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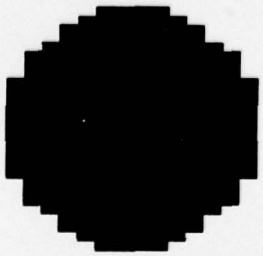

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THE CONTRIBUTION OF TACTICAL AIRPOWER IN COUNTERING A BLITZ: EUROPEAN PERCEPTIONS

by

Steven L. Canby

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This report is the second in a series articulating European air force positions on various tactical airpower issues, juxtaposing them with those of the U.S. Air Force. The first report dealt with comparative command and control and operational doctrine. The present report deals with the broader theme of the contribution of airpower in armored warfare. The belief underlying these studies was that the European position had neither been understood nor given enough attention in this country. The Europeans have worked out an approach to

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tactical airpower which, while possibly inappropriate for the USAF, may nevertheless be cheaper and more effective than our own for application in Europe.

PREFACE

This report is the second in a series articulating European air force positions on various tactical airpower issues, juxtaposing them with those of the U. S. Air Force. The first report dealt with comparative command and control and operational doctrine. The present report deals with the broader theme of the contribution of airpower in armored warfare. The belief underlying these studies was that the European position had neither been understood nor given enough attention in this country. The Europeans have worked out an approach to tactical airpower which, while possibly inappropriate for the USAF, may nevertheless be cheaper and more effective than our own for application in Europe.

The purpose of this study is to generate debate on and comparative assessment of an expensive component of land mass warfare. This should be useful to policy makers attempting to understand the thinking underlying European programs and policy positions, as well as in the shaping and design of our own tactical air force and RDT&E program.

The study was funded by the Director of Defense Research and Engineering. Nevertheless, this report does not reflect either the opinions or official policies of the sponsor.

ACKNOWLEDGEMENTS

The principal investigator and author of this study is Dr. Steven L. Canby. The research was carried out during 1976 in the United States and Europe. The expressions of European views reported here are distillations of a large number of personal interviews conducted by Dr. Canby during the summers of 1975 and 1976. The perceptions and conclusions are European; the logical framework and its extensions are the author's.

The author wishes to thank Mrs. Angeliki D. Cutchis, LTC Robert M. Foley, and Mr. Charles E. Myers for their encouragement. Debts must also be acknowledged to LTC Juergen Schlueter in Bonn and Air Commodore Michael Armitage in London. A particular debt is owed to Col. (Ret.) John R. Boyd for tightening the author's frame of reference and presenting several new perspectives.

The issues involved are more than the cost and effectiveness of tactical airpower's internal structure -- itself a question of major importance, particularly given the dependence the West has placed upon its air forces to offset Eastern ground force superiority. These issues also affect the balance between ground and air forces and the degree of American and Allied force specialization. As matters now stand, the West may be paying a disproportionate price for an airpower which is not obtaining its payoff because of insufficient ground forces.

Tactical airpower cannot be justified for its firepower content alone. Tactical airpower's true value is the way it assists or hinders the maneuver of ground forces. A Soviet-style offensive resembles an echeloned pile-driver. It is vulnerable to over-extension and counterattack. Attempting to counter it by attrition through firepower on the battlefield is a prescription for defeat.

NATO's problem is that its tactical air forces have been consuming the funding necessary for tactical airpower itself to be effective -- namely the existence of army reserves. A true trade-off between armies and air forces begins only after the army has a semblance of reserves -- the ingredient which gives an army the ability to block enemy initiatives and impose its own upon an opponent. These reserves -- despite U. S. enamourment with its own reinforcements -- can only come from the Europeans themselves. Fortunately, these reserves can be obtained at zero cost and at no loss in deployed airpower by recognizing and exploiting asymmetries between ourselves and our Allies.

NATO air forces in recent years have come to accept the primacy of the ground battle and the need to support ground forces. The question is HOW? Logically, one works backwards from the task. This has not proved possible. The task has not been well understood and the inherited equipment inventory and organization has been oriented towards a quasi-independent air mission which at one time was NATO's mainstay. NATO has therefore attempted the reverse. Coping with armor plated field forces, however, has proved difficult.

The U. S. has sought to resolve the difficulty directly through firepower: tank-busting. The Europeans have sought less-demanding techniques akin to their inchoate maneuver approach to war, seeking to leverage the effect of airpower by attacking the linkages in the time-sensitive armored system. Neither approach -- to date -- has been noticeably successful.

The reasons for this relative lack of success can only be speculative. Nevertheless, both approaches have internal inconsistencies which may be explanative. The American suffers from its attrition premise, attrition being a function of rate-of-destruction times time. USAF has sought to meet this condition by hyping up its surveillance and response cycle through the potentialities of sensors, computers, and electronic data processing machinery, in effect replacing the art with the mechanics of war. The pitfalls of this response have been (i) dependence upon technologies which among other liabilities can be spoofed, (ii) the hydra-like nature of echeloned Soviet reserves in the critical sectors, and (iii) an internal organization designed to support a cost-effective "supply-determined" sortie rate (as opposed to demand-determined).

For their part, the Europeans have lacked the wherewithal to implement their view that the purpose of tactical airpower is disruption of the opposing forces, destruction being but a by-product. They seemingly presume a "German" opponent who, lacking reserves, substituted finely honed staff coordination and high quality combat units. Europeans have played over the reality that the Soviets do have large hydra-like reserves and that their existence is itself a substitute for staff perfection. The Germans in particular like to emphasize the rigidity of the Soviet system; but they have failed to distinguish between the flexibility inherent in echeloned numbers and the inability of a programmed system to cope with the unexpected from its flanks and rear. European airpower is seeking to affect the first. The second is an obvious case requiring ground maneuver units for appearance and substance; tactical airpower is the lubricant.

THE CONTRIBUTION OF
TACTICAL AIRPOWER IN COUNTERING A BLITZ:
EUROPEAN PERCEPTIONS

Technology Service Corporation

by: Steven L. Canby

THE CONTRIBUTION OF TACTICAL AIRPOWER IN COUNTERING A BLITZ: EUROPEAN PERCEPTIONS

Tactical airpower has become the single most expensive component of the U.S. defense budget. Its share of defense outlays is larger than that of the strategic, ground, or naval surface forces. While tactical airpower has played a crucial role in the past, its raison d-etre has changed over time. In World War I, its salient military function was reconnaissance and artillery-spotting; a role soon overshadowed by the more glamorous, but derivative, mission of escort protection. Douhet-type theories of strategic bombardment which have had a dominant influence on British and American air forces (and on some theories of modern war) gained their attraction from the possibility of avoiding the horrors and strains of attrition warfare on land* -- a problem which the Germans solved quite differently in World War II by restoring mobility to their ground forces.

In today's world, the Soviets deploy a combined-arms, tank-heavy force with large numbers of smallish maneuver units, echeloned in depth. Given the scarcity of Western combatant strength (as opposed to active duty peacetime and mobilizable personnel strengths), some argue that the Soviets could overrun Western Europe in a matter of weeks, or even days.** Such scenarios, almost by definition, invalidate the classic tactical air missions of air superiority and deep interdiction. While air forces have come to recognize the importance of ground support, the requisite changes have been difficult to make. The existing inventories -- ordnance, aircraft, and avionics -- have been largely designed for deep penetration using conventional and nuclear weapons in a quasi-strategic mode. Most tactics and the organization to support them have also been designed for independent air operations.

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* Giulio Douhet, The Command of the Air, London, Faber & Faber, 1943.

** See for instance Maj. Gen. Robert Close, "Feasibility of a Surprise Attack Against Western Europe," NATO Defense College, Rome, Italy, 24 Feb. 1975.

In Europe the on-going shift from a nuclear-oriented strategy to a conventional mission has raised two fundamental questions: which targets and what tactics? In answering these two questions, the U. S. and its European allies have evolved towards opposing viewpoints. For the U. S. Air Force, this disagreement has come at a paradoxical moment. The legacy of Southeast Asia is a strong emphasis on precision weaponry and electronic defense-suppression techniques, both of which have seemingly resolved the problem of target destruction while reducing over-target requirements and losses. Indeed, tactical air forces can now be extremely destructive, provided that targets can be acquired for the newly developed family of air weapons (precision-guided and area munitions, as well as armor-piercing cannon) and provided also that the air-defense environment is permissive (e.g., that it lacks up-to-date electronic countermeasures and an opposing air force).

Critical questions remain unanswered. First, <u>destructive capacity is not necessarily synonomous with military value</u>. These terms would only be interchangeable if firepower were the essence of conventional warfare. This condition may exist in strategic bombardment, but it is not the case in armored warfare and certainly not in insurgency and other amorphous forms of conflict.* Second, the operational mode developed in Southeast Asia has failed to come to grips with the problem of target acquisition. Targeting a high-contrast bridge in relatively clear weather is considerably different from targeting mobile tanks in the European haze or light infantry in the African bush. There is finally, a paradox: air forces designed for a sophisticated electronic environment in an Asian "infantry" context may be unnecessarily costly in a high-intensity armored conflict.

In short, of the most-probable conflicts that the U. S. may face -- (1) armored warfare in Europe, (2) slow-paced infantry warfare in a Korea-like context, (3) intervention against a small power with some modern weapons, and (4) intervention in an Angolan-like situation -- the USAF may be appropriately organized and equipped only for the middle two, and not for the most dangerous (European) or most likely (Third World) scenarios.

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* For excellent articulations of the firepower versus maneuver theme, see the debate generated by William Lind in the <u>Armed Forces Journal</u>, October 1976, and Col. (Ret.) John R. Boyd, "Patterns of Conflict," January 1977, unpublished. The implications of this theme are addressed in Appendix III.

The requirements of a European war supposedly drive the size and shape of the U. S. air forces. As with the ground forces*, the major question is whether the air forces have been properly structured for the mission. The U. S. approach has evolved towards a high technology system, based upon real-time command and control, sophisticated defense suppression, and precision guided munitions. The Europeans, on the other hand, argue that this system is unduly costly, too susceptible to countermeasures (i.e., non-robust), and that it is based on an incorrect perception of the nature of the ground war.** They make the telling point that the medium-altitude window in which the USAF is attempting to fly is in fact closed, and can only be propped open by hyper-expensive and uncertain defense suppression means. European programs, on the other hand, are oriented to the still-open low altitude window.*** They have derived different views on command and control, operational methods, ordnance choice and aircraft design, relying more on organizational technique than on high-cost technology. The remainder of this paper compares European and American views on tactical airpower, with a particular emphasis on how tactical airpower might cope with an integrated combined arms team in a relatively short war, commonly termed blitzkrieg, but tactically more aptly termed "shock groupings" or "shock column" warfare.****

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* See e.g., Steven L. Canby, The Alliance and Europe: Part IV: Military Doctrine and Technology, Adelphi Paper 109, IISS, London, 1975.

** See Appendix I for a brief summary of the European approach; for a more detailed discussion, see Steven L. Canby, Tactical Airpower in Europe: Airing the European View, TSC, July 1976. For the best published account of the European position, see Johannes Steinhoff, Wohin treibt die NATO? Probleme der Verteidigung Westeuropas, Hoffman und Campe, Hamburg, 1976, pp 143-17[illegible] For the most authoritative open literature accounts of the U. S. approach, see Edgar Ulsamer, "TAC-AIR - History's Most Potent Fighting Machine," Air Force Magazine, February 1976, pp. 22-26, and Brig. Gen. J. E. Ralph, "Tactical Air Systems and the New Technologies," in G. Kemp et al., The Other Arms Race, D. C. Heath & Co., Lexington, Mass, 1975, pp. 15-33.

*** After arguing this window was closed, the USAF at Nellis AFB and Marine Air have rediscovered the advantages of on-the-deck flight operations. Much of the U. S. problem has been caused by a semantic confusion of terming the dead man's altitudes of 500-1500 feet as low.

**** The original German blitzkrieg relied heavily upon demanding reconnaissance, the excellence of their small units, and the sheer competency of their commanders and command system. The brilliance of the Soviet mutation has been their recognition of their own strengths and limitations (which runs deep in the Russian psyche and is rarely mentioned in their doctrinal debates). Thus, rather than mirror imaging a system which only

the Germans (and Israelis) might pull off, the Soviets have quite appropriately substituted resources for in-depth ability, relying instead upon large numbers of units, the relative flexibility inherent in such numbers, and an apparently professional and able general staff and corps of senior officers. Recent evidence indicates that the Soviets are attempting to upgrade the quality of their sub-units to more clearly imitate German battlefield techniques of small unit maneuver, infiltration, and tactical surprise.

The operational objectives of the two blitz systems is similar; the major difference is that the Germans -- like Gengis Khan centuries earlier -- created the illusion of a strength which really did not exist, while the Soviets have replaced illusion with reality.

Accordingly, many of the hypotheses and techniques being broached for countering the Soviet blitzkrieg may be based upon questionable perceptions of the Soviet system, a problem particularly acute for the Germans.

For an excellent Soviet rationalization of the origins of their system (which typically credits Suvorov [the great 18th century Russian general] rather than the Germans) see V. Y. Savkin, Operational Art and Tactics, U. S. Government Printing Office, Washington, D. C., 1972, pp. 13-17 and 206-209. For an excellent account of Soviet doctrinal evolution, see Phillip A. Karber, The Tactical Revolution in Soviet Military Doctrine, BDM, March 2, 1977.

I. THE PROBLEM OF BALANCE

Of the numerous asymmetries between NATO and the Warsaw Pack, the most glaring is in the emphasis that the West places on tactical airpower. Whereas the Soviets have traditionally relied upon their preponderant ground forces, NATO -- for varied reasons -- has relied upon tactical airpower to offset its relative disadvantage in ground forces. Accordingly, NATO has and continues to spend more than a third of its general-purpose budget upon tactical airpower, twice the equivalent share of Soviet tactical airpower.*

These asymmetries raise the major -- and perhaps theological -- question of exactly what NATO is buying. In NATO's formative period, tactical aircraft were the principal means of implementing NATO's strategy of nuclear deterrence and retaliation. Time has downgraded this rationale. Tactical airpower must now justify itself for its impact upon the conventional battle, in particular tasks of immediate or near immediate concern to ground forces -- this is now widely recognized (and even gracefully accepted) by the air forces. The implied reduction in the importance of tactical airpower, however, has not been translated into smaller budgetary shares. The relative emphasis upon tactical airpower has been institutionalized by the following factors: (1) institutional inertia; (2) Western faith in high technology (in the U. S. in particular); (3) increasingly expensive manpower costs for labor intensive ground forces; (4) greater awareness of Soviet capabilities for a surprise attack; (5) the changing nature and sophistication of Soviet air forces and ground air defense; and (6) most importantly, the growing relative deficiency of NATO ground forces.

Whether NATO should continue to maintain the present emphasis upon air forces is a question of fundamental importance. While the tradeoff between ground and air forces has never been satisfactorily quantified -- or for that matter even understood, it nevertheless follows that monies and long-term regular personnel assigned to air forces come at the expense of ground forces. Of some importance too, is the fact that the rate of substitution between value and cost is not identical for the U. S. and Europeans. The Europeans have

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* "A Dollar Cost Comparison of Soviet and U. S. Defense Activities 1965-1975," Intelligence Report, July 1976, p. 35.

possibilities for allocating additional funding increments to their armies that the U. S. and, to a lesser degree, the British do not have. On the value side of the equation, a threshold may exist, suggesting that air forces per se may have little substantive value until army forces are of sufficient size to field reserves.

Air forces acting alone can only exact attrition. In conjunction with ground forces, they can obtain more than their firepower value through the medium of disruption, becoming particularly effective in the attack as the leading edge of armored thrusts attempting to shatter the cohesion of the defense.* In the defense -- in the absence of a major counterattack -- airpower fits into this scheme by disrupting the enemy's operational planning and coordination, gaining time for the ground force to sort itself out from bad situations and to position its reserves. For this disruptive contribution to take hold, however, the ground force must have organized and deployed itself in such a manner that reserves are stacked in echelons, available for forward deployment in blocking and counterattacking roles. (If these reserves do not exist -- as currently -- little is gained, regardless of the tactical airpower's success.) Once the defense builds reserves behind its forward deployments, air forces can be instrumental in developing and breaking the attacker's plan. Airpower's full premium, however -- that of assisting in the dislocation of the enemy system -- can only be obtained in conjunction with friendly forces in the attack/counterattack.

NATO's problem is that tactical air forces have been consuming the funds needed to make tactical airpower effective, i.e., the funds needed to field European army reserves. The value of airpower is contingent upon the size of ground forces; a true trade-off between armies and air forces begins

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* While apparently not realized by the Germans themselves, or the various authors writing about the Luftwaffe, this is the real between-the-lines message of such accounts as the Luftwaffe War Diaries [C. Bekker, New York: Doubleday and Company, 1964]. Significantly, this seems to be the direction the Soviets are now following. For an excellent articulation of this theme, see John Boyd, "Patterns of Conflict," op cit.

only after the army has adequate reserves. In short, NATO must face the question of whether the appropriate air-to-ground balance exists, particularly for the Continental nations which have a greater mobilization potential than the offshore countries, a fact compounded by their English heritage.* Integral to this question is the manner in which tactical airpower copes with armored forces.

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* The origins of this problem are due to the peculiar development of political theory and the King-Parliament struggle in England as opposed to corresponding developments on the Continent. The result is a reserve system more oriented towards thwarting the man-on-horseback syndrome than military effectiveness.

II. THE FOUR QUESTIONS

The cost and effectiveness of U. S. and European (central front) air forces dedicated to ground support devolves on four questions:

A. The extent of deployable U. S. air assets

B. The operational modes

C. The choice of missions

D. The choice of targets

A. The Extent of Deployable U. S. Air Assets

U. S. tactical air forces (excluding attack helicopters) consume a quarter of the pro-rated U. S. defense budget. Though air forces are highly mobile and U. S. air reinforcement programs like CRESTED CAP receive high marks from the Europeans*, only a portion of U. S. air assets are deployable to the European theater. Forty percent are siphoned off by the Navy and Marines for service-oriented missions, most with little relevance to a conflict with the U.S.S.R.** Nor can the full strength of the U.S.A.F. be deployed to Europe, due to secondary commitments, sustaining base training requirements, and the limited supporting capacity in Europe itself. The result is that if a war in Central Europe were to last only several weeks (i.e., M+30 days) almost two-thirds of U. S. tactical airpower would not have been brought to bear. The staggering implications are: (1) that American air assets double the size of the central front air forces (including France) cannot be deployed.***; and

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* The Army counterpart REFORGER receives a 'fair' on symbolism and a 'poor' on military substance.

** For a discussion of these issues see Stansfield Turner, "The Naval Balance: Not Just a Numbers Game," Foreign Affairs, January 1977 and Nancy Bearg, Planning U. S. General Purpose Forces: Tactical Air Forces, Congressional Budget Office, January 1977.

*** The Military Balance, 1976-1977, credits the Central Europeans (including France) with 1700 aircraft (unit equipment aircraft; with floats, total numbers are 20 - 30% higher); the U. S., 6000 (including training base, reserves, and maintenance float). The U. S. can deploy somewhat less than 2000 aircraft to Europe in the first several weeks, leaving a balance twice as large as the combined European peacetime strength. International Institute for Strategic Studies, London, 1976. The Annual Defense Department Report FY 1978, (p. 208) credits the U. S. with an authorized active inventory of 5200 tactical aircraft. Lucas Fischer [Defending the Central Front: The Balance of Forces, Adelphi Paper No. 127] lists 1734 U. S. aircraft available for Europe.

(2) that since an incremental funding unit released from continental air forces can be leveraged seven-fold with the appropriate mobilization system, NATO is foregoing an opportunity to create large numbers of rapidly mobilizable Category II divisions at essentially zero cost (while still maintaining the same deployable air strength) through alliance specialization.

A shift from balanced national contingents towards (partial) alliance specialization -- the U. S. to airpower, and the Europeans to land power -- has a potential military payoff exceeding the totality of current policy initiatives, including standardization. Force specialization indirectly leads to equipment standardization and interoperability as a side-effect of the implied dominance of countries in specified functions.* This presents a military argument for standardization which is lacking in the conventional approach (which attempts to superimpose standardization upon diverse military establishments via the rationale of economies-of-scale, many of which do not bear scrutiny). In addition, the specialization route skirts the political pressures for multinational procurement and production of common equipment inherent in balanced forces, which, besides eroding the savings, makes standardization almost unmanageable (e.g., F-16 and Roland).

The major arguments against specialization are: (1) the military vulnerability inherent in entrusting national security to the constancy of interdependent partners; (2) the emotive charge that Europeans are to serve as cannon fodder for the U. S.; and (3) the reluctance of European air forces to relinquish their institutional prestige and status. The second objection can be satisfied by increasing the absolute numbers of U. S. combat troops in Europe for a short war. This can be best accomplished by recognizing that the salient constraint on rapid army reinforcement is not lift capability, but a self-imposed organizational constraint. The U. S. could field 11 divisions in

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* Economists and system analysts tend to categorize specialization under the economic rubric of economies-of-scale and international comparative advantage, producing savings on the margin. The logic of specialization in this section, however, is based on the much different concept of structural asymmetry and meshing.

Europe by M+14 days at no additional cost.* The U. S. forces available in the first few weeks of a war would then be doubled, blunting the emotive edge of the charge that Europeans would serve as the cannon fodder.

The vulnerabilities of functional interdependence are less serious than they appear. Interdependence need never become total. Each of the traditional greater powers of Europe would want to, and can retain, some capability in each area. The defense of Europe is already interdependent; no defense is practical without the joint participation of Britain, France and Germany. Functional interdependence would simply acknowledge explicitly the existing interdependence. At worst, functional interdependence might cause some additional difficulties from the smaller countries, which tend to opt out of proportionate burdens with the plea that their smallness makes their contribution insignificant.**

The analytically intractable argument against specialization is its impact upon the industrial complex associated with high-technology air forces. The impact on the institutional status of air forces is not as serious a problem in Europe as it might be in the U. S. Except for Britain, the military staffs have traditionally been army-dominated. The main problem in reducing the institutional status of the Continental air forces is not the resistance of the uniformed personnel, but of industry. The emotively powerful assertion is that spillovers from a sophisticated aerospace industry are necessary for maintaining industrial modernization. The validity of this once widely-held belief has eroded over time. Spill-overs are readily passed along via the mechanism of the multi-national corporation, and even the employment-intensive commercial airframe industry has become less dependent on military R&D and

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* For an elaboration see, Steven L. Canby, European Mobilization: The Policy Issue of U. S. and NATO Reserves, Technology Service Corporation, February 1977, pp. 17-24.

** On the other hand, functional specialization increases each country's significance, somewhat countering the "small country effect". Functional assignment of traditional or politically sensitive tasks can also be a form of pressure. The Danes, for instance, have become increasingly sensitive to encroaching Soviet exercises in the Baltic, recognizing that closing the straits (a NATO mission) is a prerequisite for their own defense across a variety of scenarios.

procurement volume. At a more aggregate level of comparison, it is now recognized that industrial modernization in the three countries which lead in the aerospace industry -- U. S., U. K., and France -- has fared worse than in Germany and Japan. Only Sweden, which depends partly on aerospace licensing, has maintained both a rapid rate of industrial modernization and a large aerospace industry.

Finally, shifting the Continental countries toward ground force specialization would mean greater industrial employment. The relative shift from air to ground would not mean greater wage bills for soldiers: active air personnel would shift to army cadres; the mobilizable troops would be essentially previously-trained conscripts on extended leave (but structured into organized units rather than assigned to amorphous replacement pools). The funding impact from the shift from air to ground would thus be mainly felt in the procurement programs. And whereas aerospace purchases have a large import content, army procurements are more representative of indigenous industrial production.

B. The Operational Modes

The U. S., following its operational experiences in Korea and Viet Nam, has opted for an operational style highly dependent upon sophisticated technology. The Europeans for their part have opted for a cheaper approach relying more upon tactics and procedure. The result has been a breakdown in common alliance procedures, and much controversy.

The USAF -- at least until very recently -- has argued that the Europeans have failed to understand modern warfare and the requirements of modern technology; the USAF also believes that the Europeans are awed by the U. S. approach and would opt for a similar approach if costs were not an obstacle. The author's own reading -- based mainly on discussions with the most senior German and British air officers and large numbers of designated "air" staff officers in all the MODs -- is that the Europeans are indeed awed by the U.S.'s ability to ride roughshod over strength by virtue of its technology. They too, would like to be capable of a similar approach. But they

balk at its cost and doubt its wisdom. Cost makes the approach unfeasible unless the numbers of combat aircraft are reduced -- an approach which the Europeans find unacceptable.* The Europeans believe that (1) strength should be avoided, not met head on; and (2) that technological approaches based upon electronics are too susceptible to countermeasures, and are therefore undependable.**

The differences in operational style have two diverse sources: the Europeans have only regional responsibilities while those of the U. S. are global. Europeans have faced their situation with philosophical insight -- the U. S. has employed its technological virtuosity. The Europeans have sought solutions with only their theater in mind. The U. S. has sought solutions applicable to many theaters, relying on technology to overcome all difficulties. In doing so, the U. S. approach may have the attributes of the lowest common denominator: either effectiveness in specific contexts is lowered or so much capability is built into the forces that costs in any one specific combat context are unnecessarily high. In point of fact, such logically keen solutions can only occur under conditions of optimality (i.e., along the economist's envelope or transformation curve), and the U. S. may in fact be obtaining the worst of both worlds: less than the best performance in all contexts and unnecessary costs in each.

The problem inherent in the U. S. approach is perhaps highlighted by recent exercises (Blue Flag) in which the commander of Tactical Air Command stated,

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* This perception alone should have been an ample warning sign that the Europeans would in fact buy AWACS only under political duress, the question then becoming one of "buying" a continued American presence. For a summary of the European position on AWACS see Appendix II. For a critique of the European emphasis on quantitative "bean counts" which underscores their sensitivity to both their Soviet opponent and their U. S. ally, see the Nunn Report's comments that quantitative "bean counts" are a poor measure of equitable burden-sharing. NATO and the New Soviet Threat, Report of Senator Sam Nunn and Senator Dewey F. Bartlett to the Committee on Armed Services, U. S. Senate, January 24, 1977, p. 11.

** Even more serious is the possibility that command decisions may be based upon computerized sensor inputs, creating the possibility that a clever enemy could spoof the program and get inside the decision-makers time frame, breaking down command effectiveness. For a development of this point, see John Boyd, Patterns of Conflict, op cit., and S. Canby, Tactical Airpower in Europe, op cit., pp. 12-17.

> "Special emphasis will be [placed] on standardizing the operational procedures that the tactical air forces use in the Pacific and European Theater."*

Thus, in an attempt to obtain marginal economies (i.e., micro efficiency) from nationally standardized equipment and training practices, the U. S. is foregoing major opportunities (i.e., macro or structural efficiency) to optimize the force for local conditions (i.e., weather, terrain, and the nature of the threat). The result is a force unduly constrained by weather in Europe. Worse, the USAF approach neglects the major distinction between slow-paced infantry (i.e., firepower) conflicts in the Pacific, and fast-paced armored (i.e., maneuver) conflicts in Europe and in the Mid-East.**

Whether or not because of the U. S. experiences in Viet Nam, the U. S. has fashioned its air forces (AF, Navy and Marine) on the basis of a task force of orchestrated (CAP, SOJ, WILD WEASEL, C^3 aircraft, etc.) so that the force as a whole can suppress enemy missile defenses and strike at point targets with precision. The problems with this approach for Europe are three fold:

(1) Even on clear days, European weather causes such poor target contrast that aircraft must enter the gun envelope of light AA at altitudes where the guns can be neither suppressed nor finessed. Infra-red (IR) and laser (in lieu of electro-optical, EO) guidance can increase stand-off, but only at the price of introducing additional liabilities. An IR Maverick is considerably more expensive and more subject to spoofing than an EO weapon. A pass-off system (where the forward observer designates

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* "TAC to Test Electronic Warfare Abilities," and "TAC Training Emphasized by Commander," Newport News Times Herald, 30 November 1976 and 4 January 1977 (Reprinted in Current News, Part II, 7 December 1976, p. 14-F and 12 January 1977, p. 11-F).

** For a juxtaposition of firepower versus maneuver, see Appendix III, "U. S. Conventional Forces: A Faulty Underpinning?"

the target with a laser spotter) introduces another set of problems, the most serious being observer-to-target intervisibility and the redundance of the sophisticated delivery platform.*

(2) High-flying task forces with improved guided munitions (e.g., IR) may be able to fly above the gun envelope and suppress SAM's, given the finite number of batteries and fire control radars (typically 17 in a Soviet army)** and the fact that fast-moving Soviet forces will be moving beyond most of their air-defense SAM envelope. In doing so, however, high-flying task forces maximize the value of the Warsaw Pact's large commitment to air defense fighters (nearly half of the Pact's tactical aircraft were so designated in 1975).*** In contrast, flights flying on-the-deck at ≤ 200 feet are extremely difficult to intercept, especially with the Warsaw Pact's present and projected aircraft inventories and surveillance equipment.****

(3) The U. S. approach, with its dependence on guided weaponry, defense suppression, and orchestrated command and control exposes a large component of total U. S. military capabilities

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* For a detailed description of these problems, see Steven L. Canby, Terminal Guidance on the Battlefield: Obtaining Its Potential Payoff, TSC, Santa Monica, California, May 1975. FM 100-5 also contains excellent charts depicting the problem of target disappearance. Operations, Department of the Army, Washington, D. C., 1 July 1976, pp. 13-13 to 13-16.

** "Europe's New Generation of Combat Aircraft: Part 1: The Increasing Threat," International Defense Review, April 1975, p. 183.

*** "A Dollar Cost Comparison of Soviet and U. S. Defense Expenditure," op cit.

**** For historical interest, the obsolescing German JU 87G anti-tank Stuka did not require fighter cover for low-flying anti-tank missions on the Eastern Front in World War II. [L. O. Ratley, A Comparison of the USAF Projected A-10 Employment in Europe and the Luftwaffe Schlachtgeschwader Experience on the Eastern Front in World War II, Naval Undergraduate School, Monterey, California, March 1977, p. 180.]

to the vagaries of electronic warfare. This is an unacceptable risk, given the asymmetric dependence of the West on tactical airpower to offset the East's dominance on the ground.

The European approach, on the other hand, is well suited to European weather. While the U. S. must curtail operations (or rely only on expensive all-weather aircraft at ceilings $\leq$ 3000 feet), the Europeans can maintain normal operations to several hundred feet ceiling, 500 feet being the peacetime safety limit.* By chance -- more than by design -- the European approach is also well-suited to armored warfare. The European approach circumvents enemy air defenses; suffers less from virtual attrition; has a more immediate impact; has greater sortie rates; and it is less susceptible to ECM disruption. At $\leq$ 200 feet, high performance aircraft can underfly enemy surveillance and guidance radars and transit the area before non-electronic optical systems can react. The radar-lock obtained by the ZSU-23/4's J-Band radar dish is tenuous at this altitude, and can be broken by minimum self-screening ECM. These radar dishes are also vulnerable to the high fragmentation of area munitions (as opposed to unity PGM's).

Flights at this altitude are also difficult to counter by enemy fighters. Soviet air defense practice is based on the strata concept whereby ground air defenses handle the lower altitude and fighters (supplemented by the larger SAMs) the higher altitudes. To do otherwise is difficult, if not impractical.** (1) Air space management for ground and fighter air defenses has proved almost impossible to coordinate (even AWACS does not attempt to resolve the problem over front-line divisional airspace). (2) Since the Soviet ground-controlled intercept (GCI) system is radar-dependent for surveillance, low-altitude intercept would require an expensive Soviet AWACS or else look-down radars aboard individual interceptors. (3) Even if interceptors do spot low-level penetrators, attack is difficult. Shoot-down missiles of the Sparrow

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* According to Hans Rudel, absolute weather minimums for JU87G Stuka employment were 30 meters (100 feet) ceiling and 3 kilometers visibility. Ratley, ibid, p. 140.

** The U. S. recognizes the various difficulties, but is attempting to resolve them via AWACS. In the compiled list of AWACS virtues, low-level intercept (in principle) is the one mission which cannot be handled by somewhat less effective, but much cheaper alternatives. For the USAF position, see Maj. Gen. John S. Pustay and Maj. Dennis W. Stiles, "The E-3A and Deterrence in NATO," undated.

variety cost several hundred thousand dollars and have low hit probabilities.* This forces the defense to combine expensive avionic capabilities with even more expensive high performance in the aircraft platform , in order to "bounce" penetrators with the traditional tail chase, using heat-seeking missiles and guns. If the penetrator has maneuverability, the interceptor pilot may have difficulty obtaining the necessary gun and missile tail angles (for Sidewinder-like missiles, the shot must also be upwards to avoid ground "clutter"); further, the interceptor faces the high possibility of an overshoot which would expose it in turn to a quick going away tail shot.

Reduced virtual attrition and more immediate impact are the two corrolary advantages of ducking air defenses. Under the European approach, almost all aircraft allocated for ground support deliver ordnance. In the USAF approach, only a fraction of the force actually attacks the opposing ground forces. In the extreme -- as in the Viet Nam deep interdiction campaigns, as much as 80 percent of the force may be diverted to functional support (escort, suppression, and command and control, etc.). Added to this disadvantage is the proclivity of ordnance-laden aircraft to abort their mission when enemy fighters appear in their airspace. To this must be added a new form of diversion: the use of army resources for defense-suppression at critical junctures of the battle. The coordination of doctrine between the U. S. Army and Air Force accepts the primacy of defense-suppression:

> "Whenever and wherever the heavy use of airpower is needed to win the air/land battle, the enemy air defenses must be suppressed, or losses of aircraft will be too high and the effectiveness of air support too low. Suppression operations may include temporary neutralization of selected facilities and short-term degradation of other installations, as well as the planned destruction of critical defensive elements." ...
>
> ... "Suppression operations also require an immense application of artillery and surface-to-surface missiles on those identified targets that are within range. These ground weapons are employed at the same time that penetrating aircraft use a sophisticated array of antiradiation missiles, standoff precision guided missiles, conventional bombs and ECM pods, as well as supporting

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* "Missile Problem One for F-15, Too," St. Louis Post Dispach, 28 December 1976, p. 10 (Reprinted in Current News, 17 January 1977, p. 11-F).

> airborne jammers. The target priorities are to first destroy enemy air defense command control center, then systematically reduce the surface-to-air missiles (SAM) and anti-aircraft artillery (AAA) sites in the vicinity of targets to be struck by the fleets of follow-on aircraft or in the corridors to be opened."*

There is a major inconsistency between the doctrine and the very nature of blitzkrieg warfare. If a breakthrough is imminent, the Army has already (by definition) been stretched to the breaking point and could not possibly afford to divert artillery (or management attention) for the complex task of defense suppression. The Army can, at best, destroy the larger surveillance and SAM radars over a period of time. But the Army cannot divert large-scale artillery fires from ground targets - and particularly counter-battery targets -- if its own anti-tank weapons are not to be suppressed by enemy artillery**. The task of tac air is to assist the Army; mutual inter-service accommodation should not be allowed to mask the essentially unidirectional nature of this relationship.***

If time is critical, the advancing Soviet armored forces must be attacked immediately if friendly ground forces and key terrain points are not to be overrun and cut off. For instance, in the increasingly cited surprise attack scenario (which NATO air forces tend to emphasize) enemy air defenses cannot be allowed to divert expensive air assets upon targets of derived importance. This may be acceptable in a semi-static conflict; but to have air forces fighting their own war first is not acceptable in a fast-moving conflict which may be decided in days if enemy columns are able to crash quickly enough into West Germany, unraveling military cohesion and the

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* FM 100-5, op cit., pp. 8-4 and 8-5.

** For an excellent discussion of the importance the Soviets accord to suppressing anti-tank weapons, see Phillip A. Karber, "Anti-Tank Weapons and the Future of Armor," Armed Forces Journal, November 1976.

*** At a more aggregate level, the classic example of roles becoming reversed is the Yom Kippur experience whereby the Israeli Army had to penetrate behind the canal and begin the unraveling of the SAM system before the Israeli Air Force could offer effective support.

political will to continue fighting.* By definition, enemy air-defenses cannot be quickly suppressed in the surprise-attack scenario if only because the attacking armor would then still be within its intact peacetime SAM envelope. Ergo, air forces must develop tactics which can attack the armored columns immediately, or at worst, with only minimum diversion to defense suppression.

In semi-static combat situations, when time is not so pressing, time and resources are available for suppression. The critical question then becomes whether expensive aircraft should be used for ground support (especially CAS) or husbanded for periods of imminent breakthroughs. If no breakthrough is imminent, most enemy field forces will be in "shielded" assembly areas (or "hides"); only their air-defense will be out in force. Attack now means attacking into main strength and possibly falling into the trap of an air-to-air defense duel. Given the increasing capabilities of ground air defenses and the importance NATO has attached to its air forces, NATO cannot allow its air forces to duel away their strength with possibly little impact upon the Soviet ground-gaining arms.**

Finally, under the European approach higher sortie rates and a smaller potential for flight interference are to be expected. A steadier sortie rate and a capability to divert airborne aircraft (via TACS)*** is advantageous only in slow-paced conflicts. A standardized approach based on logistical efficiency may be suitable for Pacific operations, but it could lose a war in Europe.****

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* As Senator Nunn has stated, "If this assessment is correct ['that the air war in the Central Region has shifted westward, and although the ultimate mission of NATO's air forces remains that of providing the Army firepower, we must now first save ourselves before we can save the Army'] -- that the new and emerging character of Soviet tactical aviation has deprived NATO's own air power of its traditional role as the great "equalizer" of Pact preponderance on the ground -- the size and role of NATO's air forces demand a thorough reevaluation." NATO and the Soviet Threat, op. cit., pp. 5-6.

** This is a dominant argument: if air forces are truly effective, they cannot be risked in this manner; if not effective, the expensive outlays should never have been made.

*** Tactical Air Control System.

**** A more general problem is that the U. S. may have designed its logistical systems and equipment on the appealing but deceptively false economic criterion of minimum peacetime ten-year costs. A case in point is U. S. and Israeli experience in turning around battle-damaged F-4s. The U. S. required an average of 40 days in Viet Nam (with a possible reduction to 20 days in a full-wartime situation). Left unexplained is the Israeli average of 2 days. Such turn-arounds obviously question the supply procedures developed by operations research; instead one should seek out the "trade secrets" of countries like Israel and Sweden which are able to provide efficient "on-site" repair.

Diversion of airborne flights is most advantageous in a target-scarce context, particularly at extended ranges. Neither is at all useful in Europe. Haulage is short -- or should be, if air forces are to avoid being locked onto runway-vulnerable main operating bases (MOBs). Targets appear as quiet or stepped-on anthills: that is, when no breakthrough is imminent, targetable field forces are scarce; where one is imminent, 'hides' empty and the context becomes target-rich as the enemy attempts to push massive reserves into the corridors. Ergo, wartime sortie rates must be based on military demand; sortie rates should not be supply driven by the peacetime criterion of logistical cost-effectiveness.

Autonomous operations facilitate high sortie rates as small flights can be more readily turned around. The approach is also less susceptible to enemy ECM action against navigation and command and control.

This is not to argue the European approach does not have its own limitations. In many respects, the U. S. approach was specifically structured to overcome these deficiencies. However, the U. S. has failed to recognize that a combination of tactics and training as well as less sophisticated technology could reduce these deficiencies, and thus mold its tactical air system into one potentially more cost-effective for Europe than the more generalized approach relying upon sophisticated technology.

The deficiencies of the European approach are associated with low-level, fast, transience: navigation, target acquisition, and delivery errors.* Autonomous, low-level flight forecloses dependence upon non-self-contained systems like TACS. Similarly the Europeans dislike navigation emitters like doppler radar (the exception being all-weather terrain avoidance). Instead the Europeans have placed their navigational hopes on inertial systems, head-up and rolling map displays, and demanding training. Their training offers a particular advantage: their pilots tend to be older with many years experience flying over the same rather constrained geographical space. If the war were to become prolonged and these cadres lost -- as has happened in previous wars,

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* The electric pylons crisscrossing Northern Germany are an additional complication.

the European system could not be sustained. However, given present pilot ratios, and the difficulty of repairing high performance aircraft [see Fn 4, p. 18] (and the shortage of replacement aircraft) cadre losses are unlikely to be a key constraint in Europe. Intensive training and terrain familiarity can therefore make low-level navigation a feasible proposition for the Europeans, if not for the U. S.

The Europeans have sought to overcome the difficulties of acquisition and delivery by stressing area munitions, an approach which fits in well with the nature of armored forces. Armored units of at least company size must remain grouped for control, security and effectiveness. They are mostly road-bound, moving cross-country only when in proximity to the enemy. (To do otherwise causes intolerable demands upon maintenance, fuel, engineer support, and command and control.) The problem is the present inadequacy of area munitions. Worse, some of the smaller countries are still relying on older, less expensive and virtually ineffective munitions. With area munitions, the pilot can avoid the pop-up-maneuver and can continue on a flat plane. Without area munitions, delivery aircraft are forced into pop-up tactics, causing several deleterious effects. Foremost is that without prior knowledge of approaching targets, pilots are forced into a second pass, foregoing any possibility of surprise. Even so, pop-up deliveries are dangerous and relatively ineffective. Against modern air defenses, pop-ups are dangerous regardless of the pilot's 'twisting' skill. Unless new munitions are carried (PGMs, cluster bombs, or armor-piercing cannon), the pop-up (assuming aircraft survival) is also likely to be an exercise in futility: rockets, bombs, and napalm require virtually unobtainable accuracy for lethality against armored vehicles.*

The success of the European system would require a major improvement of today's first-generation cluster munitions. The U. S. found Rockeye unrewarding and dropped further development for guided delivery. The British, Germans and French however, have focused upon area munitions. The next generation promises an order-of-magnitude improvement. Particular emphasis has been placed

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* In addition, the effectiveness of all air munitions are degraded by such target acquisition factors as weather and battlefield haze; degradation is highest in present-day PGMs, lowest for area munitions.

upon concrete cutters and shaped-charge bomblets.* Concrete cutting has been emphasized for cutting runways and the transportation network, these being chosen as easy targets to acquire and an effective way to disrupt enemy air and ground operations. The major problem is with the shaped charge bomblets if the tank itself is to be targeted. Until terminal guidance can be employed (introducing its own problems), random bomblet distribution means good hit probabilities can only be obtained by trading-off warhead weight for quantity. The bomblets therefore are always of marginal effectiveness even against the tank's relatively weak top-sides and for mobility kills. Various devices could be developed to render them ineffective. For instance, Chobam armor topside or overhead tripping screens (like the fences put around U. S. APCs in Viet Nam) could be mounted during administrative marches. Hence, the cluster bomblet could be a weak underpinning for tactical air forces unless direct attack upon the tank can be avoided. This is, of course, the European position. While the USAF has interpreted fighting armor as tank-busting, the Europeans have focused on ways of negating the effect of the armored onslaught.

C. The Choice of Missions

An interesting aspect of the tactical airpower problem is that only the Germans have had extensive practical experience (in World War II) with integrating tactical airpower into the combined-arms armored team. Their key insight was that the air-supported tank could restore maneuver to war, in a manner once traditional but lost in World War I. Their original intent, however, was rather limited: to extend the scope of artillery. Armored-style infiltration tactics would be unable to maintain momentum unless "artillery" could be leapfrogged to the front whenever serious opposition appeared. In the defense, the Germans tended to rely on tac air for day-to-day attrition and for "pouncing" operations upon opposing tank columns during counterattacks to blunt and delay reinforcements (or enemy maneuver from unexpected directions). As the war continued on in the Eastern Front, the Germans converted their obsolescing Stuka into the war's best tank-killer.** Overall, support to the army steadily dwindled as the Luftwaffe was forced to concentrate on home air defense, and as total capability declined.

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* For technical details of these munitions, see S. Canby, Tactical Airpower in Europe, op. cit., p. 24a.

** The best accounts of Stuka operations are Generalleutnaut Helmut Mahlke, Nahkampfflieger Verbände, Celle-Westerielle: Schweiger und Pick Verlag, 1971, and Oberst Hans Rudel, Stuka Pilot, Washburn & Sons, Dublin, 1952.

The American, British, French and Soviet air forces on the other hand, have had little experience with the support of armored warfare. The Soviets, for their part, were mostly preoccupied with neutralizing German fighters. Their much-maligned practice (in U. S. eyes) of assigning tac air to the Army Front (the command level responsible for organizing the breakthroughs) can be interpreted as their way of integrating air cover and airpower with fast-moving, exposed and unsupported tank columns.

The Anglo-American and French air forces have had virtually no experience in this field. The USAF and RAF have always been bombardment air forces. Their tactical air forces were secondary adjuncts devoted to supporting slow-paced, linearly disposed forces. Patton-style operations were the exception, not the norm. Tactically, this led to a style of tactical airpower akin to mini-bombardment -- one which sees firepower as an end in itself, rather than as a means to facilitate maneuver, as was the German practice now seemingly revived in the most recent Soviet approach to tactical airpower.

Following World War II, USAF officers under the leadership of General Pete Quesada interpreted the lessons of the war to mean that fighters with greater range and payload could fulfill the role Douhet had envisaged for bombardment aircraft: defeat the opposing army without costly assaults by one's own army via the semi-strategic missions of deep interdiction upon enemy supply routes, rail marshalling yards, etc.* Nuclear weapons carried this approach to its logical conclusion -- expensive, casualty-producing ground forces could be reduced to the tripwire function allowing Europe to concentrate upon its economic reconstruction.

The consequence was that the NATO air forces concentrated upon quasi-strategic deep interdiction targets and the counterair mission, the latter being interpreted as air-base attack and interception. Tie-in with the army was minimal, particularly in 4ATAF. In the British-dominated 2ATAF, air-to-ground

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* Robert F. Futrell, Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force 1907 - 1964, Air University, Maxwell, AFB, Ala., 1974, pp. 92-93. For a recent articulation of this long sought goal, see Brig. Gen. J. E. Ralph, op. cit., p. 23. For a discussion of the interdiction mission, see Appendix IV, "The Interdiction Mission -- An Overview."

coordination continued (in attenuated form) if only because of the co-location of ATAF and Army Group headquarters. (And because 2ATAF was assigned shorter-range targets more closely related to war-fighting than to deterrence and bombardment as in 4ATAF.)

Since the Bundeswehr has adopted Anglo-American methods, the NATO air forces tended to be remarkably similar. The divergence in approach only occurred when the air forces shifted from a nuclear QRA to a conventional support-the-army orientation.* Though USAF (Europe) remained oriented to its QRA mission until 1969-70 (MC 14/3 having been officially adopted in 1967), the USAF as a whole began shifting toward a conventional outlook in the early Kennedy/McNamara period, gaining impetus with USAF's adoption of the Navy Phantom and Viet Nam. This early shift has given the USAF a leg up upon the Europeans in terms of earlier equipment replacement and war experience. The negative side is that the nature of the experience may have led the USAF into techniques and approaches inappropriate for Europe. Foremost, by visualizing all warfare as exercises in coordinated firepower with the armored blitz being simply hyped up warfare, the USAF has erroneously accepted the plausible conclusion that the greater tempo of armored warfare could be matched by the even greater speed of modern data processing machinery.

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* Organizationally, the air forces remain remarkably similar. While such standardization may appear as a plus, its negative side is a lack of organizational innovation. In the author's opinion, this has been particularly undesirable, as NATO's cost-effectiveness (men-to-plane ratio) averages about 5 times worse than that of the Swedes and Israelis. [The Military Balance, op. cit., less ground air defense for comparability.] Interestingly, the Swedes -- who probably have the best aircraft inventory in Europe other than the U. S. -- have developed their own production functions. For instance, a Swedish Viggen wing with two-fifths the operational aircraft of an US F4 wing performs roughly similar tasks with one-sixth the peacetime personnel, including mobilizable (in place) civilians and conscripts. In wartime the Swedish establishment is beefed up, with most of the personnel increases used for an elaborate dispersal system of no more than one squadron per base, with each base having several offsite emergency strips. (This experience compares with that in the Air National Guard, suggesting large-scale inefficiencies in the active military personnel system.) [Data provided by Swedish Air Staff, Stockholm].

While neither the USAF nor the European approach has any articulated theoretical underpinnings, the Europeans have nevertheless displayed consistency in mission-allocation. USAFE has not. Uncertainty has caused USAFE to veer from one position to another. Its initial preference was air-base attack, pursuing this objective even in the face of mounting evidence of the futility of attacking sheltered aircraft. In pursuit of a policy of strength against strength, technological solutions were sought to the problems of shelter targeting and penetration. At some institutional cost to itself, the Rand Corporation convincingly showed the unfeasibility of this approach. Unfortunately, when the USAF did reverse itself, it accepted too uncritically Rand's advocacy of close air-support (which was based upon quantitative models which qualitatively misunderstood the nature of conventional warfare.*)

The result has been undue emphasis on CAS, compounded by old-style coordination procedures carried to the extreme of allocating two pilots (an ALO and a FAC) to each line battalion.

The Europeans have adhered to their initial choice of missions. In their view, the purpose of tac air, whether against ground or opposing air forces, is disruption; killing is a byproduct. Their thinking is based on the concept of cohesion: armies gain their power through cohesion; if cohesion is lost, force is diffused and more easily defeated. [While not articulated by the Europeans, this is, in fact, an articulation of the maneuver concept of warfare, as opposed to the US's firepower approach.]

Airbase attack is seen as the best means of neutralizing opposing air forces, particularly for a short war. But, whereas the U. S. sought earlier to destroy aircraft in shelters, the Europeans have sought the less demanding but arguably more effective means of sortie suppression. In this view, aircraft do not have to be destroyed; non-use is sufficient. Accordingly, the Europeans have developed munitions for cutting runways. The result is that while the U. S. pursued guided weaponry and is now foregoing air base

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* The series of Rand reports leading to the Rand conclusion were based on the so-called TACS model, a highly aggregated computer model of air-ground warfare built upon firepower indexes. For elaboration of the model, see D. E. Emerson, TAGS-V: A Tactical Air-Ground Warfare Model, R-1242-PR, June 1973.

attack because of low cost-effectiveness, the Europeans have become increasingly interested in this mission as their developmental programs in concrete cutters have shown promise, the British and French versions now being near production.*

Against ground forces, battlefield interdiction (BI) is seen as the most promising means of disrupting enemy cohesion. As the Europeans see it, the ground forces themselves can generally handle the Soviet's first echelon. What the ground forces cannot handle are repetitive 2nd echelons bearing in if penetration does not succeed initially, and the resulting exploitation if penetration does succeed.** In the first case, tac air is seen as a means of disrupting Soviet timing, giving the Army respite by slowing the power and pace of the attack. In the second case, tac air serves as a delayer, providing time for the Army to move up reserves and sort itself out from a bad situation. The actual physical destruction of enemy forces is only a byproduct in both cases.

While the European position is consistent with a maneuver doctrine, there are also many elements of convenience (which may well be the real reason the Europeans have opted for BI in lieu of CAS): (1) In the case of the Germans, the familiar issue of interservice roles and missions is at work: the Luftwaffe was authorized multi-role combat aircraft (MRCAs) and the Bundesarmee attack helicopters, if the Luftwaffe would forfeit CAS for BI. (2) Allied aircraft -- both older aircraft as well as aircraft entering production -- were designed for the dated MC 14/2 strategy. Their high wing loadings make these aircraft

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* If the Europeans were to shift their mode of delivery from aircraft to SSMs (largely American), the possibility arises that a Soviet style air offensive could become a liability for the Soviets. New SSM technology offers capabilities lacking in present air forces: simultaneous, all-weather targeting of the fifty or so recovery sites of a Soviet air offensive. This creates the possibility of (1) major physical damage to the Soviet air fleet if they should land on the cratered runways or emergency sod strips (for newer aircraft) or (2) reduced physical damage but major disruption to future air and on-going ground force operations if they should use the roadnet for recovery. Costs can be moderated by (i) designing specialized low O&M-type units for this task, and (ii) using ballistic trajectories, radar area correlation for terminal homing, and cratering sub-munitions.

** The term 2nd echelon is ambiguous, since all Soviet units employ the notion of 1st and 2nd echelon. The specific German and British meanings are the reserve divisions of the Soviet Front's 1st echelon. 2nd echelon Front forces are viewed as too far removed for any immediate impact on the battlefield.

difficult to handle for CAS, but satisfactory for the less demanding (i.e., maneuverability) BI mission. (3) BI is much less demanding in terms of air-ground coordination. BI targets tend to be high-contrast targets on roads in free-fire zones. CAS targets, on the other hand, tend to be low contrast deployed forces, often interspersed with one's own units. Detailed and time consuming coordination is generally necessary for CAS target acquisition to avoid hitting friendlies.* Such coordination is moreover expensive in personnel and in foregone sorties. (4) CAS in the European mode of low-level tactics means punctual time-on-target attacks and temporary suspension of army artillery at a critical juncture when the army is already hard-pressed.** (5) The Europeans see CAS as attacking into strength. Air defenses can be expected to be particularly strong at the point of penetration. While the U. S. is predisposed to handle air defenses head-on by defense suppression, the Europeans prefer the finessing route of attacking enemy columns, which would be protected by a less dense and more strung-out air defense umbrella. This is particularly important in low-level tactics as the major danger to aircraft is barrage fire from randomly dispersed ground troops. (6) CAS tends to imply one-on-one tactics (i.e., expensive aircraft versus cheap ground vehicles) which the Europeans -- almost without exception -- find too costly and logically unattractive.

The foregoing should not imply -- as is sometimes alleged -- that the Europeans have no capability for CAS. They do have some capability, if only by virtue of an in-place request system, and the allocation of one or

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* In South Viet Nam a CAS pilot required roughly 5½ minutes to acquire the target with the aid of an airborne FAC; somewhat more with a ground FAC. Pave Penny in combination with a laser designating ground FAC reduces this time to roughly 1 minute.

In 1973, Israeli pilots found their communications jammed on all UHF and VHF frequencies in less than a minute of pilot-FAC coordination.

** The U. S. system of high-flying aircraft using guided munitions does not require artillery suspension [FM 100-5, p. 8-6, op. cit.]. However, the U. S. system also has an element of unreality. Weather and battlefield smoke and dust, in fact, will make target contrast difficult for E-O weapons, forcing them into the arch of artillery/mortar fire. Given the present cumbersome FAC procedures, this poses the dilemma of risk to aircraft or artillery cessation without tight timing at critical junctures in the battle. If the USAF does in fact adopt on-the-deck delivery techniques for CAS, this dilemma will be heightened from exploding shells, calling into question present time-on-target procedures and the TACS system.

two FACs per brigade.* When CAS is required, they also seem capable of handling a surprisingly large number of sorties by surging their sortie rate and by using a zone-designation technique requiring minimum FAC coordination (this technique is now being adopted and tested by USAFE in its on-going Creek Braile Exercise with the 3rd Mechanized Division).**

The dilemma the Europeans face is that the peak demands for CAS and BI would occur simultaneously. In their view, CAS should be done only when the army is about to be over-run and the front is being penetrated. The dilemma is that this occurs when BI is the most lucrative. Diverting allocations to support the army directly may be necessary in a crunch, but it comes at the cost of foregoing the disruptive effect of BI upon the Soviet's 2nd echelon where the real danger is believed to lie. When the front is not in danger of being over-run, expensive aircraft should not be risked for the sake of destroying a few tanks: enemy 2nd echelon forces are then generally in their hides, foreclosing the opportunity for profitable attack. Thus, for the Europeans, CAS is pure firepower; it may at times be necessary, but it comes at the price of sacrificing the leverage potential of tac air and the main strength of their air system.

The remaining choice of missions are supply interdiction, quick reaction alert (QRA), armed reconnaissance, and air defense. Of the four, the long cherished mission of supply interdiction, is at least temporarily, no longer an issue. All seem to agree to its impracticality for Europe. QRA still receives a major allocation, its proportion increasing as the war progresses. Armed recce is a form of BI, now coming back in fashion with the new family of area munitions and the emphasis upon 2nd echelon reserves. With

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* In British terminology, an air liaison officer (ALO) is a pilot; a FAC, a specially trained army officer. Each British brigade-size unit has either a FAC or an ALO. The Germans have similar terms, allocating each brigade one FAC and one ALO. The Belgians use only army FACs, one per brigade. The Dutch use an ALO per brigade; the Danes use airborne FACs, having 1+ per brigade. The French are striving for one per regiment, having at present 1+ FAC/ALO per their new light division of four light regiments.

** For a discussion and critique of Creek Braille, see S. Canby, Tactical Airpower in Europe, op. cit., p. 24a.

the British leading the way, the Germans and now the USAFE in its Creek Braille exercises are following suit. The British have found it attractive for circumventing demanding intelligence; USAF, for circumventing the ECM vulnerability and the delays of air-ground coordination in the FAC system.

Air defense is somewhat of a paradox: it was the U. S. which reintroduced the notion of the dogfighter, but it is the Europeans who are recognizing its potential. The U. S. -- probably because of its fixation upon tightly centralized command and control (made possible by advances in electronics) and the initial Soviet air offensive tends to view air defense in the intercept mode. The Europeans for their part, are reintroducing the concept of the melee, bifurcating air defense into interception and dogfighting. This is doubly paradoxical as the European style of offensive air minimizes the potential for Soviet fighter interference, while the U. S. style of orchestrated "alpha" strike task forces seemingly calls for a large air-to-air capability. The explanation seems to be that the Europeans (after the initial Soviet air offensive see the air war being concentrated over the armored thrusts, whereas the USAF retains an old-style FEBA-like image of warfare, partly due to the quantitative models to which it has become addicted. For implementing their notions, the Europeans are contemplating leading edge slats for present aircraft and lower wing loadings for future aircraft. This "double duties" their aircraft, allowing ingress as a fighter-bomber and egress as a dogfighter for protecting their own flights as well as for neutralizing Soviet fighter-bombers in the thrust area.

D. The Choice of Targets

Doctrinal reasons as well as budgetary constraints preclude any major shift within the next decade in the European operational modes and mission allocations. The major question up for discussion is type and timing of targets to be attacked. Should the tank itself be attacked -- as the USAF believes -- or should the tank be incapacitated by targeting other components of the synergistic combined arms team?

The answer for the Germans, French, and British is, of course, the second approach. All three countries have major study efforts underway. The French study at Metz has surfaced several solutions, none apparently workable in practice. The Germans are half-way through a major two-year study at Köln-Vaihingen. All agree that the tank is too demanding a target, but none have apparently found an acceptable solution.

For CAS, many Europeans feel that the artillery is potentially the best target for tac air. Artillery is soft* and offers leverage because if Soviet artillery could be destroyed, a NATO defense laden with anti-tank weapons would levy a high toll upon an attacker. (If, on the other hand, Soviet artillery can lay down a suppressive blanket, NATO's emphasis upon sophisticated ATGMs and long-range tank fire may be to little avail.) Artillery, however, has apparently proven difficult to attack. To be effective, a good share of the artillery would have to be destroyed or at least neutralized. During CAS operations, this has not proven possible. Reliable and timely targeting intelligence is difficult to come by on any battlefield. Indeed, on the dynamic armored battlefield -- contrary to the claims of the data processing industry -- timely intelligence of this sort is probably impossible. If the Soviets can manage their forces in accordance with their stated doctrine of dispersal and quick concentration, too many weapons may be moving into position for too short a time for effective targeting. The multiple rocket launchers -- the best weapons for suppressive fire -- are particularly difficult to target due to their "shoot and scoot" capability. In short, if artillery is to be the primary CAS target, much of it is going to have to be destroyed before it reaches its firing positions.

This conclusion presents a problem for BI. If tac air were all-powerful, enemy columns could be stopped before they could reach the battlefield and no need would exist to discriminate for artillery in BI. Since few Europeans would argue the extreme case that tac air possesses such capacities, most tend to agree that tac air's real purpose is to disrupt the enemy's scheduling. This has two implications: first, disruption per se is difficult enough; the time and the means available are inadequate to distinguish between artillery and other soft targets. Under the European operational mode, disruption requires hitting as much as possible in as short a time-span as possible. Discrimination would slow the European sortie rate and risk aircraft, as opposed to the U. S. operational mode, where task forces and guided weaponry could possibly make artillery discrimination feasible.

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* Contrary to most impressions, even SP artillery is soft. Only the guns themselves and part of the gun crew are sheltered.

Second, the notion of disruption itself may be invalid. The notion was based upon World War II experience, largely against a German opponent, who was depending upon tactical brilliance and fine coordination to offset inadequate resources and reserves. Against the Soviets, this notion may not be valid. Soviet command rigidity may, indeed, make them susceptible to maneuver counter-attacks, but that is quite distinct from the attrition losses to firepower and the inability to replace forces at critical points in time and place. The Germans could not absorb such losses; the Soviets can. Traditionally, they function amidst high losses; their echeloned system of reserves can make up for losses. Even in an unreinforced surprise attack, the Soviets have the combat units to field an operational system that is almost hydra-like (the Soviet system may similarly not be vulnerable to losses unless its command-brain system is itself damaged.*) Ergo, much of the pay-off the Europeans are hoping to gain by disrupting 2nd echelon forces may evaporate, limiting the payoff to simply gaining time for the army to "tidy itself" and to move in whatever reserves are available. This implies a requirement (as the British prefer) for attacks upon the transport net.

The Europeans have not voiced this line of argument; yet it may explain why their approach to force disruption is not promising as yet. Their hopes are pinned upon better area munitions and new tactical insights which might open the way to unraveling the totality of the combined arms team. The latter seems unlikely under present circumstances in which reserves are too small and the defense is too passive. If synergism is to be broken, this must come about either by fouling of the attacker's timing and coordination or by unbalancing the combined arms team. Better cluster munitions could conceivably lead to greater delay via more effective destruction of enemy columns or of their road net. But improved cluster weapons are unlikely to provide the discrimination necessary to unbalance the armored team, except to the extent that cluster munitions are designed to strip away everything save the difficult tank.

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* While the U. S. has sought firepower destruction in CAS, the Europeans a modicum of destruction and disruption, the modernized Soviet Air Force, which is not needed to support its ground forces, except for penetrations outrunning the bulk of supporting artillery, seems to be oriented towards command dislocation (the old Luftwaffe technique) in support of rapidly moving armored thrusts. Other roles of this modernized force are diversion of Western resources to air defense and the compartmentalized task of destroying NATO nuclear systems.

Indeed, with Chobam armor and the like, the Europeans might be wise to forego sophisticated tuning, striving instead to destroy the road net, or to strip away the supporting elements of the tank team. The latter approach becomes particularly effective if the defense can force a serious fight. Indeed, with a serious enough defense in depth, destroying soft reconnaissance and resupply vehicles would be sufficient to reduce an armored thrust to repetitive halts and short forward movements by eliminating the wherewithal of the armored attack: infiltration, and failing that, suppressive fire for attacking vehicles. This removes the real danger of blitzkrieg-style attacks: its capacity to move beyond the battlefield. Such a capability removes the need for relying on the favorite German tactic against the Russians in World War II - that of allowing breakthrough forces to pass through and create its own conditions for destruction through over-extension, setting the stage for a major counter-attack to turn self-imposed dislocation into forced dislocation, thus breaking the blitz's cohesion through the German ideal of the Cannae.

Currently the French, British and German air forces are generally in accord as to the primacy of BI and the type of targeting. All three rely on area munitions: the Germans and British using the BL755; the French naturally having a French design, the Beluga. Nevertheless, within this accord, divergences exist, manifesting themselves in national developmental programs. The British tend towards the roadnet. This hopefully would cause bottlenecks and the queuing of vehicles, creating more static targets for subsequent flights. The Germans tend towards attacking the columns directly, seeing few possibilities for creating bottlenecks. In terms of immediacy, the British mean to target the reserve divisions of the attacking armies; the German, these divisions plus the 1st echelon follow-up armies of the Soviet Front. In time/distance factors, the British emphasize depths of up to 100 kms, impacting on the battlefield within 24 hours; the Germans 200 - 300 kms, impacting within 2 - 3 days. The French seem to be opting for the German position on the choice of targets and the British position on time/distance factors.

Developmental programs now underway will accentuate these divergencies.* The British have apparently developed a highly effective concrete cutter, increasing the attractiveness of their approach. Similarly, the Germans have developed a more generalized Strebos system, providing a variety of options, including a less optimized runway cutter.** Neither system is effective for bridge busting; the Europeans would instead depend on cratering the approaches. [The Germans have cancelled their low-level precision weapon program.] The U. S., for its part, lacks good area munitions in general, and concrete cutters in particular, suggesting that the two approaches can be complementary.

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* In aircraft development, the British and Germans have become proponents of STOL aircraft, mainly to foreclose the possibility of being bottled up by destroyed runways. Both countries are also pushing all-weather capabilities, but for different reasons. The Germans see all-weather capabilities as necessary for attacking enemy penetrations; the British see all-weather in terms of cost-effectiveness via reduced over-the-target requirements (OTRs). For their part, the French are planning to disperse to squadron size on a multitude of bases in Northeast France and appear to show little interest in all-weather. However, the French are also lagging several years behind the Germans and British, being still oriented primarily towards nuclear missions.

** For a description of the British and German cluster munitions, see S. Canby, Tactical Airpower in Europe, op. cit., p. 24a.

APPENDIX I

A BRIEF SURVEY OF EUROPEAN TAC-AIR OPERATIONAL MODES

Until recently, European air forces have been oriented towards tactical nuclear deterrence. As Europeans have accepted the need for strong conventional forces and have re-oriented their tactical air forces toward conventional warfare, they have developed a different style for tactical airpower than the USAF, which, while having doctrinal origins similar to that of the RAF, has been heavily influenced by experiences in Viet Nam and by the 1973 Arab-Israeli conflict. These differences in style are driven by cost, by perceptions of the role of technology, and by different views of the nature of ground warfare. Accordingly, the Europeans -- led by the British -- have developed different views on command and control, and operations as well as different equipment and ordnance preferences.

The Europeans view the U. S. approach, with its emphasis on elaborate electronic warfare, sophisticated command and control, and supporting aircraft as unduly expensive. Their opting for such a style, given budgetary realities, would only mean smaller aircraft inventories, which would reduce the credibility of European capabilities and therefore of deterrence.

The Europeans believe that much of new technology is susceptible to countermeasures and that it can inhibit adaptive behavior. Rather than develop such capabilities, they have sought operational robustness through organizational and tactical adaptation. As they see it, the three pillars of the U. S. approach -- sophisticated C^3, PGM's and defense suppression -- are keyed to high technology and are operationally suspect.

The major difference, however, centers around the differing perception of the nature of warfare in Europe. The USAF views tactical airpower as a centralized reserve for delivering firepower to supplement that of the Army. The Europeans view tactical airpower as too expensive for the simple delivery of firepower; their emphasis is upon leveraging tactical airpower

by integrating it into the ground commander's scheme of maneuver. This orientation implies a different perception of ground warfare which in turn leads to different notions of target arrays and hence ordnance, attack modes, and command and control. Whereas the USAF emphasizes PGM's, medium level flight altitudes, and real-time surveillance and command and control for diverting in-flight aircraft, the Europeans emphasize area sub-munitions, on-the-deck altitudes, and autonomous operations. The Europeans also reject the U. S.'s Tactical Air Control System (TACS), and the tempo of operations envisaged by the USAF. In their view, flexibility is not gained from diverting airborne aircraft but in generating high sortie rates from forward dispersal sites and in minimizing the virtual attrition entailed by the deployment of dedicated supporting aircraft.

For NATO, the present diversity in operational tactics and techniques is probably desirable; in any case, it offers the Europeans the best possible situation. The U. S.'s reliance on high technology to overcome the ground air defenses by prying open a medium altitude window, has allowed them to develop an alternative approach relying more on organization and procedure than upon technology. It also means that since the U. S. is buying expensive defense-suppression systems, the Europeans could always, if necessary, supplement the U. S. aerial task forces should their own low-level window prove closed and their approach fail. Because of this uncertainty, the Europeans have adopted an open view. That is, they are not arguing the U. S. ought to imitate their style but that NATO gains by the two approaches and should not attempt to impose a standardized U. S. approach. Thus, while sincerely believing in their own approach, the Europeans are also given, by the U. S., a hedge against failure. The U. S. however, has no similar hedge and is more constrained in shifting to the European style because of equipment in general and training in particular.

APPENDIX II

THE EUROPEAN POSITION ON AWACS

A. POLITICAL

The Defense Ministers themselves seem favorably inclined, but only because of U. S. pressure and their desire to appear as good allies. Support within the Ministries is slim; and it is even less in the Parliaments. Only the British have been generally favorable; their support, however, is contingent upon offsets and on NATO picking up an even larger bill for maritime surveillance by U. K. air. In recent months, British support has waned with the approach of the irreversible decision date for NIMROD, and this to some extent, explains the German attitude.

B. MILITARY

The Europeans see AWACS as the best system available and value its airborne early warning attributes of extended-range detection and, in particular, low-level tracking. They are not attracted by its capabilities for supplementing TACS, which is philosophically unsuitable to their operational style even if AWACS were to remove several of the physical limitations on possible control at low altitudes. However, they are sympathetic to the notion that AWACS may be a prerequisite to obtaining U. S. aircraft to reinforce 2ATAF. As they see it, AWACS provides the familiar command and control environment that U. S. aircraft need if they are to operate effectively; it would also allow the U. S. to operate low, should defense suppression fail.

C. FINANCIAL

For funding, two conditions will have to be met. First, political expediency requires the appearance of a group effort to reduce its saliency, to create the impression of getting something on the cheap, and, perhaps most important, to make the decision appear supra-national.

Second, funding will have to be in the form of a supplementary appropriation. All the European air forces are reluctant to finance AWACS out of their regular appropriation; this would only exacerbate the downward trend in aircraft numbers, weakening European credibility and its associated deterrence (though it may well strengthen U. S. efficacy).

The notion of supplementary budgets is a possible way out of the budgetary impasse. The Belgians, for instance, would not consider financing AWACS out of their already delicately balanced, long-term program of an annual real increase of four percent which has been approved by the Belgian Parliament. But they note that in the past, special NATO projects like the European Defense Improvement Programs for shelters have been financed as budgetary supplements. The Italians use the same device.

APPENDIX III

U. S. CONVENTIONAL FORCES: A FAULTY DOCTRINAL UNDERPINNING?

As each new administration takes office, crash studies are undertaken to develop new initiatives and to correct the obvious "deficiencies" inherited from the past. Never asked in these reviews is a crucial question: Is it possible that the U. S. has a faulty conception of conventional warfare? If so, policy initiatives are being based upon a flawed strategy and a misleading data base.

Military tactics -- whether guerilla or armored -- are based on fire and maneuver. The critical distinction is in the relative purpose of each. Is maneuver to be used for creating killing zones, or is fire-power to be used to facilitate maneuver? The question of which is to be the hand maiden for what drives the design of armies and tactical air forces. A killing zone approach leads to the practice of applying strength against strength, leading to attrition and protracted war. A maneuver approach seeks to beguile the opponent, focusing strength against weakness, eventually getting inside the opponent's time-decision window. Firepower seeks to defeat the enemy through his physical destruction; maneuver, by collapsing his system (Viet Nam being a good example).

The U. S. approach to warfare is firepower oriented. In Viet Nam, the U. S. attempted to counter an insurgency with firepower. It is well known that in the U. S. Lanchesterian firepower models are influential, the bombardment orientation of our air forces (from which strategic theory sprang), is pronounced and the evolution of army tactics and organization has also been firepower oriented, their genesis being of French World War I experience. The army now accepts the notion of a blitzkrieg in Europe; but its new FM 100-5 suggests that it remains tied to its earlier firepower and organizational habits.

German armored doctrine (as well as that of the Soviets today) and guerilla warfare are maneuver oriented. They attempt to use maneuver to create conditions for surprise and shock, to gain a psychological advantage over the opponent.

The two approaches are thus diametrically opposed philosophically. As could be expected, they also imply different tactics, organization, equipment, and uses of technology for their implementation. Which approach is right? U. S. policy initiatives and equipment choices implicitly presume that the firepower approach is right -- for that is the system embedded in the U. S. military structure. If that premise is faulty, it follows that many initiatives and choices are correspondingly amiss.*

The problem is, indeed serious. Adversaries of the U. S. in Europe, Korea, and elsewhere are generally deploying a maneuver concept, its origin being German World War I infiltration tactics designed explicitly to finesse firepower-oriented set-piece battle tactics. It also appears that the great aces and the great captains of history have had a similar objective -- their target being their opponents' observation-decision-action span.** Only the techniques have varied as the technology has evolved.

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* For example, it is sometimes alleged that NATO and WP forces are roughly balanced, given the defensive nature of the Alliance. This statement implies (1) NATO has fewer combat forces and (2) the defense can organize the battlefield, obtaining an axiomatic 3 to 1 advantage. However, an outgunned opponent can only win if the attacker were to attack across-the-front (i.e., losing by attrition) or if he were to become over-extended, setting himself up for a riposte (i.e., losing through maneuver). The first is representative of quantitative firepower models in this country; it is not the Soviet style. Rather a Soviet offensive resembles an echeloned pile-driver. Accordingly, it is vulnerable to over-extension and maneuver. Attempting to counter it by attrition through battlefield defenses, however elastic, is a prescription for defeat. The defender is faced with a hydra; and if the defense is pierced, it is too readily out-maneuvered and defeated.

** Boyd, op. cit.

APPENDIX IV

THE INTERDICTION MISSION - AN OVERVIEW

Interdiction, and in particular deep interdiction, has been the primary focus of U. S. tactical airpower. Deep interdiction -- with its heavy demands on speed, range, payload, and avionics -- is the most demanding of the tactical air missions. This concentration upon deep interdiction has driven the prorated cost of American air forces to the point where the tactical air forces -- Air Force, Navy, and Marine -- consume a fourth of the pro-rated defense budget, i.e., more than the strategic forces or the ground forces.

Clearly the need for such expensive forces must be periodically re-evaluated.* This appendix discusses the particularly expensive mission of interdiction and develops an overview for evaluating interdiction in the context of the evolution of technology and of military strategy.

For the purposes of aircraft design, two types of interdiction can be distinguished: deep interdiction and battlefield interdiction.

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* A cynic could argue that the glamour of airpower has masked its diminishing utility as it evolved from its origins: (1) For naval aviation, the concept was initially to use cheap planes against expensive ships, ships then being able to support a multitude of tasks like amphibious support. We now have expensive planes to protect an expensive fleet built to support the plane, while many of the Navy's positive functions have atrophied (in other words, a system operating within itself and for itself, with little regard for external utility).

(2) For continental mass aviation, the initial concept was observation to support the Army. Protecting observation aircraft soon led to pursuit aircraft and airbase attack. Then came the Douhet bomber strategy, requiring fighter escorts and anti-bombers.

Battlefield interdiction, armed recce, and CAS developed as extensions of the artillery, a role rapidly being eroded by new technologies. Deep interdiction came during World War II, but it has never been fully successful and was from the beginning a strategy intended most of all to keep tac air our of army clutches.

Deep interdiction attempts to destroy high value targets deep in enemy territory such as airfields, nuclear delivery systems, marshalling yards, power plants, political centers and the like. These target categories can be classified into air base attack, strategic interdiction, and supply interdiction. These missions may have been valid in the past, but their present and prospective validity for manned aircraft is now in doubt.

The rationale underlying air base attack has been the relative ease of destroying an air force in its nest rather than in the air. Aircraft sheltering, the STOL-like qualities of many Soviet fighters, and increasingly effective ground air defenses, however, have made air base attack increasingly difficult and expensive. New technology can only worsen this equation for manned aircraft. Terminal guidance increases the effectiveness of air defense and long-range standoff missile systems (particularly with runway cutting cluster munitions), while only marginally improving that of the manned aircraft. Moreover, SSM technology offers a capability lacking in present air forces: the simultaneous targeting of prepared recovery sites for aircraft in the air.

A more controversial proposition is that the notion of a generalized air superiority has been supplanted by that of temporary, local, superiority which serves the purpose of preventing enemy air from locally interferring with friendly air support and ground force operations. Generalized air superiority is only a prerequisite in a long war where the air effort must be sustained over the long haul. Then general air superiority is needed to mount repetitive bombing operations, and to permit the shifting of air resources from air superiority to ground support.

The first consideration, i.e., strategic bombing, is no longer relevant for tactical aircraft. The second consideration (i.e., the shifting of air resources) implicitly presumes the conditions of World War II, whereby allied forces could standoff from an island to neutralize the defending air force before ground forces landed and closed. This condition obviously does not exist for a war in Europe. Given the size of the air inventory in the USSR,

aircraft sheltering, and the enemy-to-friendly-force ratio, an attempt to attain air superiority before devoting resources to ground support would take much too long. A preliminary "air superiority" battle would relegate tactical airpower to a sideshow with little relevance to the final outcome, and it would negate the rationale behind expensive multi-purpose aircraft.

Similarly, strategic bombing and supply interdiction also assume a long war waged by stalemated (or separated) ground forces -- as presumed by Giulio Douhet from his observations of World War I. Under such assumptions, the possibility indeed existed that the Will to resist of the enemy, could be affected directly, without the costly process of defeating his ground forces.* If this failed, his industrial base could be destroyed to deny sustenance to the deployed forces. This assumption was only partially valid in World War II -- the German blitzkrieg invalidated it in the initial phase, but the slow-moving allied ground operations appeared to validate it subsequently. In any case, large-scale strategic bombing or interdiction is now the domain of strategic nuclear forces.

Somewhat similar to the thinking underlying strategic interdiction is the rationale of supply interdiction whereby a deployed force is denied resupply until it collapses of its own weight. In World War II this form of interdiction was only possible against overextended armored forces like the Afrika Corps with its sea LOC. It was not effective against low-supply Japanese infantry in the Pacific or on large land masses. The increased

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* The notion of Will is fundamental to the art of warfare -- strategic and conventional. As Liddel Hart wrote [Thoughts on War, p. 48], "The real target in war is the mind of the enemy commander, not the bodies of his troops." Yet, this abstract theme is continually forgotten by political and military practitioners (as well as by the quantitative analysts) who tend to focus on the mechanics of war. While Americans pride themselves in the professionalism of their military, this is professionalism in the civil-military sense [i.e., Samuel Huntington, The Soldier and the State], not knowledgeable and understanding of the military art.

range and carrying capacity of jet aircraft (and various anticipated improvements in delivery accuracy), fostered a belief in its efficacy in the years following World War II. And supply interdiction also served as a rationale for enhancing the intra-service prestige of tactical air, while ensuring that it would not again become a mere auxiliary for the army.

In Korea and Viet Nam, where there was no opposing air force and not much of an industrial base to attack, supply interdiction became the primary focus of air operations. The empirical evidence is conclusive that the goal of forcing a military collapse of the deployed forces was not achieved. This objective was in fact unobtainable because of the enemy's ability to adjust to nighttime movement, and because of the low consumption rates of Asian light infantry. Technology in the form of sophisticated sensors aboard large gunships did permit night targeting, but only in a permissive air environment.

In Europe supply interdiction is ruled out by (1) difficulty of blocking a dense transport net with conventional ordnance, (2) the inability to loiter and to attrit enemy vehicles in a sophisticated air defense environment, (3) an attacker's ability to anticipate requirements by forward stockage, and (4) by the time-lag before interdiction affects deployed forces. The result is that supply interdiction cannot accomplish its objective of strangling the forward forces, nor, and more important, can it disrupt enemy operational planning and command. It can only impose extra costs upon the attacker in the form of detours, additional engineers, and replacement losses. In a short war these costs are not significant; in a long war they are important only if the interdicting side can bear his aircraft and pilot losses better than the side being interdicted can bear his repair and replacement losses. In the era of iron bombs of the recent past, the interdicting side clearly has had the worst of the bargain. "Smart bombs" and concrete cutting cluster munitions can help redress this equation against a sparse transport net with vulnerable choke points. In Europe, however, these new technologies are not likely to be sufficiently effective. The road net is too dense, while alternative standoff technology is becoming available to target geographically fixed chokepoints such as major bridges and their approaches. Supply interdiction would only be viable if these new techniques were to become cheap or if tactical nuclear weapons were used.

Battlefield interdiction is the second generic type of interdiction. It seeks to destroy the road net, vehicles, and supplies approaching the Forward Edge of the Battle Area (FEBA). More fundamentally, battlefield interdiction has the potential of disrupting the enemy's operational plans and -- particularly in conjunction with offensives and major counter-attacks -- of dislocating the enemy command system. The random destruction of bridges and vehicles across a wide front has little military utility other than costing replacement losses which can only be significant in a long-term sustained conflict. The real purpose of battlefield interdiction must be to obtain leverage by hindering the enemy from moving his reserves, and shifting his forces, to critical sectors. This means that the payoff is obtained only from a narrow segment of the total front, and that it can be achieved only by large-scale road cutting or vehicle attrition within this narrow segment. On the NATO front, this is the type of interdiction which is critical. Prior to a penetration, its task is to dissipate the attacker's ability to focus the power of his penetrating effort. After a piercing of the front, its task is to slow the flow of 2nd echelon reserves (ideally by destroying them but at least by blocking their movement) so that the army can prevent the attacker from exploiting his opportunity to pour armored forces through the penetration and into the rear of a defense now lacking in cohesion.

Battlefield interdiction can be accomplished in three areas and against two types of target. Interdiction can be focused (a) in the penetration area behind the line-of-contact, (b) at the penetration base to seal off the penetration, or (c) in the cone (or "funnel") extending from the anticipated point of penetration slanting outwards and backwards 100 km or so into the attacker's rear, where his reserves are assembled. The general target categories are the enemy's vehicles and the transport net. Interdiction in support of the defense should be focused against vehicles in the penetration area itself and against the roadnet at the penetration base. The new reference guidance technology could be particularly useful in sealing off the penetration by attacking the known grographical vulnerabilities of the transport net.

Attacking into the cone is to be avoided, except for the short period (at the most several days) between the identification of a major thrust area and the actual breakthrough. The cone is the area in which the Soviets will have concentrated and coordinated their formidable fighter and ground air defense. Organic air defense will be deployed, but parent units themselves will be in forested assembly areas (British term is "hides") and generally not subject to effective air attack. Even if they were, ground losses would have to be severe before their effect can be significant, because of the large size of the reserves stacked up in the cone waiting for the penetration and subsequent exploitation. Consequently, if the cone is to be attacked, the primary target must be the road net, with the emphasis upon the apex of the cone.

But while Soviet air defenses are strongest in the cone, they are weakest in the penetration area itself. If the enemy is to exploit his opportunity, only a fraction of his organic air defense units can be deployed in an overwatch position. Even more important, the hurried nature of the operation inhibits careful weapons positioning and weapon-coordination. In the penetration area, the radar redundancy and overlap, and the weapon density in depth characteristic of Soviet air defenses will not be present, while ground air defense and tactical fighters cannot be coordinated. Effective GCI will also be impeded because of altitude constraints (against low flying ground support aircraft) and situations of radar saturation (against high flying aircraft). Moreover, the shape of the penetration area will be such that interdicting aircraft can crossfly the penetration from many angles in repetitive passes and sorties; this would compound the difficulties of ground air defenses against aircraft flying on the deck. The target choice is upon vehicles in general. If the enemy continues his advance, clustered targets can be readily identified in column on roads, simplifying target acquisition and time over target; breaks in the roadnet serve to compress the enemy's columns, facilitating this process. If systematized discrimination were to become a feasible proposition,

artillery -- and not the tank -- would be in the easier and the higher payoff target category for tac air. Assuming that the road net can be (at least partially) blocked at the penetration base, vehicles in the penetration area cannot be readily replaced.

Interdiction in support of an offensive must attack into a cone-like area projected from the point of penetration. This area is generally one of the attacker's choice and air defense should correspondingly be less concentrated. The objective of attacking into the cone is to hit the enemy's operational reserves. Ideally, these should be destroyed or their movement blocked; more pragmatically the object is to disrupt the coordinated movement of these reserves into the area. Operational surprise dictates that tac air should not be used excessively in this area prior to the attack (nor should the enemy be moving reinforcements into the area if operational surprise is being maintained). If surprise is lost it follows that the focus of the offensive should be shifted.

With restructured army forces and proliferated anti-tank weapons, the need for battlefield interdiction into enemy territory can be restricted on the defensive; instead, expensive air resources should be husbanded for the penetration, and its preparatory phases. Battlefield interdiction forward of the FEBA may be needed on the offensive, but it may be more desirable to rely on saturating rocket artillery to attack ground troops, while the road net can be attacked with standoff weapons, delaying the introduction of ground-support aviation until ground forces have started their battle of maneuver and have begun the unraveling of the defender's air defense system. This, of course, reverses the traditional view of tactical airpower: the army is now instrumental for the operation of tac air in the attack rather than the opposite (as was the Israeli experience in the Yom Kippur War).