neither does any element of

probability or chance play a role in swimming, in which there is a simple competition of man against nature.

A game of strategy differs from both a game of skill and a game of chance. A strategic situation, strictly speaking, is a conflict situation in which the success of each participant's decisions depends in part on his opponent's decisions. An excellent example is a poker contest. Player A's decision to raise, stand pat, or fold will be a good or bad decision depending not only on how good his hand of cards is but also on how good the opponent's hand is *and* on how the opponent decides to play his hand. In turn, the opponent, Player B, must take into consideration whether Player A is bluffing or not. At this point the game is said to become "recursive"—that is, it "runs back into itself." The wisdom of Player A's decision to bluff or not to bluff depends on Player B's decision, which depends on Player B's interpretation of Player A's decision, and so on. In other words the two players' decisions interact with one another and therefore prevent any solution other than hunch or guess.

Rather, this was true *before* the development of game theory. As we have seen, decision-making on the basis of hunch or raw intuition is alien to the analytical mode of thought. And decision-making in nuclear war on the basis of hunch or unsupported intuition is similarly at odds with modern defense imperatives. Game theory reduces the "hunch factor" by showing mathematically, on the basis of explicit assumptions about the players' capabilities and goals (whether the game be poker or war), that there *is* an optimum choice for each opponent, a choice that will minimize his losses even if the opponent makes his "best choice."

An objection sometimes made to game theory is that in eliminating the hunch factor it eliminates precisely that element of conflict which is most important. In doing so, it is charged, game theory becomes *unrealistic* as a model of conflict and hence *dangerous* as a decision-making tool. To this objection a number of answers may be made.

First of all, it is not true that, because the theory of games is concerned with strategic problems only, skill and chance factors are to be ignored when applying the theory. On the contrary, the decision-maker will use game theory as a tool to assist his understanding of the strategic elements of the situation, given his appraisal of the skill of his troops and the chances that, say, the weather will cooperate.

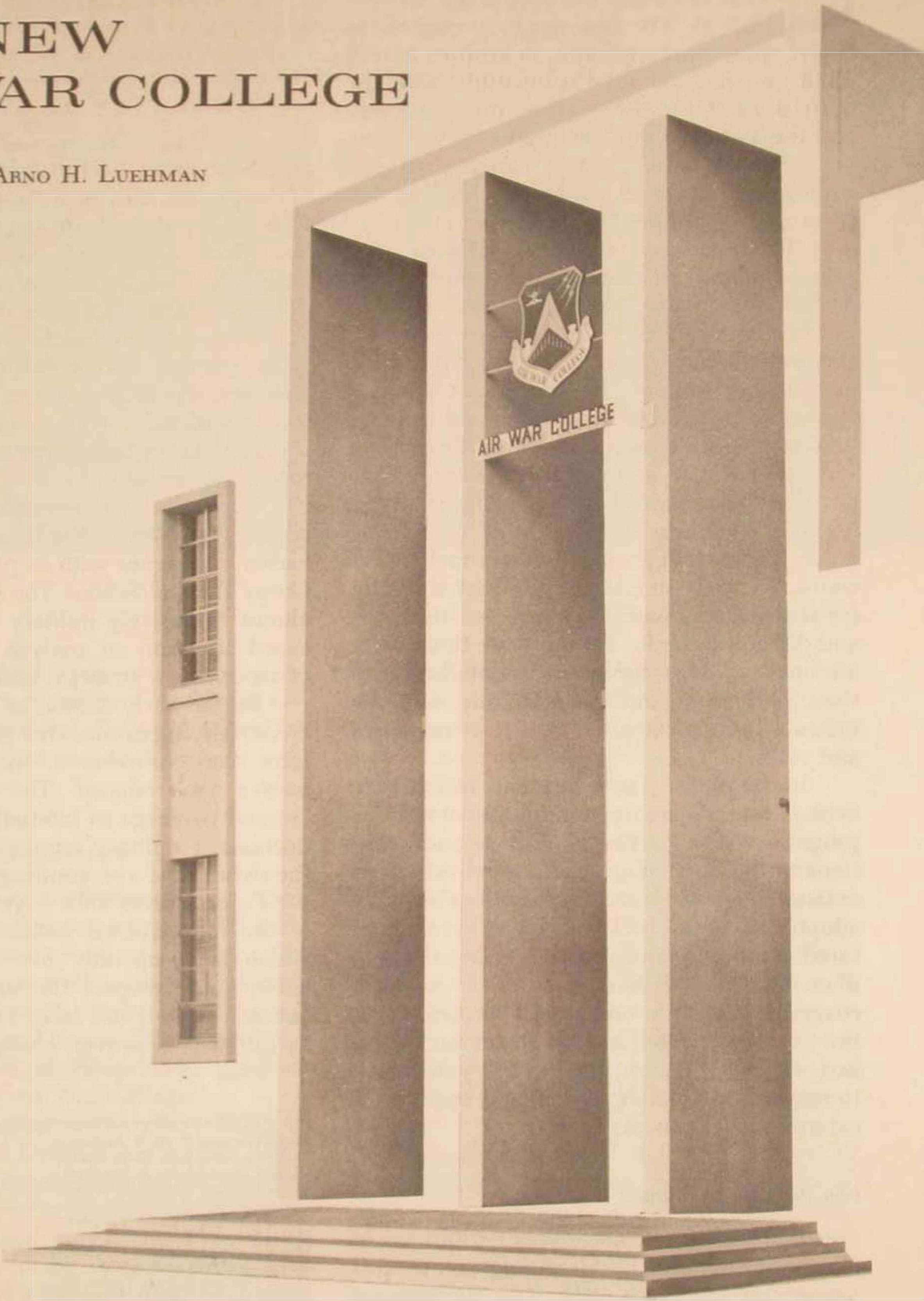
In the second place, use of game theory does not preclude a decision-maker from playing a hunch and adopting a certain course of action which the theory would stigmatize as "suboptimal." The point is that the intuitive decision-maker or commander who does play a hunch can now do so with a better understanding of the costs he will pay if he is wrong and the gains he will achieve if his hunch happens to be right.

This, then, is the central point. Analysis does not eliminate the "human factor"; rather, it puts the human factor in perspective. Analysis admittedly presumes rationality; but only by understanding the implications of this (admittedly) sometimes invalid assumption can the decision-maker hedge against the jeopardy which results if he or his opponent acts irrationally. Finally, analysis itself never makes a decision; all it can do is help the decision-maker to gain a better understanding of his problems and therefore make a more informed decision.

Headquarters United States Air Force

THE NEW AIR WAR COLLEGE

Major General Arno H. Luehman



SINCE ITS inception in 1946 the Air War College has undergone a continuous process of evolution to keep its curriculum and methodology compatible with the needs of the Air Force and the nation. To maintain the AWC program's relevance to the varying international scene, the changing national strategies, and the expanding technology has presented a considerable challenge to the planners. This challenge has been met, for the most part, by annual adjustments of the curriculum. A shift in emphasis, the replacement of some lectures with others, an updating of materials and assignments—these have been the typical innovations from one class to the next. In short, change at the AWC has been measured and evolutionary rather than spasmodic and sweeping.

Generally, it is preferable that an educational institution avoid abrupt changes in direction. "Make haste slowly" might well be its guide. Basic changes in a school's methods or courses of study should not be adopted hastily, for if proved unwise they may be disruptive and difficult to undo. Yet there are times when a school must re-examine its essential assumptions, philosophy, and purposes and make the indicated modifications if it is to remain vital and viable.

In the recent past it has been increasingly evident that a searching reappraisal of the AWC program was due. The alterations and accretions to the curriculum that had slowly accumulated over the years—each reasonable when adopted—had resulted in a somewhat unstructured and amorphous whole. Piecemeal curriculum change had tended to result in broad coverage of a wide range of subject matter at the expense of internal consistency and depth and without retaining the flexibility necessary to respond adequately to demands imposed by external developments.

two decades of change

The Air War College was established by General Order No. 11, Headquarters Air University, on 15 March 1946, with the mission:

> To prepare selected officers for the employment of large Air Force units to insure the most effective development of the Army Air Forces as a whole and to consider the broad aspects of air power.

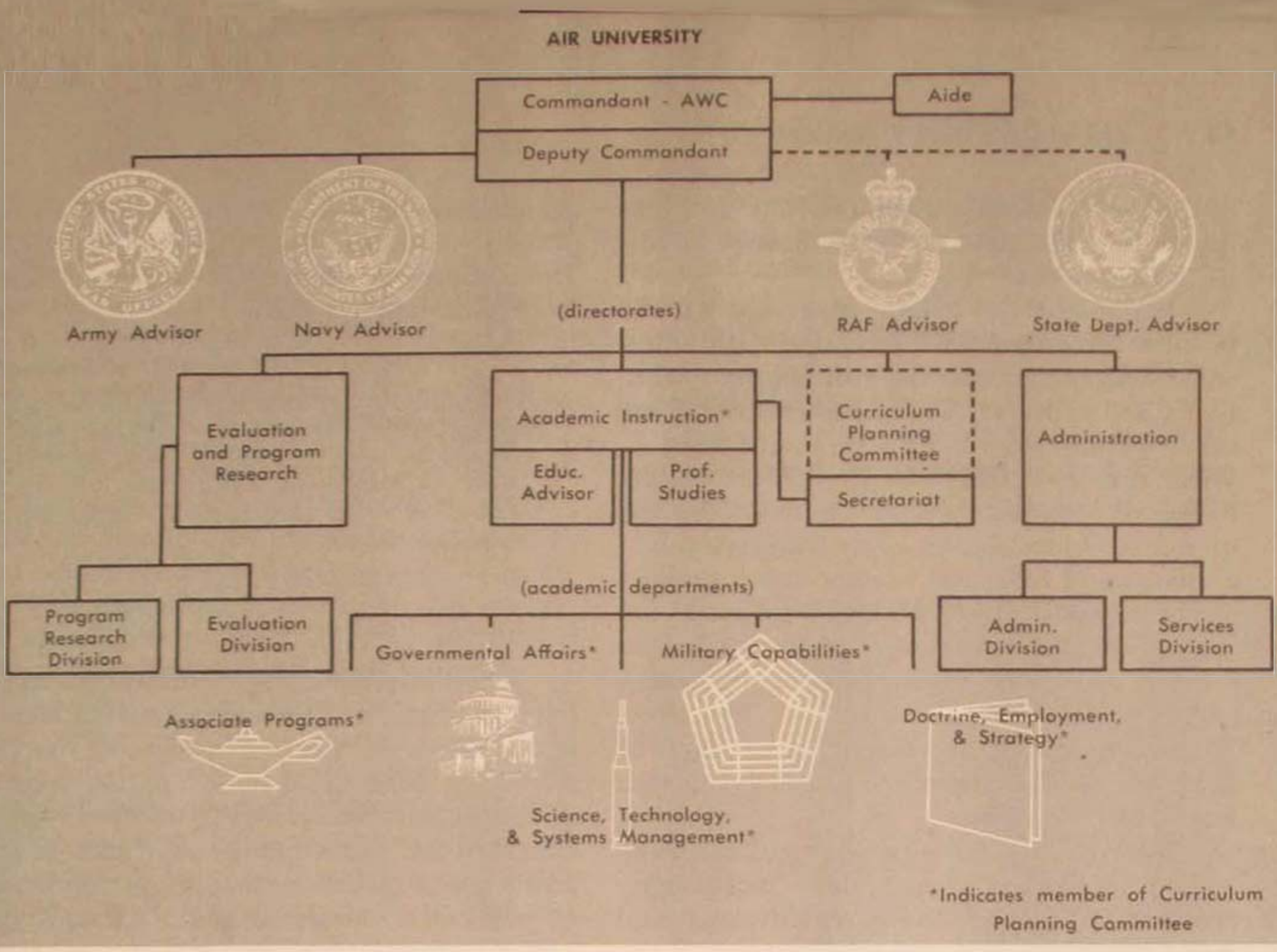
The school officially opened at Maxwell Field on 3 September 1946 in Austin Hall, the home of the prewar Air Corps Tactical School. Major General Orvil A. Anderson was appointed as first Commandant of the new institution.* Originally the AWC course was of nine months' duration. After two years it was extended to approximately ten months and has so remained to the present, except that during the Korean hostilities the 1951 class was first canceled and then reinstated as a six-month course. The following year the college restored its normal ten-month curriculum.

The early AWC curriculum was developed largely from World War II experience and from earlier experience with its predecessor, the Air Corps Tactical School. The subject matter was almost exclusively military in nature and focused attention on analysis and development of air doctrine, strategy, and tactics.

In the early 1950's, as studies in the increasingly important area of international affairs were introduced, the military subject matter was reduced. The trend toward increased coverage in international affairs, with decreasing military emphasis, continued into the sixties. The AWC continues to recognize that Air Force officers must have an understanding of the international political environment in which they operate, how national security policy is developed, the various elements of national power, and other subjects not primarily military. However, changes in the military

*Air War College Commandants:

Major General Orvil A. Anderson	1 Jun 46 – 1 Sep 50
Major General John DeF. Barker	5 Sep 50 – 1 Aug 51
Major General John A. Samford	2 Aug 51 – 17 Oct 51
Major General Roscoe C. Wilson	18 Oct 51 – 28 Apr 54
Colonel Robert J. Goewey	29 Apr 54 – 25 Jul 54
Major General Delmar T. Spivey	26 Jul 54 – 15 Jun 56
Major General Robert F. Tate	3 Sep 56 – 30 Jun 59
Major General Richard H. Carmichael	1 Jul 59 – 30 Nov 60
Major General Leo P. Dahl	1 Dec 60 – 31 Jul 62
Major General Robert Taylor III	1 Aug 62 – 13 Jun 64
Major General Arno H. Luehman	18 Aug 64 – Present



Air War College organization

profession, associated with the greatly increased complexity of military problems and tasks facing senior officers, dictate a redirecting of emphasis toward an essential body of military subject matter.

the changing military profession

Today's military professional must operate in a changed and changing scientific, technological, social, and political context. The military profession (as well as its political leadership) is going through a period of transition stemming from several irreversible trends bearing upon the kind of educational program appropriate for the Air War College.

The centralization of decision-making in the Department of Defense and higher levels of the government has made it more imperative than ever that senior Air Force officers be capable of developing and supporting proposals in a logical and convincing manner. More than ever the Air Force officer working at higher staff levels is required to present detailed, documented justification for Air Force programs, including their effect on other military programs, support requirements, cost analyses, and available alternatives.

The traditional roles of the component services have changed considerably. The development of unified, specified, and combined commands has placed a premium on the senior officer who can effectively serve as a commander or staff member of a joint or combined organization. While an Air Force officer in such an assignment requires an understanding of the other services, he must first—and more importantly—be an expert in the concepts and capabilities of the Air Force and aerospace power.

During the past five years the subject of technological change has been discussed so much that terms such as "technological revolution" and "scientific explosion" have become clichés. Nevertheless, since these advancements have taken place over a relatively short period of time, many of us are still not fully aware of the depth and extent of their influence on our lives and careers.

Rapid advances in technology which made possible thermonuclear weapons with ultrasonic delivery systems have in one sense simplified the military task. In another sense, these same advances have greatly complicated it. While it is now possible to apply force leading to vast destruction in a few minutes, the requirement to be able to apply the more subtle gradations of force has become much greater. Today the Air Force has to be prepared not only for general or total war but also for limited wars, so that a wide variety of weapon systems, tactics, and strategies is required. Therefore, the Air Force must develop a greater degree of flexibility in its approach to strategy, tactics, and weapon systems.

The military management and decision-making processes have become increasingly complex, requiring sophisticated analytical techniques and data automation systems. Moreover, the high cost of weapon systems has imposed significant restraints on the options available to the military decision-maker. These changes and trends have vital implications for the professional military education program of the Air War College.

Over the past several months the Air War College has conducted a critical analysis of where it has been, where it is now, and where it should be headed in the future. As a result, an integrated plan for its future development was prepared and is now being implemented. Fundamental changes in the mission, philosophy of education, objectives, curriculum content and emphasis, methodology, organization, and faculty selection and utilization have been adopted, to increase the responsiveness of the AWC to the changing needs of the Air Force and the military profession.

mission

Throughout the two decades of Air War College operation, the basic mission of the institution has undergone several restatements. The current concept of the AWC mission recognizes that although senior officers need an understanding of all elements of power, they are primarily concerned with the military aspect. That concept is reflected in the present statement of the AWC mission:

> To prepare senior officers for high command and staff duty by developing in them a sound understanding of military strategy in support of national security policy in order to insure an intelligent contribution toward the most effective development and employment of aerospace power.

philosophy of education

The AWC philosophy of education is formulated in terms of the changing environment in which senior Air Force officers must function. The AWC believes that the nation requires strong military forces led by officers who are educated and trained in the profession of arms and whose function is the ordered application of military resources to attain national goals and objectives. Professions are founded on the mastery of a body of knowledge and its expert application. The Air War College must give its students the opportunity to master the professional military subject area essential for competent performance of duty at the highest command and staff levels. AWC's concern is not specialty training but rather the exploration and development of knowledge, skills, and attitudes significant to the profession of arms, particularly aerospace power.

The Air War College student is a mature and successful officer who has a demonstrated potential for higher levels of responsibility in his profession. He is entering the most significant phase of his career. Upon leaving the Air War College he will continue to be occupied principally with the military profession itself—the preparation for orderly application of force to accomplish national objectives. Fundamental to this task is the requirement to develop a high degree of flexibility in weapon systems, tactics, and strategy in order to control the escalation of conflict under a wide variety of international situations. More than ever before he must be an intelligent, flexible, and adaptable individual who can play his full part in the overall defense structure unhampered by convention or preconceived ideas. He must be intellectually honest and articulate and trained in logical mental processes. He must constantly strive for increased professional competence and practice a code of highly ethical and moral behavior.

In dealing with this high-caliber, high-potential student, the Air War College uses a variety of instructional methods for challenge and motivation. Whatever the method, intellectual freedom and open discussion are encouraged and nourished. The program calls for thorough, analytical examination and evaluation of competing points of view and diverse military doctrines, policies, and strategies.

Essential, critical areas are studied in depth, rather than giving cursory coverage to a wide range of subject matter. The AWC concerns itself with principles, concepts, strategies, theories, and criteria for the development and employment of aerospace forces and with those attitudes and skills necessary to the application of these factors in the total spectrum of conflict. Aerospace power is studied in the context of total U.S. military power, which implies an appreciation and understanding of the roles of other U.S. services in the total defense structure. The curriculum includes treatment of the objectives, doctrines, capabilities, and related problems of allied and potential enemy forces. Other nonmilitary areas are covered when essential to comprehension of the primary body of military knowledge. Emphasis is placed on analysis and evaluation of military concepts and doctrine, as opposed to the mere acquisition of knowledge. AWC fosters in its students development of the capacity to weigh evidence, critically evaluate conclusions, and select sound courses of action affecting national security. They are guided in developing sufficient flexibility to devise and consider a wide variety of strategic concepts. Maximum individual responsibility and initiative are encouraged in each student. Students and faculty examine current and future Air Force problems in depth with a view to contributing to solutions.

The school maintains an atmosphere in which each student is challenged to achieve the maximum growth of which he is capable. The students are guided, taught, and counseled by a knowledgeable and competent faculty of professional officers with extensive knowledge and experience in appropriate subject matter areas. As officers, teachers, researchers, and contributors to professional military knowledge, the faculty is a source of motivation and inspiration to the students.

The AWC accords importance to evaluating the effectiveness of its programs and the performance and achievement of its students.

Guest lecturer General Jacob E. Smart fields a student's question.

Seminars in action

High standards of excellence are established and maintained. Progress toward established program goals is measured. The evaluation system aims to identify those officers who demonstrate outstanding performance and achievement and those who do not perform or achieve at an acceptable level.

As specific objectives, the AWC prepares its graduates to understand the causes, purpose, and nature of war; understand current and potential threats to the security of the United States; know how national security policy is formulated; be capable of developing, evaluating, and applying aerospace concepts in support of national security policy; understand how military concepts, doctrine, and strategy are developed; be capable of evaluating doctrine, responsibilities, capabilities, and limitations of U.S., allied, and potentially hostile military forces; know how the techniques of systems analysis apply in the military decision-making and management process; understand the impact of science and technology on current and future military concepts, doctrine, and strategy; and be capable of performing effectively as articulate advocates of aerospace power and as members of joint, unified, or combined staffs. Further, by providing a program of intensive study and research by students and faculty, the AWC as an institution assesses current trends and from them projects implications for the Air Force beyond the current planning cycle and thereby makes an effective contribution to military concepts, doctrine, and strategy.

the course of instruction

The curriculum which has been developed to implement the AWC mission, philosophy, and objectives is divided into seven major subject areas:

I – National Policy in the Nuclear Age. Treats of the elements of power and international affairs, that is, the world environment in which the military professional operates.

II – Theory of War. Looks at the history, nature, and social impact of war.

III – The Military Threat. Involves an intensive study of potential enemy military forces and, in particular, their capabilities, limitations, doctrines, and strategies.

IV – U.S. National Policy. Examines U.S. national objectives and policies and their formulation, which U.S. military policies and strategies must implement.

V – Military Decision-Making. (Largely new this year for AWC.) Covers systems analysis, war gaming, cost effectiveness, computer theory, and other analytical decision-making techniques.

VI – Military Capabilities. Includes an analysis of U.S. and allied military capabilities by functional forces, with particular emphasis on aerospace power, and an examination of the organization of the Department of Defense for force employment as well as for administration and support.

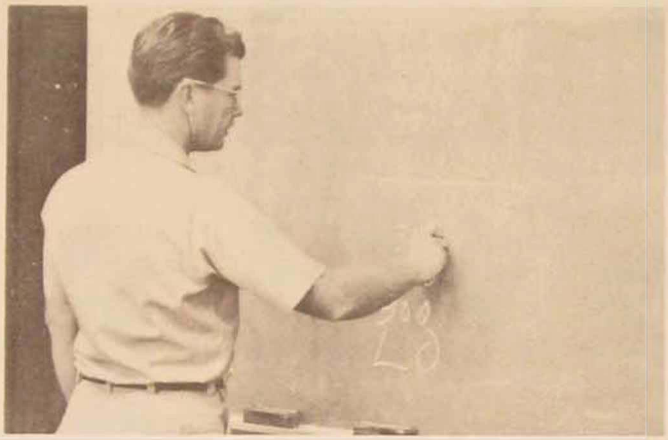
VII – Military Strategy—Current and Future. Deals with current strategy throughout the conflict spectrum, again with emphasis on aerospace power, and gives the student the opportunity to analyze, evaluate, synthesize, and devise alternative future military concepts, doctrines, and strategies.

The military emphasis of the curriculum is indicated by the approximately 78 percent coverage of primarily military subject matter and 22 percent that is essential and directly supporting but not primarily military. The seven curriculum areas are functional and not necessarily separate phases of instruction. The overall curriculum is designed to be internally consistent, forward-looking, and interdependent, with continuity and cohesion throughout. Each phase of instruction builds on and uses as basic inputs the knowledge gained in preceding phases.

methodology and the role of the faculty

To present the new curriculum, Air War College has made substantial modifications in the instructional methodologies traditional here and at other senior service schools. In the

Reading and research



Student presentations

past by far the most prominent feature of AWC methodology has been the guest lecturer program. Each academic day typically has seen a formal presentation by an outside lecturer. Over the years the AWC has been able to acquire the services of a wide variety of distinguished authorities at a relatively low cost to the Air Force. No institution's faculty could ever contain such a rich variety of talent. However, stimulating though these guest speakers certainly are, too much reliance upon them can present several disadvantages: they can take up an inordinate amount of available student time; student participation is largely passive; and we may not achieve the desired degree of resident faculty control in insuring highly integrated and meaningful learning experiences directly responsive to established objectives.

The new AWC curriculum, therefore, features fewer formal lectures and a corresponding increase in student activity and application of acquired principles. Formal lectures will be more frequent in the early phases of the course. In addition, resident faculty members will present more of these lectures, as is consistent with the increased military emphasis and in order to insure meaningful continuity throughout the course.

The greater teaching responsibility of the resident faculty likewise will carry over into the seminars. In the past, the seminars have been largely student-led, with the faculty member in a monitor or adviser status. Postlecture discussion seminars now will be chaired by faculty members, whose primary task is to ensure that the purpose and scope of the lectures and assigned readings are achieved and that the desired learning outcomes and objectives are attained.

The number of problem-solving seminars —with this same student/faculty composition— will increase. These groups are constituted for the specific purpose of achieving individual and group solutions to selected credible, relevant, and meaningful problems designed to support and contribute to a better understanding of the subjects in the formal curriculum. These will include case studies, current topical studies, and hypothetical problems requiring the exercise of newly acquired knowledge and techniques.

The traditional requirement for the AWC student to produce a graduate-school type of thesis has been discontinued in favor of a more relevant, dynamic, and productive Professional Studies Program. In this program, students and faculty with common research interests will be grouped together to undertake individual and group research projects dealing with real, current, and anticipated Air Force problems. This program is fundamental to the full achievement of curriculum objectives, and students will devote a significant portion of their time to it. In addition to accomplishing the educational objective of teaching the student to organize and treat with complex research and study projects, the time devoted to this program by hundreds of AWC students should aid in solving vital problems facing the military profession. Appropriate research topics are solicited from major air commands and are coordinated with other studies in related areas.

Throughout the academic year the student

Proficiency flight planning

is given ample opportunity to develop his communicative skills—oral and written—through individual and group problems for which he must develop, articulate, and present solutions.

evaluation

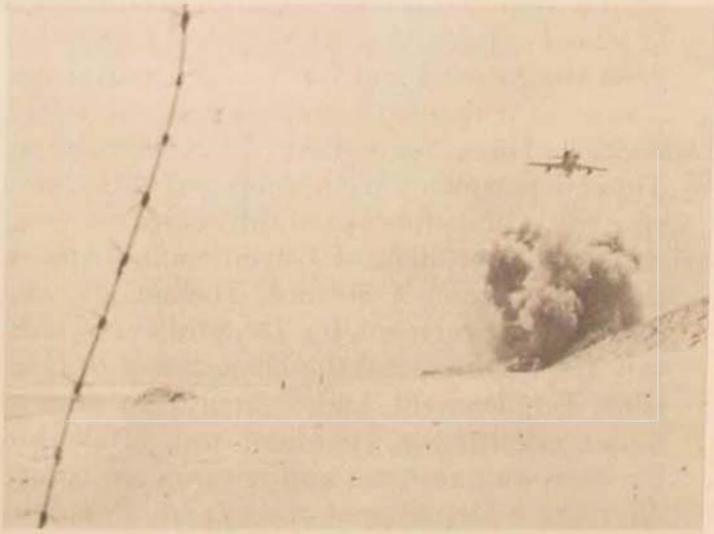
Evaluation plays an increasingly important part in developing and implementing the revised program. A curriculum evaluation system measures the progress toward established educational objectives and assesses the selection and organization of learning experiences to attain these goals. Inputs appertaining to the effectiveness of the overall curriculum are constantly fed into the evaluation machinery from the AWC staff, faculty, student body, and alumni, from higher headquarters and major commands, and from various boards, visitors, and consultants. These data are collated, analyzed, and evaluated, and they have an immediate and continuing effect in the curriculum planning cycle.

Individual student accomplishment and progress are measured throughout the course. Each student is evaluated on relevant traits and abilities by as many as eight different faculty members during the year. Such a system provides student motivation, assists the student in self-analysis, and identifies and gives recognition to the outstanding student as well as those who need special counseling and guidance in order to achieve maximum potential. Additionally, the student evaluation system produces data required to provide a meaningful personnel training report relative to the officer's achievement, capability, and potential in areas that are of vital concern to the Air Force and will particularly assist in future personnel actions.

the student body

The AWC student body has increased from 71 in the initial class to 284 in the current twentieth-anniversary class. This present class is composed of 231 U.S. Air Force officers; 16 U.S. Army officers; 10 U.S. Navy officers; 6 U.S. Marine Corps representatives; 1 U.S. Coast Guardsman; 4 Royal Air Force officers; 1 Royal Canadian Air Force officer; and 15 civilians from various U.S. governmental departments. With few exceptions, the students are lieutenant colonels or equivalent. They average 42 years of age and typically have 19 years' promotion-list service. Over 75 percent saw service during World War II, 44 percent were in the Korean conflict, and 4 students have served in Viet Nam. Approximately 77 percent hold aeronautical ratings. Over 90 percent of the Air Force members have some college, 64 percent have bachelor degrees, 24 percent master's degrees, and 14 percent doctor's degrees or other advanced graduate work.

Orientation trip, SPECEX-65



The class members represent virtually all commands, skills, and career areas. This great diversity is capitalized upon in seminar groupings. Students are assigned to seminars in accordance with a nonrepeating matrix which provides representation consistent with overall class makeup, taking into consideration the various skills, background, experience, and parent service of individual students.

The high quality of the Air War College as an institution is recognized and is enhanced by the high degree of selectivity of the student body. Students are selected by a Headquarters USAF Central Senior Service School Selection Board. Since only a small percentage of officers can be afforded the opportunity of attending AWC, those chosen represent the cream of the Air Force lieutenant colonel population. Eligible are outstanding lieutenant colonels with between 15 and 21 years' promotion-list service, not over 44 years of age, and a pattern of past performance that clearly demonstrates maximum potential for growth, future advancement, and increased responsibility. The record of achievement and success of AWC graduates is highly gratifying. From the students of today, indeed, will emerge the leaders of the Air Force during the next decade.

organization

The fundamental change in the role of the AWC faculty member, from primarily an administrator, planner, and monitor of the educational program to a teacher and research resource, required a corresponding modification in school organization. The resident faculty has been reorganized into functional departments, consistent with major curriculum subject areas, within a Directorate of Academic Instruction. These departments, each composed of teaching specialists in its functional subject matter area, are the Department of Governmental Affairs, the Department of Science, Technology, and Systems Management, the Department of Military Capabilities, and the Department of Doctrine, Employment, and Strategy. To achieve better consistency, cohesion, and parallelism between AWC resident and nonresident course offerings, a Department of Associate Programs likewise has been placed under the Director of Academic Instruction. Continuing detailed curriculum planning is accomplished by a Curriculum Planning Committee, headed by the Director of Academic Instruction, with the heads of the functional departments as members.

Organizational support, facilities, personnel, and other planning are performed on a normal military staff basis. A Directorate of Evaluation and Program Research is responsible for evaluation of students, curriculum, and the overall program and for institutional research. This staff agency constantly analyzes and assesses the educational program of the college and provides the commandant with timely data and recommendations for change as appropriate.

The quality of an educational institution is directly dependent upon the quality of its faculty. The AWC is no exception, and it has been fortunate to have had many outstanding officers assigned. The current AWC faculty represents a wide cross section of Air Force skills and experience. The typical faculty member is a colonel, 47 years of age, with 26 years' promotion-list service; 75 percent of them are rated. Eighty-four percent have master's degrees; 14 percent doctorates. Graduates of all the senior service schools—National War College, Industrial College of the Armed Forces, Army War College, Naval War College, and Air War College—as well as allied and subordinate service schools are represented on the AWC faculty.

The requirement for top talent is obvious and becomes even more so in view of the trend in faculty utilization and duties. The Air War College requires more specialists to accomplish effectively the teaching-research role. Thus, expertise in one of the major subject areas of the curriculum will receive major consideration in identification and selection of potential faculty members.

Air War College and the future

These, then, are the highlights of the *new* Air War College. Fundamental and dynamic changes have been and are being made throughout its educational program. The curriculum is one of increased depth and greater military emphasis. Methodology features increased instruction by the resident faculty, increased student activity, application of newly gained knowledge to credible problems in the context of today's real world, and a vital and productive Professional Studies Program. The faculty, composed of teaching specialists, is organized into functional departments. A curriculum and student evaluation system provides the feedback required to stay abreast of changing needs.

Continuing trends which will have major impact on the college include the exponentially advancing science and technology which result in fantastically destructive weapons of enormous range, vast cost, and rapid obsolescence; the necessity for maintaining military forces in a high state of readiness over long periods of time, responsive more and more to centralized political control; the requirement to react to all gradations of tension and confrontation in situations short of general war; the political instability of emerging nations constantly under the threat of Communist insurgency and "wars of national liberation"; and the proliferation of nuclear weapons both within and outside our alliances. These, I think, are the main ones.

The *new* Air War College is in-being. The changes described have largely been accomplished; those remaining will be phased in at the earliest practicable time. Members of the college—staff, faculty, and students—enthusiastically implement these changes. The results to date have been gratifying.

In the future we envision an even better Air War College—one keeping pace with developments in the aerospace age and continually "preparing senior officers for high command and staff positions" at whatever level of complexity may be required to preserve, protect, and defend the nation.

Air War College

...anomalous display of auroral activity appeared in unusual intensity, degrading the performance of detection systems

HIGH-ALTITUDE NUCLEAR EFFECTS

Lieutenant Colonel John E. Mock

An unmarked submarine surfaced under cover of darkness in the South Pacific, fired three missiles vertically overhead, then submerged, its mission completed. This same act was repeated within a short period of time both in the South Atlantic and in the north polar region. Although the United States Government was unaware of the fact, World War III had just started.

Within a matter of minutes many communication links spanning the Atlantic and Pacific slowly went out. Only transoceanic cables and circuitous radio routes gave reliable service. The flow of normal military communications was seriously impeded; a backlog of messages started to build up.

Ballistic missile early-warning system (BMEWS) *operators began to curse the anomalous display of auroral activity which suddenly appeared in unusual intensity, degrading the performance of their detection system. The transmission from a satellite slowly faded as its equipment failed.*

None of these effects was wholly unfamiliar, since nature with its magnetic storms, auroral activity, and solar flares frequently produces intense disturbances which cause degradation of communications and low-frequency radar systems. There was no reason for the radar or communications operator to suspect that the drop-off in performance of his system was attributable to other than natural causes, no reason to suspect that these effects had been induced by high-altitude nuclear bursts skillfully placed by an enemy attempting to gain the element of surprise in his war plan.

During the ensuing confusion the enemy launched an all-out attack.

TO GAIN an understanding of the enemy's strategy, let us shift back to 1958, the dawn of a new era in weapon effects. That is the year in which the first high-altitude nuclear tests were conducted. On 1 August 1958 a megaton nuclear burst (code name TEAK) was detonated 252,000 feet above Johnston Island. This was followed eleven days later by shot ORANGE, 141,000 feet above Johnston. The results of these two shots were startling and extremely significant. Communication links in the central Pacific were blacked out for several hours. Explorer IV instrumentation detected charged particles trapped in the earth's magnetic field. Visible auroral effects were noted at Apia, in the Samoan Islands, more than 2000 miles from the point of burst! A hydromagnetic wave traveled around the world.

These tests were quickly followed by the Argus series conducted during late August and early September at a nominal altitude of 300 miles above the South Atlantic. These small kiloton bursts resulted in auroral displays (noted over the Azores at the northern magnetic conjugate point) and in considerable trapping of charged particles in the earth's magnetic field.

During the 1961–62 U.S.S.R. and U.S. nuclear test series, each side conducted several high-altitude tests to investigate further the effects of such bursts. These nations had now gained the capability of duplicating some of nature's most powerful disturbances.

the ionosphere

Before discussing the effects of high-altitude nuclear bursts, let us briefly review the structure of the ionosphere, i.e., the ionized region which surrounds the earth. In the early 1900's, with radio transmission in its infancy, anomalous long-range radio propagation was explained by postulating the existence of an ionized layer at high altitudes. In recent years, direct measurements by rocket probes, satellites, and sounders have confirmed the existence of such an ionized region.

The ionosphere can be somewhat arbitrarily divided into three regions, the D, E, and F regions, which are most readily characterized by their daytime peak ionization densities and the altitudes at which these peaks occur.

Layer	*Altitude (kilometers)*	*Electron Density (electrons/cc)*
D	80	10^3
E	120	10^5
F	300	10^6

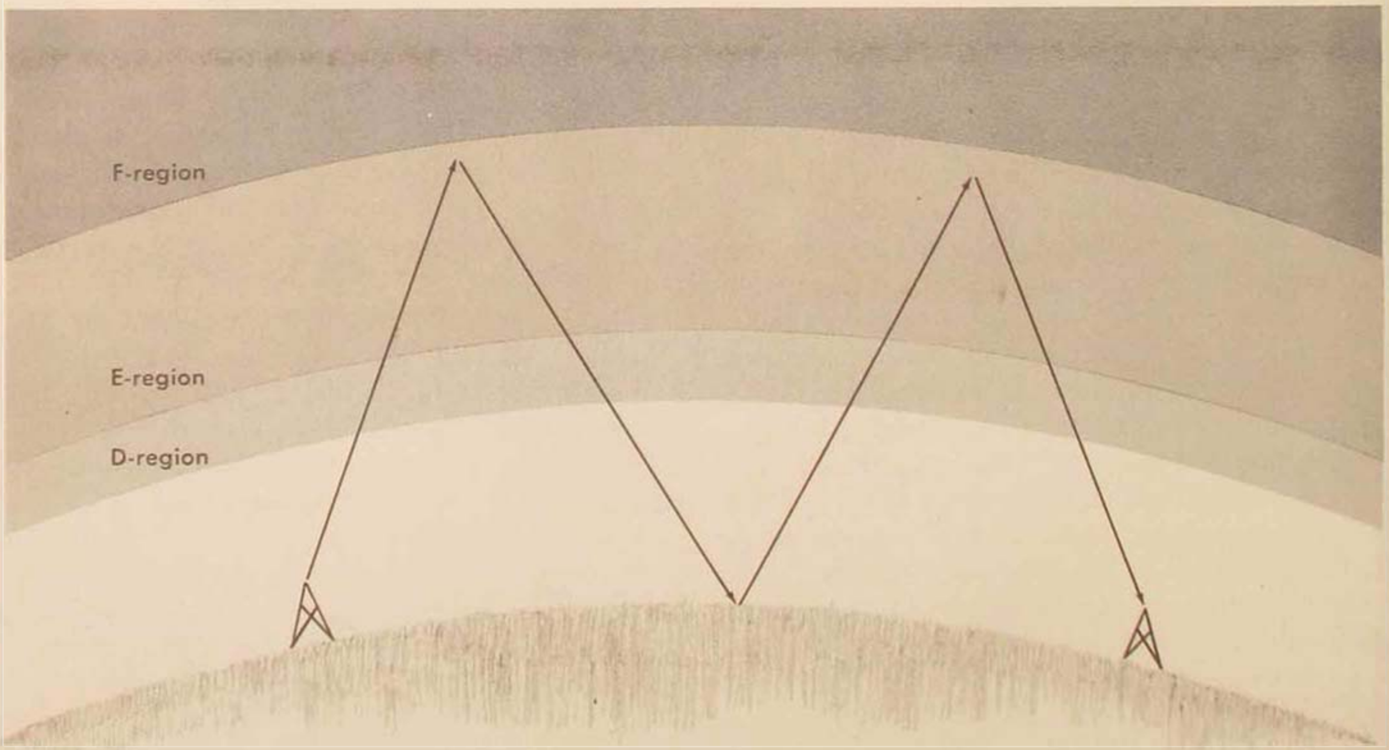
These layers are created primarily by solar radiation and to a lesser extent by cosmic radiation. In general, the ionized layers tend to disappear on the nighttime side of the earth, except for the upper F-region, which, because of its low particle density, loses its ionization very slowly.

An ionized region is capable of refracting and reflecting electromagnetic waves (which includes both radio and radar waves). The bending of radio waves by the ionosphere, as shown in Figure 1, is the basis of our ability to communicate over long distances. In general, higher-frequency radio signals are reflected from the regions of highest electron density, i.e., the F-region. The normal ionosphere has little effect on radar waves, which typically have a much higher frequency than radio waves; hence they will not be reflected but will pass on out into space.

phenomenology of high-altitude bursts

Let us now digress for a moment to discuss the phenomenology of high-altitude bursts and the interactions between the bomb-produced radiations and the earth's atmosphere and ionosphere. Probably the one parameter of most significance in characterizing these interactions is the depth of penetration into the earth's atmosphere attained by the fission debris and the various radiations emitted by a weapon in free space. For this purpose we shall somewhat arbitrarily define the stopping

Figure 1. VHF communications link



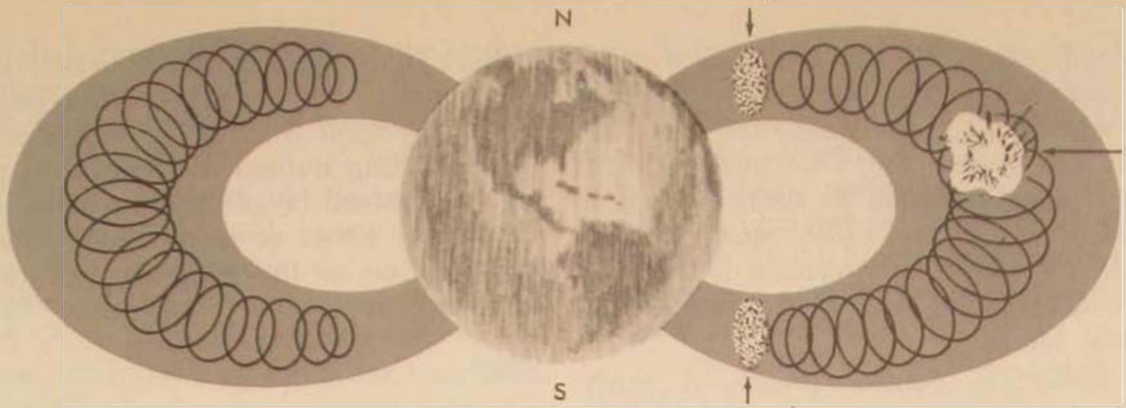


Figure 2. High-altitude nuclear effects, showing trapped radiation belt encircling the earth

region of these penetrating particles as that region in the earth's atmosphere where their horizontal mean free path is equal to one atmospheric scale height (the vertical geopotential distance within which the density changes by a factor of 2.72). Specifically, the penetration depths are as follows:

fission debris	150 kilometers
X-rays (4 kev)	80 kilometers
beta particles (1 mev)	60 kilometers
gamma rays (3 mev)	30 kilometers
neutrons (1 mev)	30 kilometers

As these energetic particles and radiations are slowed down and ultimately absorbed in the surrounding atmosphere, they produce intense ionization. It is this resultant ionization which is responsible for the degradation of radio propagation.

Consideration must also be given to the interaction between charged particles and the earth's magnetic field, which exerts forces on them so that they are constrained to travel in helical paths along the field lines. Because of the convergence of the earth's magnetic field lines, many of these particles bounce back and forth between the northern and southern magnetic conjugate points, as shown in Figure 2. Superimposed on this motion is a longitudinal drift, electrons and other negatively charged particles drifting eastward while protons and positively charged particles drift westward. A trapped beta particle can drift around the earth in from half an hour to several hours, depending upon its energy. In this manner the beta particles emitted from the nuclear burst can establish a radiation belt around the earth similar to the natural Van Allen belts.

The charged bomb particles that are emitted approximately parallel to the earth's magnetic field lines will travel into the two magnetic conjugate regions, producing brilliant auroral displays and intense ionization as they perturb the atmosphere at these widely separated points. Thus there are three key regions in which ionization effects may be critically important, the burst region and the northern and southern (magnetic) conjugate regions.

communication links

Communication links which depend completely on sky wave propagation (i.e., which depend upon reflection of the transmitted wave by the ionosphere, as shown in Figure 1) can be seriously degraded and even blacked out by high-altitude nuclear explosions. Figure 1 is an idealized diagram of a long-range VHF communication link reflected twice from the F-region of the ionosphere. There are several critical points at which such links are especially vulnerable:

• Absorption control regions. The combination of electron density and high particle density in the normal daytime D-region causes absorption of radio waves passing through. (Although the electron density is higher in the E-region, the neutral particle density has dropped off sufficiently that absorption is far less serious than in the D-region.) Thus the regions where the radio wave intersects the D-region are called the absorption control regions. If the ionization in these regions is increased by any means, radio signals traversing them will be strongly absorbed, resulting in total blackout over large geographical areas for several hours.

• Reflection control points. A fairly smooth surface is required at the point in the ionosphere where the radio wave is reflected, else the wave will be diffusely scattered or reflected at an unfavorable angle. In either case, reception at the receiving station will be very poor or nonexistent. If for any reason the ionization in the reflecting layer becomes depleted, the radio signal will pass into space and will not be received at the terminal station.

High-altitude nuclear bursts can be used to exploit both of these vulnerable regions. As depicted in Figure 3, any burst that enhances the D-region ionization will cause serious absorption of signals passing through. It is also possible (as was demonstrated by TEAK) to initiate hydrodynamic shock waves that will "sweep out" the ionization from large areas in the F-region. Such areas will be incapable of supporting normal communications until a smooth ionized layer has been re-established. Obviously either of these effects alone, or a combination of the two, can be very detrimental to sky wave propagation.

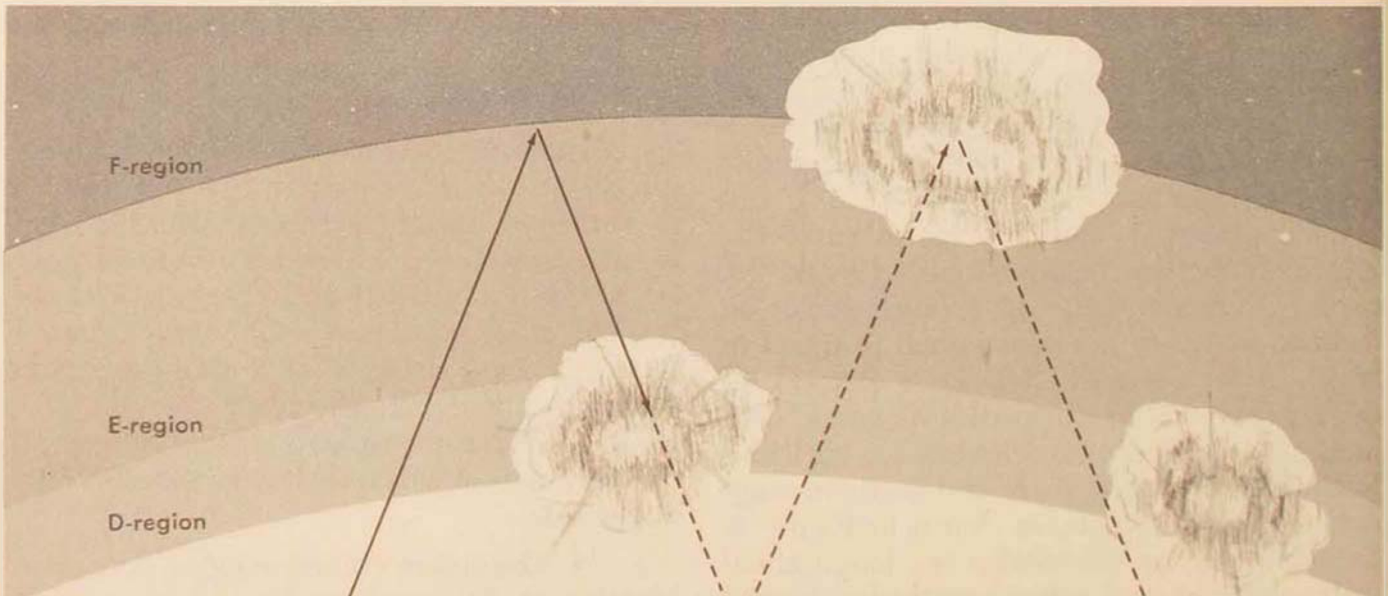
radar

Radar performance can be degraded by high-altitude nuclear bursts in several ways:

Absorption. A highly ionized plasma, such as the nuclear fireball, can cause severe absorption of a radar wave passing through it. If the radar wave after being reflected from a target (such as a re-entry vehicle) must make a return passage through this ionized region, it may be completely absorbed.

Reflection. Above a critical electron density, a radar wave will no longer penetrate an ionized region but will be totally reflected. Thus the nuclear fireball may act for several seconds as a mirror-like reflector hiding all objects lying on its far side. As the electron density

Figure 3. Communications blackout, indicated by broken line



in the fireball gradually falls below the critical value, absorption effects will still be serious, resulting in several additional seconds of radar blackout.

Refraction. Because of electron-density gradients both inside and immediately surrounding the fireball, radar waves traversing these regions will have their propagation paths distorted. In such a case the apparent target position as determined by the radar may have a considerable angular displacement from the true target position.

Noise. Both thermal noise emanating from the fireball region and synchrotron noise produced by the beta particles trapped in the earth's magnetic field can cause degradation of radar system performance, especially where the signal-to-noise ratio of the system is already marginal.

These, then, are the problems which high-altitude bursts impose on the already difficult intercept problem for an anti-ballistic-missile (ABM) system. Obviously the problems of early warning, discrimination, and precision tracking have been made more difficult by the possibility of high-altitude nuclear effects.

satellites and manned spacecraft

High-altitude nuclear bursts can produce intense ionization belts surrounding the earth. This fact was demonstrated by the 9 July 1962 nuclear test STAR FISH, a megaton burst at 400 km altitude. According to Professor Harrie Massey, "the fact that the intensity of the radiation belt produced is high was dramatically demonstrated by its effect on the satellites Ariel, Transit IV-B, and Traac. In all cases the data transmissions from these satellites became intermittent or ceased altogether."

Here, then, is a technique which could be used during a cold or hot war to seriously hamper the enemy's use of manned spacecraft or surveillance satellites in near-earth orbit. The following factors should be noted in conjunction with the possible use of this technique:

a. There is no intention of destroying or damaging the enemy vehicle by blast damage; the damage is all produced "accidentally" by the trapped radiation.

b. The burst point, i.e., the point of injection of the charged particles into the geomagnetic field, could be directly over one's own country, thus avoiding to a large extent international complications.

c. Such bursts can be reasonably justified as tests vital to national defense.

To a certain extent, it is possible to shield a space vehicle against such trapped radiation; but if the radiation belt is sufficiently intense, it can make the amount of shielding required to protect the vehicle so heavy as to render the mission uneconomical or so short-lived as to be perhaps not worth the effort.

HIGH-ALTITUDE nuclear effects have introduced a new dimension into strategic planning and have already pushed the frontiers of military operations into outer space. A strategic capability now possessed by any nation having a combined nuclear and missile technology is the ability to degrade the performance of enemy radar systems and long-range sky wave communication links. If suitable use is made of conjugate-area effects, it is possible to cause harassment of the enemy by detonating nuclear weapons over international waters thousands of miles from the target area. In addition, it is possible to limit severely the use of near space (300 to several thousand kilometers altitude) by manned spacecraft as a result of the unacceptably high radiation levels that can be produced by high-altitude bursts. Even unmanned spacecraft would experience extremely difficult shielding problems, especially if sensitive electronic or photographic materials were involved. In the future these effects must be weighed appropriately in both offensive and defensive strategies. Any neglect to do so could lead to serious consequences.

United States Air Force Academy

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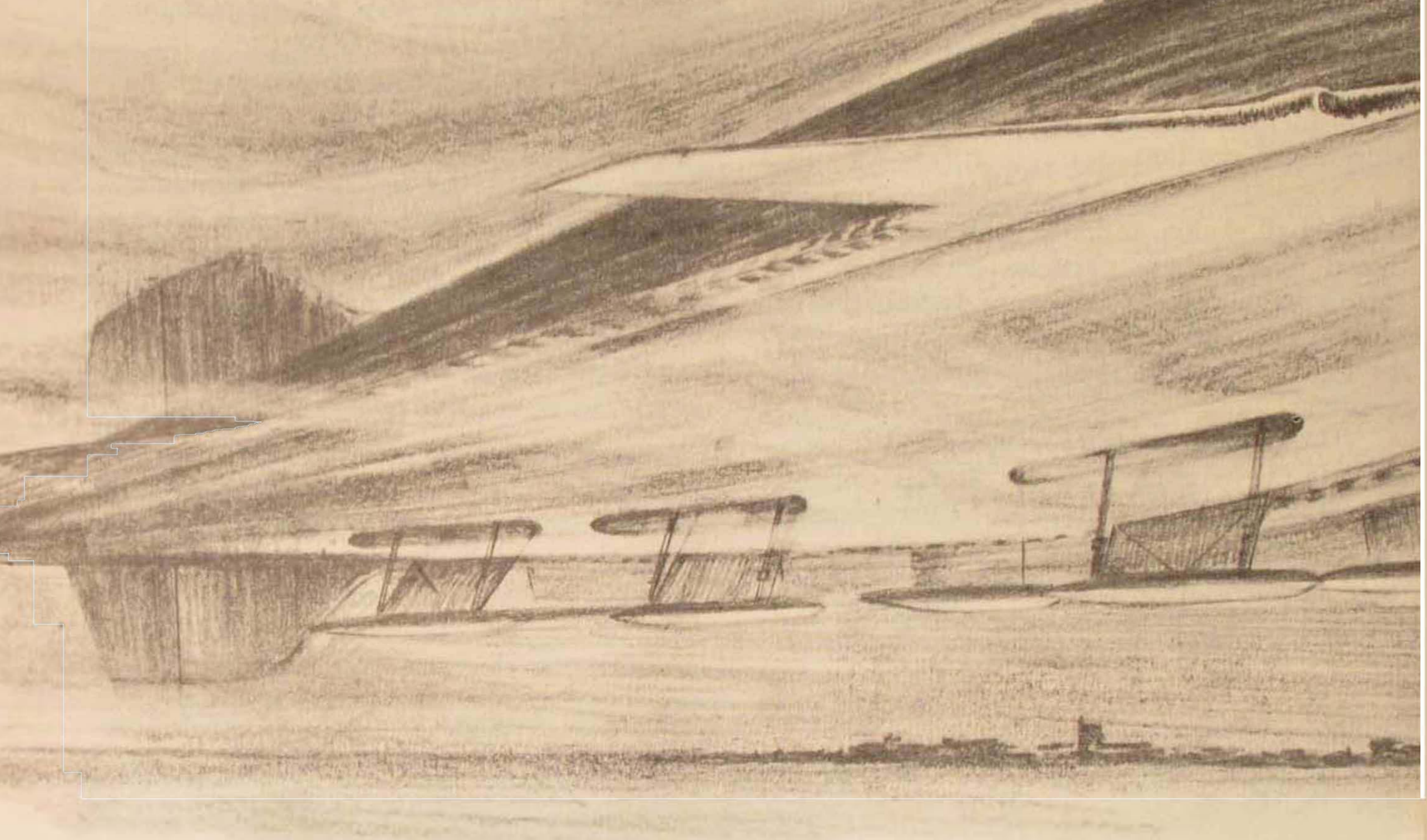
THE DIRIGIBLE–A RECONSIDERATION

Major John H. Scrivner, Jr.



Nosing down out of the low-hanging clouds over Lakehurst Naval Air Station, New Jersey, on a rainy evening in May 1937, the giant German dirigible *Hindenburg* prepared to moor. The inbound passenger manifest showed every space filled. Waiting on the ground below was another capacity crowd, counting on the sleek airship to deliver them to London in time for the coronation of George VI.

With its powerful engines at idle, the *Hindenburg* paused less than a hundred feet off the ground. Lines were dropped to the upraised hands of the waiting ground crew. At that moment a spark of static electricity ignited some escaping hydrogen, and a tongue of flame appeared at the top of the airship just forward of the upper stabilizing fin. In thirty seconds the entire hydrogen-filled envelope was a mass of flame. One of photographic history's most famous pictures was snapped as the fiery *Hindenburg* settled, stern first, to the

sandy ground below. As darkness closed upon the twisted, smoldering wreckage that had been the world's largest and finest dirigible, the era of the airship ended.

Under construction at the Zeppelin works in Friedrichshafen, Germany, at the time of the crash were two successors to the *Hindenburg*. Neither the nearly completed L.Z. 130 nor the super dirigible, the L.Z. 170, ever flew. Both apparently were destroyed during the Allied offensives of World War II. No dirigible has been built since. Yet now, from Friedrichshafen, comes the announcement that these graceful grand dames of the air are being considered again as a possible solution to the problems of booming tourist and cargo transportation in the space-age world.[1] Incongruous as it seems in this age of moon shots, those floating queens of the sky may once again provide a glamorous aspect of flight as well as a practical answer to the rapidly increasing need for dependable, prompt, and inexpensive transportation to the remote corners of the earth.

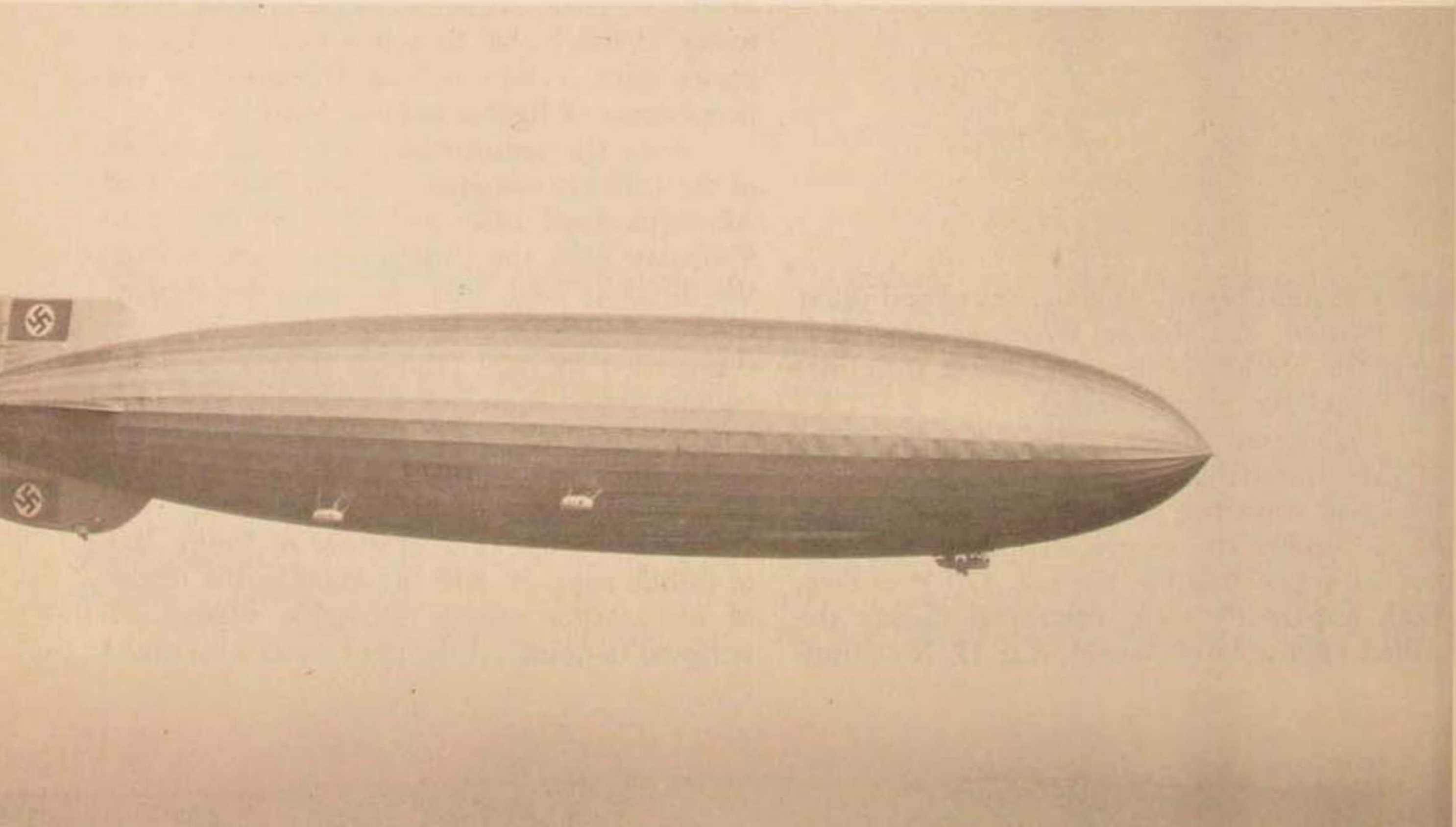
A new generation of dirigibles is not a radical concept. Yet in the day of supersonic travel and bigger and better rockets the relatively slow dirigible would appear to be an anachronism. Public acceptance of the outcast lighter-than-air rigid dirigible remains, at best, uncertain. In the interval since the crash of the *Hindenburg* a few Americans have been championing the return of the dirigible, including Vice Admiral Charles E. Rosendahl, USN (Ret), Paul W. Litchfield of Goodyear Aircraft Corporation, Captain Eddie Rickenbacker, and various aviation writers. For the most part, they have been fighting a losing battle. More recently Edwin J. Kirschner, in his fascinating book on the history of lighter-than-air and its future possibilities, has presented a telling argument for a super dirigible designed to surpass anything previously built.[2] Much in their argument makes good sense today. If this be so, then it is time the United States gave a fair, unbiased hearing to the proponents of lighter-than-air vehicles.

After the unnecessary and tragic crashes of the USS *Shenandoah* in April 1925, the USS *Akron* in April 1933, and the USS *Macon* in February 1935, the United States retired from the dirigible field. Our one remaining airship, the aging, German-made USS *Los Angeles*, was dismantled in 1939 (though it had been decommissioned some seven years before), in a hangar not far from the spot where the *Hindenburg* had crashed in flames. Pre-World War II advocates of airship rebuilding were rebuffed because of a shortage of funds, lack of public support, and the abominable record of our earlier efforts. Dirigible experts attempted to point out the poor conditions under which our airships had been used and had perished, but they failed to sway their opposition. Citation of the excellent records set by the commercially successful German airships, *Graf Zeppelin* and *Hindenburg*, proved a waste of time. The excellent design and flight characteristics of both these ships did not counterbalance the disadvantage of their enforced use of hydrogen for lifting power. The tragic results of this gas for the *Hindenburg* outweighed any past accomplishments of airships in the minds of the antiairship majority. At the time of the *Hindenburg* crash, Congress had appropriated money for one more small dirigible, but in the aftermath of the crash the airship opposition made sure that it was never constructed.[3] Consequently no dirigibles flew during World War II—a time when the cargo and personnel-carrying capacities of the rigid-framed monsters would have been of inestimable value in combating the submarine menace in the Atlantic and the vast distances of the Pacific theater.

The dirigible's smaller and nonrigid cousin, the blimp, however, performed a valuable service in convoy escort and antisubmarine patrol during World War II. With the end of the war, the "rubber cows" continued to find a place of duty in the U.S. Navy as reliable, stable, and economical radar carriers in the early-warning net that was hastily erected to prevent a surprise attack. Not until 1961 did our radar net become so sophisticated that the last of the blimps could be retired from military service.

With World War II over, renewed proposals were heard for the building of super dirigibles, airships incorporating the latest in technological advances. One such proposal was contained in federal legislative bill H.R. 6628, placed before the Congress in 1948. During the hearings on this bill before a subcommittee of the Senate Interstate and Foreign Commerce Committee, Paul W. Litchfield, president of Goodyear Aircraft Corporation, advocated the building of six of these huge super dirigibles.[4]

Preliminary designs were already drawn, Litchfield stated, for a larger and far more sophisticated airship than had been dreamed of in the days of the *Akron* and the *Macon*. The airship would be approximately 950 feet long as compared to the *Hindenburg's* 803 feet. If operated on conventional fuel, it would have an estimated range of 6000 miles compared to



the *Hindenburg's* trans-Atlantic capability. With steamship-to-airship refueling, a technique perfected by the Navy's blimps during World War II, the range could be increased indefinitely. The proposed airship would contain some ten million cubic feet of helium, now a plentiful, cheap, and politically unrestricted gas; the *Hindenburg's* volume was slightly over seven million cubic feet.

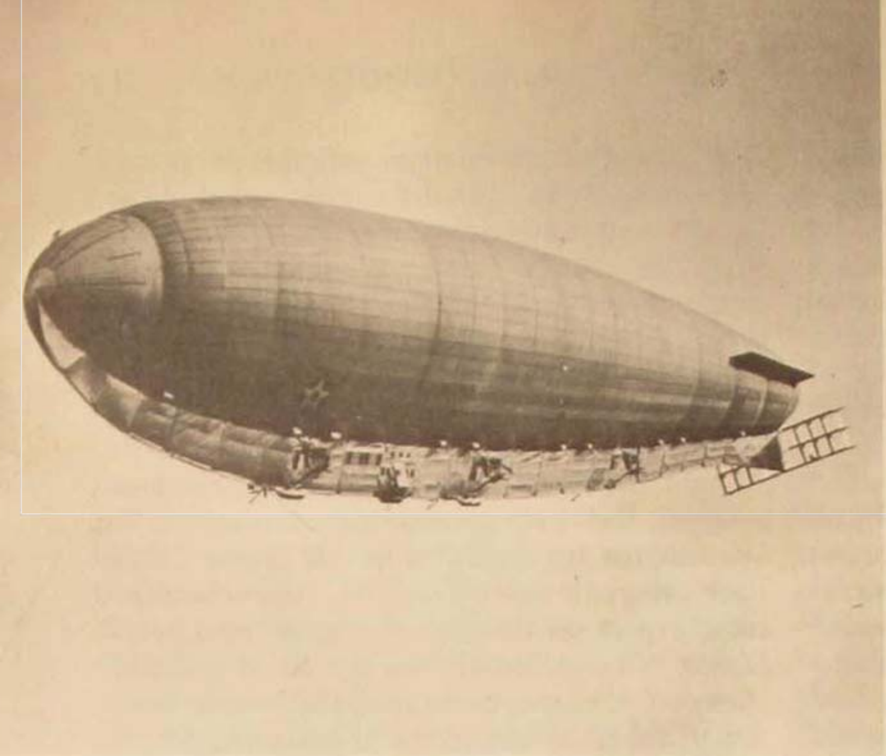
An artist's drawing showed glass-walled staterooms running the length of the ship on both sides. On top of the dirigible was a promenade deck, helicopter port, and an observation lounge that would truly be "in the clouds." The nose would be of clear plastic, shielding a large radar set for weather forecasting and avoidance of storms. This capability would have saved both the *Shenandoah* and *Akron*, testimony disclosed. An atomic engine could be located amidships along the bottom to provide the power for one very large propeller aft of the four horizontal stabilizers at the stern of the ship. Along the bottom of the ship would be more passenger accommodations, a detachable exhibition hall, four retractable pontoons for a water landing, and a pickup area and hangar for small jet aircraft used to ferry passengers to intermediate stops. This latter technique, proven in the *Akron* and *Macon*, would allow passenger transfer without requiring a pause in the flight of the dirigible.[5]

Designers indicated that jet propulsion was not too practical for dirigibles because the maximum speed of the bulky airship is below the speed at which a jet engine functions most economically. Atomic power is adaptable, however, and the size and weight barrier, currently a problem for aircraft, would present no such obstacle in a rigid airship. Gordon Dean, former chairman of the Atomic Energy Commission, stated in 1953 that he felt there was one place where the atomic engine could come into its own, and that was in the rigid airship. With an atomic power plant, the nonstop range of the super airship would be limited only by the crew's endurance. The lift capability of the helium-filled airship allows more flexibility in carrying the extra weight required by the atomic engine's shielding materials.[6]

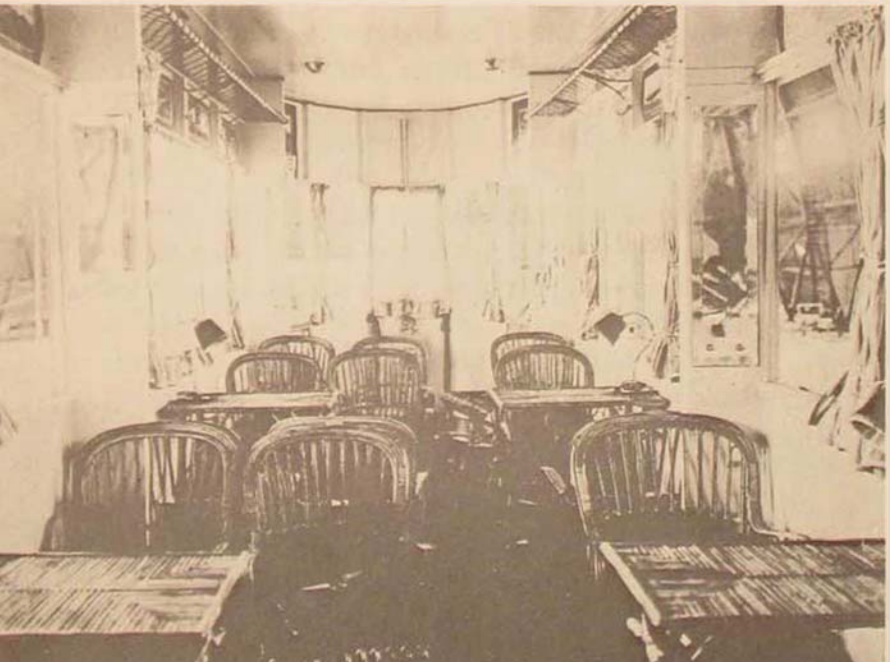
But safety in the air was the prime concern of the 1948 Senate subcommittee. To Washington, to testify in behalf of the dirigible's inherent safety features, came the foremost expert on dirigible flying in the United States, Vice Admiral Charles E. Rosendahl. From an extensive background of having flown every dirigible owned by the United States, he spoke eloquently for the cause of the airship. Painstakingly he explained to the Senate subcommittee the causes of the crashes of the *Shenandoah*, the *Akron*, and the *Macon*. These ships, he said, were, at best, experimental and were victims of structural weaknesses, inadequate instruments, and, most of all, inexperience in flying them.

Not that the crews of the respective airships did not know their jobs; they did. But the United States had had only about ten years in which to gain a foundation of knowledge in the operation and proper employment of the big lighter-than-air craft. By way of contrast, we have been learning constantly about the airplane for the past sixty-two years, and few are the knowledgeable people who would claim that we do not have a long way to go even today. When a commercial plane crashes for some reason, no great public outcry is heard to halt all flying. The Air Force spends years and millions to work the "bugs" out of new airplanes. Yet after the disasters of the American dirigibles, plus the dramatic hydrogen fire aboard the otherwise safe *Hindenburg*, the general public and the military wanted nothing more to do with the airship. Admiral Rosendahl showed that slightly better judgment, which would come with more extensive experience, plus better instruments, would have saved all three of our dirigibles. Indeed, in the crash of the *Macon* the basic cause was a well-known structural weakness that was

The German airship Hindenburg *glided majestically above the New Jersey shoreline near the end of the last of the ten scheduled round trips on which it had transported 1002 passengers between Germany and the U.S.*

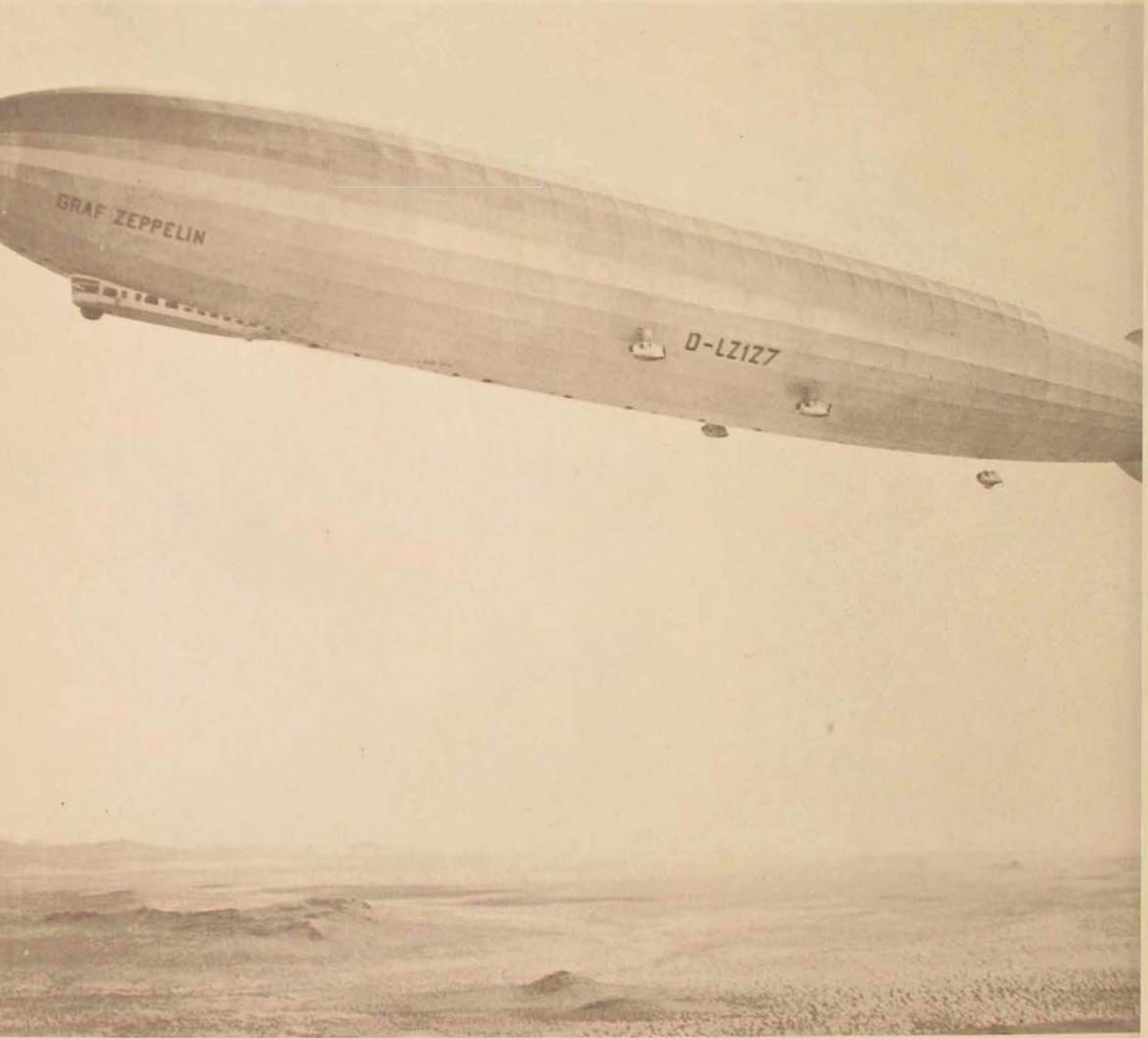


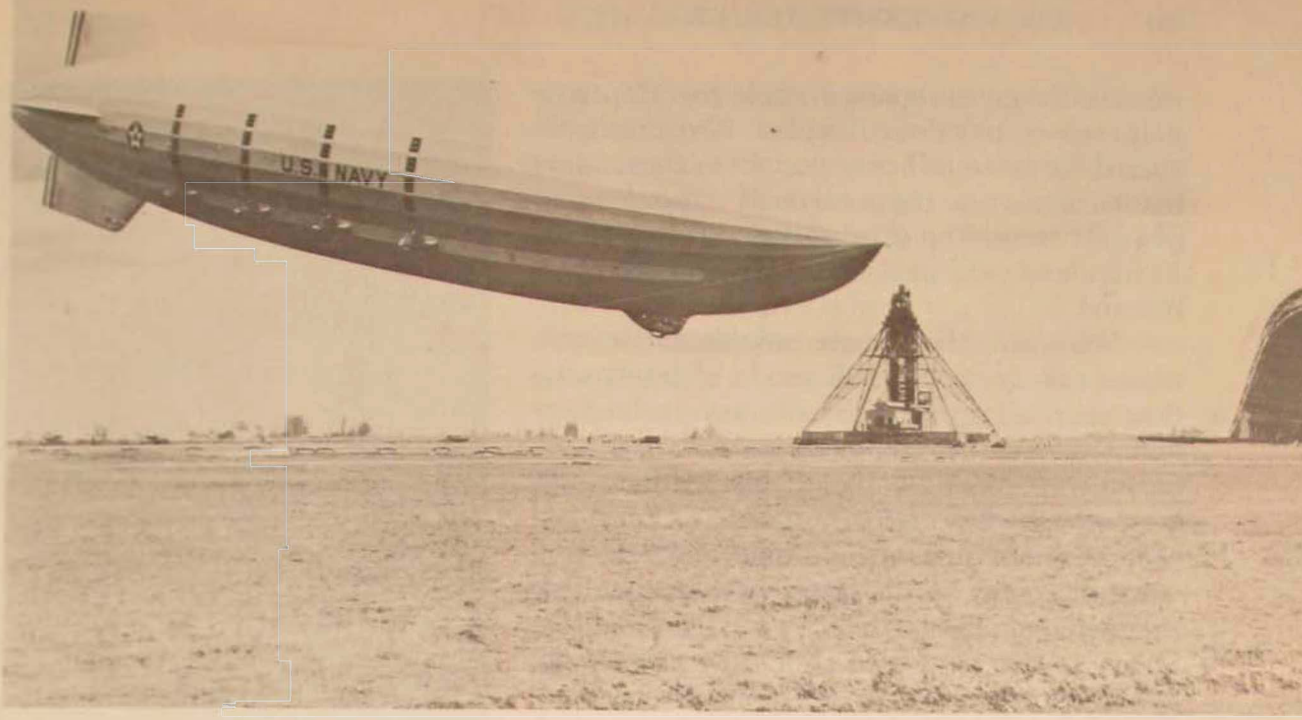
Italian-made semirigid Roma, *purchased by the U.S., made its first official flight on 17 December 1921. . . . Interior of the passenger cabin, Dirigible F-6.*



The Shenandoah *(originally ZR-1) was first U.S.-made dirigible and first to use helium. Commissioned 10 October 1923, she carried out many important missions.*

The Graf Zeppelin, *German rigid airship, flew from Friedrichshafen to Lakehurst, New Jersey, nonstop in 112 hours with 60 people aboard in October 1928. It made a round-the-world trip from Friedrichshafen 14 August–4 September 1929, via Tokyo, Los Angeles, and Lakehurst, covering approximately 21,200 miles.*





The Macon *and* Akron, *built for the Navy by Goodyear-Zeppelin Corporation, were 785 feet long and 134 feet in diameter and had an internal hangar for 5 scout planes, to be released or taken aboard in flight. The* Macon *(above) is about to anchor to its mooring mast at Sunnyvale, California.*

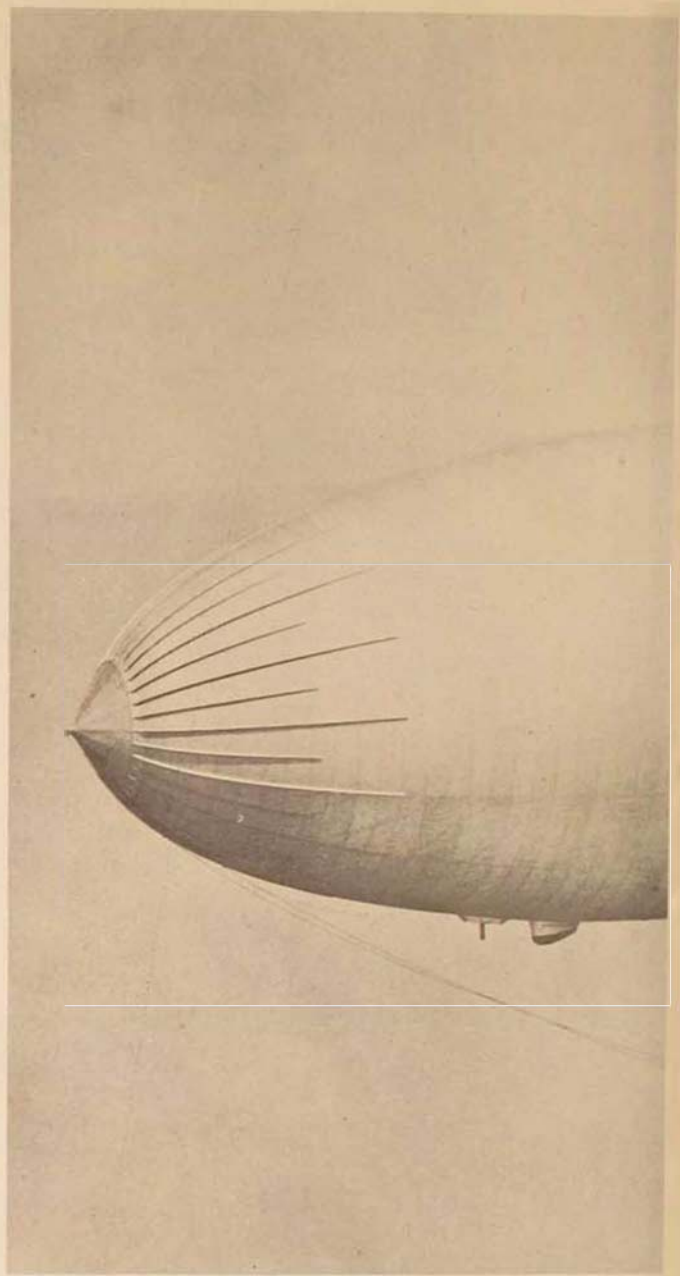
allowed to go unrepaired while the ship participated in naval maneuvers. The crash occurred en route to home port from those same maneuvers when the weakened structure simply gave way. The ship settled slowly into the Pacific, and all but 2 of her crew of 83 were rescued.

Why not, the Senate subcommittee witnesses asked, explore this mode of transportation once again in light of new technology and the ever expanding need for cargo and passenger-carrying vehicles? Could there now be, they asked rhetorically, a demand for transoceanic travel in a vehicle that would fit conveniently between the fastest airplane and the oceangoing vessel, that could combine the luxury of the big ocean ship with a 24- to 36-hour crossing of the Atlantic? Those who advocated a return of the dirigible clearly saw such a need.[7]

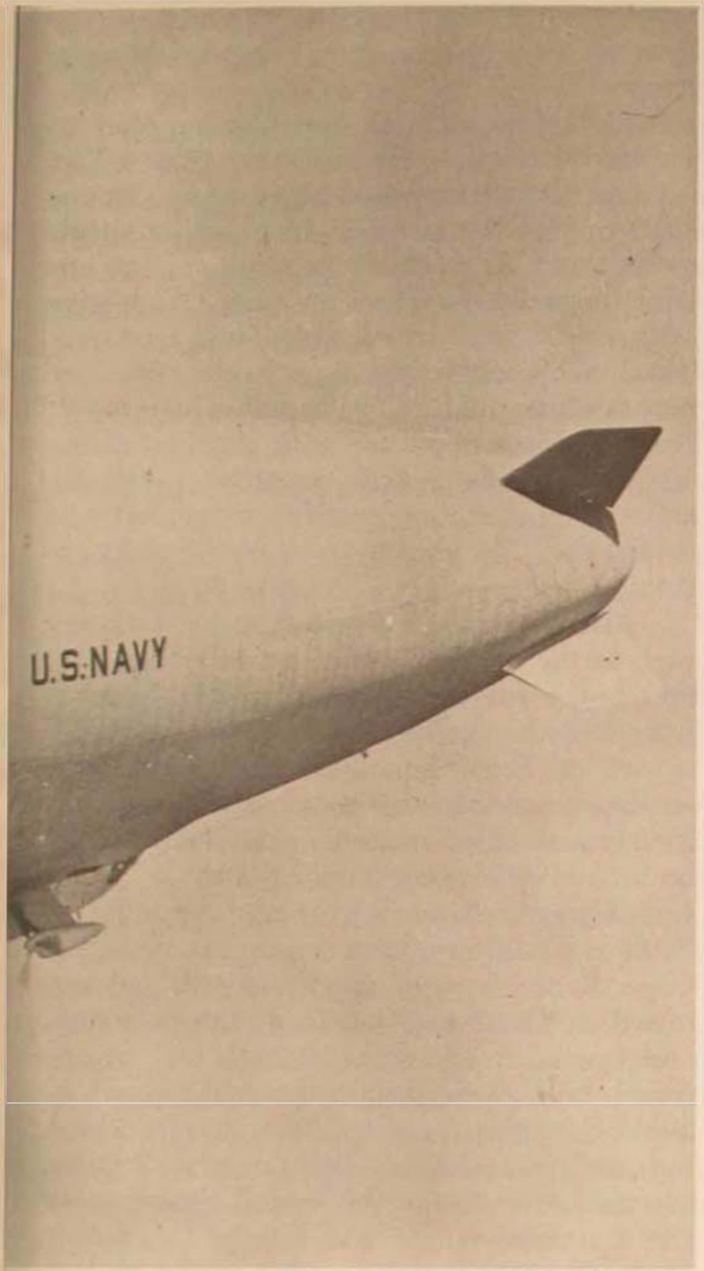
To Edwin Kirschner and other postwar dirigible advocates, leadership in world transportation was at stake. World War II had left a great shortage of ocean shipping and aerial transport. To the witnesses and the subcommittee members in 1948, the commercial possibilities of the super dirigible seemed truly exciting. What better way to fill the void than with a safe, dependable, long-range, and luxurious passenger and cargo carrier?

In the competition for world markets, the best, fastest, most luxurious (and the cheapest) carrier would win. Used for cargo, the capacity of the super dirigible would be better than 100 tons. Such a capacity on long-range hauls would reduce the ton-mile cost to below that of commercial jet cargo aircraft. The nonstop capabilities of the airship would speed up delivery time from the 5 to 7 days of the ocean freighter to a commercially acceptable 24 to 72 hours. More important, neither deep water nor an elaborate airdrome would be necessary for the dirigible: it would be free to unload passengers and cargo almost anywhere in the world.

For passengers, the dirigible would offer a new element in quiet, vibrationless, seemingly motionless transportation. Depending upon the lavishness of the accommodations offered, the super airship could carry from



The ZPG-2W blimp, Goodyear-built vet[...] of World War II escort duty, served a[...] in the picket line defending the Atla[...]



...oast, after first being modified to carry ... its one-million-cubic-foot envelope the ...orld's largest airborne radar antenna.

232 to 288 passengers plus a crew of 60. Trans-Atlantic travel to London would be overnight, and from San Francisco to Honolulu only a few hours longer. Even longer trips, such as one from San Francisco to Sydney, Australia, would be in the ideal nonstop range for the dirigible. Small jet aircraft, which could be carried aboard, would be used for airlifting passengers desiring an intermediate stop. Given the world's current affluent society, the outstanding luxury and quiet of such an airship could fit well between the ocean liner and the jet transport as a co-competitor. One way to assist in redressing the current outflow of gold from this country is to create a new means of transportation that would attract both customers and investment.

The bill supported by Litchfield, Rosendahl, and others passed both houses of Congress, only to be pocket-vetoed by President Truman in June 1948. Economy and lack of interest on the part of the military were the main reasons given for the Presidential action. More recently other legislative efforts have been made to obtain government support and/or funds for super dirigibles; e.g., in 1953 a firm called Airships International, Inc., proposed to develop rigid airships for the government. The President's Air Coordinating Committee, charged with advising the President on the role of the airship for commercial purposes, reported that they could not recommend that the government back rigid airship development. This spelled the end of attempts to gain federal backing for dirigibles.[8]

THE LACK of commercial acceptance need not spell the end of the dirigible. There are other important uses to which the rigid airship can be applied—uses vital to the national defense of the United States. It would not be the first time that commercial uses had come from military development, research, and initiative. Spurned by the military since the fatal crash of the *Hindenburg*, the airship with its large and stable airborne platform, unlimited range, and huge capacity now opens a whole new realm of possible military uses.

Two practical military applications of the dirigible are immediately apparent. The first concerns the airborne alert of the Strategic Air Command, which currently maintains a constant 24-hour-a-day watch as a backup control headquarters for the vast SAC retaliatory effort.[9] This whole airborne effort could be carried aloft more comfortably and conveniently in a dirigible without sacrifice in efficiency. Not only could the rigid airship land anywhere regardless of available runways, it would be as cheap to build as the several airplanes currently in use. Further, the very small number of airships would require no refueling (assuming an atomic engine) and fantastically little maintenance. Two or at the most three airships would do the work of the several airplanes now needed to allow for maintenance and malfunction backup. A saving in manpower and ground handling equipment would be the immediate result. In-flight repairs, while hovering, could be accomplished easily without interruption of the mission, whereas the alert aircraft must stay in the air until relieved despite minor emergencies that might place the mission in jeopardy. The time spent in the replacement of the on-station aircraft by another with its fresh crew is the most vulnerable period in SAC's otherwise fine alert system. The crew of a dirigible could transfer by helicopter or liaison aircraft while the airborne communications platform continued its flight on station and in full operation. Even infrequent major repairs often could be accomplished while in the air.

The second most practical use is in logistics. The super dirigible proposed in 1948 had a planned 100-ton cargo capacity, which would enable rapid resupply of such far-flung bases of operation as Viet Nam or the Congo. At the same time resupply is accomplished, vital combat aircraft could be ferried to the critical area, arriving simultaneously with the essential ground handling equipment. Moored behind combat lines to a temporary mast mounted on the back of a truck carried internally and lowered to the ground upon arrival, the airship would need no hangars, revetments, or extensive runways except at its home station. Remote arctic radar sites, isolated for months during extreme weather, would be easily resupplied with large, bulky items which usually have to wait for the brief summer shipping season.

The worldwide delivery of supplies to sudden crisis areas, whether in the Congo, Viet Nam, or elsewhere, would be a time and money saver ending the necessity of planning airlifts around mid-air refueling or routing cargo aircraft to specific air bases en route which have a runway of sufficient length. Such a conventional airlift inherently requires the expensive prepositioning of fuel and handling equipment. None of this is necessary with airships—an immediate savings in time, material, personnel, and money. But these two functions are by no means the only military uses of the rigid airship.

Many of today's massive rocket boosters, such as the mighty Saturn, are much too long and bulky for conventional rail or highway transport when fully, or in some cases partially, assembled. Even the one or two specially built airplanes cannot carry many of today's completely assembled rockets. Some missiles must be broken down into sections at the manufacturer's plant, shipped by barge through the Panama Canal in a time-consuming voyage to Cape Kennedy, and there reassembled and tested, at a tremendous cost in time, personnel, and special materials. This high cost of sectional breakdown and reassembly could be avoided by the use of specially designed loading mechanisms easily built onto a dirigible. The rocket could then be loaded aboard inside the dirigible or secured snugly beneath it. Mounted this way, the missile could be lowered directly onto the pad itself in an erect position ready for firing with a minimum of checkout and delay.

But the military role of the dirigible does not stop with the transportation of troops and cargo or the movement of fully assembled rockets from factory to launch pad. The U.S. Navy's experience with blimps during and after World War II amply demonstrated their ability and reliability as a stable platform for super-powerful airborne radar sets. The blimps proved that patrolling a fixed position in adverse weather for extended periods of time was operationally sound and extremely valuable in the early-warning network. If the non-rigid blimp was that durable, a rigid dirigible would be even more reliable.

What could then function as an airborne radar platform could today serve as an electronic countermeasures station, a satellite monitoring and tracking station, and even as a missile launching platform. Because of its extended range and endurance, the dirigible makes a practical air-sea rescue vehicle for aircraft or ships in distress, able to hover and pick up without having to land in choppy seas. Several dirigibles on station around the world would be able to patrol remote areas along the path of flight of the Gemini space capsules. Last but certainly not least of the airship's more important functions is that of a military airborne hospital for casualty evacuation and transfer.

Opponents of the dirigible have argued that vulnerability and the initial high cost of some $8 million each make the airship impractical.[10] Without doubt the size and relative slowness of the huge craft would be a serious hindrance in combat. Yet the dirigible, except for its early World War I bombing missions, was not and would not now be designed for front-line combat service. Its mission is support, behind-the-lines movement of men, planes, and missiles to strategic points, quickly and in quantity. While parasite planes or missiles could defend it, this need not be the primary concern. Properly used in a support capacity, it is no more vulnerable than an ocean ship or a huge jet transport would be.

Worthy of consideration in favor of the dirigible is the fact that the ease of repair and lack of continual maintenance reduce the number of ships necessary to maintain constant airlift operations or cargo delivery systems such as the Air Force's famous LOG AIR. This in turn considerably reduces overall cost factors, to say nothing of the reduced ton-mile cost. On a 2500-mile flight, say Honolulu, Hawaii, to Los Angeles, the cost per ton-mile for the airship would be about 11.9¢ as opposed to approximately 18.2¢ for an airliner. On a 4000-mile flight where aircraft would usually land or possibly rendezvous for air refueling, the ton-mile cost for the dirigible would be close to 15.2¢ while that for a plane jumps to 34.9¢. Costwise a good argument can be made for the construction of a super airship despite the admittedly high initial cost.[11]

What the airship needs, then, is simply the improvements of modern technology and a proper test. This has long been advocated by Admiral Rosendahl, Litchfield, and others. Opposition will always exist under the guise of economy, competition, vulnerability, undefined mission, and half a hundred other standard arguments against change. At each hearing on the dirigible there have been many opponents of the airship speaking at length to prevent a fair and unbiased trial. All the opponents lack the coup de grâce, however: they cannot prove that a dirigible will not do what is claimed for it. Based on the outstanding commercial record of the *Graf Zeppelin* and the *Hindenburg*, the claim that a dirigible "just won't work" simply is not borne out by the facts. The huge ships need only the chance and the effort given to modern airplanes.[12]

Captain Rickenbacker, World War I ace and prominent airline executive, was once a passenger on the *Hindenburg*. The ride deeply impressed him because of its comfort, quietness, stability, and lack of vibration. Testifying before a special subcommittee of the U.S. Air Coordinating Committee in 1945, Rickenbacker firmly defended the dirigible.

> "No one," he said, "is going to compete with the Zeppelin because of transportation cost. No one but America can build them; no one else can afford them. If the airship had had the experimental money in proportion to that the airplane has had, it would be with us today. And this difference in cost, of putting 3 or 4 or 5 airships in the air, is a drop in the bucket compared to our national debt. The only way we can pay off the national debt is to get world business, and you can't get it without world transportation."[13]

The world situation has changed somewhat since Rickenbacker made his statement. It is known that within the past three years both Russia and Germany either have built or are preparing to build dirigibles. The Soviet experiments have been conducted without publicity, and the results are not known. The Germans already have a super airship on the drawing boards which they plan to use for both passengers and cargo.[14] In the United States only the Air Force has shown any interest in lighter-than-air vehicles since the Navy retired its last blimp in 1961. A feasibility study has been conducted, but the results have not been made public.

There continues to be talk, with some agreement in principle, but inaction neither proves nor disproves the feasibility of dirigibles. With the civilian and military need for transportation as urgent as it is today, the dirigible appears to provide the long-sought solution. Certainly it deserves very careful consideration. We cannot afford to accept the "rearview mirror" approach to the dirigible and its present-day use while seeing the airplane in "the narrow field of a periscope."[15] Such a lack of perspective might well cause this country to pass over the immense possibilities inherent in the airship only to find itself spending fantastic sums to catch up. The thrilling sight of these giant queens of the sky in useful, profitable flight might once again become a reality. There are many practical aspects to recommend such a thing. They deserve careful, unbiased investigation now.

United States Air Force Academy

Notes

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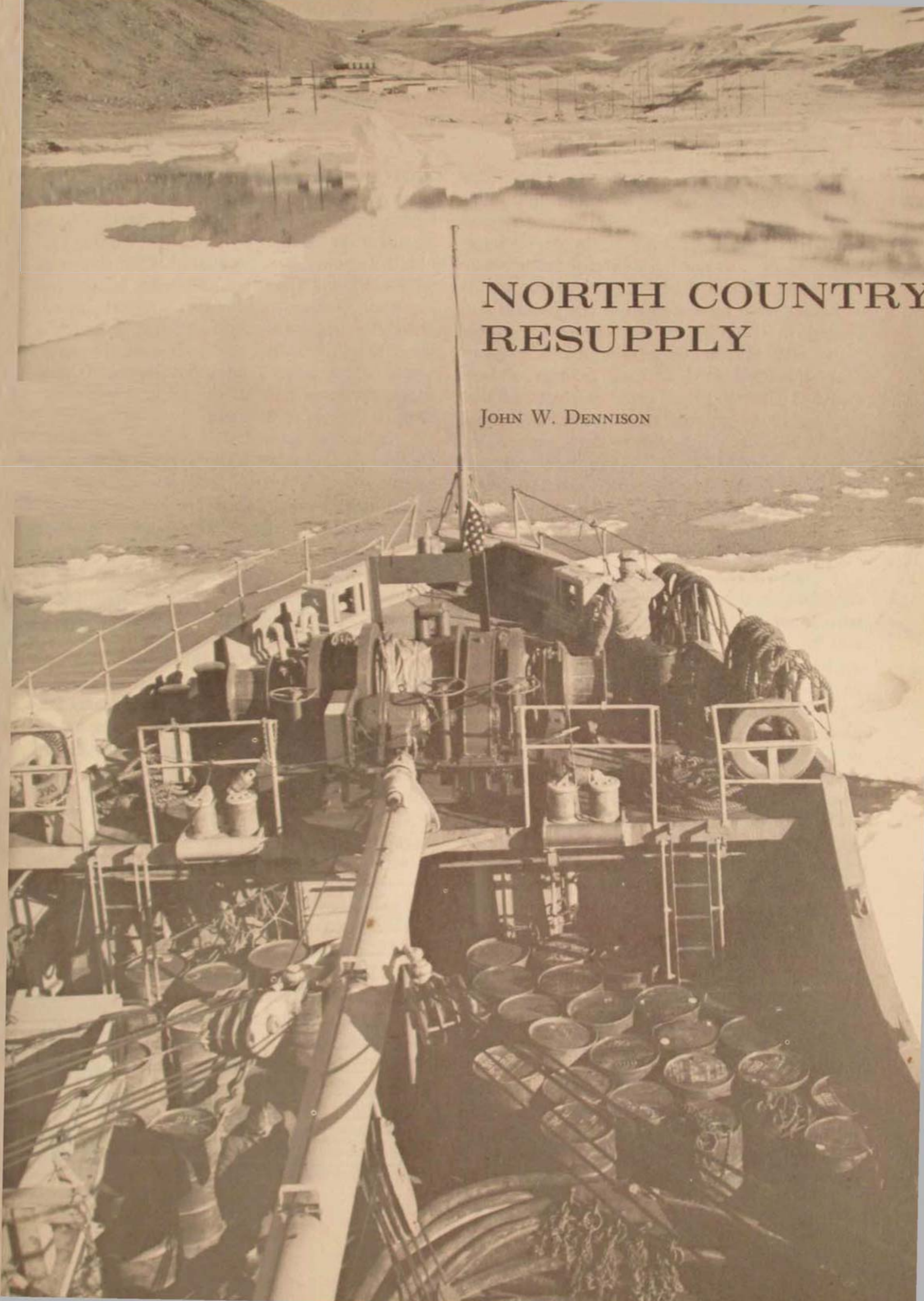
4. U.S. Congress, Senate, Subcommittee of the Committee on Interstate and Foreign Commerce, *Safety in Aviation (Study of Thunderstorms)* and *Development of Lighter-than-Air Rigid Airships*, 80th Cong., 2d Sess. (Washington: U.S. Government Printing Office, 1948).
5. Kirschner, pp. 39, 43.
6. *Ibid.*, p. 38.
7. Congress, *Safety in Aviation*, p. 16.
8. Kirschner, p. 64.
9. Defense, "35,000 Hours Through the Looking Glass," *Time*, LXXXV, 7 (12 February 1965), 19.
10. Kirschner, p. 55. In testimony presented in 1948 the estimated cost of the first super dirigible was $8 million. Costs have risen since then; however, if more dirigibles are constructed, the cost is estimated to slip to a little more than half that of the first one constructed. At that, the cost is little more than that of two or three fully equipped jet cargo aircraft capable of the same job—cheaper when the jet's necessary extra equipment is added in.
11. Kirschner, p. 54.
12. Congress, *Safety in Aviation*, p. 17.
13. As quoted by Kirschner, p. 51.
14. *Commercial Aviation News*, 1 November 1962, and Periscope, "Behind the News," *Newsweek*, LXV, 7 (15 February 1965), 15.
15. Personal letter from Vice Admiral C. E. Rosendahl to the author, 1963.

NORTH COUNTRY RESUPPLY

John W. Dennison



ON 7 AUGUST 1965 the refrigerator ship USNS *Bondia* arrived 690 miles north of the Arctic Circle at the port of Thule Air Base, Greenland, the Air Defense Command's most northern defense installation. One hundred and thirty-five thousand pounds of bacon were unloaded from the *Bondia* and placed in cold storage—breakfast bacon for Thule until the *Bondia* returns in another year. Also unloaded were 436,442 pounds of beef and 212,892 pounds of pork products. If that appears to be a large meat order, remember that in the arctic every item required for survival, comfort, and livelihood has to be planned for and ordered the year before so that delivery can be made during the short arctic summer. It is the unique story of supplying the Free World defense forces in the arctic.

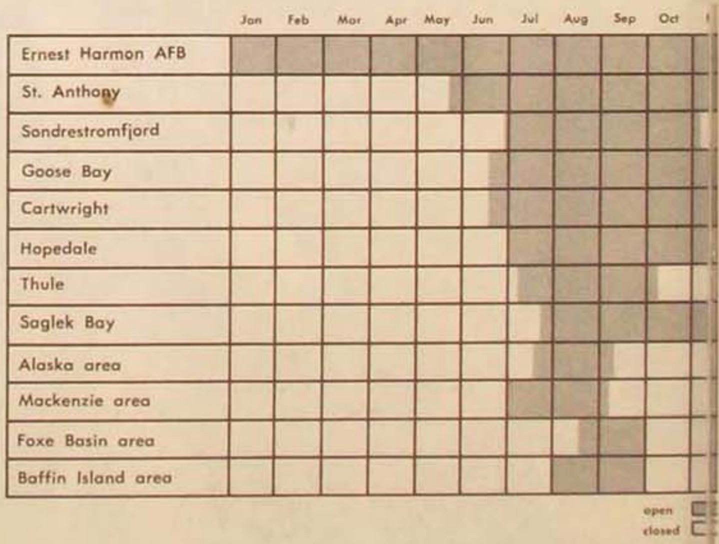
The arctic is dominated by ice, wind, and cold for nine months of the year. Then, as warm weather weakens the ice pack, Coast Guard and Navy icebreakers start forcing a channel up the Davis Strait, clearing a path for ships. In June the cargo ships operated by the Military Sea Transport Service, Atlantic, are completing their loading at the military and transportation terminal service docks at Hampton Roads, Virginia, and Brooklyn, New York, for the dash north. Other vessels are loading cargo at Seattle, Washington, and Canadian ships operated by a company contracting its services to the United States Air Force are loading at Waterways, Alberta, Canada.

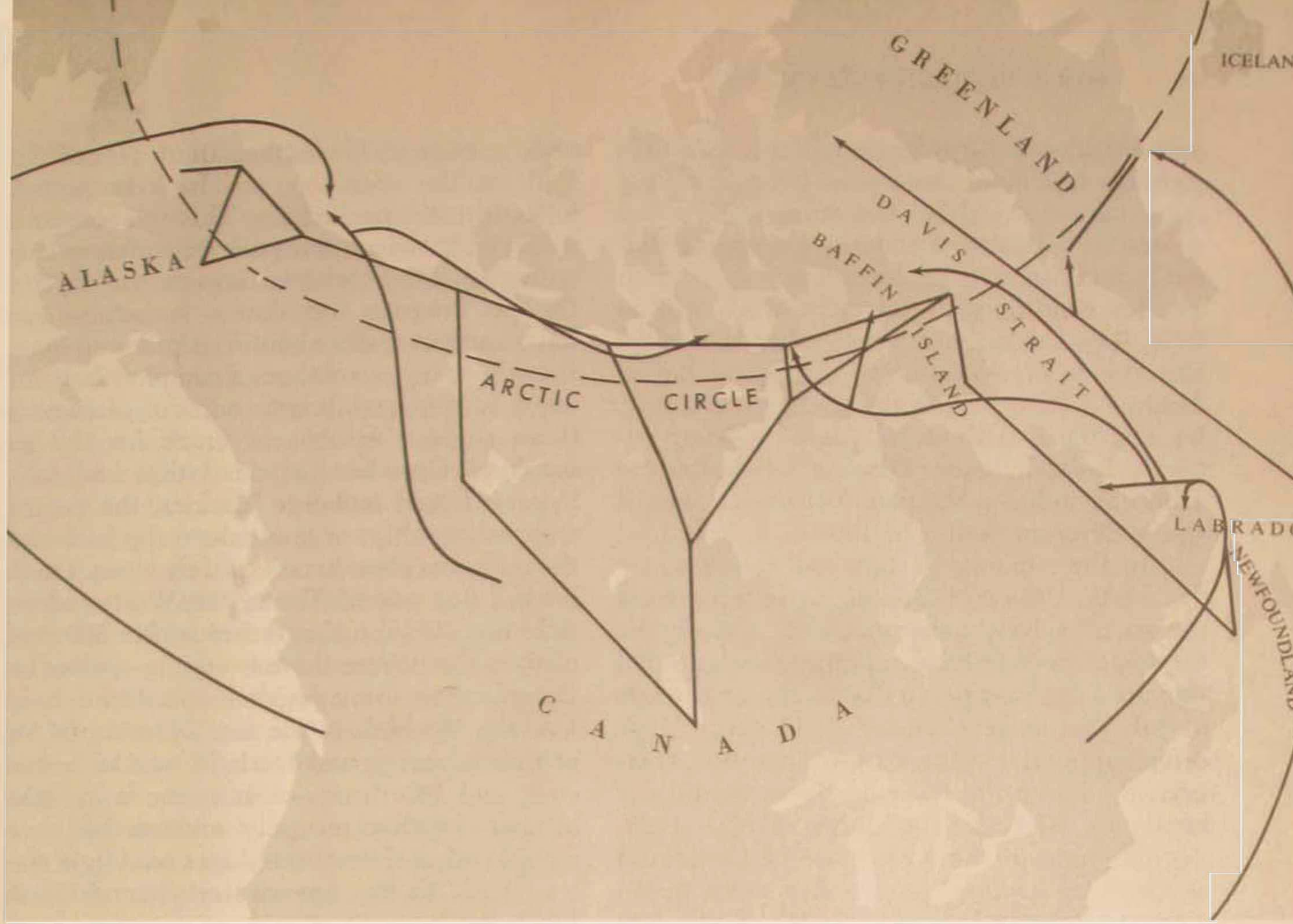
Telephone power cables and dental floss, lifesaving medical drugs and smoking pipes, jet fuel and mouthwash, 50-ton cranes and tea bags—all have their place on the requisition lists. Thule uses 120,080 pounds of coffee a year. The men consume 25,000 pounds of potatoes per week. Every item delivered into the arctic propounds a logistics problem.

Some things such as perishables, priority items, and personnel can be brought into the far north by air, but generally the greatest mass of supplies is delivered by seagoing vessels during the period when the arctic sea-lanes are comparatively ice-free. The shipping period and amount of ice in the ocean vary as the ships move above the Arctic Circle. Sondrestrom, Greenland, near the Arctic Circle, has about 160 days available for shipping, whereas Cape Christian, on Baffin Island, has less than 60 days. Icebreaker support can extend the open-water period, but only for a short time preceding and following the open-water season. At Thule, the largest United States military base in the arctic, the harbor is open for about 80 days.

Inland sites and sites without adequate harbor facilities must be supplied by other means. At Sondrestrom and some of the DEW Line sites, landing craft are used to unload ships standing offshore. Dye-2 and Dye-3 on the Greenland ice cap are resupplied by ski-equipped C-130 aircraft. The runway for 12 months of the year is an endless stretch of snow. Helicopters are used to transport cargo and passengers from Sondrestrom to Dye-1. On the DEW Line every site has at least a 3500-foot gravel runway or a helicopter pad. C-47's supplying Hofn Naval Installation in Iceland land on a gravel beach. The material is then loaded on a fishing boat for a trip across a small inlet,

Shipping season for 26th Air Division arctic units





Arctic supply routes

to be unloaded and reloaded on trucks for the final leg of the trip. At Saglek, Kulusuk, and Cape Dyer the aircraft land in a pocket between steep cliffs with a mountain hazard at the end of the gravel runway. In the arctic there are no railroads and very few miles of gravel road.

As warm weather reduces the ice in the sea-lanes, the cargo-carrying ships scurry north. Military Sea Transport Service (MSTS) tankers operated by the U. S. Navy, with Indian names such as *Maumee, Yukon, Shoshone,* and *Suamico,* begin delivering diesel fuel, aviation gas, vehicle gas, and jet fuels. Danish vessels with names foreign to our English language—*Erika Dan, Thora Dan, Elfy North, Nanok S*—move along the Greenland coast bringing European supplies to the native villages. The USNS *Redbud,* a utility ship, arrives early in July to prepare the underwater tanker connections in the harbors for the unloading of the petroleum supplies. The *Redbud* also repairs the damage that the arctic winter has done to harbor facilities. The USS *Greenville Victory,* USNS *Lt. James E. Robinson,* USNS *Sgt. Morris E. Crain,* and USS *Wyandot* discharge heavy and bulky equipment, palletized materiel, and any item not requiring specialized shipping.

As the vessels probe deeper into the arctic seas, huge icebergs measuring between 200 and 300 feet float past. Sometimes the ice pack will again enclose the ship, and structural damage to reinforced hulls is not uncommon. On 21 September 1964 the *Wyandot,* bringing supplies to Thule, moved one mile through ice between 0500 in the morning and 2130 in the evening. During whaling days ships often got trapped in the ice, and if not freed before the ice became impassable they would be gradually crushed by the tremendous ice pressure and would sink. Growlers, smaller in size than icebergs but more dangerous because only a small part shows above the water while a vast amount is submerged underneath, appear suddenly and threaten navigation.

Ice conditions in the arctic were mild in 1965. The Coast Guard icebreaker *Westwind* was able to break a path to North Star Bay at Thule Air Base two weeks ahead of schedule. Usually the Fourth of July, besides being national Independence Day, is celebrated at Thule as independence day from ice, but it was a different matter in 1964.

In the summer of 1964 the sea-lanes up the western coast of Greenland suffered from the worst ice conditions since 1922. Usually the coating of ice that blocks shipping in the Baffin Bay area deteriorates so that in the first weeks of July icebreakers, tankers, and cargo ships can resupply the military sites. That year, however, the ice in the Melville Bay area did not break up. Melville Bay forms almost a 90-degree angle in the west coast of Greenland at the 75th parallel. In previous years ocean currents, tides, and winds moved the ice toward the south across Baffin Bay, concentrating it along the coast of Baffin Island and opening a wide channel up the Davis Strait. In 1964, overcast skies prevented the spring thaw, and the driving winds that usually force the ice toward Baffin Island did not materialize. The village of Savigsivik in the Melville area remained ice-blocked, and food dwindled to starvation levels. Some food was airdropped, but attempts to carry by sea the large amounts of coal, kerosene, medicines, and food needed to supply the village with its entire ration for the long winter continued to be unsuccessful.

The *Nanok S* in one try came within 50 miles of the village before she was stopped dead by heavy ice. The Danish motorship *Elfy North* had been trapped in the ice and required the Navy icebreaker *Atka* to rescue it in August. The situation was so desperate that Danish authorities considered evacuating the Eskimos —or Greenlanders, as the Danish refer to the natives of Greenland. One final rescue effort was to be made in September. Two icebreakers, the USCG *Westwind* and USNS *Atka*, were to escort the *Nanok S* through an ice pack 45 miles wide outside of Thule, then south around Kap York, in the open sea, and back through 50 miles of solid packed ice. Through a mass of icebergs, growlers, and pack ice the three ships struggled. They took two days passing through the ice. Progress was slow — sometimes four knots (a man walks about four miles an hour), sometimes less, sometimes a complete halt, and every once in a while even a loss of yardage. At times the ice would not crack for the icebreakers. Growlers appeared that had to be bypassed, and icebergs blocking the passage stopped the ships or made them slip back until the path was clear to move safely again. On the second day out of Thule, the *Westwind* and *Atka* escorted the *Nanok S* to within 500 yards of the shore. From there everyone—sailors and Greenlanders using dogsleds—pitched in to unload the *Nanok S*. In the next 24 hours, 50 tons of general cargo and food, 75 tons of bagged coal, and 150 drums of kerosene were taken ashore. Another resupply mission had been completed, and the three ships could fight their way back to the open-water channel in the Davis Strait.

The Davis Strait acts as a funnel for arctic storms and tropical hurricanes. In 1964 the USS *Wyandot* arrived four days late at Sondrestrom Air Base, Greenland, because of sea ice conditions and a gale which held up the ship at the entrance of Sondrestrom Fjord. The narrow entrance to Sondrestrom Fjord is tricky in any kind of weather. Jagged rocks require a zigzag course. Once inside the fjord, steep perpendicular cliffs protect the traveler; the winds cease, and the water becomes calm. A violent storm with high-velocity winds may be raging above the high cliffs and outside at sea, but inside the fjord, passage becomes serene.

On the other side of Davis Strait a resupply convoy escorted by the Royal Canadian Coast Guard icebreaker *James A. MacDonald*, moving past Brevoort Island toward Dye-Main, on 1 August encountered ten-tenths heavy winter ice, requiring a change in route. Two days later the convoy entered seven-tenths heavy winter ice, but nightfall and increasing southerly winds complicated maneuvering. Before morning the winds reached gale force, and the convoy had to ride out the storm for 38 hours.

Similar ice difficulties were experienced in western arctic waterways. Sealift sailings from Tuktoyaktuk were delayed until August, and the first deliveries were not made at PIN-Main until 14 August, approximately four weeks later than usual.

When a ship docks, the unloading continues 24 hours a day until completed. Cranes lift vehicles off the decks; cargo nets swing, heavily loaded with crates and boxes; wooden pallets are laboriously hoisted from the holds of the ship. Since the sun is as bright at midnight as it is at noon in July and August, light is not a problem. Summer temperatures above freezing are not uncommon, but a frigid wind blows out to sea. Icebergs and pack ice drift in the harbor, and in the morning the harbor is covered with a sheet of ice.

The North Country Resupply Program is divided into four parts: SUNEC, GAP-PINE, FOXE-BAFFIN, and MONA LISA.

SUNEC designates the annual resupply program to Greenland installations. (Coined from the words "supply of the Northeast Command," SUNEC continues to refer to the same program although the Northeast Command was inactivated in 1956.) SUNEC covers resupply of the Greenland installations of Thule, Sondrestrom, Dye-1, and Dye-4 during open-water season.

GAP-PINE designates the resupply of aircraft control and warning stations and other installations along the Newfoundland and Labrador coasts and Resolution Island.

FOXE-BAFFIN designates the portion of the program that supplies the Foxe Basin and Baffin Island areas; the DEW Line sites in Canada east of Alaska and west of FOXE-BAFFIN, called the DEW-Mackenzie River; and DEW-Alaska, which is operated in conjunction with Alaskan Air Command's MONA LISA, the term used to designate the resupply of Alaska. Movement of cargo begins at the port of Montreal. Cargo for DEW Line stations CAM-4, CAM-5, and FOXE-3 is shipped to FOXE-Main, where it is unloaded and shipped by air to the designated sites. Cargo for FOXE-1 and FOXE-2 is also shipped to FOXE-Main, then loaded on smaller seagoing vessels for delivery.

The remaining DEW Line stations in the region receive their supplies directly from ships plying from Montreal. The western portion of the DEW Line in Canada (BAR-1 through CAM-3) is supplied by means of shallow-draft vessels plying the Mackenzie River. Ice conditions in the Beaufort Sea preclude using the sea-lanes of the Arctic Ocean. Two U. S. Navy LST's and one U. S. Navy tanker support the cargo movement. These Navy ships are assigned to the USAF and operated by a contractor for the USAF. The vessels are left in the ice of Kugmallu Bay all winter. When the ice frees the ships a U. S. Navy dry-dock vessel, also assigned to the Air Force and contractor-operated, prepares the vessels for the summer operation. All the dry cargo is shipped from Waterways, Canada. Barges take the cargo up the Mackenzie River system—the Athabasca, Slave, and Mackenzie Rivers—to Tuktoyaktuk, better known as Tuk-Tuk, Northwest Territories. En route up the Mackenzie River there is a 25-mile portage where the cargo is trucked between rivers and reloaded aboard barges for transport to Tuk-Tuk.

In 1964 the amount of cargo delivered in the North Country Resupply Program was 56,684.77 short tons, distributed as follows:

SONDRESTROM	4,327.7
GAP-PINE	13,778.57
DEW-ALASKA	499.2
FOXE-BAFFIN	19,095.8
DEW-MACKENZIE RIVER	2,493.5
THULE	16,490.

The method of procurement is as complicated as the shipping route is challenging. Denmark, Canada, Iceland, and the United States are all involved in the resupply of the arctic stations. The DEW Line is maintained by Canadian citizens in the Northwest Territories and by American citizens in Alaska. Radio Corporation of America operates the Ballistic Missile Early Warning System (BMEWS) at Thule, supplied by the military. Danish stevedores unload the ships at Sondrestrom, while stevedores of the United States Terminal Transportation Unit unload ships at Thule. Canadian stevedores unload at FOXE-Main.

To process an item for Greenland, one needs knowledge of ten supply and procurement channels for requisition:

—annual Greenland requirements for general supplies via USAFE Procurement Office, Copenhagen, Denmark

—annual requirements via 3121st Logistical Control Group, Brooklyn, New York

—Greenland requirements via General Services Administration, New York, New York

—Greenland requirements via Air Force depots and Defense supply agencies

—Greenland local purchase requirements via 3121st Logistical Control Group, Brooklyn, New York

—local purchase requirements via 26th Air Division support

—subsistence procurements via New York Region, Defense Personnel Support Center (Subsistence), Brooklyn, and USAFE Procurement Office, Copenhagen, Denmark

—DEW Line requirements via Central Control Point, Paramus, New Jersey

—BMEWS support via Rome Air Materiel Area

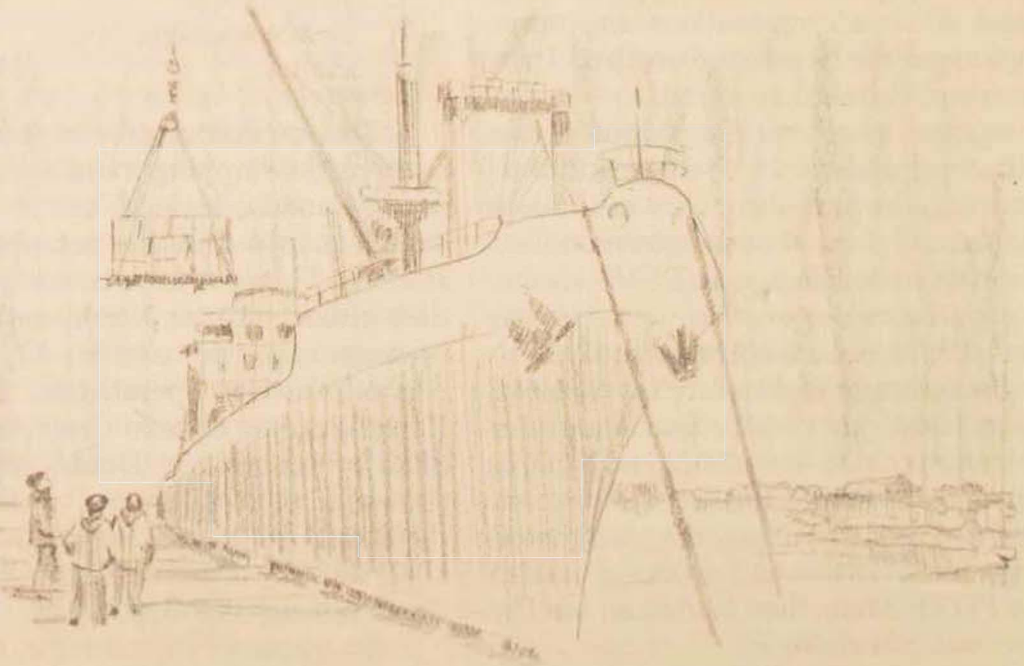
—service contracts via USAFE Procurement Office, Copenhagen, Denmark.

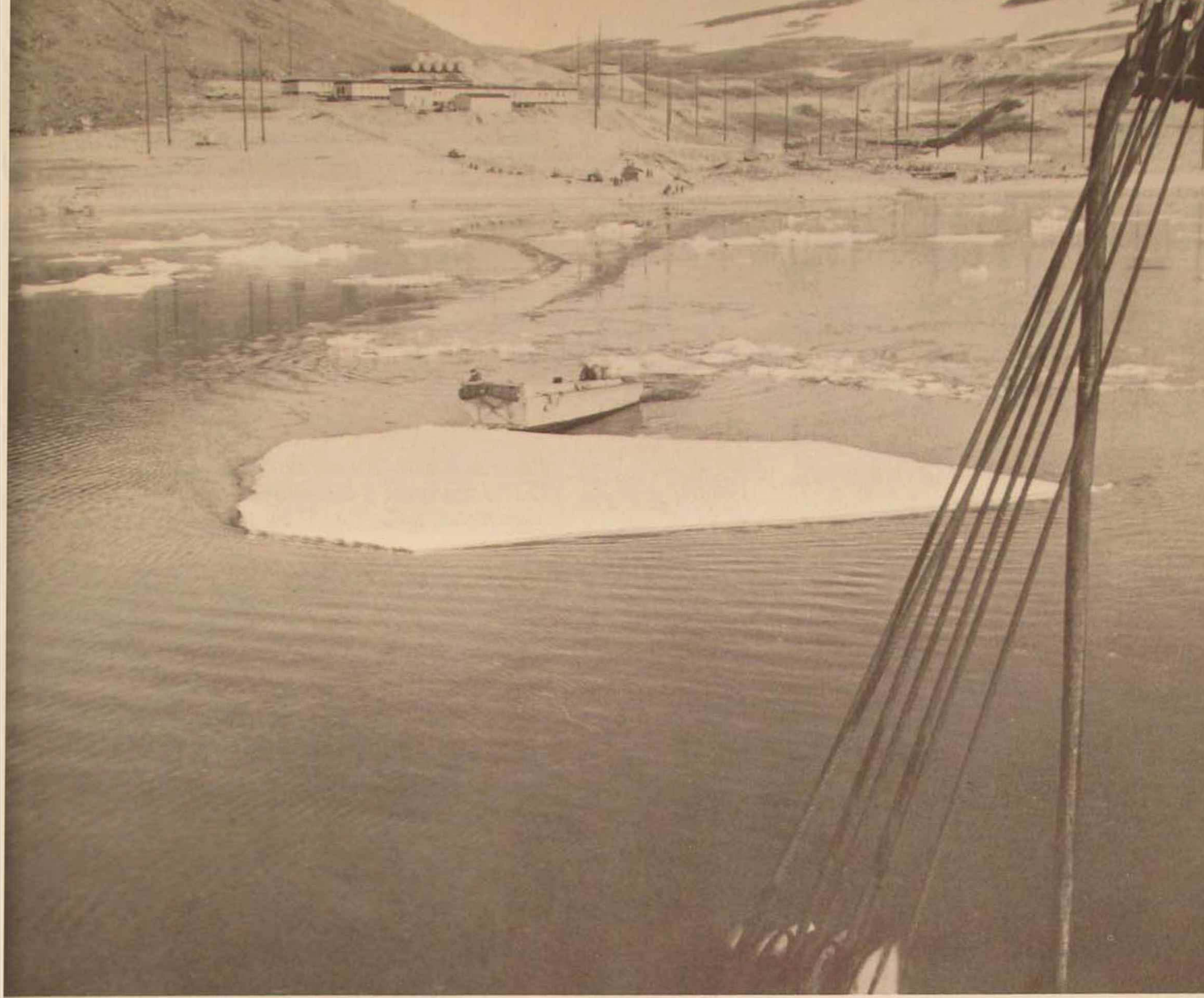
Sites in Canada and the United States have as many procurement channels, each with its own individual quirk.

Supply men in the arctic say "Your predecessor better be your best friend." This is understandable when one considers that, once winter sets in, supplies are almost impossible to get. If a requisition is completed late in 1965 or a piece of equipment misses the departure of the ship in June 1966, the winter and spring of 1967 will be an unhappy period of shortages for the on-site supply man. Supply in the arctic is that complicated, especially considering that approximately 90,000 separate items must be ordered.

Thus, the resupply for our north country outposts is a prodigious task, compressing as it does multitonnages and numerous ports of call into a very brief time span. Yet such labors constitute little enough in support of those far-flung sentinels keeping watch there to protect the Free World from surprise attack.

Hq 26th Air Division, ADC

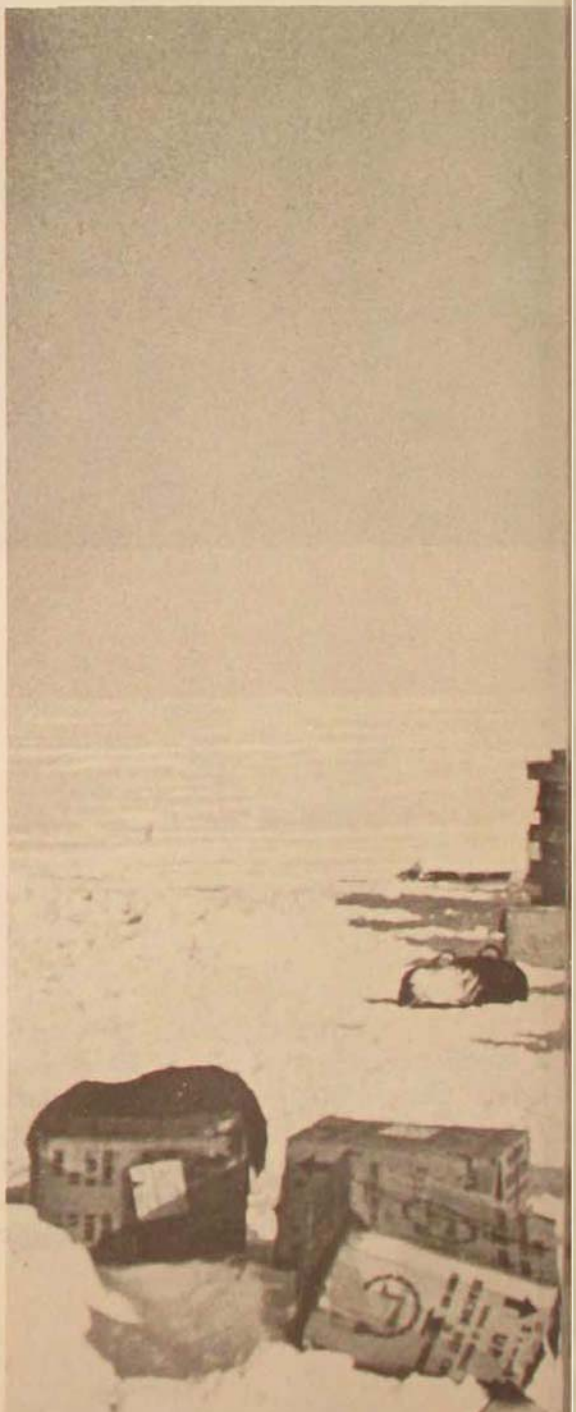


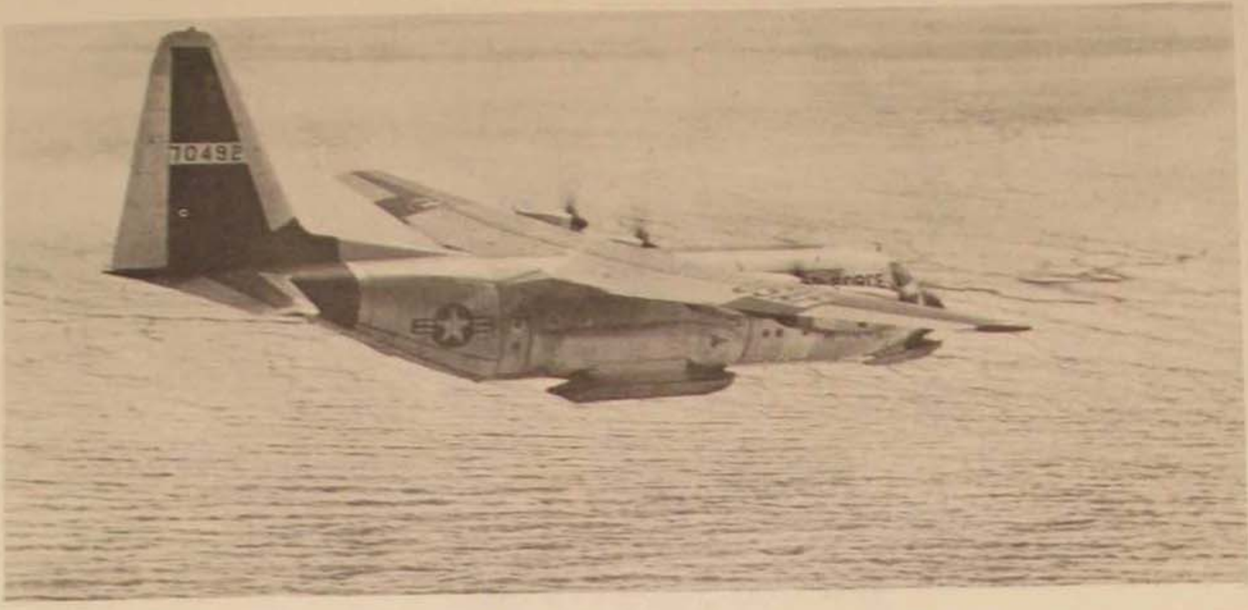


A landing craft pushes a large ice floe out of the way at Cape Athol, the Coast Guard station near Thule, Greenland. As there are no docking facilities at Cape Athol, supply ships rest offshore and unload into an LCM. . . . Supplies are unloaded from the landing craft to a truck at Cape Athol.

Fuel is pumped through pipes from ship to shore. . . A C-130 (right) completes the delivery of supplie across the polar icecap to a remote DEW Line site

Equipped with 20-foot skis, a Tactical Air Commana C-130 lands on a Greenland snowfield and offload: onto sleigh to be towed by tractor to a storage site

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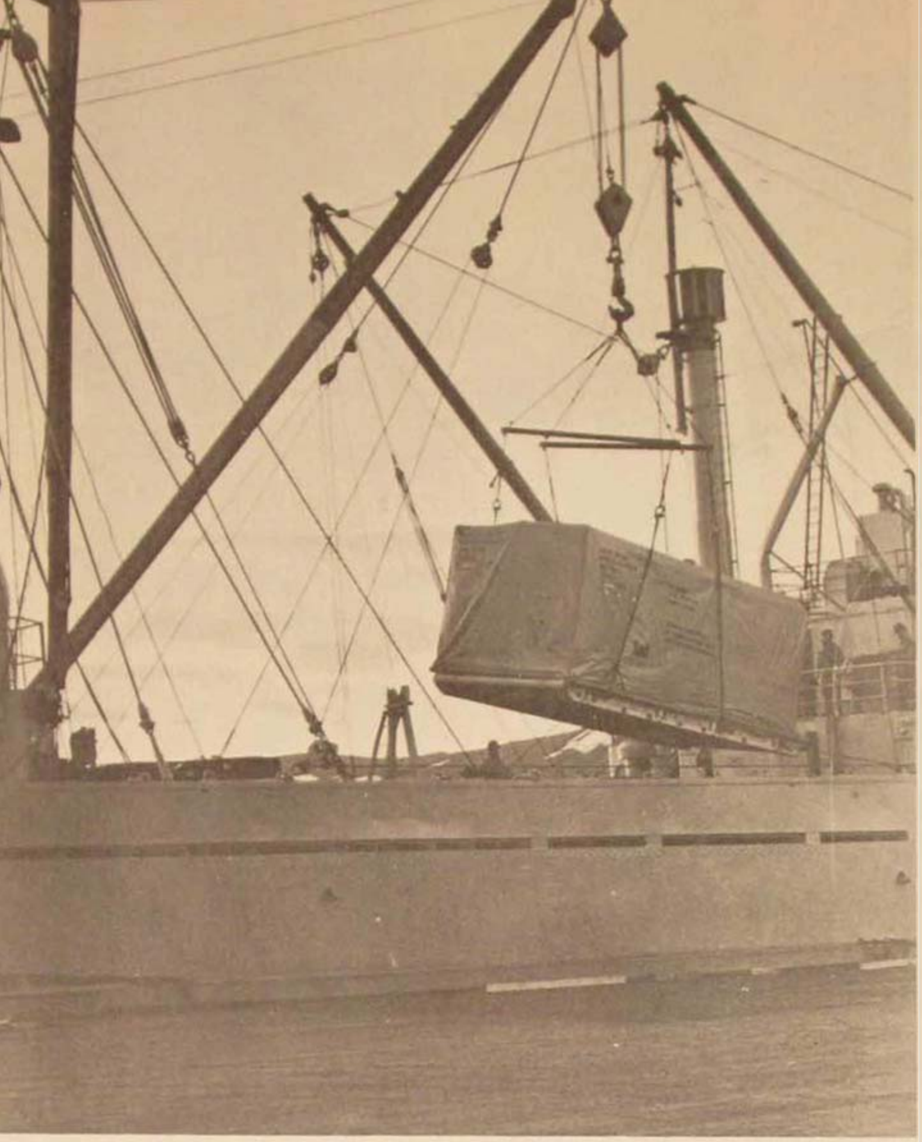


Supplies of all shapes, sizes, and weights are unloaded at arctic ports during the brief summer shipping period. . . . The Danish supply vessel Nanok S *rests adjacent to the USS* Wyandot *in the harbor at Thule. With assistance from the icebreakers USCG* Westwind *and USNS* Atka, *the* Nanok *got emergency supplies through to the starving villagers of Savigsivik in 1964.*

A summer snowstorm, not uncommon in the arctic, presents a wintry scene on the pier at Thule Air Base, Greenland, as the USS Wyandot *prepares to weigh anchor.*

A helicopter sits on its landing pad aboard the Navy icebreaker Atka. As icebreakers push through floe and pack ice, helicopters scout ahead for icebergs. . . . On 18 September 1965 an arctic storm broke the USNS Yukon from its moorings and ran it aground in the harbor at Thule. Before the storm the Yukon had been unloading fuel. The vessel took no water and by unloading fuel and discharging ballast from the forward compartments freed itself the next day.

THE QUALITY INDEX

A New Tool for Personnel Planners

Major Richard W. Haffner

In recent years retention of personnel has become one of the most pressing problems facing the Air Force. Because of its complex nature, retention is also one of the most difficult problems to solve. Personnel planners and top Air Force leaders alike bemoan the fact that every year the Air Force loses many good men. But how many is "many," and how good is "good"?

The number of people who separate from the Air Force can be readily determined. In fact, sources such as the 6570th Personnel Research Laboratory at Lackland Air Force Base can quickly compute the loss of people by specialty code, grade, age, total active federal military service, source of commission, or other criteria. This type of analysis helps to assess what impact the losses will have on the Air Force mission. Such analysis also assists personnel planners in procuring replacements, and

This article is based on a thesis prepared by Major Haffner as part of his academic work at the Air Command and Staff College, Class of 1965.

it may eventually lead to a reliable method of predicting who will stay in the Air Force and who will separate.[1]

Because of the availability of these data, questions concerning the number and type of personnel being retained can be answered. The big problem is how to determine the quality of those who are retained. I believe that retention should be selective and not merely quantitative. In other words, the Air Force should be able to select those on active duty whom it *wants* to retain instead of keeping only those persons who may want to stay.

This objective, although desirable, will be difficult to attain. However, the first step toward the objective is to determine, with some precision, the quality of individuals. The term "quality," when used to define human achievement, represents a complex attribute. Level of proficiency or ability, aptitude, skill, high performance, and degree of competence or excellence are all descriptive terms which approach the meaning that should be associated with the word "quality" as it is used in this paper.

As an aid to personnel planners, I propose the use of a new analytical tool to help in the selective process. This new tool is a numerical value called a Quality or Q Index which relates various criteria that are indicative of quality. I shall first describe what the Q Index is and how it is computed, then apply the Q Index to a real problem using actual data, and finally point out possible Air Force applications for which the index is intended.

What is the Q Index?

In order to simplify the explanation of the Q Index, only three criteria will be considered. These criteria are all measures of personnel quality. They are education, skill, and experience. In order to combine these criteria into a mathematical expression, we must quantify or assign numerical values to each criterion.

Education. To quantify the educational criterion, one must consider the level of education attained by an individual. An arbitrary number can then be assigned to represent each level. For example, a doctorate degree can be assigned a value of 4; a master's degree, 3; a baccalaureate degree, 2. College training short of baccalaureate degree requirements can be rated between 1 and 2, depending upon the years completed. An individual with graduate work completed above the baccalaureate level but insufficient for a graduate degree would be rated by using a decimal fraction between 2 and 3. Similarly, a person who possessed more than one master's degree would be rated by a decimal fraction between 3 and 4.

Skill. The last digit of an officer's or airman's Air Force Specialty Code (AFSC) denotes his skill level. For an officer this number is 1 at the entry level and either 4, 5, or 6 for the fully qualified level, depending on the AFSC grade spread.

Experience. The experience factor is the most difficult aspect of quality to analyze, quantify, and compare. Each individual has been exposed to different experiences, the sum total of which affects his ability to do a specific job. It is experience that develops judgment, sensitizes feelings, improves skill, increases knowledge, refines human behavior, and commands respect from others. In order to include this factor of experience in a consideration of quality or proficiency, one is compelled to evaluate experience in a most oblique way.

Rather than consider an individual's age per se, which is often thought of as an index to experience, I propose to consider of primary interest the factors of total active federal military service (TAFMS) and grade. These two elements bear sufficient relation to age for our purposes, since promotions usually are based on longevity and TAFMS relates somewhat to a serviceman's age. Also these two elements can be measured and compared, though of course they can serve only as indirect measurements of experience.

To quantify grade level, the standard Air Force code can be used. To avoid confusion, grade levels for officers only will be discussed. The numerical code for a colonel is 6; lieutenant colonel, 5; major, 4; captain, 3; first lieutenant, 2; and second lieutenant, 1. TAFMS is already in numeral form and represents the number of years which a serviceman has spent on active duty.

Having quantified the factors representing the three basic criteria, we can now produce a mathematical formula for arriving at a numerical value, as follows:

$$\text{Q Index} = \log\ (E \times S \times G) \times \text{TAFMS}$$

where E is education level
S is skill level
G is grade level
TAFMS is years of active federal military service.

Note: The logarithmic function is used only to obtain a linear curve, the slope of which is somewhat easier to interpret.

To find the Q Index of an officer in the grade of captain who has a master's degree, a 2845 AFSC, and 9 years' TAFMS, we merely substitute in the formula:

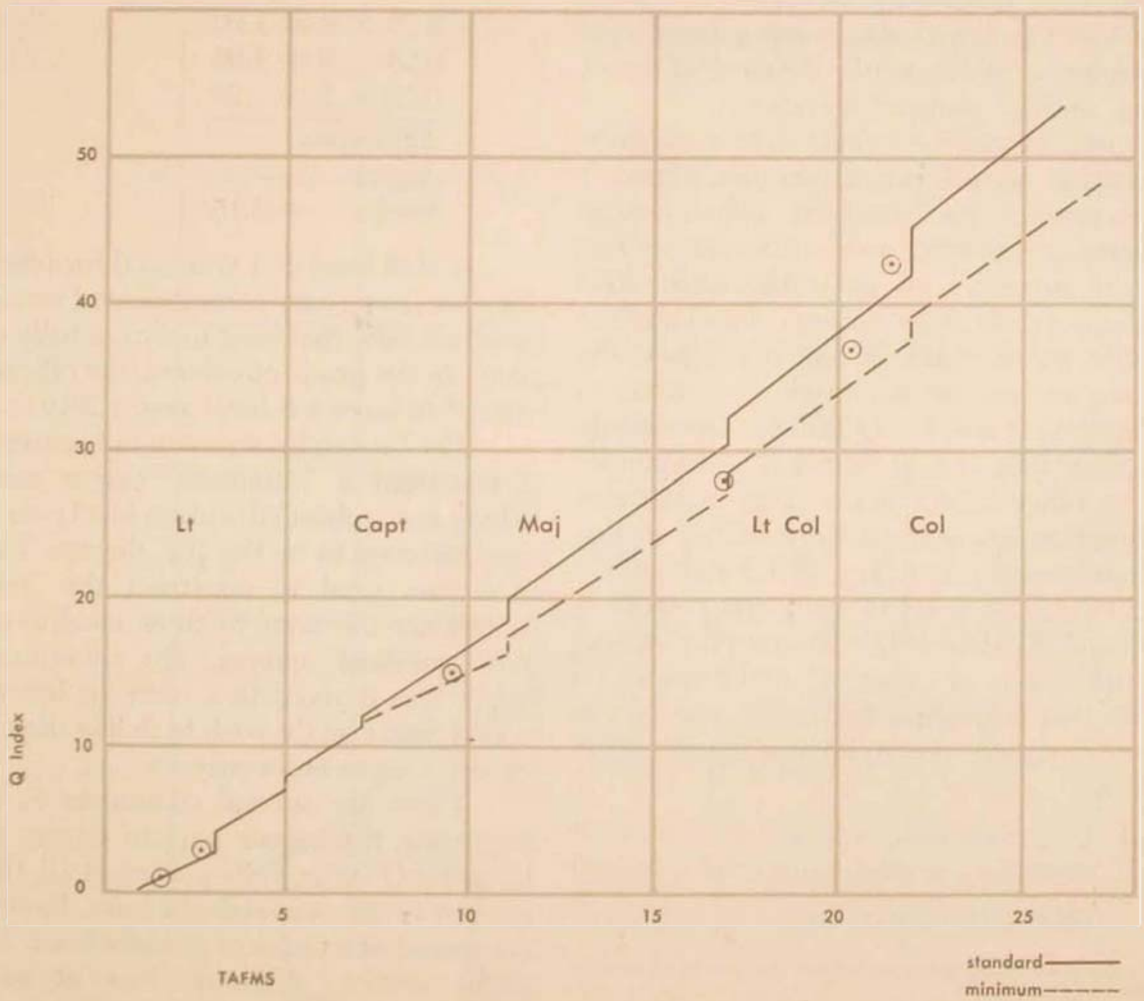
$$\begin{aligned}\text{Q Index} &= \log\ (3 \times 5 \times 3) \times 9 \\ &= \log\ (45) \times 9 \\ &= 1.653 \times 9 \\ &= 14.88.\end{aligned}$$

If this same captain had a Ph.D. degree instead of the master's degree and if the other factors remained the same, his Q Index would be

$$\log\ (3 \times 4 \times 5) \times 9 = 16.00.$$

If this captain with a Ph.D. degree were not fully qualified in his AFSC, his Q Index would be much lower, i.e., $\log\ (3 \times 4 \times 1) \times 9 = 9.72$. In this manner a Q Index value can be calcu-

Figure 1. Career progression pattern, scientific utilization field (26XX)



lated for every officer and airman in the Air Force, though for this discussion only officers will be considered.

Having calculated this value for each officer, the Air Force could then rank all officers in numerical order by their Q Indexes. The higher the index number, the more valuable the officer, according to the criteria considered. It is also possible to compare each officer against a standard or norm that is established by specifying the minimum Q Index which an officer must attain at a given point in his career.

The solid lines shown in Figures 1, 2, and 3 represent a "standard" officer's career progression pattern in terms of the Q Index for the 26XX, 27XX, and 28XX utilization fields (scientific and development engineering).* The promotion time periods and education levels prescribed in Air Force Pamphlet 36-1-2, *Officer Career Fact Book*, were used to construct this curve.[2] (All succeeding statements of a statistical nature are based on this pamphlet.) The "standard" officer was promoted at the completion of 18 months, 5 years, 11 years, 17 years, and 22 years of service.

To understand how these career progression patterns were formed, consider Figure 1 as an example. The "standard" officer whose Q Indexes are plotted over a 25-year service span was assumed to have the AFSC 2645 through the grade of lieutenant colonel and the AFSC 2616 in the rank of colonel. Since the 26XX career progression guide was used to construct this curve, the Q Indexes are slightly higher than they would be for the "standard" officer in other career fields. This is because the education requirements are higher in this field than in any other. AFP 36-1-2 indicates a desired education level of 10 percent master's degrees and 90 percent B.S. degrees for officers with 0 to 3 years of commissioned service. To quantify this education factor for use in the Q Index equation, the following computation was made:

0.10 × 3 (code for master's level)	= 0.30
0.90 × 2 (code for baccalaureate level)	= 1.80
Aggregate degree level	= 2.10

*A progression pattern for any career area could have been constructed and used here

For the officer scientist with 3 to 7 years of commissioned service, AFP 36-1-2 indicates a desired education level of 10 percent Ph.D. degrees, 50 percent master's degrees, and 40 percent B.S. degrees. The Q Index value for the education level of this group is computed as follows:

$$\begin{aligned} 0.10 \times 4 &= 0.40 \\ 0.50 \times 3 &= 1.50 \\ 0.40 \times 2 &= .80 \\ \hline \text{Aggregate degree level} &= 2.70 \end{aligned}$$

Officers with 7 through 21 years of commissioned service should have 25 percent Ph.D.'s, 65 percent master's degrees, and 10 percent B.S. degrees, according to AFP 36-1-2. The corresponding Q Index education value for this distribution is obtained in the following manner:

$$\begin{aligned} 0.25 \times 4 &= 1.00 \\ 0.65 \times 3 &= 1.95 \\ 0.10 \times 2 &= .20 \\ \hline \text{Aggregate degree level} &= 3.15 \end{aligned}$$

A skill level of 1 was used for officers with less than two years' commissioned service, since it would take that long to earn a fully qualified AFSC. In the grade of colonel, the officer was assumed to have a 6-level AFSC (2616).

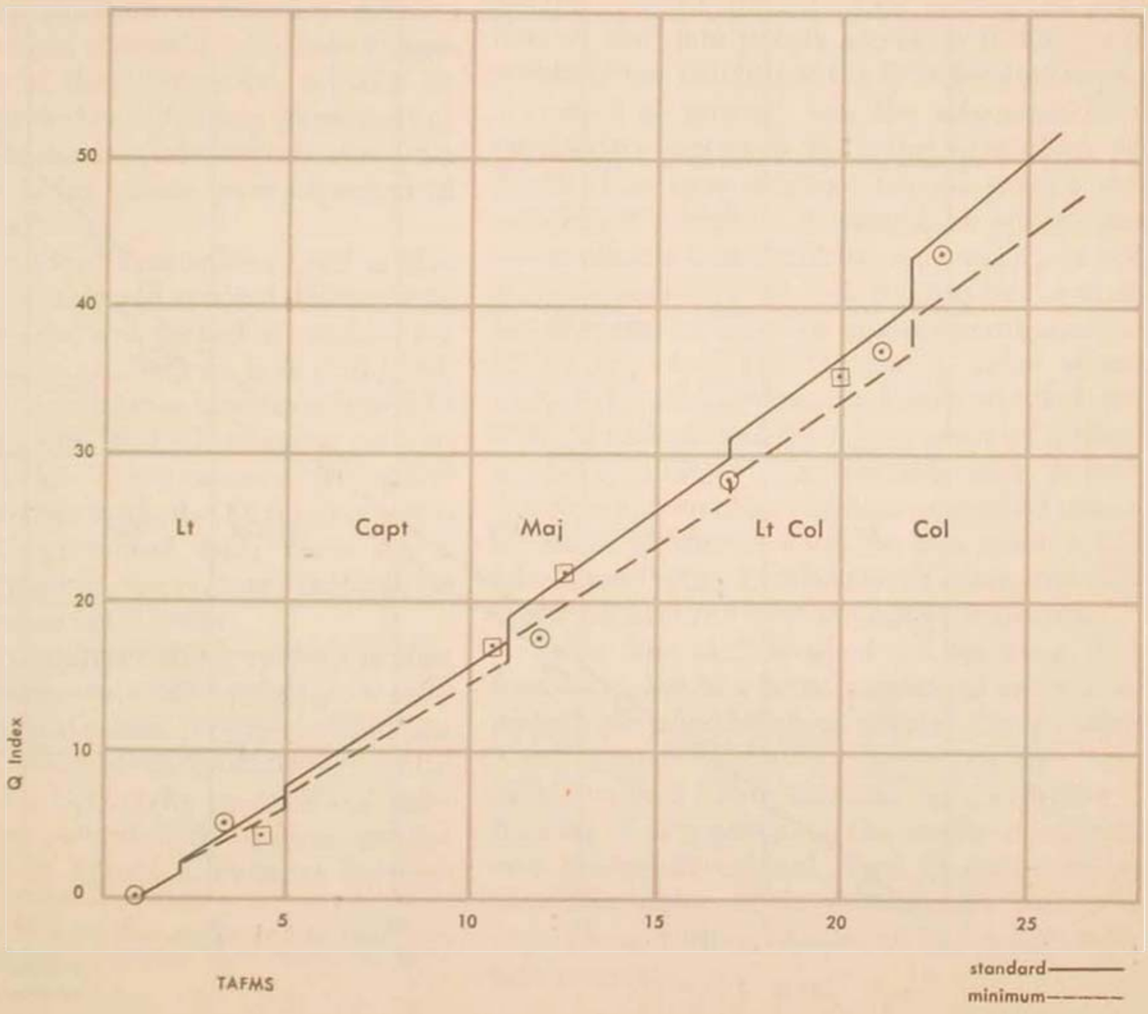
The broken lines shown in Figures 1, 2, and 3 represent a "minimum" career progression where the highest education level ever attained was assumed to be the B.S. degree. The G and S factors used to construct the "minimum" curves are the same as those used to construct the "standard" curves. The minimum career curve was derived in a more or less arbitrary way. Others might wish to define the minimum career in some other way.

There are several comments to be made regarding the career pattern curves obtained by using Q Index values. First of all, the curves are not continuous straight lines. Each curve is composed of a series of straight lines. There are slight vertical discontinuities at each year where promotions occur. However, the general slope of the entire career progression pattern curve is remarkably constant, which indicates a very uniform professional growth because of an increase in education, experience, and skill. This definitely seems to validate the career development process as outlined in AFP 36-1-2.

Secondly, these curves provide a convenient way of classifying officers into above-standard or below-standard categories. An officer whose Q Index lies above the standard curve has been promoted ahead of his contemporaries because of outstanding performance and capability, or he has obtained additional education. An officer whose Q Index is lower than the standard curve for his AFSC has allowed his contemporaries in some way to pass him by. The below-standard officer can be quickly identified by simply computing his Q Index and referring to a standard curve, such as Figure 1. The index can be used to compare the abilities of two officers competing for a promotion or specific assignment, or it can be used to evaluate an aggregate group, e.g., all colonels holding a 2716 AFSC could be compared to a standard Q Index curve for that AFSC.

Certainly one advantage of the Q Index is its ease of calculation. All data necessary to compute a Q Index can be found on an officer's Form 11, and combining these data mathematically is not difficult. Individual characteristics such as education, skill, etc., can be compared; but no single expression has been available which took into account *all* the factors contributing to quality. The main purpose in creating the Q Index was to compare the qual-

Figure 2. Career progression pattern, R&D management utilization field (27XX)



ity of Air Force officers with some standard.* To make these comparisons, an internal Air Force standard was chosen. This standard, which was developed by USAF personnel planners to guide officers throughout their careers, is AFP 36-1-2.

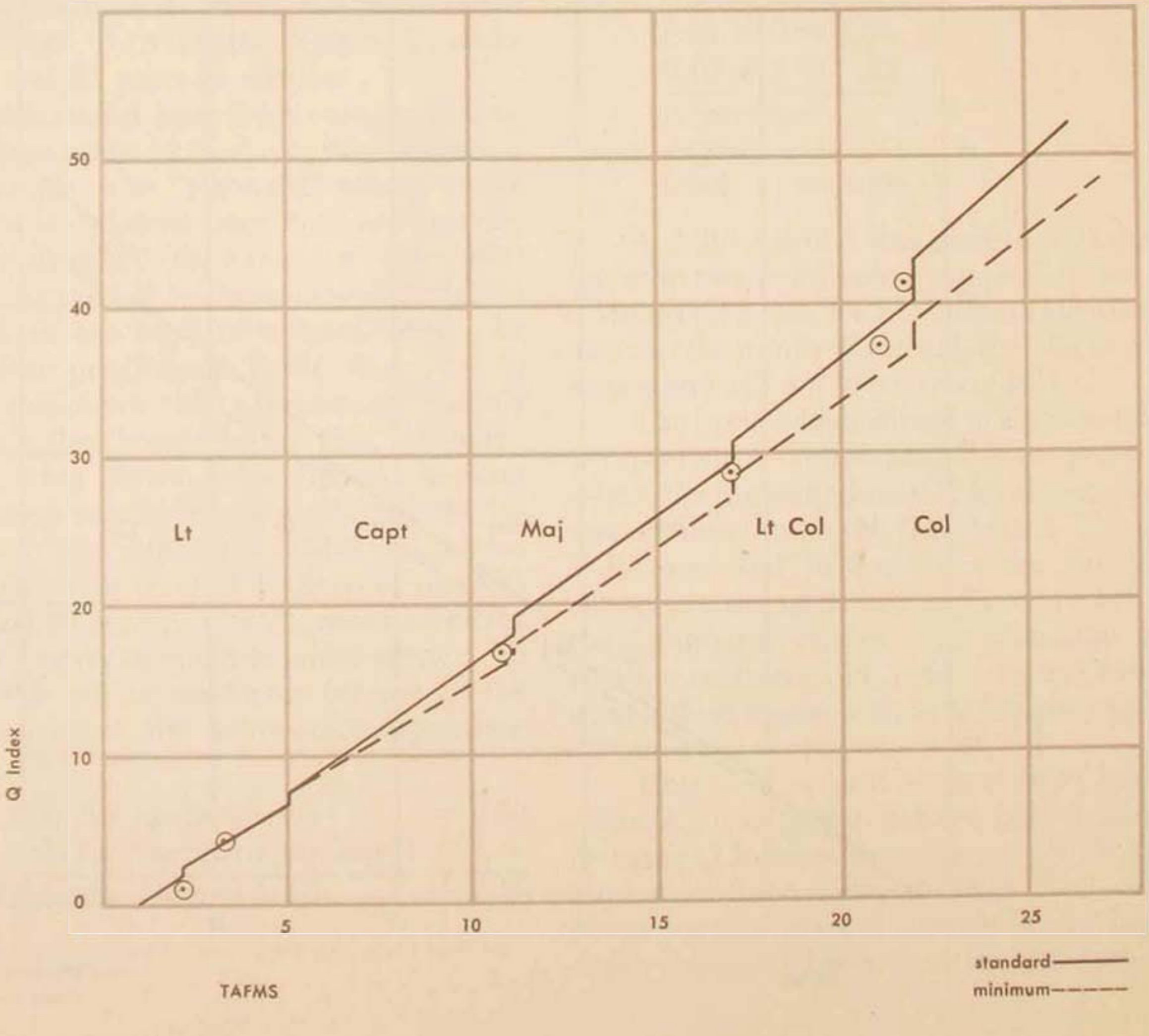
application of the Q Index

Using personnel data obtained from the Air Force Systems Command, I calculated typical Q Index numbers for each officer grade in the three scientific and development engineering (S&DE) utilization fields (26XX, 27XX, 28XX).[3] These aggregate Q Index values appear on Figures 1, 2, and 3 as circled data points. Note that these points consistently fall inside the bandwidth between the "standard" and "minimum" curves. Only one point, that representing second lieutenants in the 28XX field (Figure 3), is below the "minimum" curve. This indicates to me that on an overall basis, considering experience, skill, and education levels, Systems Command S&DE officers are uniformly of high quality throughout the grade structure.

The fact that the Systems Command data points fall below the "standard" curve should not mislead the reader into thinking that these S&DE officers are of low quality. The reason for this is that the educational levels desired by the Air Force for these AFSC's are very high. Also Air Force promotion cycles have lagged far be-

*The Q Index was initially devised by the writer to organize research data for his Air Command and Staff College thesis, "A Qualitative and Quantitative Analysis of Air Force Systems Command Scientific and Development Engineering Officers," June 1965.

Figure 3. Career progression pattern, development engineering utilization field (28XX)



hind the Bolte recommendations which were used to construct the career progression patterns. This means that an average officer's Q Index number would fall below the "standard" curve. This Air Force "standard" is a relatively high standard, and for that reason it is a worthwhile goal toward which to strive. Therefore, an officer whose Q Index value falls above the "standard" line is an exceptional officer, and any officer whose Q Index falls between "standard" and "minimum" is doing quite well.

In a further attempt to determine the validity of the Q Index, I was permitted by Headquarters Air University to use Squadron Officer School, Air Command and Staff College, and Air War College student records as a source for additional Q Index data.

The records from these three schools were reviewed to identify all officers who were serving in S&DE assignments prior to their arrival at Maxwell in 1964.* This group of 81 students cannot be considered a representative sample from the total population of Air Force officers because of the rigid criteria used to select them for attendance at their respective schools. In fact, they are probably in the top 20 percent of their respective grade distributions. For this reason their Q Index values were expected to be higher than average.

For each student S&DE officer used in this study, an equal number of student officers with an operations DAFSC was picked at random for comparative purposes. Data such as skill level, education level, and TAFMS were combined to obtain a single value for each grade in each of the two career fields. These values are compiled in Table I, together with the Q Indexes computed from the personnel data. There are a number of interesting observations that can be made from the data in this table.

The most important thing to note is that the Q Indexes of the S&DE officers fall on or very near to the standard career progression pattern curve. Q Index values for S&DE officers currently attending the Air University professional military schools are plotted with squares around the data points in Figure 2. Because the majority of student DAFSC's were 27XX and 28XX (they both have the same patterns), Figure 2 was used instead of Figure 1.

Table I. Q Index Data for Selected Students at Air University, Maxwell AFB

S&DE Group	G	S	E	TAFMS	Q Index	Size of Sample
1st Lt	2	2.9	2.4	4.2	4.9	25
Captain	3	5.0	2.7	10.8	17.4	16
Major	4	5.1	2.8	12.7	22.3	15
Lt Col	5	5.0	2.6	19.9	35.6	25
Ops Group						
1st Lt	2	4.8	1.8	5.4	6.6	25
Captain	3	5.0	1.9	11.5	16.8	16
Major	4	5.0	1.9	14.5	22.8	15
Lt Col	5	5.6	1.5	20.7	33.7	25

Note: Values used for S, E, and TAFMS are averages.

Source: Data contained in this table were derived from Air University SOS, ACSC, and AWC students' Forms 11 personnel data.

Since the student sample would be expected to have high Q Index values, the position of the data points serves to further substantiate the validity of the Q Index technique.

Also of interest was the education-level comparison between S&DE and operations officers. The S&DE average for all grades was significantly higher. It should be noted that many officers had credit for some college work, which is indicated on their records by the number of semester hours or quarter hours successfully completed. To obtain an *E* value, it was assumed that 32 semester hours equaled one year of college and that four years of college were equivalent to a baccalaureate degree. Therefore, if an officer had completed 64 semester hours of college work, he was given a 1.50 education factor. *E* values were computed only to the nearest full year of college education.

The low skill level of 2.9 for S&DE lieutenants is due to a large number of entry-level DAFSC's recorded for these officers. On the other hand, almost all the operations people were fully qualified. This accounts for the higher Q Indexes of this group. In the grades of captain and lieutenant colonel, S&DE Q Index values were the higher of the two groups. Note also that the operations officers all had longer military service.

*Again it must be noted that any career field could have been used as an example. I happened to be particularly interested in the S&DE field.

The Q Indexes computed for operations officers are plotted on Figure 4 and fall near the "standard" career progression pattern, which, like the S&DE patterns, is a high "standard." One would then suspect that, since this student group represents an elite portion of the officer corps, the Air Force-wide averages would fall somewhat below the desired pattern for the operations career field.

suggested uses of the Q Index

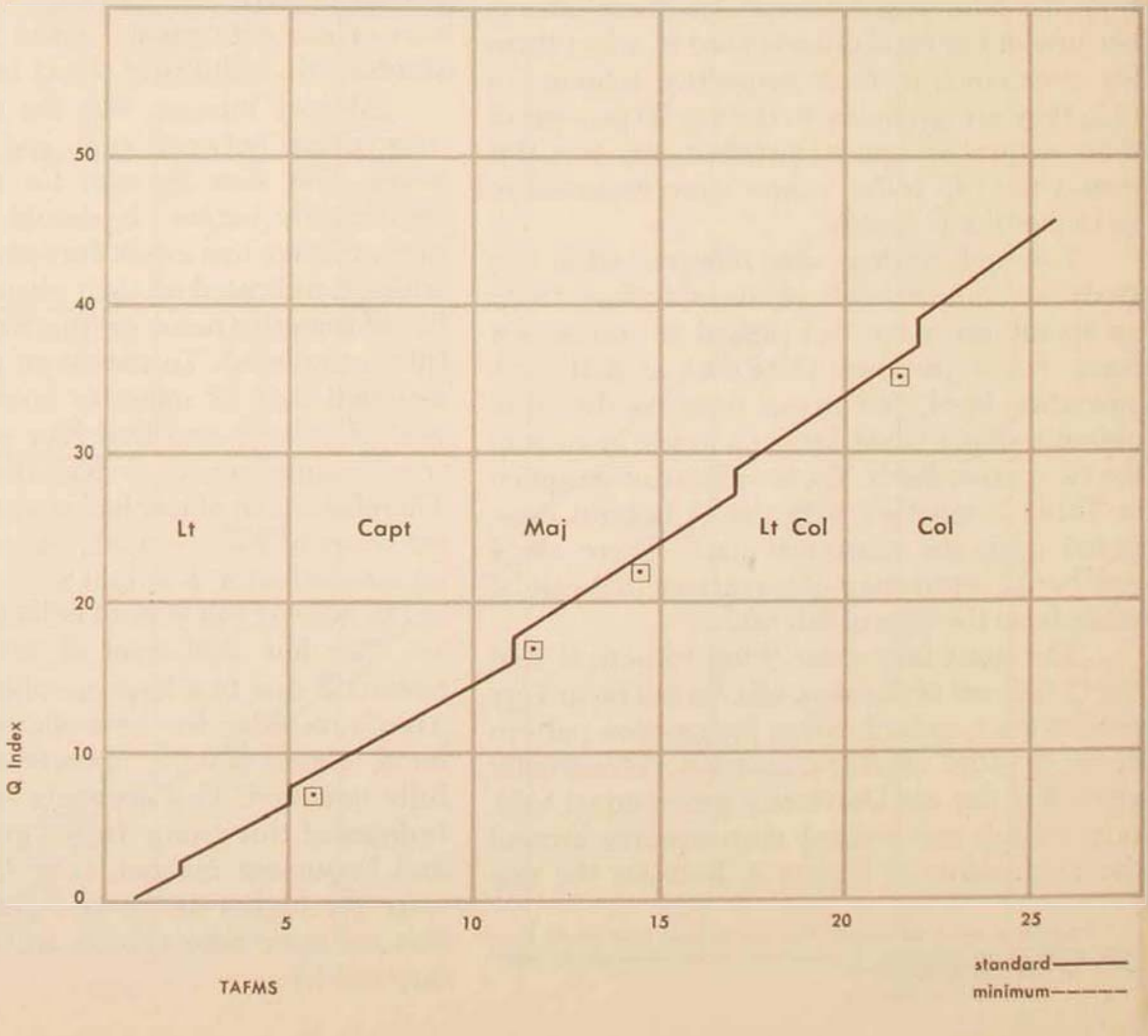
Although the Q Index was originally devised as a mathematical tool to aid in the analysis of Air Force personnel quality, there are other uses for which it is well suited.

- The Q Index provides a standard or norm which could be used for assignment purposes. For example, a request for the assignment of an officer would have to include only the AFSC, grade (if field grade or above), and the desired Q Index. The job description for each Air Force "billet" or position would also include the appropriate Q Index for the position. The index could also be used for airman assignments.

- The Q Index could be used as a selection factor by officer and enlisted promotion boards. Since the numerical value of the index represents a truly impersonal and empirical measure of a serviceman's ability, it would be ideally suited for screening large numbers of candidates.

- The Q Index could also be used as a convenient planning factor for determining promotion policy, education requirements, the adequacy of job/man matching techniques, and so on.

Figure 4. Career progression pattern, operations field



• If utilized Air Force-wide, the Q Index would serve as an incentive factor for all officers regardless of grade. In my opinion, the index would create keen competition among personnel to achieve the highest index number possible, thereby enriching the capabilities of the Air Force. The simplicity of calculating the Q Index would permit each individual to compare himself with his contemporaries throughout his entire career.

• Other factors can be added to the Q Index equation to refine or adjust it, depending on the intended use. For example, a factor can be included which credits the officer with service school attendance. Because it can be very flexible, the Q Index appears to have great utility.

• As with other numerical codes, the Q Index can be used more readily in statistical reporting, in manning documents, in abbreviated job descriptions, for assignment actions, and for automatic data processing of personnel records.

It should not be implied that the Q Index in its present form can readily be adopted by the Air Force for the uses outlined above. The Q Index can undoubtedly be improved by others more skilled in statistical mathematics. A complete regression analysis was beyond my capability because of the great bulk of data required to establish the exact relationship between all variables that should make up the Q Index. Equal weight was assigned to each variable as a first approximation.

It is also possible that others might challenge the factors used to construct the Q Index. Certainly the fourth digit of the AFSC is, at best, a crude indicator of skill level. If this number were awarded on the basis of an examination score, and if a greater number of skill levels could be identified (between entry and fully qualified), the fourth digit would be more meaningful and so would the Q Index. Perhaps the S factor should include all AFSC's in which an officer or airman maintained proficiency. There are many other possible modifications that could be made. The Q Index is not yet perfected; in its present form, it is the experimental model of what could be a very valuable tool.

To IMPROVE Air Force personnel management, a new analytical tool, the Q Index, has been devised. The Q Index is a simple mathematical expression which combines personnel factors such as education, experience, and skill level into one number. Although still unrefined, the index appears to have some merit in making qualitative comparisons between individuals and groups of individuals.

The Q Index has been used to evaluate two select Air Force groups of officers and was found to correlate well with other known information about the quality of these groups. Because of its simplicity and wide range of application, the Q Index can be used for numerous personnel actions, from initial procurement to separation from the service.

United States Air Force Academy

Notes

1. 6570th Personnel Research Laboratory Technical Documentary Report PRL-TDR-63-9, *Career Experiences of AFIT Classes of 1955 and 1956* (Lackland AFB, Texas: 6570th Personnel Research Laboratory, Air Force Systems Command, April 1963), p. 7.
2. Air Force Pamphlet 36-1-2, *Officer Career Fact Book* (Washington, D.C.: Department of the Air Force, 15 July 1963), pp. 29-58, esp. p. 56.
3. Air Force Systems Command Data on All S&DE Officers by TAFMS assigned to the Systems Command in Air Force Specialty Codes 26XX, 27XX, and 28XX as of 15 May 1964.

Air Force Review

THE USAF MANAGEMENT ENGINEERING PROGRAM

A New Attack on an Old Problem

Colonel Peter J. Hoke

A MILITARY commander's governing interest in manpower lies in achieving a capability to meet the unexpected as well as the expected. Nonetheless a commander is forever being asked to cut costs by reducing his manning. These are conflicting objectives with which he can cope only in limited degree, and then only in dealing with his subordinates. He is limited in degree because the net sum of information and authority available to him would be unlikely to support large strength reductions on his decision. His control is limited to his subordinates because his is a dynamic and unpredictable operation that will always support more manning increases than any decreases he may be able to identify. In the Air Force, he can and does forestall the forwarding of many manpower requests by realigning his resources internally. But as a rule he is not in a position to volunteer manpower reductions and simultaneously make progress in his own preparedness objectives.

This is particularly true of the major air commander, who operates a vast one-of-a-kind enterprise. At any given time the projects of his planning staff are more likely to cost than to save manpower, and in the absence of a finite means of proving and defending his exact total requirement, he cannot seriously be expected to rank austerity above defense.

It is axiomatic that military manpower decisions must be determined by the highest competent authority. Failure in this respect means failure to achieve manpower equitability, an open invitation to outside interference. This defines a requirement for a professional manpower resource management capability, organized to provide flexibility of control that will best protect *all* Air Force interests. The Air Force's Management Engineering Program, wedded to the traditional manpower and organization function, promises to overcome or at least ease this long-standing problem.

In 1949, following several years of struggle with the uncertainties of manpower determination and allocation, the Air Force provided its major field commands with manpower and organization staffs. These staffs resulted from recognition of the dissimilar missions involved and the need for specialization in manpower determinations beyond that which could be provided from a single headquarters. Except for primary mission or "Table of Organization" units, authority to determine skill requirements was delegated to these commands. At a later date, presumably to ease administration, some major commanders further delegated manpower skill determination authority, issuing their lower echelons the same type of bulk manpower authority as was issued them by Air Force headquarters, i.e., a voucher prescribing only numbers and grades. Under such conditions, publishing their own manning documents and entering the controlling USAF master authorization change files at will, the lower commands became accustomed to a manning prerogative both powerful and luxurious. Cooks could be transposed into mechanics by fairly junior commanders. While such an arrangement did simplify some local problems for the short range, it was fundamentally inconsistent with service-wide personnel planning and manpower management responsibilities.

In 1959, operating from command to command under various evolutions of these conditions and still seeking the tools needed for proper manpower management, the Air Force initiated the Manpower Validation Program (MVP). Its purpose was to achieve credibility for the Air Force's stated manpower requirement by covering the requirement with engineered manning standards, developed from the ground up.

Organizationally, the MVP was composed of teams located at air bases, reporting direct to the major commander. Operating control and scheduling were vested in the major commander; policy control and procedural standardization were provided by Air Force headquarters. The techniques used by the teams were those accepted by the industrial engineering community, such as work sampling, time study, and predetermined time standards. The skills required were, in part, those of the professional industrial engineer.

Because the Air Force was creating a whole new function where none had existed before, problems of procurement, training, and retention of personnel were great. Moreover, the procedures and techniques used, although accepted by progressive industry, were not generally known to Air Force commanders. Continuing education and program image-building were required. Despite these obstacles, the MVP established itself as a needed and useful arm of major command manpower management.

Meanwhile, existing side by side with the MVP was the Air Force's older Management Engineering Program established in 1956. This program defined management engineering in broad terms and directed its implementation in generalities. It addressed itself not to manning standards, the MVP's objective, but rather to all other management objectives. This early Management Engineering Program was not successful. There were no centralized data to prove its achievements and no central procedural control or standardization. In some commands a few "management engineers" were hired to implement the directive, but little came of the effort. The 1956 Management Engineering Program did little that its title inferred, while the Manpower Validation Program took on the aspects of a true engineering-based, scientific operation.

One problem almost upended the MVP at the outset, however. The first MVP standards were developed for Air Force-wide application. When these early standards were applied, it became evident from the furor and demands for adjustment that even the simplest functions varied widely in detailed tasks performed, both from base to base within commands and from command to command. Some of this variation was the product of historic military deference to "command prerogative," which resulted in nonstandardization. Variations were prevalent in almost all activities, even those alleged to be standardized by their Air Staff functional offices. Differing facilities and levels of managerial competency compounded the problem. Additionally, peculiar local workloads were far more common than was generally known.

A good illustration is the military pay function, which might appear ideal for precise central manpower control. The differences between Lackland, a training base, and McGuire, a port of embarkation, and Seymour Johnson, a tactical base, and many others soon became evident. Such variations, well understood locally, were not responsive to Air Staff analysis until management engineers measured the steps required for the different types of disbursement performed. Findings such as these in many functions introduced the necessity for a new Air Force concept of functional manpower control. This concept held that the achievement of uncontestable common manning standards required standardization of work center organization and tasks from the Air Staff level. This was an unprecedented and monumental objective. It would have to be realized function by function; complete "commonality," that is, standardization in all functions, was obviously impossible.

In early 1961, when the MVP effort seemed destined to become another gravestone among many previous manpower control efforts, an important decision was reached: develop *major command* standards. This decision considered (1) the importance of the professional teams being developed by the major commands regardless of whether or not common standards were within easy reach; (2) the need, in most functions, for commands to standardize or reduce their own inconsistencies; and (3) the need for developing within the Air Staff the requisite ability to establish the necessary standardization and follow-on controls. With command support thus intensified, the program moved forward.

As its experience and reputation expanded, the MVP began to attract competent officers, including qualified young industrial engineering graduates from ROTC and other sources. It was becoming increasingly clear that the 1956 Management Engineering Program and the 1959 Manpower Validation Program should be combined and the title "Management Engineering," the more descriptive of the two, should be retained. This broadening of MVP objectives meant that the untapped talents of the MVP officers could be fully used. The programs were combined in 1964. Achieving a first generation of engineered standards remained a priority project of the new Management Engineering Program (MEP), a project which, with the MEP's limited manning, did not leave time for much else in the way of application of the many other professional techniques that were within the capabilities of the teams.

Clearly, the Air Force possessed the nucleus of a promising and potent military manpower control organization, if it could be brought to its full potential. The need to expand the usefulness of this corps became as urgent as that to develop a first generation of engineered standards. Its field-tested young officers would be lost to the many opportunities awaiting their talent if this were not done. The rising demands of the Secretary of Defense for quantified, professionally developed manpower requirements further emphasized the need for this direction. What the Air Force needed was an organization that applied the expanding talents of its management engineers objectively to all manpower management problems requiring such help, and most especially to the many long-standing management problems inherent in the administration of the manpower function itself.*

The needed organization was one which wedded the traditional manpower administration structure to the new-found capabilities of the industrial engineering-based MEP. In this manner the manpower and organization function could hope to achieve the best management of Air Force manpower, using the science of the management engineer to refine the methods of the past.

*A part of manpower and organization Project ECONOMAN (Effective Control of Manpower) is concerned primarily with the achievement of automation to improve and expedite manpower computations, allocations, projections, and service in general. In staffing the project office for this ECONOMAN objective, the Management Engineering Program was found to be the best source of qualified officers. Similarly, there is little question but that this type of officer is educated and oriented to provide the best manpower and management services for most other manpower and organization missions.

This organization began to take form in 1964 as the Management Engineering Team (MET) concept. Its thesis was that separate manpower staffs below major command headquarters were becoming less necessary as standards were achieved; that more professional and faster manpower service could be provided the lower commander in this manner than he himself could provide; and that in any event the Air Force could not continue to sanction loosely delegated manpower control authority if it was to compete successfully for missions and resources. The MET concept, which is to be fully effective by July 1966, centralizes manpower controls at the major command or Headquarters USAF level, depending upon the function, and provides the major commander with field teams (combined MEP and traditional manpower and organization staffs) to assist in the job.

Thus far we have reviewed the background experience of the Air Force leading up to a concept of professional field teams, reporting to major commands, organized to provide a combination of manpower and management engineering services to the local commanders and higher echelons. Several points must now be touched upon in order to depict the MET concept as a sound approach for the future. These include the rationale for the one-echelon delegation involved; the degree of this delegation; and the potential of the program to provide future services of a general management consultant nature.

In light of the unique military control problem, why did the Air Force not organize the MET directly under Air Staff control? The answer, initially, was one of reducing a large and newly evolving program to manageable proportions. Problems of activation, command, and administration alone for the many widely scattered teams were great. Recruiting and training in a new skill area posed major problems. Most significant, it was apparent that field commands and their bases differed sharply in policy emphasis, facilities, priorities, and tasks. The teams, to be fully effective, could not represent a higher echelon.

Other reasons for delegation developed as time passed. Management engineering personnel were required to work closely and in some degree of confidence with the staffs of the major air commander. The impending stepped-up use of the teams for methods improvement, for organization studies, as monitors for work simplification projects, and as general management engineering troubleshooters indicated that they would be most successful as a part of the fabric and personality of the command itself. To date, this decision has paid dividends in full command support of the program.

The MET concept will support a smooth transition into central functional control as circumstances warrant. Air Force headquarters issues policy directives, develops procedure for the teams, and prescribes functional emphasis. It also compares MEP functional studies across command lines and uses this field work to produce Air Force *common* engineered standards wherever feasible. Thus less real delegation of authority exists in practice than on paper. Like Alfred P. Sloan's much-discussed organizational decentralization of General Motors, any decentralization that is accompanied by delegated authority and controlled by a competent policy-making, goal-setting higher staff is likely to be more an expression of centralized control than of decentralization.*

Much remains to be accomplished before the USAF MET concept can claim full effectiveness. Nearly all MET effort continues to go into standards setting and updating; many of its talented members have not yet been sufficiently challenged; centrally established techniques for doing the numerous repetitive management engineering tasks that are applicable Air Force-wide have yet to be developed. Refinement in its organizational alignment will be necessary.

Looking to Air Force needs for general management advisory and consultant services in the future, one can anticipate that, whatever the needs, they will be largely met by personnel of the caliber now being developed on the teams. Members of the typical team will possess many years of diversified Air Force experience, intensified technical training in the several Air Force management engineering techniques at the Air Force's own MEP courses, and college

*For a discussion of this theme, see "The Great GM Mystery" by Harold A. Wolff, *Harvard Business Review*, September-October 1964.

degrees in industrial engineering, industrial management, and related subjects. Many MEP officers now possess advanced degrees, and this trend is being supported in recently announced career field educational objectives.

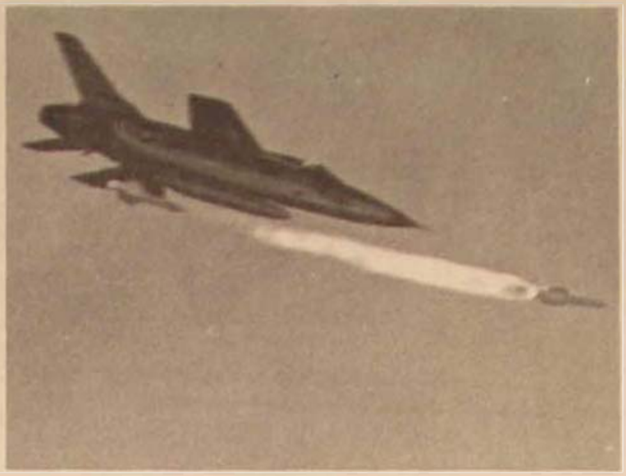
USAF management engineering teams are today providing many specialized management improvement services beyond the scope of their scheduled standards work. These projects range from organizational studies to contract services analyses, to general manpower-utilization troubleshooting. These services are, at present, incidental to the achievement of a first generation of manning standards and are not centrally directed by Hq USAF. The Air Force plan is for this potential to be methodically harnessed, as it strengthens through the same techniques used in the standards work: USAF policy and manuals specifying controls and procedures. Given the continued input of trained personnel and the availability of current reference materials (team libraries are maintained), it is difficult to conceive of management engineering problems that could not be resolved within the MET organization.

The biggest single remaining problem is retention of field-grade officers who have the necessary technical capabilities to exploit the potential of the teams. Many veteran MVP officers, with their wide variety of skill backgrounds, have returned to other functional areas. Others, discovering the industrial demand for this type of experience, have been lured into early retirement from the Air Force. In a few commands, field-grade MEP officers are almost nonexistent. Correction of this condition is a priority project of the Director of Manpower and Organization, Hq USAF.

The outlook for the USAF Management Engineering Team concept in contributing to scientific management of military resources is bright. The influence of the management engineer is felt beyond the scope of the pure standards work that he does in engineering the requirement for Air Force manpower, even during this work. Such is the fortunate result of exposing those trained in the techniques of modern management to real-life examples of management's field forces in operation. But this is only a beginning. Far greater benefits will be realized when emphasis on manning standards development and maintenance gives way to emphasis on the refinement of the organizations and procedures which govern the functions measured. This Air Force achievement could become a hallmark in scientific military resource management.

Headquarters United States Air Force

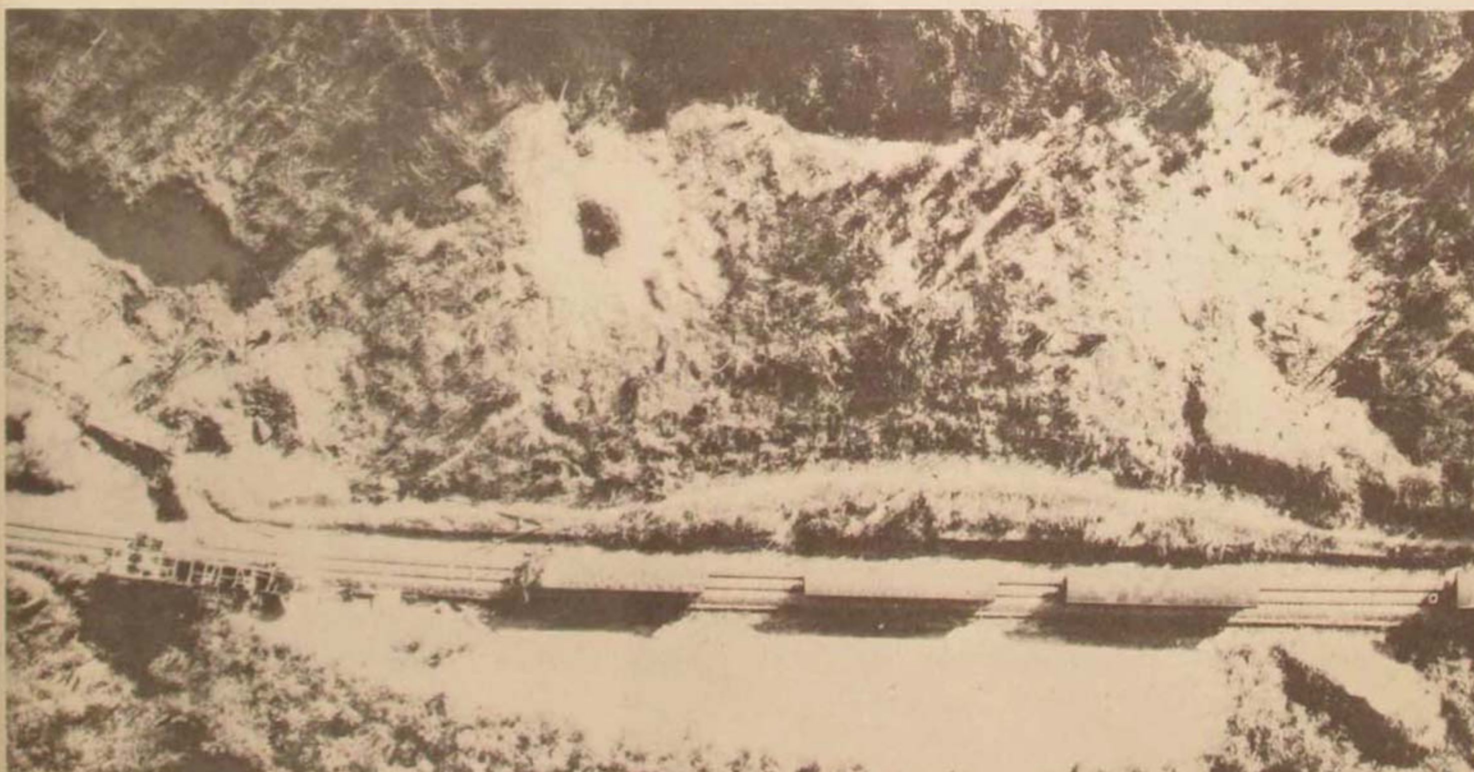
Air Operations in Viet Nam



AIR ATTACKS ON NORTH VIET NAM

THE autumn of 1965 saw intensification of USAF and VNAF attacks on military targets in Communist North Viet Nam. A total of 1958 sorties in September (1939 of them by the USAF) was almost a third of all those flown since the attacks began on 7 February 1965. Typical targets included radar and antiaircraft sites, military barracks and camps, ammunition depots, storage areas, communication lines, and vehicles. The accompanying aerial photographs document some of the strike damage.

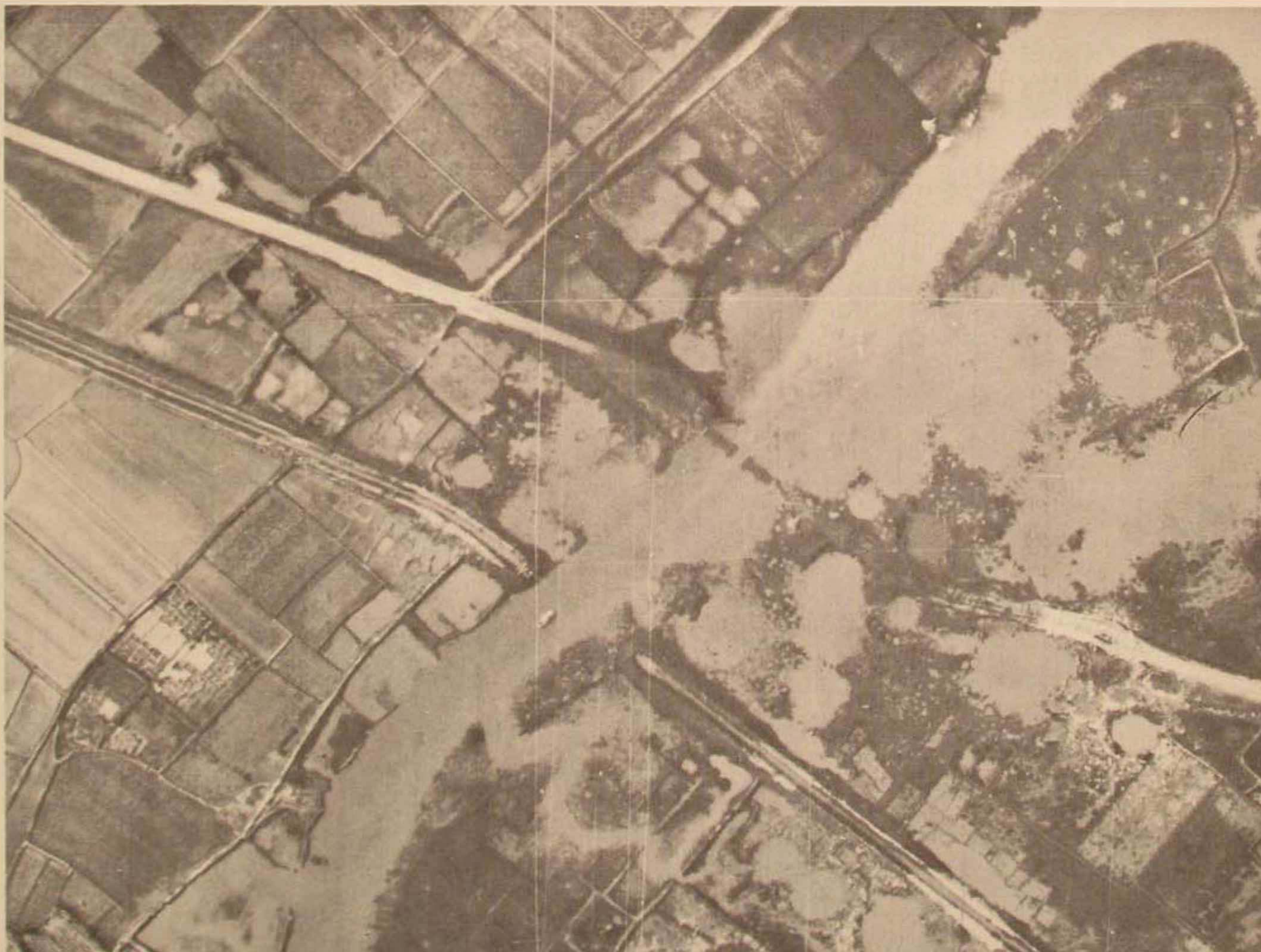
Four USAF F-105 Thunderchiefs attacked a string of railroad boxcars about 95 miles northwest of Hanoi, destroying at least 12 of them and ripping up 600 feet of rail.



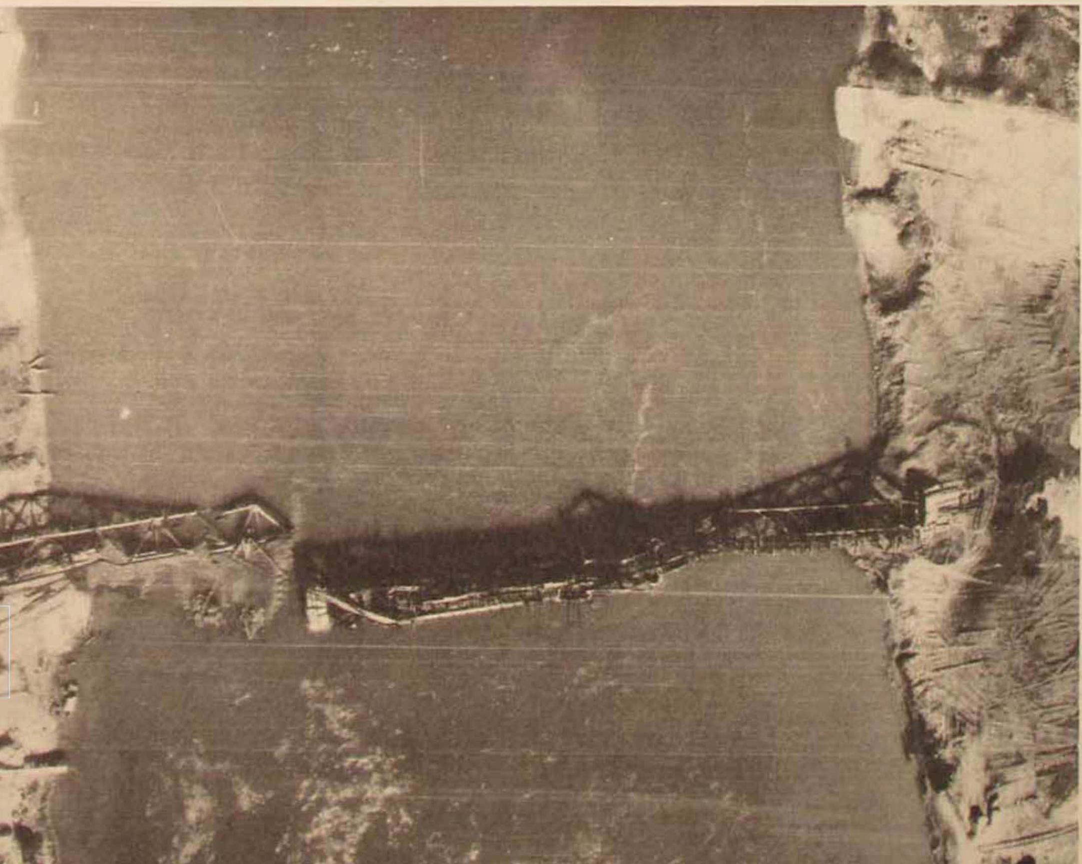
In the Taun Gial barracks area about 30 miles northeast of Dien Bien Phu, 9 buildings were destroyed and 2 damaged by 1000-pound bombs dropped by 4 Thunderchiefs.

Two 750-pound bombs (lower left and center) slam into a riverside repair area in North Viet Nam, disrupting the repair of naval patrol craft.

Thunderchiefs using 750-pound bombs smashed the Dong Phuong Thong rail and road bridges along Route 1A about ten miles north of Thanh Hoa.



The Lang Met highway bridge on Route 1A 45 miles northeast of Hanoi (above) bears evidence of the Thunderchiefs' first strike in this area. . . . Their 3000-pound general-purpose bombs also destroyed the Phuc Thien bridge (below) on Route 7 about 20 miles north of Vinh.



UNCOVERING THE VIET CONG

THE capacity of the Viet Cong for sudden attack and easy disappearance into the dense, protective jungles of Viet Nam has made him an elusive foe. To deprive him of his natural concealment, particularly in areas subject to ambush along highways, canals, and railroads, has become one of the unusual requirements of the war there.

In December 1961 six C-123 Providers were deployed to Southeast Asia with the mission to defoliate selected strategic areas in the Republic of Viet Nam. Organized as the 309th Air Commando Squadron Special Aerial Spray Flight, more popularly known as "Ranch Hand," these specially equipped aircraft now average more than 100 sorties a month throughout the RVN. Flying in a tight formation of four just above the treetops, on a slow, precise track to spray defoliating liquid on a 1000-foot-wide swath, these twin-engine transports are especially vulnerable to Viet Cong ground fire and thus require maximum performance. In less than a year they have been struck by more than 500 rounds of ground fire without losing an airplane or a crewman, though not without their share of Purple Hearts. The flights are accompanied by A-1H Skyraiders of the RVN Air Force, striking the Viet Cong positions with 20-mm cannon fire, and sometimes are supported by spotter planes and Army and Air Force helicopters.

Ranch Hand "weed killer" spraying is but one of many counterinsurgency techniques used by the USAF to get at the Viet Cong more readily and deny him his ambush advantage.

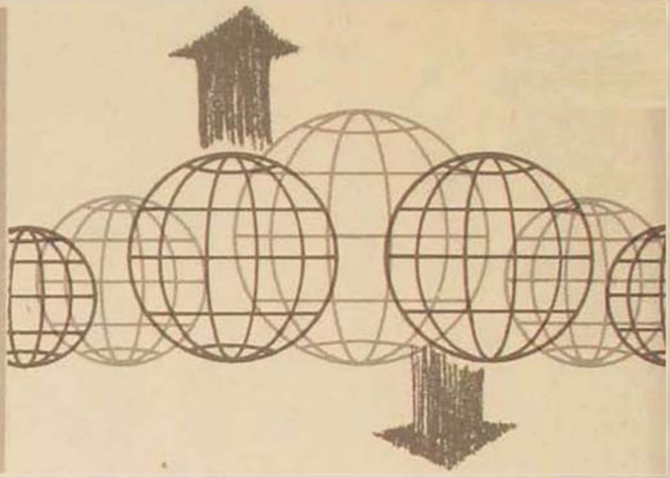
Ground support personnel at Tan Son Nhut Air Base, Saigon, load a "weed killer" type liquid into spray-equipped C-123's.

A Ranch Hand flight engineer releases the defoliating liquid on a suspected Viet Cong concealment.

A fog of defoliant spray settles on the jungle cover, stripping leaves but not harming man or plant roots.

In the usual operational pattern, Ranch Hand C-123's sweep wide swaths back and forth.

Books and Ideas



AMERICAN SECURITY AND THE BALANCE OF POWER IN A NUCLEAR AGE

Dr. Rodney C. Loehr

THE present widespread interest of Americans in security matters can be traced to World War II developments. The United States emerged from that war as one of the two super powers of the world. The European shield that had protected us from foreign harm in the nineteenth century lay battered and broken. European empires were in the process of dissolution, and the future of the former colonies was in doubt. Europe was no longer the world's banker, and much of Western Europe was in ruins. The horror of the concentration camps froze the imagination of the world, and old hatreds were crystallized. Disorder abounded, the word "progress" left a bitter taste, and on the horizon of the future hung an ominous, mushroom cloud that threatened to engulf the world and end the human experiment. The United States was thrust into a role for which it was not mentally prepared. A fearsome, complicating factor was the existence of weapons of mass destruction for which there was no precedent and no body of experience.

In terms of population, natural resources, industrial and agricultural production, labor skills, geographical position, and military might—in short, of all the power factors—the United States was a giant among nations and could not avoid a world position. To do nothing would have been as much a policy as a carefully calculated plan. However, in a "satisfied nation," such as the United States, it is extremely difficult to do political planning for the future, since we have no territorial ambitions and it is only the conduct of other nations that we wish to influence. When General Marshall was Secretary of State he established a Planning Group in the Department of State in the hope that a long look into the future could be taken. This hope proved illusory, and the Planning Group was soon working on current events. As a "satisfied nation," it will probably be our fate to react to events and not to initiate them. Since it will be the "unsatisfied nations" or those suffering from messianic delusions that will make the first moves, and since these moves can be made over a vast part of the globe and under conditions difficult for us, we are in for a series of jolts and shocks. Under these circumstances military policy and planning face enormous difficulties because we must be able to react to a wide range of possibilities over great geographical areas. Growing familiarity with these problems is part of the general interest in security affairs.

Security problems, however, are not really new for any nation. All nations, even the emergent ones, have internal security problems, sometimes of considerable extent. Roughly, internal security seeks to create and maintain an environment that will favor the continuation of the species. With a given physical environment of soil, terrain, natural resources, and climate, a nation strives to preserve and enhance cultural developments that have effectively utilized or that promise to utilize these resources. The agencies of internal security are all the forces of government, but especially such instruments of order as police bodies. Other organizations, like political parties, churches, and fraternal groups, add to the security of the individual. The aim of all these agencies is that, according to the particular rules of the culture, the individual shall be protected in life, limb, and property and shall have a favorable opportunity to rear a family and, in the Western world, enjoy life, liberty, and the pursuit of happiness. We take this order of security for granted because it is close to us and its absence would be immediately apparent. Human societies that do not provide a minimum of internal security for their members cannot last.

External security is not as familiar to Americans as internal security. This unfamiliarity results from our history and from our geographical position. Today's threat to our existence may be only 15 minutes away in flight time, but its base lies thousands of miles distant, with oceans or arctic ice as barriers to the more conventional dangers. For the past century and a half these barriers have permitted us the luxury of isolation, and we have become accustomed to an America inviolate from the profaning footsteps of a foreign invader. We could afford the luxury of disdain for "entangling alliances," "balance of power," "power politics," large standing armies in time of peace, and other evidences of European decadence. The bright New World, surrounded by its ocean moats, would receive adequate protection from its minutemen, who, musket in hand, would spring to arms in time of danger, leaving plow and anvil for a season until the emergency had passed. No large professional forces, with their dangers to civilian control, would be needed, only a few John Smiths and Miles Standishes to train willing civilians in the military arts.

In our colonial period we could not afford a large professional force; we had to depend on our cornstalk militia and the Mother Country for protection from domestic or foreign enemies. Few Americans, however, needed to be told about internal or external security matters. Indians were an ever present danger, and it was not until after the Civil War that the Indian menace disappeared from American doorsteps and became only a headline about an encounter in the Wild West. Foreign enemies threatened invasion until the decade prior to the American Revolution, and the threat was not completely ended until the Battle of New Orleans in 1815.

During the Napoleonic wars we had a stake in the balance of power in Europe. When Napoleon acquired the Louisiana Territory from Spain, Thomas Jefferson talked of "marrying" the British fleet, for a Napoleon victorious in Europe could become an instant menace in the Caribbean and on the American Continent. Fortunately, French weakness led to the sale of the Louisiana Territory, and Waterloo ended Napoleon's dreams of glory and conquest. With the end of the Napoleonic wars, French efforts to dominate Europe, which had convulsed that continent from the time of Louis XIV to Napoleon, ceased, and a long century of general peace began. Behind the shield of the British Navy we could devote our resources largely to peaceful purposes. An American pacifist movement sprouted after the second war with Great Britain and found fruitful soil in the era of the long peace. It was an era of demonstrable progress, especially in material things, and it was believed that man's nature was capable of similar improvement. A minor interruption to this era of peace came with the Mexican War, but since its outcome was happy it did not detract from the general feeling about the nature of mankind and the belief in progress and reason. The tragic Civil War seemed to prove that good had again triumphed over evil, and in any case the long, productive years of the nineteenth century had been without a serious foreign foe and had seen no foreign war after 1815. Americans could and did lecture decadent Europeans about the benefits to be derived from adherence to democracy—one, supposedly, peace.

Towards the end of the century a new power arose to disturb the balance of power in Europe. After a series of short, victorious wars Prussia unified most of the former petty German states into a powerful nation. A burst of energy followed, and Imperial Germany, supported by a potent industrial base, an energetic people, and a mighty army, sought a place in the sun. Germany threatened to dominate the continent of Europe, and the threatened powers sought safety in an alliance.

Then in 1898, after a "splendid little war" with a fourth-class power, another rising nation, the United States, became a world power with which to reckon. Emerging from its cocoon of isolation, the United States was forced to take an interest in the balance of power in areas that stretched from western Europe to the far reaches of the Pacific. Now that the United States stood in the front rank of nations, something became clear that had been there all the time but had become obscured during the long century of European peace: the United States *did* have a stake in the balance of power in Europe and in the Far East. A sudden realization of the meaning of world power politics was probably the primary reason for the acquisition of the Philippine Islands when it became known that if we did not take them the Germans would.

After the Spanish-American War we followed a balance-of-power policy both in the Far East and in Europe, and we still adhere to that policy. Such a policy is normal for a country that does not want to conquer an area but wishes to keep it from the hands of a potential conqueror. Any other policy would mean that a conqueror could dominate an area, bend it to his will, use it in pursuit of his aims, and become unbeatable in that region. It would mean submission or even slavery for the conquered area and a position of extreme danger for countries still free.

Up to the present there have been three great powers in the Far East that had to be balanced against each other: China, Japan, and Russia. Since under a balance-of-power policy the weakest power must be supported against the strongest, lest one later face an unbeatable combination alone, we have shifted our support in the Far East among the three powers as their relative strengths changed. In the late nineteenth century this meant supporting Japan against China and later against Russia. It was a period when *The Mikado* was popular in the West and when Japanese art influenced the Impressionists. The United States used Japanese ports as stations for its navy and was proud that Perry had "opened" Japan to Western influences. The Japanese picked up Western ways with commendable speed, and, having acquired the cultural advantages of baseball, they seemed remarkably civilized.

Then, in the course of a decade the Japanese easily beat the Chinese and whipped the Russians. By 1904 Japan had become the leading power in the Far East and threatened to upset the balance of power in that area. From that time on our security forces had to reckon with Japan as a potential or even as a probable enemy. Our support was then given to China under the Open Door policy, for we believed that it was in our interest to maintain the territorial and administrative integrity of China. Our support of China continued until after World War II. There was a short interim period from 1918 to 1920 when Russia, in the throes of revolution and civil war, was the weakest power in the Far East, and during that period we had forces in eastern Siberia to keep an eye on the Japanese, who seemed to covet Russian maritime provinces.

With the eclipse of Japanese military power and the rise of Red China, our support has shifted back to Japan. Red China is now the power that threatens to upset the balance of power in the Far East, and our activities in Korea and Southeast Asia are aimed at containing Red China, lest it achieve a dominant position in the Far East. During China's long history, periods of weakness have been marked by foreign invasion and conquest, but during periods of strength China has extended her influence and power to Tibet, Nepal, Bhutan, Sikkim, northern Burma, the area that was formerly Indochina, and Korea. Some of these areas were occupied, and others became tributary states. Should our present efforts to contain Chinese influence in Southeast Asia fail, we can expect Chinese power to expand until it meets a serious obstacle. Perhaps Indonesia will find itself looking down a Chinese gun barrel, and American popularity in Indonesia will take a meteoric rise.

The missing piece in the Far East jigsaw puzzle at present is Japan. The United States now is cast in a role that Japan should be playing with American support. Japan seems content to loll under American protection, and it may take a shock to awaken Japan to its dangers. However, the appearance of Japanese forces as allies or rescuers in any part of Asia probably would arouse great suspicion and resentment; the time is not yet politically ripe for Japan's reappearance as a world power.

No shock was necessary in Europe to awaken the Germans. German rearmament came not as a result of a rebirth of militarism but rather from a keen sense of the dangers of Russian conquest. The example of East Germany was always before the Germans, plus the nightmare of a possible American withdrawal into isolationism. American policy, however, remains firm in support of West Germany and will continue in this support because a Russian takeover of Western Europe would be the greatest possible threat to American security. The reason is a simple one: the power centers of the modern world are the industrial areas, and the second-greatest industrial area in the world (next to that in the United States) is the triangle whose base rests in Great Britain and whose apex extends to cover Belgium, northern France, Luxemburg, and the great Rhine-Ruhr industrial complex. If that region should come under Russian domination, the Soviet Union would become the most powerful nation in the world and probably could not be defeated by conventional means. The United States would be isolated and could find little compensation in the rest of the world to make up for the lost industry and pools of skilled labor. Policy, diplomacy, and even military means must be used to prevent such a disaster from happening. In a similar way if industrialized Japan should come under the sway of Red China or of the Soviet Union, the combination would probably be too powerful to beat by conventional means. Although such a combination would not be the threat to our security that the loss of Europe would entail, it would mean that our national objectives in the Far East could not be attained.

Our stake in the balance of power in Europe, then, is a first charge upon our national resources. To prevent any one nation from dominating the European industrial-power complex, we have fought two great wars. In World War I we could remain neutral as long as a combination of European powers, namely, Great Britain, France, and Russia, promised to contain Germany and to restore the balance of power. But when the Triple Entente was weakened by the defection of Russia, it was necessary to enter the war to prevent Germany from dominating the continent of Europe and eventually the world.

Our problems were even greater in World War II, for then the balance of power both in Europe and in the Far East was threatened, and the war assumed global proportions. It should be noted that our political objective in both wars was the restoration of the balance of power and not the acquisition of territory. The balance of power is not subject to exact measurement and does not lend itself to the arts of propaganda. To popularize the two World Wars it was necessary to speak of "making the world safe for democracy," "the war to end wars," "the Four Freedoms," and so on. The means used to restore the balance of power are pretty much a matter of capabilities but may include forcing the enemy back into acceptable political boundaries, disarmament, the imposition of reparations, a change in government, and causing a feeling of defeat among the common people. Since the rewards of victory may be intangible, although real, the victor may have the feeling that all he got out of the war was OUT.

In a sense wars to restore the balance of power are preventative wars, for the objective is to prevent a future war that cannot be won. Such wars, of course, should always be limited wars and should not include the complete destruction of the enemy, lest this destruction upset the balance of power in another direction. The objective, one must remember, is to prevent the domination of an area by a single nation. If the enemy's power to resist is destroyed so thoroughly that some other nation, possibly a current ally, is in a position to dominate the area, one enemy has been exchanged for another, and one must either occupy the power vacuum oneself or lose the fruits of the war. Unfortunately, the political slogans of World War II and the special circumstances of that conflict led to such an unhappy situation. The demand for "unconditional surrender," which grew out of American anger at the attack on Pearl Harbor and from the dreadful nature of the Nazi regime, led to the complete destruction of the German and Japanese ability to resist and to the creation of power vacuums in Europe and the Far East. Parenthetically, one might note here that in the spring of 1944 the U.S. Joint Chiefs of Staff approached President Roosevelt on a number of occasions, urging that the demand for "unconditional surrender" be dropped or modified. Their reasoning was based on the belief that "unconditional surrender" was impossible, since any surrender has terms, possibly even of the greatest stringency. In addition "unconditional surrender" had a different meaning in Europe than in America, and insistence upon it was sure to cause unnecessary casualties. Worry about the success of the coming landings in Normandy was a contributing factor to the Chiefs' request. Roosevelt refused, however, to modify "unconditional surrender," and the great tragedy was played out to its grievous end. Certainly no truce could have been made with the Nazis or with the Japanese militarists, but support could have been given to reasonable elements in both countries and the war possibly could have been ended sooner, with happier results for the world.

One of the elements of the tragedy in Europe was that the Western allies knew too much history. They resolved to avoid the mistakes of Versailles, where, it was believed, a harsh peace had been made before tempers cooled. This time a peace treaty would be postponed until sanity had reappeared. Awaiting that happy moment, the allies would occupy Germany, which would be treated as an economic whole. Cracks in allied unity soon appeared, and divergent interests led to the cold war. Neither side could afford to let go of its portion of Germany, and although the "occupation" ended, troops continued to face each other across narrow barricades. No reasonable solutions to the problems of a divided Germany and Berlin are apparent. Even if Germany could be reunited in some peaceful way, the problem of Germany's eastern boundary would pose formidable difficulties. The United States has never recognized the Oder-Neisse line as the eastern boundary of Germany, in spite of Soviet claims.

WHAT NOW of the present and of the future? Three recent books cast some light on current thinking about the present and future. Professor Jacques Freymond, a distinguished historian and the Director of the Graduate Institute of International Studies in Geneva, examines the various efforts to unify the Western world after World War II in a study entitled *Western Europe since the War*.†

†Jacques Freymond, *Western Europe since the War* (New York and London: Frederick A. Praeger, Inc., 1964, $5.50), vii and 236 pp.

Since public archives for the period under examination are not open, Professor Freymond has had to depend upon published material. This dependence upon published material means, of course, that real reasons, true motives, and underlying pressures may remain obscure until the archives are opened. Another limitation on Professor Freymond's study is his interest in the European unification movements, almost to the exclusion of anything else. Certainly it is possible to have a deep emotional attachment to the idea of European union—a dream that has rather deep historical roots—but beyond union for union's sake there are very practical reasons for hoping that Western Europe at last will end its civil wars and unite to face a common enemy.

Two problems faced the Western allies in the years following World War II. How could a resurgent Germany be prevented from threatening the balance of power, and how could the West prevent the Soviet Union in the meantime from conquering Western Europe? To Americans, with a history of federalism, the answer seemed simple: form a United States of Europe. The happy events of 1789 and the success story of the American union provided a glowing example. From the American standpoint some form of European union would be in the American interest, for a European barrier to Soviet expansion would permit some American disarmament and a consequent reduction in taxes. And why shouldn't Europeans contribute to the defense of Europe? If Western Europe were united, it could fend off the Russians.

The notion that Europe could become strong enough to resist successfully a Soviet attack overlooked the possibility that such a third power would also be strong enough to stand up to the United States. However, the feasibility of European union seemed doubtful, although in the period immediately after World War II, when most of Western Europe lay crushed and in despair, Europeans probably would have accepted almost any solution that promised to relieve them of their misery. Young Germans in particular, fed up with Nazism, Socialism, Communism, and even patriotism, saw in a united Europe a hope for the future. But the circumstances of World War II prevented any quick union, for the barbarous cruelties of Hitler made the thought of union with Germans revolting to many Europeans. By the time the hatreds of World War II had died down, the economic revival had led to a resurgence of nationalism that made political union very difficult. Underneath was a mass of old hatreds, jealousies, rivalries, fears, and cultural differences that would have made union exceedingly difficult under the best of circumstances.

Nevertheless, some men of good will and vision persisted in the attempt to unite Europe. Professor Freymond rightfully gives Jean Monnet much of the credit for what was done, but he overlooks the work of the American Robert Bowie, who was one of the architects of the "New Europe." Among those who sought the New Europe there was debate over whether political or institutional union should come first. In the end the possibility of political union faded, and only institutional unions, such as the Coal and Steel Community, Benelux, and the Common Market, have survived. Besides the difficulties already mentioned, there were others that Professor Freymond neglects. A common political body must have a common monetary system and a common taxing power; it should have a central budget and some responsibility for the welfare of its members. If this be granted, it could mean that Frenchmen and Englishmen would be taxed to take care of the Italian unemployed. Other sticking points were the problems of subsidized agriculture and of empires. Economic unions, except for agriculture, were easier to attain than political associations.

The success of the Common Market led to the hope that Great Britain would join and that eventually the United States and the Common Market countries, inspired by President Kennedy's Grand Design, would form an Atlantic Community. Besides the obvious economic and political advantages to be gained from such a union, there were possible political motives which seem to have escaped Professor Freymond. If the Common Market evolved into a political union, as it was hoped and believed would happen, the area would soon be dominated by Western Germany, which would then have won peacefully what had been lost in two wars. Perhaps the addition of Great Britain would provide a balance of power within the Common Market area. But it soon became apparent that the addition of British weakness would not make up for German strength and that only the addition of the United States would provide a balance in the Common Market area if that area became united politically. De Gaulle's veto of British entry into the Common Market has delayed or ended the development of an Atlantic Community, and even the future of the Common Market is in doubt.

Besides the political advantages to be gained from European union, there were military advantages, for a political union would provide political backing for the military alliance known as the North Atlantic Treaty Organization. A recent volume on NATO† consists of a series of papers read by contributors to the volume and a debate between them at the Center for Strategic Studies, Georgetown University. The papers and the debate dealt with political, military, and economic problems of the alliance. The political problem, it is believed, has to do with American leadership. With the resurgence of Europe and the proliferation of nuclear weapons, Americans can no longer command but should lead by convincing; and that in turn means exploring problems together and arriving at common decisions. The fundamental problem is really that of sovereignty and of where decisions should be made that will mean literally the life or death of nations in a nuclear age. Since a confederation or an Atlantic Community is a remote possibility, statesmen of the West should create common interests little by little.

The military problems of the alliance, it is believed, revolved around the control of nuclear weapons, and discussion centered on the current proposal for a multilateral force (MLF). The strong point in its favor seems to be that the Soviets oppose it. Opponents, however, call it a waste of money and hold that the solution to the control of nuclear weapons within NATO is the organization of a nuclear force under NATO control. Other possibilities are to farm out to the allies work in nucleonics procurement as a substitute for the MLF or to build on existing French and British programs. One suggestion is to use electronic computers to preplan and preprogram an entire range of NATO responses to enemy moves so as to minimize last-minute panic decisions. This would, of course, relieve statesmen of the awful responsibility of making decisions about the use of nuclear weapons; but one doubts that any machine could or should contain all the elements that would go into making such a grim decision. There are also the problems of who punches the cards for the machine, who feeds the cards into the machine and when, and who in general controls the machine.

In the course of the discussions of the economic problems of NATO, two interesting points were made. Measuring production in terms of gross national product, it was noted, was a disservice to the underdeveloped countries, for in their economies few goods or services go through a market. Emphasis on GNP, then, tends to stress the urban development of these countries to the detriment of their agriculture. By depriving agriculture of needed aid, the old culture is made to crumble, and the new developments around urban centers are not always beneficial. The second point was that private business must be subject to political supervision when it goes into regions where rivalry with Communism is intense, lest the search for profits lead to victories for Communism.

In their search for ways to strengthen NATO, all the contributors to this book seem to have overlooked some rather simple developments. The whole purpose of the NATO alliance was to contain Soviet aggression. Once the likelihood of Soviet aggression diminished,

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†Karl H. Cerny and Henry W. Briefs, ed., *NATO in Quest of Cohesion* (New York and London: Frederick A. Praeger, Inc., for the Hoover Institution on War, Revolution, and Peace, 1965, $8.00), xii and 476 pp.

the need for NATO was lessened, and differences or even disputes among the allies could surface more easily. Thus, the apparent weakening of the NATO alliance need not be a cause for mourning but rather should lead to recognition that the chances for peace have improved. There are always differences between nations. Sometimes these differences become so great and so difficult to compose that war seems the only solution. Allies usually compose or hide their differences, but that does not mean that their interests are identical; it only means that for a time their interests are parallel. Once the enemy is defeated or the danger passes away, the differences emerge.

What can be done about NATO? Keep the planning organizations intact and up-to-date and keep as much of the forces as possible in place. Then, if a sudden emergency appears, some forces will be available to meet the emergency, and plans will be ready for use. Beyond that, stop the carping, lest the differences be magnified.

The third book† deals with the future. In it Neville Brown discusses such grim subjects as nuclear warheads and their strength, bombing planes, electronic warfare including countermeasures, land- and sea-based missiles, space weapons, biological warfare, civil defense, and conventional warfare. He believes that a strategic stalemate between the West and the Soviet bloc exists but that American intercontinental ballistic missiles are superior in terms of quantity and quality, both on land and on sea. He sees little chance that, in numbers of present nuclear weapons or in the development of new nuclear weapons, either side will be able to gain strategic superiority. But advances in microbiology, the author feels, might allow some nation to gain a strategic advantage. If so, World War III might be the biologists' war, just as World War I was the chemists' war with poison gas, and World War II was the physicists' war with radar and the atomic bomb.

Current American doctrine of the controlled or measured response receives the author's approval. Under this doctrine the amount of violence is carefully limited and slowly raised until the desired political response from an adversary is received. Since the objective of war is to make a more perfect peace and since today's enemy is tomorrow's friend, an excess of violence beyond that needed to achieve a desired political end is a waste of resources and politically undesirable because it may complicate the peace. If the doctrine of the measured response is to be applied successfully, we must be able and willing to move to higher levels of violence than those available to an enemy. However, since one of the objects of the measured response is to avoid strategic nuclear exchanges, which could lead to catastrophic results for the whole world, it may at times be necessary to apply a given level of violence for a considerable period of time, rather than to escalate to a higher level that could lead to strategic nuclear exchanges. The aim of the measured response is to avoid strategic nuclear exchanges and so to limit war. It should be noted that a policy of limited escalation of violence means that war aims such as "unconditional surrender" are no longer acceptable and that total victories of the kind achieved in 1918 and 1945 can no longer be expected. A constant willingness to negotiate will accompany the application of the measured response, since the use of violence will cease the moment a viable peace can be achieved and since the total destruction of an enemy is not among the war aims. Measured response means limited war—the only kind that is conceivable in a nuclear age. It is also the best way of balancing power and in this way serves our long-range political interests.

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†**Neville Brown, *Nuclear War: The Impending Strategic Deadlock* (New York and London: Frederick A. Praeger, Inc., 1964, $6.50), viii and 238 pp.**

NATO AND WORLD STABILITY

Sir George Mills

Mr. Timothy Stanley's *NATO in Transition* is well worth every bit of the sabbatical granted him to research and write it. I like the objective and levelheaded approach and the well-reasoned optimism which it leads to, so very different from the sensational pessimism of some skin-deep-only writers on the subject. Both Mr. Stanley and his sponsors, the Council on Foreign Relations, deserve our deep gratitude for this invaluable work,† for NATO is, after all, one of the most important elements in the world today—and one which simply must be understood properly.

Mr. Stanley's clear and very readable English prejudiced me in his favour straightaway; I really enjoyed reading it for itself alone. To illustrate in a small way: only once did I trip up on any of my really disliked phrases, and even then my bête noire, "until such time as," that word- and time-wasting phrase, seemed to have been put there on purpose to give the poor critic something to find. Like the men of my mess deck on a troopship once who occasionally used to leave something for the captain to find on his rounds, they thought it kept him in better temper! Nor need one be alarmed by the great number of footnotes; they can be ignored without affecting the even flow of the book—they are essentially for students who want to research more deeply.

But good writing would still be empty unless it disclosed a deep and detailed knowledge of the subject in hand, and this Mr. Stanley has in full measure. He has more; he has a truly sympathetic understanding of the different national approaches to NATO problems and takes good care to explain them properly, an attribute which adds immeasurably to the value of his book. He does not take sides nor push seemingly logical solutions, for his studies have taught him that pure logic is far from being the most reliable counselor in the solution of multinational problems. No one can make any useful assessment of NATO's achievements or valid suggestions for its future until he has fully grasped this essential fact.

Equally essential is an objective and unprejudiced understanding of the nuclear problem. Here again we are very fortunate, for Mr. Stanley gives us a very valuable examination of the evolution of thought on nuclear strategy and on the role of nuclear weapons. At first I was inclined to be put off by his explanation of the various theories expounded and explored; they seemed unreal and indeed unnecessary in face of the realization that there is no future in large-scale nuclear war. But then I remembered that he is in the main telling us what has been and is being done, and I realized that these studies had to be made if our thoughts were not to run unchecked in any direction. They at least provide a base to start from, and I began to feel deeply grateful to all those who have relentlessly pursued these seemingly unreal and chaotic lines of approach.

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†Timothy W. Stanley, *NATO in Transition—The Future of the Atlantic Alliances* (New York and London: Frederick A. Praeger, 1965, $7.50), 417 pp.

While accepting most of Mr. Stanley's conclusions on nuclear affairs, I cannot go all the way with him in his assessment of the value or, as he seems to see it, the lack of value of the small national nuclear force. I agree that the small force would have no practical value in deterring attack by one of the major nuclear powers, but not simply because of the great difference in size between the two forces as Mr. Stanley seems to argue. I do so because I cannot believe that either Russia or the U.S.A. could afford to stand by and see a third nation blackmailed into submission, let alone battered out of existence, by the nuclear power of the other. The same would probably apply if any smaller power tried to exert nuclear pressure on a nonnuclear neighbor. Indeed in their own interests I believe that the U.S. and Russia would most likely unite to prevent its happening.

Nevertheless we cannot deny that in a world that is terrified at the prospect of nuclear war the ability to use nuclear weapons in however small a way is a most potent threat vis-à-vis even the most powerful of nations. It must at least ensure that very serious notice is taken of the holder's rights and wishes. As an example, this ability to unleash a small number of weapons could have a very healthy restraining influence where a major power might be tempted to menace a smaller nation through a third power or by clandestine aid to insurrectionaries—a practice not unknown in this present world. For in these circumstances it is the power whose vital interests are the more seriously menaced which can afford to push the threat of resorting to nuclear weapons the furthest.

I do not believe that these more limited aspects of the potential value of a small independent nuclear force have been sufficiently considered or understood. And it is important that they should be, for real progress towards preventing the spread of nuclear weapons must largely depend on finding a way to provide the advantages of them in a less dangerous way. Some widening of the normal defense pact arrangements to cover what might be termed "second-hand aggression" might be a possibility. The problem is very urgent, for the prevention of the spread of nuclear weapons is one of the most crucial needs in the world today.

NATO as an entity does not face the sort of danger I have been discussing, and I entirely agree with Mr. Stanley in his view that she has no practical need at all for a nuclear force of her own. I recognize the possible value of the multilateral nuclear force (MLF) as an experiment in supranationality; but I wonder whether NATO would not make a greater contribution to the stability of the world, which Mr. Stanley reminds us is her ultimate aim, by steadfastly giving up any idea of having her own nuclear force.

By doing so she could achieve two exceedingly worthwhile aims. First, she would show that NATO can face facts as they really are and cut loose from obsolete conventional ways of thinking. Second, she would reaffirm fairly and squarely the belief of her members in the efficacy of the mutual defense pact, even in this nuclear age. And might this not give a lead to others and be a true step towards preventing the scourge of an ever growing range of individual nuclear forces?

Eynsford, Kent, England

IMAGE OF THE ACES, A WRITER'S BONANZA

Captain Philip M. Flammer

FEW MEN in military history have generated as much excitement, wonder, and literary profit as the aces of World War I. Those intrepid airmen who "flew as the bird flies" and who mastered the elusive art of aerial dueling were, by public acclamation, a breed apart, the cream of an already spectacular group. But what manner of men were they? What was their magic formula? Whence came the incredible popularity that outshone even the most illustrious generals? What did they accomplish and how?

As such questions make clear, excitement is inherent in the subject. Reader interest is almost automatic. It therefore pays well, which is why so many writers, good and bad, have tried their hand at it. Unfortunately, there are also dangers.

Herbert Molloy Mason's *High Flew the Falcons: the French Aces of World War I* is one of the latest additions to an already impressive body of writing.† The reading public has every right to expect it to be a good one. Mason's *The Lafayette Escadrille*, a first-rate history published in late 1964, revealed him as a talented and capable author. But *High Flew the Falcons* is a first-rate disappointment. It has the reader interest that goes with an exciting subject and a gifted pen, but it was written in such obvious haste that Mason apparently was forced to settle for careless research, overdramatization, and compromise in content.

Mason's subtitle, for example, promises the reader the story of the French aces, an ambitious task since more than 150 Frenchmen gained the five or more confirmed victories to qualify as an ace. *High Flew the Falcons*, however, is really a series of almost independent chapters about various aspects of World War I aviation, with emphasis on individuals, some of whom were aces. The first of the nine chapters deals with one Sergeant Frantz, a French pilot who is credited with being the first man to shoot down an enemy airplane with an airborne machine gun. This might pass as a more or less lengthy introduction except that the second chapter tells the story of Roland Garros, another Frenchman not an ace—although he is often credited with being one—who developed a device for firing a machine gun through a whirling propeller. The third chapter describes the unique French method of training pilots, a fascinating subject but one having little or nothing to do with the aces per se. Mason discussed it in *Lafayette Escadrille* but repeats it here, apparently because it was too interesting to leave out.

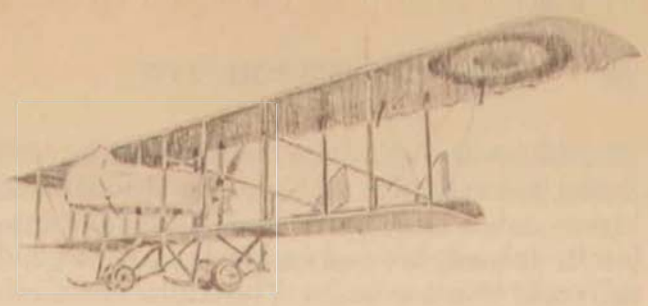
Yet another chapter, the final one, is the story of one of Mason's personal friends, an American by the name of Eugene Bullard. Bullard flew for France but, Mason admits, "never received confirmation of a German plane downed in combat" although he "came close." This leaves five chapters, little more than half the book, to deal with Jean Navarre (12 victories), Georges Madon (41 victories), Georges Guynemer (53 victories), Charles Nungesser (43 victories), René Fonck (75 victories), and Edwin C. Parsons, another American, (8 victories). All other French aces—and there are many with more than twenty victories — are passed by in silence. Yet even among the select few, Mason is deceivingly selective. Parsons is also a personal friend who rates a chapter,

†Herbert Molloy Mason, Jr., *High Flew the Falcons: the French Aces of World War I* (New York: Lippincott, 1965, $4.95), 172 pp.

while Fonck, easily France's ace of aces and probably the best pilot of the war, is given scant treatment indeed and then in the chapter devoted to Parsons. Why this remarkable neglect? Perhaps sensing the question, Mason says that Fonck was "disliked." Now why the greatest of French aces would be unpopular is worth a chapter in itself, but Mason gives no more than passing mention to Fonck's tactics, the root of the problem. Fonck, Mason suggests, was disliked because he was a supreme egotist, but this trait could also have disqualified Nungesser, who was so vain that he wore his medals on his flying clothes. That Fonck had an "unquenchable lust" for confirmations could as well be said of almost every French airman.

This selectivity precludes discussion of such fascinating and worthwhile topics as (1) the qualities that make a true ace, if, as Professor William R. Emerson has said, "Only one pilot in a hundred is a real flier. Most just burn gas." and (2) the famed Fonck-Guynemer controversy over tactics. The latter topic touched every pilot on the front and alone explains why Guynemer was more popular than Fonck and why Fonck was "disliked" by some. Guynemer, manifesting that daring spirit which was so precious in World War I, would attack any enemy, any time. He would willingly fly through his intended victim's field of fire to trigger off a few shots at murderously short range. Fonck, on the other hand, stalked his opponent. A superb shot, he carefully chose the time and place of attack, never "bouncing" an enemy on unfavorable odds. He could later brag that only one bullet had ever pierced his plane, while Guynemer would admit to being shot down eight times, more than any other ace. The fact of the matter is, "Guynemer the Miraculous" matched the spirit of the times. He made and still makes wonderful copy. The cold, calculating, and incredibly efficient Fonck, who was sometimes accused of unsportsmanlike conduct, does not. Considering Fonck's importance, there is little doubt that this is why Guynemer rates a chapter in Mason's book and Fonck a small section in a chapter devoted to a friend.

Such knifelike efficiency may deceive the reader who knows nothing about World War I



Henri Farman "Shorthorn"

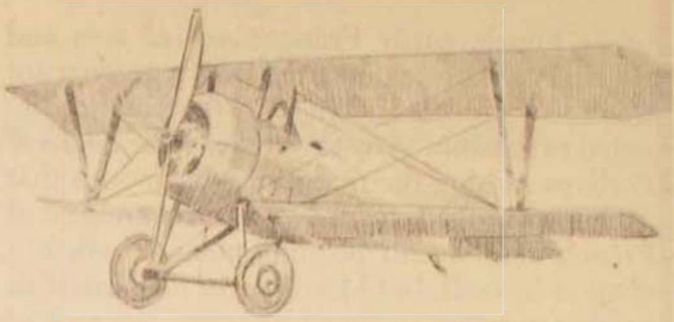
aces. Not so, however, with Mason's second great failing, his willingness to overdramatize the dramatic. The calm and careful prose of his earlier book is sadly missing, and in its place one often finds a brutal matching of words as if they had been ripped from the pages of the less reputable men's magazines. Mason, for example, relates the story of how Roland Garros lost one of the two steel wedges he used to protect his propeller from his own machine-gun bullets. The unbalanced prop nearly shook the fragile plane to pieces, a situation gripping enough to hold any reader. But as Mason tells it, the airplane went "berserk." The propeller "rose to banshee pitch" (Mason apparently forgot that the prop had a fixed blade angle and the rotary engine was already going full speed), and Garros "believed he had struck a wall in the sky" (a surprising insight, since Garros himself said no such thing). "The physical sensation," Mason continues, "combined with the noise is like that if a man decided to bang down the side of a rocky alp in an oversized tin washtub." After landing, "the bracing wires hung down like overboiled strands of spaghetti."

This is not to suggest that all such writing is bad. As a rule, military history, long known for its dullness, could use more color. Moreover, color is not necessarily foreign to it. A substantial number of gifted writers, among them Group Captain J. E. Johnson (*Full Circle*) and Alistair Horne (*The Price of Glory*), have shown that it can be absolutely fascinating as well as factual. On the other hand the brutal metaphor, the overdramatized and shallow story, never improve the product. Such techniques belong in the field of entertainment, where their purpose of triggering the imagination can be appreciated. It is therefore regrettable when authors and publishers parade such overloaded works as sound history, by implication the latest and best on the subject. They are trying to have their cake and eat it too. Good history takes time, particularly when the subject is as complex and burdened with legend as World War I aviation. The endless research and sorting out of fact and fancy simply do not match with motives for quick profit and a clear appeal to that same well-paying group that keeps the men's magazines in business.

The careful student will find that Mason's sins of omission and commission are common to a whole battery of writers on World War I aviation. Most professional writers on the subject are guilty of misusing the available sources, many of them intentionally. Few can resist the temptation to overdramatize, and fewer still willingly admit the limitations and weaknesses of their works.

The problem is primarily one of economics, since time and money factors lead to the "hurry and give the people what they want" approach. Still, considering the abundance of information about the First World War, there is very little excuse for the author who implies lack of source material and even less excuse for those who obviously misuse what there is. Every writer of nonfiction knows that all sources are not equally valuable, and most writers at one time or another have come face to face with the problem of outright fabrication. This reviewer, for example, once began a study of several World War I airmen by examining the newspapers of the period, only to find that newsmen regularly turned routine and uneventful sorties into ferocious fights with "bullets splattered by the thousands," "cockpits awash with blood," and grim and grisly death at every turn. Reading the newspapers to pick out such hilarious falsehoods was a favorite pastime at the Front, and many an airman had the pleasure of reading his own obituary.

How does one distinguish the good sources from the bad? There is no need to go into the intricacies of historiography. Lifetimes of effort, summed up in imposing books, have gone into the subject. It is enough to say that it takes a great deal of time and plenty of plodding patience. It requires a general and sound background of the chosen subject, without which the details are like chaff in the wind. And, in



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the case of World War I aviation, this demands careful study of the official histories and such thorough academic works as John R. Cuneo's two-volume masterpiece, *Winged Mars.* Unfortunately, time is what the professional writer lacks most unless he, like the historian Bancroft, gets rich first and then turns to writing. The pressure is to get the job done as quickly and economically as possible. This in turn brings on the temptation to accept any source, including outright fabrication, particularly since the purpose of the fiction in the first place was to add color to some seemingly drab event.

All this would be a big joke on the reader who thinks he is paying for the best were it not for the fact that serious distortions of aviation history have resulted from it. Take, for example, the remarkable image of the airmen themselves.

Almost without exception, the covers of the men's magazines and the endless word pictures painted by anxious authors show World War I pilots as fearless, hard-fighting, hard-loving adventurers, to whom everything was a pleasure, including the giving and taking of death. Such writers may mention the "cold air that stuck in their lungs like hot knives" and the crushing mental and physical fatigue that came from going out again and again, day after day. These discomforts, however, are usually mentioned only to suggest that the suffering

Fokker D-7

mattered little to the airmen when compared to the sheer adventure of it all.

It is significant that such pictures of marvelous manhood were almost never painted by the airmen themselves. Quite the contrary. As a rule they deplored that sort of thing. As the intimate diaries and letters, which were never intended for publication, make clear, they were human in every way. Bordeaux, in his study of Guynemer, writes admiringly, "Truly, a god possessed him," but he adds, "apart from all that, he was just a boy, simple, tender, and charming." It is doubtful that even the incredible *Capitaine* Happe or the fiery Frank Luke ever thought of the intense winter cold as "hot knives in their lungs," a tortuous test of their manhood. Like everyone else, they got cold when it froze and looked upon the cold as a miserable discomfort, to be endured because it could not be avoided. One airman, who could well have spoken for many, put it this way: "I often got so cold I wished a German would come along and shoot me. But when one did come along, I soon warmed up and got the hell out of there."

These airmen also knew fear, although they manifested it in varying degrees. They knew it just as they knew what it was to be cold and as they knew the terrible wear on the body and mind that comes with attritional warfare. All this, including the stoic outlook on life and death that is common to almost all men in combat, was a way of life with them.

What drove them on if it was not adventure or raw courage? It is strangely difficult for most moderns to realize, but idealism, as conspicuous as faith in a holy war, was dominant. And why not? It was a characteristic of the Great War, which, more than any other modern war, was a crusade. Moreover, idealism can drive men on long after adventure and raw courage have failed. Victor Chapman, for example, once attacked five German fighters single-handed, a fertile feat for an imaginative writer to pass on to the public. But raw courage was not the real Chapman. His most prominent characteristics were an empathy so remarkable that his father called it "the gift of suffering" and a fierce idealism that sent him into combat when America, his native land, was still neutral. This same idealism would not allow him to shirk his duty, no matter what the cost. And part of that cost was his life.

The image of the airmen as hard drinkers and hard lovers is no more accurate than the fearless killer image. Many drank furiously and made love the same way; but was this because they were "he-men" or because life under combat, with attrition in the air relatively greater than on the ground, was often too horrible to face without some help? Few of them would dispute Arnold Zweig's observation that "three things [are] needed to carry on a war: drink, tobacco and men." Unfortunately, many writers, like the comfortable World War I generals behind the lines, have refused to recognize combat fatigue. Anxious to have their readers identify themselves with the heroes, to spark the imagery of daring excellence in war, which comes so easy to those who have never fought in one, they have emphasized the he-man aspect. But it is no more fair to say that the fliers of World War I were he-men because they drank heavily than it is to go gunning for them on the grounds that they lacked the Christian concept of temperance.

The sad thing is that the airmen themselves deplored such a false image. They rejected it then, and they certainly do not need it now. Even when stripped of the fantasy and distortion, there is more than enough human interest, glory, and glamour for all. Nor is there anything wrong with their being human, with their resenting the hideous experience of war and the cold, danger, and fatigue that went with it, yet doing their duty because the impetus to do so was greater than the fear which rode with them on every flight. Some fliers were indeed marvels. A few were seemingly as contemptu-

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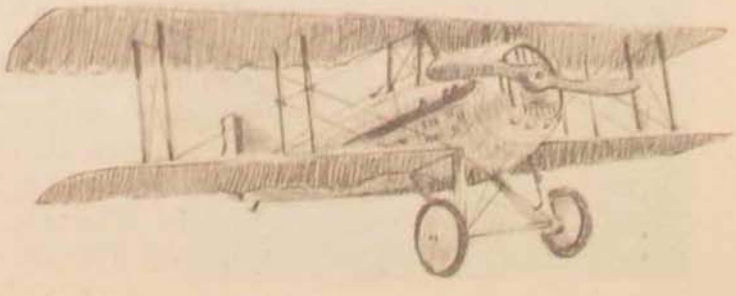

ous of death as their admirers imply. But to dwell on the "fearless" few, to distort the stories of others, and to make them all superhuman is more than an error in emphasis. It is no more the story of World War I aviation in general and the air war in particular than the stories of Sergeant York and Major Raynal are the true essence of the stalemate on the ground.

If the fliers were not so great after all, why were they so famous? Mason is one of the few to give the answer. Their fame came mostly from public reaction to the war on the ground. Every nation at war needs heroes, and for the most part they must be individuals. The ground war on the Western Front, however, was what one participant called "a battle of madmen in the midst of a volcano," an unspeakable horror on which few men could look without a shudder. What individualism was there in the colossal artillery duels, the massive charges across no-man's land, and the seemingly endless casualty lists? Almost automatically people turned to the skies, where the very idea of two men locked in mortal combat high above the earth revived images of the medieval knights. Fame was thrust upon the airmen, and some, like Guynemer, did not wear it gladly.

Another grave injustice done the history of aviation arises from the tendency of almost all air enthusiasts, including some of the more academic ones, to treat the development of air power as if it had occurred in a vacuum. Air power, they imply, grew because of the far-sighted airman, no one else, and they proceed to make merry over the "obvious" stupidity and nearsightedness of those who failed to recognize the airplane and exploit its potential. They like to cite the paucity of military aircraft at the beginning of the war as proving a point, and few can disregard the story of Lieutenant L. A. Strange, who mounted a machine gun on his Henri Farman in August 1914 and was then ordered by his superior officers to take it off. They also like to quote General Foch, who later commanded all Allied armies in the West, as saying (in 1909), "Aviation is a sport, with a military value close to zero." (Mason says that Foch "dismissed the potential of air power in the following contemptuous words: 'The airplane is all right for sport, but for war it is useless.'") And they usually go on to suggest, as Mason does, that "those words, even when well-seasoned, proved to be terribly indigestible."

Ground officers, however, did consider the airplane. Before the war they discussed it in theory and tested it in maneuvers, including bombing, strafing, interdiction, regulating of artillery, observation, and air-to-air combat. The trouble was that both aircraft and fliers of this period left much to be desired. Sometimes whole divisions could not be located from the air even though the observers had been told their general location, and it was not uncommon for untrained pilots and observers to mistake such things as gravestones for tents and spots of tar on the roadway for marching soldiers. Moreover, the machines themselves were so fragile and unreliable that few flights ended without incident, and the pilots, willing or not, became expert in the art of dead-stick landing. The German General Staff eagerly accepted the airplane in 1912, but after the 1914 maneuvers, in which the airmen performed so badly that even they lost faith, the airplane was downgraded again. The generals, in short, wanted more reliability from air power than they got. And this, matched with the seeming certainty of a short war, lasting weeks at the most, left little role for the airplane to play in the coming conflict.

Later, with the contest of arms under way, the ground officers still had to think in terms of present capability. That is why Strange was ordered to remove the machine gun from his aircraft. It was not that his superiors had anything against airplanes in general and air-to-air combat in particular. Strange had so weighted down his airplane with the machine gun that it took him 45 minutes to climb to 3500 feet, and he could go no higher, even though the German machine he wished to intercept cruised easily at 5000 feet. In other words, Strange had made his machine ineffective by the additional weight. Until he got a better airplane, the only sensible thing was to unburden the one he had.

Although poor Foch has been much maligned by aviation writers and historians, he was quite right. The airplanes in 1909 were, to put it mildly, unfit for wartime use, and his famous statement is in the present tense, not the future. And, for the record, Foch never found his words "terribly indigestible." He later said that his greatest claim to fame was that he had forgotten what he had learned before the war. The record bears him out. No other general on the Western Front was more willing to change than he. Moreover, he has left an abundance of statements, citations, and the like indicating an appreciation for air power and what it accomplished during the Great War.

By now the basic problem between the ground-oriented officers and the visionary airmen should be clear. One group was talking in terms of present capability, the other in terms of potential. If one showed a lack of understanding, so did the other. If one deserves to be condemned for shortsightedness, so does the other for refusing to face reality. In short, each side was partly right and each was partly wrong, not only during the war but also during the controversial period of the 1920's and 1930's. The two groups simply were not talking about the same thing, a grievous oversight that escaped them, mostly because of rivalry, faulty communication, and emotional reaction to seeming abuse from the opposite side. Given the circumstances, the position of both sides is quite understandable. But there can be no such apology for those writers who have made their proverbial Procrustean bed and stretched or cut their subject to make it fit.

This sadly neglected aspect of aviation history could be a marvelous object lesson. Because the foundations of aviation history have, in many instances, been laid by the wrong people giving the wrong emphasis, the problem is still with us—not so obvious as in the period just described, of course, but it is present nonetheless.

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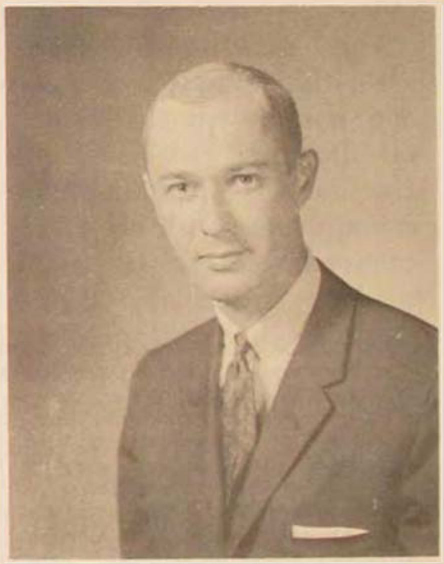

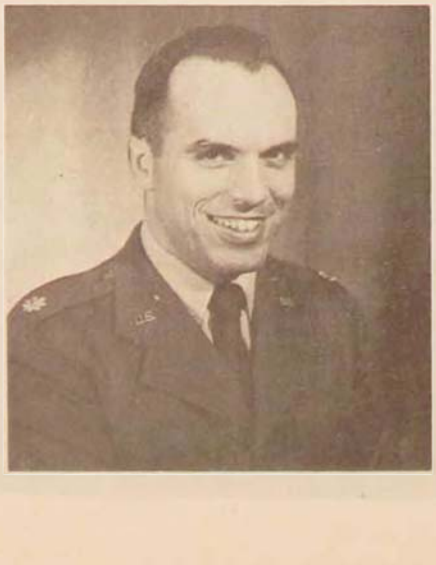

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Air Chief Marshal Sir George H. Mills (G.C.B., 1959; D.F.C., 1940; A.D.C.) was Chairman, British Defence Staffs, Washington, D.C., and United Kingdom Representative on the Standing Group of NATO Military Committee from 1959 until his retirement from the Royal Air Force in 1962. Prior to that assignment he was Commander-in-Chief, Allied Air Forces, Central Europe, 1956–59. Commissioned in 1921 upon graduation from the RAF College, Cranwell, he served in Iraq, 1922–24, and in India, 1930–34. He graduated from the RAF Staff College, Bracknell, in 1936. From late 1939 to mid-1940 he was in command of No. 115 Bomber Squadron, flying Wellingtons, and later served at Headquarters Bomber Command and on the Directing Staff, RAF Staff College. Other assignments have been in the Air Ministry as Director of Policy, 1943–45, and Director of Plans, 1947–49; Air Officer Commanding, Balkan Air Force, 1945; Air Officer in charge of Administration, Middle East Air Force, Egypt, 1945–46; Air Officer Commanding, No. 1 Group (Bomber), 1949-50; head of the U.K. Military Delegation to the Western Union Military Staff Committee (forerunner of SHAPE), 1950–51; Air Officer Commanding, Malaya, 1952, and Air Officer Commanding-in-Chief, Bomber Command, RAF, 1953–55. While in the latter post he contributed an article, "Bomber Command of the Royal Air Force," to the Spring 1955 issue of *Air University Quarterly Review*. He was Senior Air A.D.C. to the Queen, 1956–62. He has been a trustee of the Imperial War Museum since 1963. He is currently Gentleman Usher of the Black Rod, the Usher of the Order of the Garter, who also has duties largely ceremonial in the House of Lords.

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ATTENTION

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