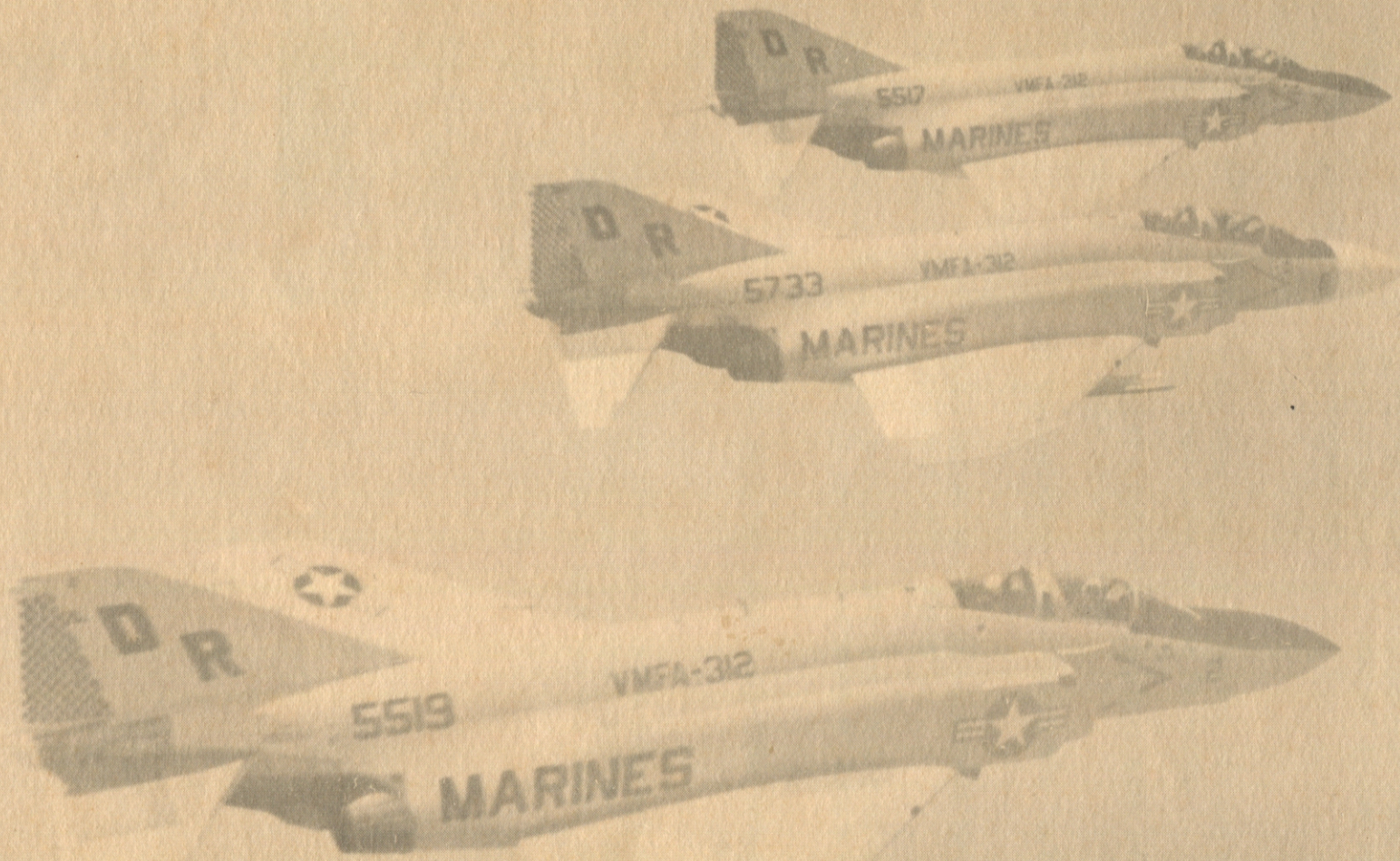
FOX TWO!



SUMMER ISSUE '77

HOW ABOUT THIS?

The cover depicts two of the present evolutions of the McDonnell-Douglas Phanton II -- an AWG-10 (1527) equipped F-4J flanked by a pair of the improved, more reliable AWG-10A (1590) equipped F-4Js (the "Alpha Birds") currently flown by the Checkerboards of VMFA-312. The "Alpha Birds" have several long-awaited improvements providing aircrews with a quantum jump in weapons system reliability and capability, and a greater tactical flexibility.

These improvements include:

1) Increased radar availability through the introduction of solid state components generating longer mean-time-between failures;

2) Incorporation of a servoed optical sight that displays both air-to-air and air-to-ground "heads up" data to the pilot;

3) Smokeless J79-GE-10B engines that eliminate the Phantom's "tell tale" smoke trail in basic engine;

4) An all gray paint scheme which reduces the visual acquisition range of the Phantom and eliminates the "white belly flash";

5) An improved built-in test which utilizes a digital test control indicator and light emitting diode for rapid assessment of complete weapon system status;

6) Improved missile profile display that includes real-time target maneuvers.

Although the smokeless engines and the all gray paint scheme are not "Alpha Bird" peculiar, their combination with the improved weapons system has produced the most viable Navy/Marine Phantom to date for countering the known threat.

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UP FRONT

THE CASE FOR THE CAREER CAPTAIN (AVIATOR)

Talk about an idea that will never sell.... But, what the heck, I might as well get it off of my chest:

The annual USMC Major's board has just reported out and, as usual, they can be commended for their considerable efforts. The F4 community in the Marine Corps is sufficiently small that we nearly all know each other, and because of that, the "community" pretty well knows who the performers and non-performers are. (Amazingly), the promotion boards over the years have often made "official" the general assessments of the community. However, there are occasional departures from that record and this year was no exception.

The Marine aviator is in the position of being graded principally as an "officer" (and all that involves) and only incidentally as an aviator. This is despite the fact that generally, he must devote the majority of his effort during his early career to developing his aviation skills, knowledge and experience. Indeed, if he does not become solidly competent as an aircrewman, he is of no use to anyone, and yet, if he is to be separated from the Marine Corps, it will be because he is a poor officer and not because he is a poor aviator. Indeed, he could be a GREAT aviator and still be separated for reasons only vaguely connected with his ability to shoot down the bad guys. It could be argued even, that the very qualities most appropriate to marked success in a fighter pilot (extreme self confidence, measured recklessness, aggressiveness, single-mindedness, etc.) might get such an individual in trouble with an unsympathetic senior. (We don't always work for fighter C.O.'s, right??) One quick FAC/ALO/ANGLICO tour could easily be enough to do in the career of a highly competent Marine aviator/NFO. I cannot think of a similar double jeopardy situation in the ground forces -- when was the last time you had an artillery officer in your squadron?

So much for the sniveling -- what's the point? Other services (RAF, IAF) have very successfully incorporated career squadron officer programs into their overall officer promotion systems. I do not propose that we do the same merely because they do, but because it has a great deal to recommend it and it is coldly efficient. I propose that instead of forced separation for twice passed Captains, promotion boards be empowered to offer a career Captain option to those officers who represent excellent risks for such and who represent a substantial investment by the Marine Corps. Such individuals should generally be left at the squadron level, in combat billets, where their expertise and skills might best be utilized. Separating an officer who is an ACTI, TopGun graduate, WTI graduate, training base, second tour, combat-ready aircrewman because he is not a particularly competent administrator or manager is difficult for me to justify. Why not offer him just what he probably always wanted anyway and perhaps precisely that for which he is most qualified?

Let's let the upwardly-mobile, high achievers do just that -- ably assisted by squadron level experts, not burdened with the daily requirement to be all things to all people. Surely in a fighter squadron, there is not only room for, but a need for, fighter pilots and RIO's who can remain year after year, damping out the departures from reason so regularly generated by the high speed passes made by itinerant Majors on their way from one administrative billet to another.

We might even offer this option somewhat earlier in the program. I think many people would be surprised at the number of takers.

SHILOH

EDITOR'S PREFACE

The following three (3) articles are representative of the current discussion concerning the effectiveness and efficiency of single aircraft tactics. As will be abundantly clear in Major Barry Watts' article, single-ship approaches to the tasks of air combat are decidedly not a recent innovation. They have enjoyed a renaissance of late, however, in reaction to changes in tactics and equipment by some of the opposition.

Since there are few constants in air combat and since pre-eminent among these is the constancy of change, it should surprise no one that honest differences of opinion will occur concerning the current "best" way to get the job done. It behooves the fighter pilot, therefore, to study his profession carefully--the detailed history of past battles and tactics, problems and solutions and the men who formulated them. It is no less germane for us to study Marseilles, Udet or the Battle of Britain than it was for Patton to have an intimate knowledge of Napoleon or Ceasar's campaigns. What you don't know can get you killed in this game.

All three (3) of the articles which follow were written by compatriots of yours who are trying their best to keep such an ill fate from happening to you. What are you doing?

1 v 1 v 1

Capt Jim Stover
MABS-11, MAG-11

Mutual support is dead. Learn KMAGYOYO (Kiss My Ass Guys, You're On Your Own*) and live. Heresy? Perhaps not. As the Israelis so aptly demonstrated in the Yom Kippur War, mutual support is virtually impossible to maintain in a multi-threat environment. We have been told that Israeli F-4s entered the mass "gaggle" fights at max Q, executed slashing attacks, refused to turn more than 90°, and then bugged out (in many cases to re-arm, refuel and launch back into the fight). The Israelis may have initially launched from their home bases with section/division integrity and mutual support, but once they entered the fight, the dynamics of few-vs-many engagement degraded all semblance of mutual support and the only tactics utilized to "clear 6" were belly checks and RIO's.

Reading the Red Baron Reports, one can see that these situations and tactics are similar to those employed by U.S. Forces in Viet Nam. With SAM/MiG/Break calls saturating the UHF and engagements often starting neutral or defensive we learned that it was the crews who adapted to the 1-vs-many scenario who were the most successful.

Every fighter crew has learned that, even in a sterile training environment, with a 2-vs-2 engagement, mutual support is extremely difficult and often impossible to maintain. If we have trouble with mutual support in a sterile training environment (no SAM/AAA threats, no UHF jamming, friendly GCI, UHF-only Atolls, etc.) how can we fly it in combat?

Is is not the intent of this article to rewrite the Navy/Marine Corps tactical doctrine of mutual support and Loose Deuce. There have been numerous times when all of us have been saved from an "Atoll" by a timely maneuver and "Fox-2" of our wingman (luck or skill--who cares how he got there? He, the Free Fighter, saved you, the Engaged Fighter, and that's good enough). Mutual support <u>is</u> vital, but one wonders if it is viable. Most conflict scenarios seem to accept the fact that we will be outnumbered in the air-to-air arena in any future war. Some figures postulated put it as high as one of us-vs-four of them. If we accept the fact that we will be greatly outnumbered in an air-to-air conflict, why not train for such a likelihood?

1-v-1-v-1 training sorties are not new to El Toro aircrews and TOPGUN graduates since the NFWS now has multi-bogey hops ("King of San Clemente") incorporated into its syllabus and MAG-11 gun squadrons have been doing similar training utilizing 1-v-1-v-1 scheduling. If this type of training is presently being done safely and producing valuable training, why not formalize it and request that it become part of the T & R Manual?

The Red Devils of VMFA-232 experimented with many methods to aid in establishing 1-v-1-v-1 hops and found that the "1-v-1 with a Wild Card" is easiest to organize and control and the safest. Lead and -2 would roll in section with -3 in three minute trail. After entering the working area, completing the Combat Checks, and requesting flight following from GCI, the two aircraft would separate to visual limits

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* With apologies to T-Bone Moore

and engage from a head-on pass. -3 would be vectored into the fight by GCI and would not engage until he had both aircraft in sight (and was at the optimum tactical advantage, of course). As soon as -3 called "Talley on both, I'm engaging," all heads were on a swivel, power was full up, and the belly checks were constant.

If all three (3) drivers were of similar ability, it was discovered that the fighters gradually assumed a three-plane "theory of the egg" fight. No one got slow, turned too much or too hard, or stayed predictable. The aircraft was usually under a constant 4-5 G's, RIO's were contorted into some of the most amazing body positions yet seen in order to check 6:00, and everyone was attempting to hide in the sun. Safety was ensured by each pilot and RIO having sight (between the two of them) of the other two aircraft for a great majority of the time. In the event that an aircraft unloaded and extended out of the fight (a rarity since this was difficult to execute without being shot), GCI was able to provide vectors back into the fight.

After several 1-v-1-v-1 engagements, some patterns began to emerge:

1) 1-v-1 and a Wild Card was the easiest method to begin a 1-v-1-v-1;

2) The competence of the aircrew and recent ACM experience were vital factors in ensuring flight safety and achieving training goals. (This is not the "if you haven't done it, you can't do it until you do it" game, but rather a caution to Ops types to ensure that there is one experienced aircrewman per aircraft);

3) Those aircrews who fought the F-4 the way it "should be" (i.e., high Q, using the vertical, sun, etc.) were generally more successful;

4) GCI proved to be invaluable in providing flight safety and vectors;

5) The RIO was responsible for any aircraft behind the wingline. He directed the defense;

6) The pilot was responsible for any aircraft forward of the wingline. He directed the offense;

7) A constant 4-5 G's left the aircrew well exhausted after two (2) 2-3 minute engagements;

8) Intercockpit coordination and trust was a primary success factor;

9) The RIO had to be able to recognize a threat and direct the pilot's maneuvers to negate an attack (once again proving the validity and effectiveness of RIO Drill hops);

10) Belly checks and the RIO are the only means available to check 6:00 in a multi-bogey environment.

Some of the results your squadron has gained from 1-v-1-v-1 may differ from those listed. If so, or if your squadron is utilizing a better method to train for a multi-bogey fight, write FOX TWO! and inform the rest of the fighter community. If your squadron is doing nothing to train for this scenario, talk to your OPSO.

SMOKEY

ONE VS ONE OR MORE FIGHTER TACTICS: An Opinion

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422nd FWS
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USAF Fighter Weapons Review,
Spring 1975, pp. 23-25

Air superiority may be achieved by destroying your enemy's air capabilities by air-to-ground ordnance or with air-to-air weapons. The segment of air superiority that most concerns our fighter tacticians is the air-to-air battle. Aerial victories require capable aircraft and skilled aircrews. Today there is little doubt that we possess the state of the art hardware to dominate any of our projected enemies. However, these resources will probably be limited by fiscal restraint. The question then becomes: how are we to manage these resources in the air to effect the best possible military results with the least possible expenditures?

Numerical force structure restraints and anticipated engagement scenario changes are the most common elements justifying alterations in aerial attack employment. As far back as 1915 aviators recognized the importance of proper resource management in determining success or failure in combat operations. Since then several utilization systems have been employed; most of them were, by and large, numerical adaptations of previous systems.

Let's take a historical look at air combat and isolate some major aerial attack variations. World War I, for instance, was a dramatic example of air operations where opposing forces, for all practical purposes, possessed numerical equality. The resulting air-to-air operations ranged from the lone wolf attack (curse you, RED BARON) to mass gaggles engaging over Pont-a-Mousson. Boelke and Immelmann teamed to form a two-airplane mutual support system.

The lone wolf used unpredictability and mobility as his support factors. While large gaggles possessed no explicit mutual support responsibilities other than to go to the battle area and engage, their strength was enhanced by the mere presence of friendly forces. However, chances of mid-airs were always possible, and the limited mobility of large formations decreased employment usefulness. Boelke and Immelmann tried to take the best of both possible worlds and form a team--one that would be small and mobile, and still provide visual protection and ennanced firepower.

As history points out, each of these particular systems worked to a degree; however, most of the primary World War I participants ended up being shot down. Their misfortune probably was not the result of an attack system failure, but rather, resulted from their extended participation in aerial warfare with its associated hazards.

World War II presented basically the same scenarios. Mass gaggles were employed. Attacks were made with a wingman. Often, the wingman split and engaged as a loner relying on mobility and basic cunning as his primary support criteria.

In the Korean conflict the U.S. suffered numerical inferiority. Transition from prop aircraft to jet aircraft and the requirement to upgrade pilots during a wartime

period in single-seat airplanes provided the impetus for the evolvement of the fluid-four formation system. This, in turn, provided for a fighting wingman. The success rate is famous but fluid-four was not the sole reason. U.S. pilot acumen proved to be far superior to that of the enemy. Simply stated, our men beat their men. The formation was merely a conveyance to the air battle and a way to train inexperienced men under combat conditions. It was tailored for the Korean conflict, and as such worked in that environment.

Vietnam presented a unique situation. The U.S. enjoyed a numerical advantage from which air superiority, but not air supremacy, was gained. Fluid-four was the system used by the USAF and several factors guided its use. Those factors were: (1) engagement over enemy territory, confronting their excellent air command and control system; (2) a requirement to see the attacker in order to defend or engage; (3) the use of mass as a deterrent; (4) the lack of a totally reliable friendly GCI system (due to excessive range limitations); and (5) the lack of aircrew air-to-air experience (most RTU graduates were going to war with less than 40 minutes of actual air-to-air engagement time). All these circumstances added up made fluid-four the best choice for the SEA air battle.

Today, tactical doctrine stresses training and tactical employment from a multi-plane mutual support system. The crux of this concept entails two or more aircraft participating in concert, each with specific responsibilities to each other. (The defined responsibilities of an engaged fighter element and a free fighter element are explicit and extremely demanding.) These intraflight responsibilities obviously restrict individual capability by sacrificing offensive potential. This occurs because the fighter/team executes in relation to each other and the bogey, dividing their attention. Although the present team concept has proven worthwhile, it is based on two friendly aircraft fighting a single bogey. Such a system based on numerical advantage will be impossible to employ in most scenarios (the obvious one being the European theater).

With the above discussion as a point of departure, I would like to address the question, "Where do we go next?"

ACM engagements possess five stages of development. They are: planning, patrolling, initial reaction, organization and terminal stages. These stages do not restrict ACM by dictating a hard-and-fast structure, but rather, provide a framework from which a viable game plan may be developed.

The planning phase is the most important, and the one on which this discussion will center. It is here that an assessment is made and a game established. The planning stage basically matches your airplanes (types and numbers), men, weapons, training and external support system, against the enemy's portfolio.

"What do we have to work with?" Present U.S. aircraft and those in the near term future, the F-15, F-4, and F-16, possess very high thrust-to-weight ratios and reasonably low wing loadings. These attributes provide us with very agile airplanes. They also possess self-contained avionic systems capable of engaging enemy aircraft outside of visual range. Our missiles are improving every day and their accuracy and range should continue to extend.

The visibility in these aircraft is almost 360° except the F-4, where a two-man crew should increase peripheral visibility. Sophisticated and miniaturized ECM gear along with improving RHAW systems further enhance the present generation aircraft capability. Aircraft size and camouflage paint will present visual and radar acquisition problems for the enemy (but unfortunately, for the friendlies as well). Even though these aircraft are superior weapon system platforms, it is fiscally impossible to buy all that the fighter tactician wants, and the end result will be numerical inferiority in most conflicts.

If our airplane resources are to be limited in the future through fiscal austerity, we must look elsewhere to balance the ledger. Training and external support systems will have to be interfaced with present generation aircraft to a point where these aircraft can operate autonomously in the air combat environment.

This article does not advocate single-ship penetration and patrol, but does advocate that, once engaged, our fighters might operate singularly against multiple bogeys. (It's obvious that while engaging single bogeys with two airplanes, current two vs. one tactics would be used).

The concept I am referring to is called one vs. one or more. Its main theme is exactly what the title implies--one aircraft, operating autonomously, fighting all adversaries at the same time. If there is only one, he fights one vs. one; if there are four, he fights one vs. four. If the U.S. continues to patrol with two or more (which I advocate), each participant will fight one vs. more than one. How many times has the "Red Baron" sneaked into a four-ship formation and fired his missiles and guns before being seen? The readers who have something in common with the great "Red Baron" will observe, "that is a valid statement, but GCI vectored the single airplane against the four patrollers." While this is true, the main reason the "Baron" saw the patrolling flight first was that they were a flight of four, rather than one or two. The reason the airplanes were easy to shoot down was that the formation size limited their in-flight mobility. The next question is, "How, in the one vs. one or more concept, can mutual support be maintained?" I submit that one vs. one or more provides mutual support as a result of the following:

1. Support is gained through inherent mobility in single-airplane operations and 360° visual lookout capability.

2. Support is gained through the lack of predictability associated with single-airplane operations.

3. Support is enhanced by not having to execute relative to your leader. Execution relative to the enemy saves time and this is critical.

4. Support is gained by an attacker having options to pursue a specific foe or switch to another without having to verbally coordinate with another aircraft. (Diminished radio use is inherent in one vs. one or more tactics.)

5. Support is gained by not worrying about a wingman's position (such as in fighting wing). Present generation aircraft are capable of pulling so many G's that anyone attempting to fly fighting wing, as it is now defined, will never have a chance to look around.

6. The old "check six" role previously assigned to the fighting wingman is now performed by the F-4 backseater. In future single-plane fighters (F-15 and F-16) the "check six" role may be performed by external means, such as AWACS or GCI.

Under a system such as one vs. one or more, engaged friendly aircraft would require: (1) an excellent one vs. one airplane driver capable of measuring the difference between the time required to achieve a kill and the time when he will be endangered by an adversary; (2) minimized individual engagement time (no more than a specified amount of time concentrating on a particular bogey); and (3) sustained high energy levels.

Let's briefly address how one vs. one or more really works.

Typically, a two-ship formation is on patrol near the battle front or Forward Edge of the Battle Area (FEBA). AWACS detects a large number of enemy aircraft heading towards the front line and the commander commits the patrol to intercept. They are offensive. The first happening is a transformation from a defensive formation designed for optimum lookout (fluid-two) into an attack formation designed for maximum mobility and minimum exposure.

If not cleared to fire head-on, the two attackers should try to bring the enemy between them where both can turn in toward the enemy fighters. The object is to keep as many enemy as possible ahead of each fighter's wing line and sandwich them. (Certainly it would be ideal to sneak up on the enemy; however, they have GCI, too.)

Once engaged, each man fights one vs. more than one. (It would be ludicrous to say that if one friendly saw another friendly in trouble, he would not come to his aid.)

SUMMARY

One vs. one or more is one idea on how the United States Air Force may best utilize its tactical fighter resources. This discussion has centered on justifying the concept, with a small amount of employment considerations added. The patrol, initial reactions, organization, and terminal phases will be addressed later.

Finally, the Air Force must maintain flexibility in its tactical assessment. Predictable changes in enemy force structure alignment require that the fighter pilot reassess his present tactical position and look towards a major system amplification. One vs. one or more tactics and training would be an ideal amplification.

We should not reiterate air-to-air history and categorically state that because a system worked in the past, it will work next time. Now it is time to interpret history and anticipate our future employment tactics, and then train in those tactics. We must continually question, "Where should we go next?"

A COMPARISON OF "TEAM" AND "SINGLE-SHIP" APPROACHES TO AERIAL COMBAT

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Preface

The discussion contained in the following essay is something more than just an ordinary history of air-to-air combat. It is a systematic investigation of the problems which have confronted adversary aircrews in air-to-air combat, and of what those adversaries did to evolve tactical concepts as a basis for gaining a winning edge. Within this context, the author presents a balanced treatment of the strengths and weaknesses of "lone wolf" tactics, as well as of virtually all currently known team proposals for gaining this edge. In examining these air-to-air systems he shows that they all have weaknesses, or limitations, of one kind or another.

To overcome the various weaknesses of existing systems, Major Watts proposes an approach of his own design. But, as he eventually discovers, his system too exhibits significant limitations. Having reached this realization, Major Watts then shows that the proposal and counter-proposal of these so-called "superior" systems becomes an endless progression of alternatives designed to deal with one or more of the preceding systems. From here he concludes that the perfect system will forever elude us since, inevitably, the formal adoption of any such candidate leads to a rigidity which can be used as a basis for uncovering new limitations and, consequently, yet another system to deal with these "new" limitations.

In this way, Major Watts' historical investigation offers a warning to those who would attempt to present a standardized air-to-air combat system as an effective way of gaining a winning edge in all future conflicts. Put simply and in fighter pilot lingo this warning is: STAY UNPREDICTABLE!

Col. John R. Boyd (Ret.)
Lt. Col. Moody Suter

Author's Foreward

"If you can doubt at points where other people feel no impulse to doubt, then you are making progress."

CHANG-TSAI*

"In reality, reason has had a greater influence than fortune on the issue of the wars that have most influenced history. Creative thought has often counted for more than courage; for more, even, than gifted leadership."

B.H. LIDDELL HART**

"A deeper truth to which Foch and other disciples of Clausewitz did not penetrate fully is that in war every problem, and every principle, is a duality. Like a coin, it has two faces."

B.H. LIDDELL HART***

If past wars teach us anything at all, they teach us that in tactics, as in doctrine generally, final answers do not exist. So the next time you catch yourself beginning to act as if contemporary doctrine had everything pretty well sewed up, that is precisely the moment you need to start reassessing current practices from the ground up. To do anything else is to invite disaster.

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* B. H. Liddell Hart, Why Don't We Learn From History?, New York, Hawthorn Books, 1971, p. 26.

** Hart, Why Don't We Learn From History?, pp. 17-18.

*** B. H. Liddell Hart, Strategy, New York, Praeger Publishers, 1967 (second revised edition of the book first published in 1954), p. 343.

Section 1. Introduction

Since the latter stages of the First World War, "team" systems[1] have constituted the predominant approach to fighter-versus-fighter combat. Recently, however, a significant departure from this longstanding doctrinal preference has arisen. During the Mideast War of October 1973, Israeli Mirages and other fighter aircraft fought many engagements as single ships. Furthermore, the available evidence suggests that this divergence from traditional practice did not outwardly erode Israeli effectiveness in the air combat area. Although the Israeli fighters were often outnumbered by ratios as high as four-to-one, Israeli aircrews still managed to impose exchange-rates on the Arab air forces which were comparable to those achieved during the Six Day War of 1967.

Inevitably perhaps, this latest Israeli experience has been interpreted by some as arguing for a revival of "single-ship" tactics. So far as I am aware, the most comprehensive post-1973 exposition of this view is that set out by Captain Dave Smith in this (1975) article "One vs One or More"

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1 Over the years the tactical literature on air-to-air combat has been persistently plagued by terminological confusions. To guard against such confusions, I want to define some of the key terms I will be using in the course of this essay.

By a SYSTEM of air combat tactics I mean a comprehensive scheme for the active employment of one or more fighters in shooting down opposing aircraft. Any complete system for air-to-air contains at least three major elements: (1) a PATROL CONCEPT (or strategy)--that is, a plan, usually embodied in a patrol formation, for entering the air battle; (2) an ENGAGEMENT (or attack) CONCEPT--which is to say, a general strategy for conducting the actual fight (both offensively and defensively); and (3) a DISENGAGEMENT STRATEGY--namely some systematic approach to the problem of leaving the air battle. Examples of air combat systems are the Air Force's classic Fluid-Four System, the Navy's Loose Deuce System, and Captain Dave Smith's recent "one-vs-one or more" proposal (described in footnore 2)

In addition, I shall use the terms 'team' and 'single-ship' to distinguish two broad classes of air combat systems. By a TEAM approach I simply mean any tactical system whose engagement concept envisions two or more aircraft fighting in concert with one another. A SINGLE-SHIP approach then is any air-to-air system in which the fighters employing it operate autonomously throughout the fight. Fluid-Four and Loose Deuce are obvious examples of team systems. The "lone-wolf" approach favored by individualists like Albert Ball and Billy Bishop in World War One exemplify single-ship

Captain Smith's position in this thought-provoking piece is that the most effective engagement strategy our pilots could adopt, once engaged against superior numbers, is that embodied in the fundamentally "single-ship" approach he calls 'one-vs-one-or-more.'[2] My purpose in what follows will be to explore the central doctrinal issues raised by this radical claim.

The foremost question precipitated by Captain Smith's thesis, of course, whether his one-vs-one-or-more approach truly is superior to all team systems. I examine this issue in sections 2 through 6. In the final analysis, the conclusion reached by the end of Section 6 regarding the relative merits of "team" versus "single-ship" tactics only serves to generate a further question: Can "team" systems be sustained in all conceivable tactical environments? This problem is taken up in Section 7. Ultimately the line of inquiry it engenders leads--inexorably I would argue--to the realization that fundamentally unacceptable limitations are entailed by trying to go either exclusively with "team" systems, or exclusively with "single-ship". To avoid these limitations, I therefore propose a hybrid system for air-to-air, called 'two-vs-one-or-more,' which incorporates both "team" and single-ship" modes. But as we shall see, even this mixed approach is not without its limitations.

Section 2. Some Preliminary Reasons for Fighting "Single-Ship"

Why might you consider using a single-ship approach to air combat in lieu of any team system? At first glance, approaches like "one-vs-one-or-more" would appear to offer several decisive advantages over team strategies. After all, whenever two or more aircraft endeavor to fight together an an integral unit, they necessarily incur certain losses relative to the single ship in terms of mobility, flexibility, and the element of surprise. These losses are easy to illustrate.

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2 Captain Dave Smith, "One vs One Or More", USAF Fighter Weapons Review, Spring 1975, pp. 24-25. The engagement stategy of Captain Smith's one-vs-one-or-more systems is to have each friendly fighter operate autonomously during the engagement, fighting all adversaries at the same time. Consequently, I shall treat one-vs-one-or-more as a "single-ship" approach. Note, however, that the system is not entirely devoid of teamwork. As Captain Smith explains its operation, fighters employing one-vs-one-or-more would enter the engagement in pairs from a standard, line-abreast patrol formation. In addition, should either friendly get into serious trouble, the other would, if possible, help out (Ibid., p. 25).

First, in order to fight together at all, the team members must stay in reasonable proximity to one another during the engagement. In the past this requirement has usually been met with formations of some sort. But most formation arrangements are, of course, going to be less mobile than the single aircraft maneuvering autonomously. * Next, to some extent, flight members must execute any attacks they make relative to their teammates (rather than exclusively relative to the opponent). At the same time, the flight leader is compelled, at least in a classical team system like Blesse's Fluid-Four, to fly his machine at less than maximum performance if the rest of the flight is to keep up. Inevitably, both of these factors tend to make team systems less flexible than the single airplane. Finally, because the formation contains multiple aircraft, it is easier to acquire visually, all other things being equal, than a single ship. *Consequently the lone fighter will frequently have the advantage of spotting an opposing formation before any one in the flight sees him.

However, despite these obvious advantages of the single fighter, historically team systems have been favored by the overwhelming majority of combat pilots. This point naturally suggests that we need to examine the reasons for this longstanding preference. Presumably any serious advocate of one-vs-one-or-more must be able to show that the traditional reasons for preferring team systems are not compelling in the air combat arena of today.

Section 3. Defensive Considerations--The Traditional Case for Preferring Team Systems; the Early World War One Scout Pilots.

In the past the objection most often voiced against single-ship has been that pilots who consistently employed such tactics in the air combat arena seldom managed to survive over the long haul. The period usually cited in this regard encompasses roughly the first half of World War One.

In retrospect, this part of the First World War constituted the high noon of the individual in air-to-air combat. Single-ship tactics predominated almost universally, and scout pilots like Albert Ball (44 victories), Billy Bishop (72), and Georges Guynemer (53) became legendary as "lone wolf" hunters who ran up their high scores mainly by personal skill and courage.[3] But as the war progressed, the attrition rate among such individualists became awesome.[4] As a result, by the end of the second year of fighting, the preeminent doctrinal problem for combat leaders on both sides had come to be that of finding a way to enhance pilot survivability. The eventual remedy was found in the team.

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3 Edward H. Sims, The Aces Talk (originally published as Fighter Tactics and Strategy 1914-1970, New York, Ballantine, 1972, p. 23.)

4 Sims, The Aces Talk, pp. 23-24.

Systematic team tactics by an entire unit made their initial appearance when Oswald Boelcke's Jagdstaffel 2 first began practicing them in September of 1916.[5] Boelcke's innovation quickly proved successful: by the end of that same month his flyers, using the new approach, had destroyed 25 enemy aeroplanes at a loss of only three pilots.[6] In the wake of such successes, the team concept soon caught on not only within the German air service, but among those of the Allied nations as well.

The historical impetus, then, which originally gave rise to team systems stemmed from the high casualty rates reaped by "single-ship" approaches in the first half of World War One. Prodded by this harsh experience, the prevailing opinion came to be that the tactic of having one pilot fight alone was inordinately dangerous[7] and, by 1918, Bishop was the only top ace who was still regularly flying by himself.[8] (Interestingly, Bishop managed to survive the war even though he persisted in "lone wolf" tactics through the final year of fighting. This fact, however, is not incompatible with the overall trend away from single-ship evident by 1917. As various remarks in his 1918 book Winged Warfare make clear, Bishop had a keen awareness of the innate limitations of single-ship[9] and, apparently, was quite meticulous about observing them in the air.)

The objection to one-vs-one-or-more in this World War One combat experience from the Western Front should be obvious. Regardless of the theoretical gains achieved by single-ship systems in terms of mobility, flexibility, and surprise, if pilots employing such tactics tend to be shot down after a comparatively limited number of aerial encounters then, at least relative to the team, single-ship would not appear to be the superior approach.

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5 Group Captain John E. Johnson, Full Circle, New York, Ballantine, 1964, p. 46.

6 Johnson, Full Circle, p. 48.

7 Air Combat experience in both World War Two and MiG Alley was widely viewed as reconfirming this conclusion (See Sims, The Aces Talk, p. 107; also the comments on single-ship in Korea by Jim Robins in footnote 39)

8 Sims, The Aces Talk, p. 87

9 In The Aces Talk (on pages 87-91), Sims has a long quotation from Chapter 17 of Bishop's Winged Warfare. In it Bishop discusses several of the cardinal rules for staying alive as a single which I list in Section 8 (See page 75). By the time I ran across Bishop's formulation of these particular pilot rules-of-thumb for single-ship, I had already arrived at essentially the same strictures based on analysis of a much more recent conflict: the Arab-Israeli War of October 1973.

* The similarity of our conclusions here is not, I think, mere coincidence. Rather it would seem to indicate just how little the fundamental realities of fighter-versus-fighter combat have changed since the First World War.

In Captain Smith's "One vs One Or More", this point is countered with the suggestion that the high attrition among "lone wolf" pilots in the past " probably was not the result of an attack system failure, but rather, resulted from their extended praticipation in aerial warfare with its associated hazards."[10] Now without question this reply is ingenuous. Nevertheless, there is a real problem with it.

Consider, after all, how many individuals during the Second World War were able to survive a comparable (and, in many cases, substantially greater) exposure to the hazards of aerial combat than that which allegedly proved fatal to so many of the early scout pilots. In particular, look at the more successful Luftwaffe fighter pilots. Many of them survived " [redacted] service from 1939 until 1945."[11] Moreover, among their ranks were " no fewer than 103 " flyers credited with 100 or more aerial victories apiece during the Spanish Civil War and World War Two (including 15 with scores exceeding 200 kills).[12] Obviously men such as these--and especially those who scored all their victories on the western front[13] --survived prodigious doses of air-to-air combat. The Luftwaffe's Erich Hartmann (352 kills--the all time record), for instance, experienced over 800 engagements during the course of more than 1400 missions without being wounded (although de did crash land or

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10 Smith, "One vs One Or More," p. 23.

11 Julius R. Gaal, "The Luftwaffe's 'Kills'", Flying International Review, December 1965, Vol. 21, No. 4, p. 246. Set operational tours, rest periods, and battle fatigue were generally unknown in the Luftwaffe during World War Two (ibid).

12 Gaal, "The Luftwaffe's 'Kills,'" p. 243. For a complete breakout of the Luftwaffe pilots credited with 100 or more kills during World War Two and the Spanish Civil War see John W. R. Taylor, Michael J. H. Taylor, and David Mondey (editors), Air Facts and Feats, New York, Two Continents Publishing Group, 1974, pp. 109 & 114-115.

13 It took Josef Priller and Kurt Buehligen nearly five years to score 100 kills in the West against R.A.F. and U.S.A.A.F. pilots; Erich Hartmann, in contrast, amassed his 352 victories on the Russian front in only two-and-one-half-years (see the editorial comments on Gaal's article "The Luftwaffe's 'Kills,'" p. 243). These facts suggest that it was generally easier in Russia. Erich Rudorffer, who saw action on all three European fronts (48 kills in the West, 26 in Africa, 136 in Russia, and then 12 more in the West during the last days of the war with the Me-262 jet), agrees; in an interview with Edward H. Sims, he stated without reservation that "...it was always tougher in the West." (Sims, The Aces Talk, pp. 198&203).

bail out on many occasions).[14]

Now in light of World War One experience, the long-term durability of these higher scoring Luftwaffe aces in World War Two is a bit unexpected. How might it be explained? Undoubtedly, most of these German aces were superior airplane drivers. Also, every one of them surely survived a few missions at least more by blind luck than by personal skill or tactical expertise.[15] But, even taking such factors into account, I would still insist that there are far too many successful individuals here to square with Captain Smith's contention that the high attrition rates observed in the early days of World War One can be essentially explained by "too much combat." The records of Hartmann, Rudorffer, and no less than 101 others, when taken altogether, fundamentally belie such an interpretation

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14 Sims, The Aces Talk, pp. 232 & 237-38; Taylor, Taylor, & Mondey, Air Facts and Feats, pp. 101-102. Hartmann also told Sims that he was never hit by an opposing fighter in combat--only by flak and bomber fire (Sims, The Aces Talk, p. 238). This claim, however, is not apparently true. In a 1968 interview, Hartmann admitted to being shot down sometime in September of 1943 by a Yak 9 ("Erich Hartmann --An Interview with WW II's Greatest Fighter Ace," Wings, Vol. 5, No. 5, October 1975, p. 35). Also, in a 1974 interview with Captain Manfred Rietsch, he stated that on another occasion he avoided being shot down by some P-51s only by bailing out first. Still, overall Hartmann was incredibly successful in avoiding hostile fighters. Moreover, when opponents did get on his tail, his use of a negative "G" diving turn (as a "last ditch" escape maneuver) probably was, as Sims maintains, the principal reason why he was usually able to get away without being hit. (This maneuver is every bit as effective today. For instance, in May of 1972 LCdr. Ronald "Mugs" McKeown tried a negative G pushover of this sort to get a MiG-17 off his tail (Lou Drendel, ...And Kill MiGs, Warren, Michigan, Squadron/Signal Publications, 1974, p. 54). It not only got the 17 off his tail but created such an overshoot that he and his backseater (Lt. Jack Ensch) were then able to get a Sidewinder kill.)

15 The role of luck in aerial combat is difficult to assess. On the one hand, the more successful aces (in all wars) have tended to be cool-headed tacticians who carefully sized up their opponents and only engaged when the aerial conditions were in their favor. This thesis is a major conclusion of Sims' book The Aces Talk, and Erich Hartmann's comments on the importance of knowing when to fight, and when to avoid combat, are especially incisive (Sims, The Aces Talk, pp. 234-35; also "Erich Hartmann--An Interview with WW II's Greatest Fighter Ace," pp. 33 & 36). But, on the other hand, the choice of engaging or waiting for a better day is not always to be had. Thus, even the most prudent of pilots sometimes find themselves forced to fight under conditions they would prefer to avoid. A classic example of such a situation can be found in John C. Meyer's account of two kills which he got after being caught by Luftwaffe fighters while rolling down the runway for takeoff (Sims, The Aces Talk, pp. 209-210).

Of course this conclusion leaves us with something of a puzzle. If over-exposure to the dangers of aerial warfare cannot plausibly explain the fate which ultimately overtook so many of the "lone wolf" individualists in 1915 and 1916, certainly we would want to find one that does. Yet, at the same time, any serious candidate would also have to be compatible with the contrasting durability of the more successful German aces over two decades later. But what line of explanation might possibly satisfy both of these requirements?

The natural alternative to suggest at this juncture is, obviously, the team. It was conspicuously absent in the heyday of individualists like Ball and Guynemer while being widely, if not universally, used throughout World War Two. Unfortunately, however, simply pointing this fact out does not really explain much. In particular, it fails to provide any palpable indication as to the precise aspect of team tactics which, if the traditionally received opinion is correct, has generally enhanced pilot survivability relative to single-ship. Thus the problem to which we are now led is that of ferreting out any common features of the various team systems employed by the Luftwaffe which might account for the durability exhibited by its top fighter aces.

The system of team tactics perhaps most widely flown by the Luftwaffe in World War Two was that associated with the "finger-four" formation.[16] This tactical scheme was originally developed for the Me-109C during the Spanish Civil War by the German ace Werner Moelders (115 career kills including 68 in the West during World War Two[17]). Its cornerstone was a widely-spaced

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16 The term 'finger-four' is not German, but British. Up through the evacuation from Dunkirk, tight "vic" formations of three fighters were used by R.A.F. units as the basic tactical element for air-to-air (Johnson, Full Circle, p. 103). These formations, however, were wholly unsuited to combat and so, following Dunkirk, many R.A.F. squadrons dropped them for the "section" of four fighters arranged one behind the other in "trail" (Ibid., p. 124). While this change was a substantial improvement insofar as maneuverability was concerned, the Battle of Britain showed that the trail configuration did not provide the critical visual cross-coverage between aircraft available in the (roughly) line-abreast arrangement of the Luftwaffe's four-ship Schwarm. Thus, beginning in the spring of 1941, R.A.F. pilots such as Douglas Bader and 'Sailor' Malan began copying the German formation from the enemy units they had been flying against. According to Johnson, it was Bader who coined the term 'finger-four' (on the grounds that, in flight, the four fighters of the Schwarm were arranged like the four fingers of an outstretched hand --Ibid., p. 164).

17 Taylor, Taylor & Mondey, Air Facts and Feats, p. 115.

pair (or Rotte) of aircraft. That is, the two-ship team, composed of a leader and a wingman, made up the basic fighting unit for air-to-air in Moelders' system.[18] Furthermore, the consistent use of this fundamental unit--the pair--turns out to have been the one feature common to virtually every team system flown by the Luftwaffe throughout this era (as well as by the R.A.F. and the U.S.A.A.F. after the Battle of Britain[19]). While all manner of variations on the basic Finger-Four System saw the light of day at one time or another during World War Two,[20] actual practice in the Luftwaffe fighter wings was unanimous on one precept: never fight alone. Thus the enhanced survivability claimed historically for the team would, it appears, have to stem from some property of the basic two-ship Rotte (or "element"[21]). But what exactly is it about this "leader-wingman" combination which affords greater longevity to both team members than either would have operating alone? The answer, ultimately, is to be found in the function of the wingman.

What specifically was the wingman there to provide in the classic team

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18 Sims, The Aces Talk, p. 105. For a discussion of why the two-ship element appears theoretically superior to the three-ship element, see Captain John R. Boyd, Aerial Attack Study, Fighter Weapons School Publication 50-10-6C, 1960, pp. 115-116.

19 For a comprehensive account of the evolution of German Rotte and Schwarm tactics, as well as of their subsequent adoption by the R.A.F. and U.S.A.A.F., see Alfred Price, World War II Fighter Conflict, London, Macdonald & Jane's, 1975, pp. 131-150.

20 Kurt Buehligen, for instance, preferred a strict line-abreast configuration to the standard finger-four in which the second, third, and fourth aircraft were all positioned somewhat aft of the flight leader (Sims, The Aces Talk, p. 154). Another variation was the eight-ship version of Moelders' system widely employed by American fighter units in Europe (Ibid., pp. 192-193).

21 U.S.A.A.F. pilots introduced the term 'element' for the leader-wingman pair during the Second World War (Sims, The Aces Talk, p. 136).

systems (Finger-Four and Fluid-Four [22])? On this point the tactical literature exhibits virtual unanimity. As the American ace John C. Meyer expressed it in 1944: "Mainly it's my wingman's eyes that I want. One man cannot see enough."[23] Here Meyer was referring, of course, to the wingman in the eight-ship version of the Finger-Four System favored by fighter units of the American Eighth Air Force over Germany in 1944 and 1945. But a decade later, in the definitive exposition of the Fluid-Four System written immediately after the Korean War, (Then Major) Frederick C. Blesse (10 kills in MiG Alley) explicated the leader-wingman arrangement on exactly the same grounds. The wingman's "... primary purpose in being there," he wrote in "No Guts, No Glory," is that, "... of supplying the eyes to the rear for the lead aircraft."[24] Thus the rationale behind the long-standing preference for team systems over a single-ship would appear to have been nothing more than a built-in limitation of the airplane driver.

To be utterly explicit, the fighter pilot, like everyone else, comes

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22 The Air Force's Fluid-Four System was developed during the Korean War for the F-86 (See Sims, The Aces Talk, p. 253 for Frank Gabreski's account). However, the original (Blesse) version of this system was a direct descendant of Moelders' Finger-Four. In fact, the two systems are indistinguishable insofar as their basic patrol and engagement concepts are concerned. Both employ a spread, roughly line-abreast patrol formation for purposes of mutual support and visual cross-coverage, and both use a "single attack" engagement strategy (hereafter termed 'shooter-cover') in which the flight leader is the attacker and the rest of the flight is there simply to cover and support that one attack. (For a discussion of subsequent variants of Blesse's classical Fluid-Four, see footnote 83).

23 Major General W. E. Kepner, The Long Reach - Deep Fighter Escort Tactics, VIII Fighter Command, 29 May 1944, p. 39. (The U.S.A.F. Academy library has one copy of this manual; it contains accounts of World War Two fighter tactics by 25 American combat pilots including Walker M. Mahurin, Hubert Zemke, David C. Schilling, John C. Meyer, and George E. Preddy). Meyer was credited with 24 air-to-air kills in western Europe during World War Two (Gene Gurney, Five Down and Glory, New York, G.P. Putnam, 1958, p. 217). If you add to this figure Meyer's 13 air-to-ground kills, he becomes the leading American scorer in the West (ibid.). Subsequently, in MiG Alley, Meyer gained two more victories (ibid., p. 253).

24 Major Frederick C. Blesse, "No Guts, No Glory," USAF Fighter Weapons Review, Spring 1973, p. 4. This reference is to a 1973 reprint of the original declassified version of Blesse's manual (which had been printed earlier in the March 1955 issue of the Fighter Weapons Newsletter). Also see (then Captain) John R. Boyd's "Air Combat Maneuvering," Fighter Weapons Newsletter, June 1957, pp. 5-6. Like Meyer and Blesse, Boyd also justified the wingman on the basis of the extra eyes he provided. However, note that in Boyd's case this view was based on reasons quite apart from the relative value of Blesse's version of Fluid-Four in comparison with other aerial attack systems. Even as early as 1957, Boyd's approach to air combat began to diverge substantially from Blesse's. (See footnotes 31 & 83), and, in his 1960 Aerial Attack Study, he reached a radically different perspective on the subject (see footnotes 38 & 117). Specifically, Boyd introduced a maneuver/counter-maneuver concept and, out of this idea, evolved his "fluid separation" concept--a notion which articulated a much more flexible approach to team mutual support (within as well as between elements) than Blesse's.

equipped with but a single set of forward-mounted eyeballs, and, so long as he has those eyeballs reiveted (for instance) on the opponent he is trying to shoot down, he cannot actively use them to clear his ever-vulnerable rear quadrant for other adversaries.

The traditional case for preferring team systems, then, apparently comes to this: IN THE PAST, EVEN SEASONED PILOTS HAVE GENERALLY FOUND IT SO DIFFICULT TO SEE EVERYTHING IN THE SKY AROUND THEM THAT FEW HAVE BEEN ABLE TO SURVIVE, AT LEAST FOR EXTENDED PERIODS OF COMBAT, USING SINGLE-SHIP TACTICS. Does this interpretation, however, resolve our earlier puzzle? In particular, does this reconstruction of the orthodox case against single-ship reconcile the high attrition among the "lone wolf" individualists in World War One with the contrasting longevity exhibited by the top German aces in World War Two? I think that it does. On my account, what proved fatal to even the more skilled among the original practitioners of single-ship would not be, in most cases, overexposure to the hazards of aerial warfare but, instead, the attacker who managed to reach an effective gun-firing position prior to being seen. Moreover, this explanation is thoroughly compatible with the known longevity of combat leaders like Erich Hartmann in World War Two. Simply put, the wingman who could cover six o'clock while the leader was absorbed in his attack provided a quantum jump in defensive capability over the single pilot fighting alone.

Captain Smith's attempt to support one-vs-one-or-more by reinterpreting the World War One experience long taken to argue in favor of team approaches does not therefore, seem historically tenable. Further, the reasoning which leads to this assessment suggests an even more damaging objection to the basic thesis of "One vs One Or More." For if the problem with single-ship is that the "lone wolf" pilot cannot always give adequate visual attention to every part of his surrounding visual sphere, then the more unfavorable the numerical odds against him in a given engagement, the harder it will be for him just to keep track of all his adversaries (unless they maneuver together in no more than one or two fairly tight formations). Moreover, if the single pilot does lose one of his opponents, then his chances of simply surviving the encounter--to say nothing of scoring any kills--are immediately and drastically reduced. Thus the more heavily outnumbered you find yourself, the less viable single-ship would appear to be from the crucial standpoint of survivability.

Nevertheless, being heavily outnumbered is precisely the situation in which Captain Smith contends that single-ship is inherently superior to any team approach. For he does not insist that one-vs-one-or-more is better in all cases. Given, say, two friendly fighters opposed by a lone enemy machine, he agrees that current "... two vs one ..." team tactics (or "Fluid-Two"--see footnote 43) would be best.[25] Only against odds like four-or five-to-one in favor of the other side does he maintain that one-vs-one-or-more offers most effective way to fight. Now indeed, you can think of a few rare situations in which the single fighter might enjoy a tenuous (though potentially devastating) edge over superior numbers of opponents. For example, if the lone pilot's aircraft had a visual profile closely resembling that of the enemy machines, he could shoot at anything in the sky whereas the bogeys would have to worry about hitting their own comrades by mistake. But, other than in these unusual kinds of situations, the overall vulnerability of "lone wolf" pilots to being surprised from the rear argues, that contrary to Captain Smith's position, the against odds one-vs-one-or-more is generally going to be the LEAST-rather than the most-effective way to fight.

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25 Smith, "One vs One Or More," p. 24. Since Captain Smith directed his proposal primarily towards situations in which the friendly fighters are substantially outnumbered, 'one-vs-many' would perhaps have been a more appropriate label for his system than 'one-vs-one-or-more.'

Section 4. Defensive Considerations -- The Defensive Case for Team Tactics; Approaches; the American Success in MiG Alley

The classical objection to single-ship tactics brought out in the preceding section was based on historical analysis. However, if the major advantage of the team stems, as I have suggested, from the basic inability of any one pilot to be constantly aware of everything in the sky surrounding his airplane, then the traditional case against single-ship can surely be restated on a purely theoretical level. Doing so will be the principal concern of the present section.

However, before I actually recast the argument in theoretical terms, I want first to examine some of the conclusions commonly drawn from the air-to-air combat which took place during the Korean War. There are two main reasons for this digression. First, the Korean War period turns out to be the one other era, besides World War One, which Captain Smith tried to draw upon in order to lend historical credibility to his one-vs-one-or-more proposal. Second, the discussion entailed in trying to assess Captain Smith's reading of events in MiG Alley also brings out the importance of clearly separating historical interpretation from essentially conceptual considerations in the discussion of tactical doctrine.

The customary assessment of the outcome in MiG Alley has been that the American pilots won a rather lopsided victory over their Communist adversaries, and, in terms of kill-ratios and "box scores", this conclusion certainly seems justified.[26] For example, the F-86 Sabre, which accounted for the vast majority of all American kills in Korea, recorded an exchange rate of slightly better than 10-1 over its principal adversary, the Russion-built MIG-15.[27]

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26 The overall Air Force exchange rate during the Korean War was 6.2-to-1 (Armed Forces Journal International, May 1974, p. 30). This ratio is based on 918 confirmed kills and 147 losses; it includes a few kills by land-based Marine aircraft and ignores some 175 "probables" (Ibid.). As a statistic it is even more impressive when contrasted with Air Force kill-ratios before and after Korea. For instance, against the Luftwaffe during World War Two U.S. Army Air Force pilots just managed to do slightly better than break even by downing 13,623 German planes while losing 11,687 for a kill-ratio of 1.17-to-1 (Ibid.). In Southeast Asia, from June 1965 through January 1973, the Air Force figure was only 2.12-to-1 based on 127 kills and 60 losses (Ibid., p. 38). (Note: this last statistic omits the two MIG-21s credited to B-52 tail gunners during Linebacker 2.)

27 Specifically, the F-86 downed 792 MIG-15s while the Russian jet accounted for only 78 Sabres ("USAF Studies Re-examine the 'Ace Syndrome,'" Aviation Week and Space Technology, 26 June 1972, p. 151). In all, Air Force, Navy, and Marine pilots shot down 941 enemy planes during the Korean conflict (Armed Forces Journal International, May 1974, p. 30). Of these 941 confirmed kills, 807 were jets (Taylor, Taylor, & Mondey, Air Facts and Feats, p. 118). Hence, if these figures are correct, the Sabre accounted for all but 15 of the MIG kills in Korea.

This result was achieved, moreover, even though the Sabres were heavily outnumbered by the MIGs during most of the fighting.[28] So, statistically at least, the Americans clearly did dominate the air combat arena during the Korean conflict.

In light of this fact the question then arises: Why did the U.S. pilots do so well? Their success cannot, I think, be accounted for on the grounds that the Sabre predominated because of being overwhelmingly superior to the MIG-15 as a fighting machine. Granted, the F-86 did enjoy specific areas of modest advantage over the MIG.[29] However, the Russian machine was not without its own areas of superiority. Thus, overall, the Sabre does not seem to have had the kind of insurmountable edge which might adequately explain its margin of victory. Hence, if the disproportionate exchange rate during the Korean War is to be accounted for at all, it would apparently have to be done on the basis of one of the following: differences in the overall quality of the opposing pilots, differences in the effectiveness of their tactics, or else differences in some combination of both of these factors.

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28 In April of 1952 the two U.S.A.F. Sabre wings then in Korea, the 4th and the 51st, were reported to have a combined strength of only 150 F-86s; in contrast, from 700 to 900 MiG-15s were estimated (at the time) to be based north of the Yalu River (Robert Hotz, "Can We Win in MIG Alley?", Air Force Magazine, April 1952, p. 24). James Jabara, the first American jet ace, subsequently stated that "It was common to encounter 150 or more MiG-15s twice a day against no more than thirty-two Sabres" (Lt. Col. James Jabara, "A Fighter Pilot's Airplane," Air Force Magazine, August 1960, p. 61).

29 The Sabre had slight advantages in range, diving ability, and ruggedness (Jabara, "A Fighter Pilot's Airplane," p. 60). It also had better controllability (due to hydraulically boosted flight controls) and superior cockpit visibility. In addition, with the advent of the F-86E, the Sabre gained a further advantage: a radar computing gunsight (Johnson, Full Circle, p. 265). However, the MiG-15 had at least one big area of superiority over the Sabre. Above 30,000 feet it could easily out-turn, out-climb, and out-run the early "A" model of the American machine (Robert F. Futrell, U.S.A.F. Operations in the Korean Conflict-1 November 1950-30 June 1952, U.S.A.F. Historical Study No. 72, Department of the Air Force, 1 July 1955, p. 110). Moreover, this advantage persisted to the end of the war. Even with its improved engine, the "F" model of the Sabre could only raise this altitude figure to 35,000 (Jabara, "A Fighter Pilot's Airplane," p. 60). As a result, the MiG pilots could generally count on being able to enter the combat arena with an altitude advantage over the Sabres. This gave them the option of engaging or not engaging. Also, when the MIGs did choose to come down and fight, they could initiate the engagement with a tactical advantage.

By and large, the overriding tendency within the Air Force fighter community has been to ascribe significance not only to the skill and aggressiveness of the Sabre pilots as a group, but to their tactical doctrine as well. As far back as 1953, the view was expressed that most of the Communist pilots in Korea were unable to exploit anywhere near the full potential of the MIG-15 aircraft.[30] Yet, at the same time, the Air Force's Tactical Air Command (T.A.C.) also came to insist that the outcome in MIG Alley demonstrated once and for all the superiority of its particular team approach to aerial combat over all the known alternatives.[31]

But if Captain Smith is to show that the Korean War does not undercut one-vs-one-or-more as an attack concept, he must dispute the second of these claims, and, in "One vs One Or More," that is precisely what he does. Team tactics per se, he argues, did not play any great role in determining the outcome in MIG Alley. Instead, he attributes the lopsided kill ratio wholly to the superior "pilot acumen" of the American flyers. "Simply stated," he says, "our men beat their men."[32] Now this assessment is by no means entirely unfair.

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30 Lt Joseph G. Albright, "Two Years of MiG Activity," Air University Quarterly Review, Spring 1953, p. 89. Albright wrote this article while assigned to Headquarters, Far East Air Forces (Ibid.). His overall assessment of the average MIG pilot encountered in Korea is still accepted today (Taylor, Taylor & Mondey, Air Facts and Feats, p. 118).

31 The Air Force approach to fighter combat was billed in 1957 by the U.S.A.F. Fighter Weapons School as being the product "... of experience gained in WW II, Korea, and Air Combat Maneuvering training by Combat Crew and Fighter Weapons instructors at Nellis Air Force Base, Nevada." (see the editorial forward to John R. Boyd's "Air Combat Maneuvering," Fighter Weapons Newsletter, June 1957, p. 3). The further claim that the considerable body of air-to-air experience underlying the Air Force approach (which centered around the four-ship flight) clearly proved it superior to all others was defended by the Aerial Attack Section at Nellis as late as 1971 (see in particular "... anything else is rubbish," USAF Fighter Weapons Review, Summer 1971, pp. 33-34). (Note, however, that enthusiasm for the four-ship flight was not universal. For example, Boyd wrote in 1957, regarding T.A.C.'s insistence upon the four-ship as the "basic maneuvering formation" for air-to-air, that: "In the past and to a great extent at the present, too few fighter pilots have a working concept of Air Combat Maneuvering. Instead they substitute numbers for skill. If the day is reached where every fighter pilot can be trained to be a qualified tactician, this strength in numbers routine might not be necessary."--Boyd, "Air Combat Maneuvering," p. 26.)

32 Smith, "One vs One Or More," p. 24.

The evidence does support the contention that those statistically rare Korean War F-86 drivers who did enjoy repeated encounters with MIGs while flying in lead positions were, in most cases, highly experienced fighter pilots.[33] (Indeed, a number of them had prior air-to-air kills from the Second World War.[34]) Similarly, on the other side of the fence, all the available information suggests that the typical MIG pilot who fell to the Sabres was relatively green, both in fighter combat generally and the MIG-15 in particular.[35] So there seems no question but that Captain Smith is on solid ground in maintaining that our polots were, on the whole, superior to those they shot down in MIG Alley. Nevertheless, does this truly warrant the further contention that team tactics made no real contribution to the Sabre's better than 10-to-1 kill ratio over the MIG-15?

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33 Of the 520 Sabre pilots who could be definitely identified in 1955 as having flown combat in Korea with the 4th Fighter Interceptor Wing (between 14 December 1950 and 27 July 1953), only 69 (or 13.3%) experienced 15 or more MIG encounters as flight or element leaders (Dennis Strawbridge and Nannette Kahn, "Fighter Pilot Performance in Korea," IAWR Report 55-10, 15 November 1955, pp. 9 & 19). Thus, relatively few F-86 drivers in the 4th Wing had any appreciable chance of becoming aces. Moreover, those pilots who were statistically "rich" in MIG encounters were also wealthy in other areas. Not only did they usually fly as leaders rather than as wingmen, but they were older, higher in rank, and had more flying experinece --"...particularly with jets and in fighter combat" (Ibid., pp. 33 & 35). As for the other Sabre Wings which served in Korea, I have found no evidence to suggest that their flight and element leaders were, all in all significantly less skilled than those in the 4th, the 51st, 18th and the 8th.

34 [illegible] MIG kill on 20 May 1951, it was reported that there were at least eleven other World War Two fighter aces flying Sabres with the 4th F.I.W. (Captain James Jabara, "We Fly MIG Alley," Air Force Magazine, June 1951, p. 65). Among them was (then Colonel) John C. Meyer.

35 Analysis of MIG operations during the Korean War consistently indicated that most of the enemy activity was aimed at training green pilots in air combat with the new jets (see, for example, Albright, "Two Years of MIG Activity," p. 83; also Hotz, "Can We Win in MIG Alley?", pp. 27 & 60). This conclusion is further borne out, I think, by the fact that the first batch of MIG-15s delivered to the Chinese Communists did not arrive until March 1951 (Niu Sien-chong, NATO's Fifteen Nations, Vol. XVII, Aug-Sept 1972, p. 70). Thus, when the MIGs made their initial appearance in November of 1950, they were almost certainly manned by Russian or European satellite pilots who subsequently acted as instructors for the Chinese flyers (Futrell, U.S.A.F. Operations in the Korean Conflict--1 November 1950-30 June 1952, p. 107). Moreover, since it was generally conceded that these MiG instructor pilots could maneuver with the best of the United Nations flyers, most of the kills amassed by the F-86 were probably made against relatively low time, inexperienced adversaries (Albright, "Two Years of MIG Activity," p.89).

I cannot see that it does. Why not? Simply because team tactics, as manifested in the Fluid-Four System, constituted the prevailing--indeed, from a conceptual standpoint, the ONLY--approach to aerial combat used by Air Force Sabre units during the Korean conflict. Granted, there were occasions when flight members became separated and had to fight as singles (see footnote 39). Still, the point is that no large, or even discernible body of single-ship air combat experience from MIG Alley exists whose results can be compared with those produced by Blesse's system and, lacking such data, I would maintain that you cannot legitimately conclude that team tactics played absolutely no substantive role in the American success.

Of course this conclusion leaves us in something of a quandary. On the one hand we are confronted with two incompatible theses regarding the role team tactics played in MIG Alley. Yet, on the other hand, we lack any indisputably compelling basis for deciding between them. Thus, so long as the discussion remains where it is, no resolution of the question at issue appears possible. But, as might be suspected, the discussion need not remain locked on a strictly historical level. Instead, you can go on to separate the theoretical advantages (or disadvantages) of any air combat system relative to another from the questions which invariably arise as to their impact in real-world situations. This decoupling of theory from reality, while subject to obvious risks, is sometimes helpful--at least for purposes of discussion. The reason is that although questions of application tend, as in the present case, to be endlessly debatable, theoretical issues considered in isolation are often susceptible to reasonably clearcut resolution.

By way of illustrating this last point, I will now set out the theoretical argument for preferring team approaches to single-ship. *The entire matter turns on the straightforward observation that, defensively speaking, single-ship is a significantly weaker approach (in an arena, it must be remembered, that is notoriously hard on those who lose). The basis for this judgment has already been suggested. To reiterate what was said in Section 3: *in the air combat arena it is virtually axiomatic that the opponent you failed to see will be the one who gets to you, and it is difficult-to-impossible for one man to always see every attacker.

But even conceding this theoretical liability of single-ship in principle, could you not nevertheless object that it neither was, nor ever has been, all that serious in the real world? I do not think so. To begin to see why, consider Erich Hartmann again. *In reflecting upon his personal experience in the air combat arena, he has emphasized that in better than 80% of his 352 kills, he was able to reach a firing position before the opponent perceptibly reacted.[36] In other words, most of his victims probably were not aware they were being attacked until actually fired upon.

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36 This aspect of Harmann's record was first brought to my attention in June of 1975 by (Marine) Captain Manfred Rietsch. His source was firsthand: as a staff-member of the Navy's "TOPGUN" Fighter Weapons School, he had traveled to Germany the year before and interviewed Hartmann about his flying experience on the Russian front in World War Two.

Still, is Hartmann's extensive personal experience at all representative of air-to-air combat generally? It certainly appears to be. Look, for example, at this statement from a manual on deep fighter escort tactics published by the U.S. Eighth Air Force in May of 1944. "... 90 percent of all fighters shot down never say the guy who hit them."[37] * Nor was it appreciably different over North Vietnam. *In astonishing correlation to World War Two experience, the vast majority of the 75 American aircrews downed by MIGs, from 1965 through 1973, either had their airplanes hit before they realized they were under attack, or else did not see the attacker until it was too late (see footnote 85).

Furthermore, there seems every reason to suppose that this pattern will persist for the foreseeable future. Among other things it is not all likely, due to fiscal constraints coupled with our tendency to prefer sophisticated weapons systems, that the United States will anywhere approach being able to match, for instance, the Warsaw Pact nations plane for plane in the air combat arena during the coming decade. Even in conjunction with our N.A.T.O. allies we expect to be heavily outnumbered. Hence, at least in the N.A.T.O. environment, seeing every opponent will probably be every bit as difficult and critical as it proved in Southeast Asia.

Defensively then, the advantage of the team over single-ship lies in the superior lookout capability inherent in extra sets of eyes. And while this theoretical result does not perhaps completely resolve the issue of the precise role played by team tactics in Korea, it does allow a more conclusive judgment regarding Captain Smith's position on the matter than was possible on strictly historical grounds. For if, as Captain Smith insists, team tactics per se were of no significance whatsoever, then it follows that neither the eyes of the covering element in the four-ship flight, nor of the wingmen within the two-ship element, were ever effective in preventing any F-86 from being shot down. But surely this implication is a bit hard to accept (even in light of the stock

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37 Kepner, The Long Reach - Deep Fighter Escort Tactics, p.10. This particular statement was written by Lt. Col. Mark E. Hubbard who, at the time, was flying P-38s with the 20th Fighter Group. The 20th was one of 15 fighter groups which served in the U.S. Eighth Air Force during World War Two (Johnson, Full Circle, p. 234). The collective air-to-air experience amassed within these units appears to have been extensive. The top-scoring fighter group in the Eighth Air Force, the 4th, claimed 583 1/2 air-to-air kills (plus another 469 enemy aircraft destroyed air-to-ground) for the loss of only 241 pilots (Gene B. Stafford & William N. Hess, Aces of the Eighth, Warren, Michigan, Squadron/Signal Publications, 1973, p. 8). Hubbard was by no means the only American fighter leader in the Eighth to stress the critical importance of seeing the enemy to survival. Among others Walker M. Mahurin (20.75 kills), Hubert Zemke (17.75), R. S. Johnson (27), and Duane W. Beeson (17.33) all emphasized this same basic point (Kepner, The Long Reach-Deep Fighter Escort Tactics, pp. 24,33,42, & 71).

difficulties associated with mutual support in classical Fluid-Four[38]. For besides its extreme theoretical implausibility, the official Air Force history of air operations in Korea through mid-1952 suggests exactly the opposite view, as the following excerpt makes clear.

> When enemy aircraft were sighted, the Sabre leader had to give his full attention to keeping them in sight; for the leader to divert his attention for an instant meant in most cases that the enemy would be lost from view. Under these conditions the wingman's duty became even more important, since he had to do all the covering toward the rear.[39]

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38 There were two main problems with mutual support in Blesse's system as it was flown in MIG Alley. The first had to do with flight integrity. The general experience during the Korean War was that even when the Sabres entered the engagement with a full four-ship flight, it was seldom possible to sustain support between the elements for very long (Colonel Harrison R. Thyng, "Air-to-Air Combat in Korea," Air University Quarterly Review, Summer 1953, p. 41; Peter Mersky, "Flying the F-86 in Korea," Wings, Vol. 5, No. 5, October 1975, p. 24; Blesse, "No Guts, No Glory", p. 15). Thus, although the Sabres usually patrolled in four-ship flights, most of the actual fighting was done in two-ship elements.

The other problem concerned the lookout capability of the "fighting wingman" within the two-ship element. In theory the wingman was there to cover six for his element. However, the physical realities of classical "fighting wing" are such that anytime the leader approaches maximum performance, the wingman is forced to devote so much of his attention to maintaining position that he cannot provide any appreciable rearward visual coverage, either for himself or his element leader (Major Donald L. Gish, "F-4 Air-to-Air Training," USAF Fighter Weapons Review, Fall 1975, p. 4; Captain A. Lee Harrell, letter captioned "F-4 Air-to-Air Training," USAF Fighter Weapons Review, Spring 1976, p. 35). (For the definitive exposition of CLASSICAL "fighting wing" see Blesse, "No Guts, No Glory," p. 6. Note that in terms of the range of maneuver permitted the wingman, Blesse's version is considerably more restricted than that given by Boyd in 1960-see Boyd, Aerial Attack Study, pp. 115-17, 121-22, & 123.)

39 Futrell, U.S.A.F. Operations in the Korean Conflict-1 November 1950-30 June 1952, p. 113. In this same vein, the veteran Sabre pilot Jim Robins has stated (based on his experiences in MIG Alley):

> In general, we were briefed to get our nose down and get out of the area anytime we became a "single". People who did not adhere to his principle were very fortunate not to be shot down. Even experienced pilots who attempted to tangle with the MIGs as a single were not successful and, in fact, most of the people who were repatriated toward the end of the war, were guys who had inadvertently gotten themselves into this single ship situation. (Mersky, "Flying the F-86 in Korea," p. 24.)

Hence, it appears most unlikely that Captain Smith's one-sided reading of events in MIG Alley could be right.

Where then does this assessment lead us? Looking back over the discussion to this point, I think it is fair to conclude that Captain Smith's revisionist interpretations of air combat experience during the Korean conflict and the early days of World War One simply do not hold up under close scrutiny. His explanation of the high attrition rates among the early scout pilots, once again, could be sustained only if one turned a blind eye to the combat records of individuals like Hartmann and Rudorffer during World War Two. As for Korea, it is highly unlikely, as we just saw, that team tactics played no part whatsoever in the outcome there. Thus, insofar as Captain Smith's comments on air-to-air experience during these two periods were intended as indirect arguments in support of one-vs-one-or-more ("indirect" in the sense of refuting the customary interpretations long taken to argue in favor of the team), I cannot see that they make much of a case for the superiority of single-ship over team systems.

*Moreover, the historical analysis underlying this conclusion has, at the same time, brought to the fore a major theoretical weakness in one-vs-one-or-more type approaches: specifically that, defensively speaking, they are a risky way to fight in comparison with team systems. Significantly, nowhere in "One vs One Or More" is this point ever explicitly denied; indeed, it even appears possible to argue that Captain Smith tacitly accepts it. Consider, after all, the concern manifested in his article over finding ways to cover and protect the lone pilot's six o'clock. Captain Smith goes to some lengths to suggest ways in which the equivalent of team mutual support can be achieved when fighting alone. *In particular he mentions warnings from friendly radar systems, sticking as much as possible to unpredictable flight paths, and (in two-place fighters) the backseater.[40] But why even bother with this problem unless you think that single-ship is inferior to team approaches defensively? My suspicion, therefore, is that Captain Smith's claim for the efficacy of one-vs-one-or-more was never intended to go beyond a purely offensive context (and his repeated use of the term 'attack concept' would seem to reinforce this suspicion.)

Have I then actually refuted Captain Smith's one-vs-one-or-more concept? Of course not. All that has been refuted is the proposition, perhaps not even intended by Captain Smith, that single-ship systems are DEFENSIVELY better than team approaches. Now admittedly, in an era of fiscal austerity this result makes it easy to argue against one-vs-one-or-more on the grounds that we simply cannot afford to adopt air-to-air tactics which are likely to incur high loss rates. (Even with the comparatively "cheap" F-16, the fly-away-cost per copy is already estimated in excess of $4 million. Hence, for the immediate future at least, our tactical fighter units cannot reasonably expect to have available the relatively unlimited supplies of aircraft (and pilots) that were common, for instance, during the final years of World War Two.) Nevertheless, nothing that has been said thus far can be validly construed as "refuting" any single-ship system as a conceptual approach to air combat. As a matter of fact, from a general doctrinal perspective I would argue that the word 'refute' is altogether out of place here. Why? Because the conclusion that has been reached is a purely theoretical one. Consequently, although single-ship certainly does appear to have a significant-and hence potentially costly-defensive weakness, this fact does not establish that in actual application no ways can be found to compensate for this liability.

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40 Smith, "One vs One Or More," p. 25.

Section 5. Offensive Considerations

Having assessed one-vs-one-or-more relative to the team from a defensive standpoint, I turn next to an offensive comparison of these two divergent approaches to aerial combat. I will begin by looking at the thought-experiment given in "One vs One Or More" to suggest that the single aircraft fighting alone has the offensive edge.

The experiment opens with the question. "How many times has the 'Red Baron' sneaked into a four-ship formation and fired his missiles and guns before being seen?"[41] In this way a scenario is introduced which most pilots have seen at one time or another and, considered as a hypothetical situation for purposes of theoretical analysis, there is nothing particularly objectionable about it. As Captain Smith suggests, it points out two things. First, if a lone attacker is able to get a good set-up on a four-ship flight (by GCI or whatever means), then, even though the flight is spread line-abreast in a defensively sound patrol formation, the single ship will very likely be able to achieve a quick kill on one--and maybe even on two-- members of the flight before they can react. Second, the initial edge inherent in the lone attacker's set-up will (perhaps) be further enhanced by virtue of the fact that, as a single, he will be harder to acquire visually than the four-ship flight. (I append the word 'perhaps' here for a couple of reasons. You would be inclined to think that the flight's greater visual profile would be somewhat offset by all the extra eyes it contains. Also, with the four-ship in a good combat spread, the visual signatures of the type aircraft involved in the encounter will be far more critical in determining which side gets the firs "tallyho" than the presence of three more airplanes in the flight.)

But now a most puzzling transition occurs. The very next thing said by Captain Smith is that the airplanes in the flight were "...easy to shoot down" because "... formation size limited their in-flight mobility."[42] Did our wiley Red Baron then manage to down all four of the planes in the flight on just one pass? And, in any case, I would have thought that the members of the flight he did get--however many they are presumed to be--were easy to shoot down principally because of the good set-up.

Of these two objections, it is the second which reveals the logical gap in Captain Smith's reasoning. Consider after all what would follow, by the same line of argument, if the hypothetical scenario had been reversed--that is, if the four-ship flight had gotten the good set-up in our Red Baron's six o'clock. Then, surely, the flight would have had a similar chance of bagging the Baron before he could react. Would we, however, want to accept this as establishing that the single fighter's in-flight mobility is limited relative to the four-ship formation's? Presumably not, and for the simple reason that there is no ready connection between a scenario whose outcome turns fundamentally on the element of surprise and the doctrinal issue of comparative mobility between formations and single aircraft. Since the thought-experiment did not involve any maneuvering to speak of, it cannot validly serve as a basis for drawing conclusions about relative mobility.

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41 Smith, "One vs One Or More," p. 25.
42 Smith, "One vs One or More," p. 25

What then ought to be said about Captain Smith's thought-experiment? Perhaps all that he really intended with his "Red Baron" scenario was to highlight the team's theoretical losses in terms of mobility (and, perhaps, flexibility as well). This point is, of course, a sound one. As I emphasized when I discussed the advantages of single-ship in Section 2, formation arrangements plainly do make genuine concessions in these areas relative to the single fighter. But can you immediately leap from these outward advantages to the conclusion that one-vs-one-or-more is offensively superior to any team system? I do not think that you can--not at least without ignoring one whole side of the issue.

That other side of the issue, which Captain Smith seems predisposed to overlook, is reflected in the following question. To what extent is the degradation of mobility and flexibility incurred with any multi-aircraft approach offset by the team's potential for mutual support (in the sense of coordinated maneuvering and attacks)? Historically, the opinion that the gains to be derived from offensive teamwork generally outweigh the sacrifices entailed has enjoyed a considerable following since World War One. Indeed, doctrinally it has constituted a second fundamental rationale behind the longstanding preference for team systems. (The companion notion, in other words, to the realization that no one set of pilot eyes can always see everything in the air combat arena is that the transition from single-ship to a flight of two (or four), while decreasing mobility and flexibility, also creates the opportunity to gang-up on any adversary fighting alone.) The theoretical issue then, in comparing the offensive capabilities of the team with those of the "lone wolf", is whether the net gains in teamwork made possible by having two or more airplanes fight together are worth the losses necessitated with respect to unlimited mobility and flexibility. And, as the following scenario makes clear, the proposition that the single fighter must come out ahead when the trade-offs are carefully weighed is not at all self-evident.

Consider a pair of slatted F-4Es making a head-on identification pass on our lone "Red Baron" in his MIG-21MF. Neither side, let us assume, gets off any ordnance during the "ID" pass, although each does acquire the other visually. Maneuvering then commences on both sides with the F-4s attempting to take advantage of their greater numbers through current Fluid-Two tactics.[43] Discounting any differences between the airframes and weaponry involved, would anyone who has seen a double attack worked by two pilots competent and proficient in the Fluid-Two System seriously want to maintain that the edge in the fight lies with the MiG because of the flight's comparative lack of mobility and flexibility? I suspect not. For even if the MIG driver maneuvers his airplane flawlessly, the Fluid-Two pair should in theory eventually beat him.[44] Or if, in the event, the MIG pilot was able to achieve a kill against the two-ship after starting from a tactically neutral situation (such as that just described), the reason would not be his greater mobility and flexibility but rather the flight's failure to capitalize on its numerical superiority through effective teamwork.

Now, conceivably, you might object that such a comparison is not entirely fair since the MIG-21 was outnumbered 2-to-1. But, besides the fact (noted earlier) that Captain Smith expressly specified being outnumbered as the one situation in which one-vs-one-or-more would definitely be better, it also turns out that even if the two sides had been numberically equal, it would still not be clear that the team comes off second-best.

43 The Fluid-Two System differs from the classical "shooter-cover" systems characterized in footnote 22 in two main respects. First, the basic team size is two fighters instead of four. Second, a much different engagement concept is used. In Blesse's Fluid-Four the attack strategy typically envisions a single attack carried out by the leader and supported by the rest of the flight. In Fluid-Two, on the other hand, both members of the team participate equally as attackers: first one team member puts pressure on the bogey, then the other, and so on until a kill is achieved. IN Fluid-Two the idea is, therefore, to mount a series of coordinated attacks rather than just making one as in classic Fluid-Four. When the sequenced attacks are properly coordinated, the pressure on the single bogey will be continuous; as a result he will find himself constantly reacting to one or the other of the Fluid-Two attackers, thus leaving the other free to maneuver towards a position of greater advantage. Double attack, the Navy's Loose Deuce System, and the R.A.F.'s Coordinated Pair all employ this same basic "double attack" engagement strategy. (Note that the tactical system I have described as 'Fluid-Two' is called 'the fluid attack system' in the latest edition--1 April 1976--of the Air Force's basic air-to-air manual; see TACM/PACAFM/USAFEM 3-1, Vol. II, Mission Employment Tactics-Tactical Fighter Weapons Employment-Counterair Tactics, pp. 2-27 through 2-29. I, however, will continue to use the somewhat more descriptive label 'Fluid-Two').

Note also that claiming a common engagement concept for Double Attack, Fluid-Two, Loose Deuce, and Coordinated Pair is not to say that no differences exist between these various systems. The fact is that the full-blown systems do exhibit differences. For example, Riccioni's original (1957) formulation of Double Attack placed great emphasis on the idea that, on offense, both team members would be "...ATTACKING SIMUTANEOUSLY" (Captain Everest E. Riccioni, "A Proposed New Method of Employing the F-100C in Combat," 1957, p. 6; a copy of this unpublished paper, written while (then Captain) Riccioni was with the 53rd Fighter Day Squadron in Europe, exists in the U. S. Air Force Academy Library). Contemporary Loose Deuce tactics, in contrast, do not emphasize simultaneous attacks anywhere near as heavily. Indeed, Loose Deuce may be viewed as a generalization of Riccioni's system in that it does not rigidly bind the two-ship team to a rapid series of sequenced passes; instead, either team member may elect to "work" the bogey if conditions permit (see footnote 119). (Fluid-Two, incidentally, seems to lie somewhere in the middle on this issue. Lt. Col. Moody Suter, who was at Nellis in the U.S.A.F. Fighter Weapons School's Aerial Attack Section when Fluid-Two was being worked out, has stated that the intent was to align the Air Force system with Loose Deuce. Moreover, Fluid-Two is currently being flown that way at Nellis. However, other T.A.C. units appear to be playing the system much closer to classic Double Attack.) Nevertheless, despite such variations in emphasis, the rudimentary engagement concept in all of these systems is one and the same--namely that of trying to force a kill by threatening the opponent (or opponents) from two different quarters--and in this sense they can be legitimately equated.

44 A very striking piece of evidence which supports this view can be found in recent experience with the F-15. In some engagements as few as two "Aggressor" T-38s using Fluid-Two have been able to achieve a stand-off against single F-15s in the close-in, maneuvering fight despite the enormous performance advantages of the Eagle. Such experiences say quite a bit, I think, about how much sound team tactics can achieve in the hands of well-trained aircrews.

To see this point consider the same scenario as before except with two MIG-21s operating autonomously against [redacted]. The obvious tack for the Fluid-Two pair in this situation will, of course, be to try and fight the MIGs one at a time using two-versus-one tactis, much as in the previous case. The F-4s' major problem then will be to force one or the other of the two MIG-21s out of the fight long enough for them to deal with the other individually. Moreover, with proficient, ACM-experienced aircrews in the F-4s, this divide-and-conquer strategy will generally succeed against two single ships--at least so long as the singles do not themselves work together to any great extent. What if they do? Presumably, for the two MIGs to combat sound Fluid-Two team tactics on the part of the F-4s with any effectiveness, they would have to work together more than just haphazardly. Indeed, to stay even with the F-4s, the MIGs would, in theory anyway, pretty much have to fight as a Fluid-Two pair. But if they did, then they would no longer be operating "autonomously"--not even in the somewhat strained sense of this word employed by Captain Smith when he appends to his account of two pilots fighting one-vs-one-or-more the qualification that, if either one of them saw the other in trouble, he would come to his aid.[45] Instead the MIGs would be operating as a team every bit as much as the F-4s.

So the above objection to my two-versus-one scenario can be met. However, there is another difficulty which can only be noted as a limitation. The problem concerns the dependence of the scenario's outcome on the presumption that a specific team system--namely Fluid-Two--will be employed by the F-4s. For it is not all clear that a single MIG-21, and still less a pair of 21s as in the two-versus-two scenario, would be at any real tactical disadvantage if the F-4s had chosen, for example, to fight as a Fluid-Four element. Again, in Blesse's system the preferred strategy is for an isolated two-ship element to operate as a single unit. Thus, against a single MIG, the fight would reduce to basic one-versus-one maneuvering. But when faced with two autonomously operating MIGs, the element would be outnumbered 2-to-1 so long as it did not perform a fluid-separation or a defensive split, and would probably lose more often than it would win. Consequently, the claim that I have made on the basis of these scenarios--namely that single-ship is not necessarily the superior approach offensively--is best couched in terms of the additional assumption that the team will use two-versus-one type tactics.

Section 6. A Theoretical Comparison of Single-Ship with Team Approaches

While it has taken considerable doing, I think we are at last in a position to render an informed judgment concerning the relative merits of team and single-ship approaches to aerial combat. Defensively the situation is about as unequivocable as theoretical issues can be. *To fight single-ship in a one-seat airplane --especially against greatly superior numbers--is to reduce drastically your chances for survival in comparison with the team. Why? Because, empirically, most kills have directly resulted from the victim's failure to see his attacker or,

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45 Smith, "One vs One Or More," p. 25.

worse yet, from his losing sight of an adversary in the midst of the engagement.[46] Thus the theoretical advantage of the team lies first and foremost in the extra eyes of the wingman; time and again he will see the enemy that one pilot fighting alone would have missed. In addition, the team also enhances survivability by furnishing a certain measure of protection against gross mistakes. If either team member commits a serious error, the other will often be able to save what might

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46 In Section 4 I offered three pieces of statistical evidence to support this key point: (1) Hartmann's observation that better than 80% of his victims probably did not see him until fired upon, (2) Hubbard's confirmation of Hartmann's observation in the combat experience of the 20th Fighter Group during World War Two, and (3) the striking persistence of this same overall pattern in American losses to MIGs over North Vietnam. Over and above general statistics of this kind, you can also cite many specific engagements in which either not seeing the attacker, or losing sight, immediately preceded the kill. A classic case of a pilot simply driving along straight and level, totally oblivious to his attacker until the bullets started hitting, can be found in Frank Gabreski's account of his first MIG kill in Korea (see Sims, The Aces Talk. pp. 254-57). A very similar scenario from Vietnam can be seen in the MIG-17 kill recorded by LCdr. Jerry Houston and Lt. Kevin Moore on 6 May 1972 (the main difference in this second instance being that the MIG-17 driver failed to see the attacking F-4s because he was overly engrossed in trying to shoot down an A-6--see Drendel, ... And Kill MIGs, p. 41). Finally, for a textbook illustration of the dangers of losing sight in the middle of a fight, read the narrative of the MIG-21 kill by Captains Sam White and Frank Bettine on 19 August 1972; here, when the MIG barrel-rolled left, Captain White counter-pulled right and came out deep in the MIG's blind area at six o'clock (Ibid., pp. 27-28).

otherwise have turned into a fatal situation.[47] (Of course it is always possible that, at some future time, gadgets like the AWACS (airborne warning and control system), or tail-warning sensors, will be able to compensate substantially for the lack of a wingman. Needless to say, this sort of technological advance would

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47 Both of these defensive advantages of the team are graphically illustrated in the following excerpt from an engagement which occurred on 8 May 1972. The narration is by Lt. Randy Cunningham. The "Brian" referred to is Lt. Brian Grant; he was the pilot in the other F-4 in Cunningham's section on this occasion (a Navy "section" being a Loose Deuce pair of two fighters). "Willie" is LtJG Willie Driscoll, Cunningham's backseater. The passage picks up the mission just as the F-4s are completing a port turn:

> I got to the inside, rocked the wings and looked over at Brian. A MIG-17 had come from down low, popped up through the clouds, and was right behind Brian and shooting! He must have been last in his class in gunnery, because Brain wasn't pulling that many G's, and the MIG's tracers were falling short. I called Brian and said; "Brian, you've got a MIG-17 on your tail..." He said; "WHAT?" I said; "You've got a 17 on your tail and he's shooting! Get rid of your centerline, unload, and outrun him!" Brian punched off the centerline and started to extend away from the MIG.
>
> Up until that time we had been told that the 17 was a guns only airplane, and that they didn't carry any missiles. Well, as soon as Brian got out about 3500 feet in front of the MIG, the MIG fired a missile! I called; "Atoll...break port!" Brian broke and the missile...couldn't make the corner. But his break enabled the MIG to turn inside and start to close for another guns run. I called: "Brian, he's closing again...unload and go again!" I was fifty to sixty degrees off the MIG's tail and trying to get in position for a shot at him. Just then, Willie called; "Duke, look up!" I looked up and saw two MIG-17's go over the top of us on a reciprocal heading. I told Willie to keep an eye on them. I figured we had lots of time to get a shot before they got turned around. I was about to get my first lesson in the turning ability of the MIG-17. They actually turned inside of each other and started down after us! But I was watching Brian as he started an arcing turn, and I thought; "That MIG is going to shoot another Atoll at him." So, at sixty degrees off, I fired a Sidewinder. That Sidewinder is a damn good missile! Even at that many degrees off, it tried to turn the corner and go after that MIG! It didn't make the corner, but it did scare the MIG driver into a hard break into it, which got him off Brian's tail. (Drendel, And Kill MIGs, p. 48.)

In this scenario Cunningham's eyes precluded the possibility of Grant being hit twice: once when Grant did not see the attacking MIG until it was at gun range, and firing; and a second time when the MIG unexpectedly turned out to have what Cunningham took to be [illegible] Moreover, it was Cunningham's out-of-parameters Sidewinder shot that finally induced the MIG to break off its attack.

make single-ship far more viable defensively than it is at present--ASSUMING, naturally, that the "black box" system employed in place of the wingman could be relied upon to handle realistic combat environments. That, however, is an awfully big assumption and, for the time being at least, I would maintain that the unassisted pilot eyeball is far and away the most dependable system around insofar as "checking six" is concerned.)

Turning next to offensive considerations, I would have to admit that the arguments given in Section 5 to support the superiority of the team on the attack were not nearly as compelling as those cited in the defensive comparison. The reason, once again, lies in their lack of generality: whereas the principal defensive advantage of the team--extra eyes--is common to all team systems, in the offensive comparison the argumentation was clearly dependent on the selection of a "two-vs-one" type approach. Now indeed, if you do choose a team system like Fluid-Two, the degradation in mobility, flexibility, and surprise relative to the single fighter is minimal. Thus, since the gains in offensive effectiveness inherent in two-vs-one tactics are so great, there is little doubt that they would more than compensate for any losses in these areas. But the point that has to be made here is, of course, that the offensive superiority of teamwork is far more questionable if one is talking instead about a rigid version of Blesse's Fluid-Four System in which the isolated element never splits, and the support element functions strictly as a "high cover."

The implications of this theoretical analysis may be summarized as follows. In general the team constitues the defensively superior approach. Short of radical advances in technology, I do not think that this conclusion can be seriously challenged. Moreover, at least with Fluid-Two (or Loose Deuce), the team would appear to have the offensive edge as well. Consequently, even if it cannot be convincingly shown that other team systems (such as classical Fluid-Four) are reasonably competitive with single-ship from an offensive standpoint, I would still submit that I have refuted the claim that, overall, one-vs-one-or-more is better than ANY team system.

Nor is this conclusion the strongest that could be supported. For I would argue, as a final point, that the offensive comparison of Section 5 was largely moot on the grounds that in aerial combat, staying alive is every bit as imprtant as shooting down enemy fighters.[48] True, the objective is to destroy enemy machines. But if you end up being shot down yourself in order to score a kill, what have you gained? In most cases the answer will be: little, if anything. (Consider, in this regard, an F-15 pilot who leaps into the fray and downs a pair of MIGs only to be nailed himself by a third bogey. I suspect that in N.A.T.O. Europe the Soviets and their allies would be absolutely delighted to "lose" at that ratio right down to our last F-15.) *Thus, I would suggest that it makes no more sense to sacrifice survival in favor of scoring kills than it does to survive by shunning risky situations to the point where you never shoot anyone down.

Obviously if you embrace this perspective, then the defensive shortcomings inherent in having but a single set of eyes provides a fairly decisive argument against team approaches--regardless of the offensive advantages of single-ship systems. The sacrifices which one-vs-one-or-more tactics make in the area of survival are simply too great. Even with a weapons platform like the F-15, if the pilot fails to acquire an adversary, or if he loses sight during an engagement, he can be shot down just as readily as anyone else. Hence, I would maintain that, generally speaking, TEAM TACTICS ARE TO BE PREFERRED TO SINGLE-SHIP (assuming, once again, that the tactical environment allows teamwork, and that you lack any reliable alternatives to the wingman's eyes).

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48 It is fair to intimate, I think, that both Erich Hartmann and John C. Meyer (just to mention two consummate veterans of the air combat arena) embraced much this same view. Certainly Hartmann's approach to aerial combat was heavily skewed towards the avoidance of unnecessary risks. He shunned the classic turning dogfight, for example, precisely because he deemed it too dangerous (Sims, The Aces Talk, p. 236). Instead he preferred slashing attacks in which both surprise and tactical position were in his favor ("Erich Hartmann--An Interview with WW II's Greatest Fighter Ace," p. 36). Nowhere is this tactical philosophy of calculated aggressiveness more evident than in his feelings on the leader's responsibility to his wingman: "No Kill," he stated in a 1968 interview, "was ever worth the life of your comrade..." (Ibid.,p.33).

Meyer's attitude appears to have been quite similar. For instance, he wrote in 1944 that "When attacked by much superior numbers I get the hell out of there ..." (Kepner, The Long Reach- Deep Fighter Escort Tactics, p. 38). Again there is the unmistakable note of calculation, of playing the percentages.

Such opinions may seem somewhat opposed to the view which came to be epitomized in the minds of many Air Force fighter pilots by Blesse's oftquoted statement: "...no guts, no glory. If you are going to shoot him down, you have to get in there and mix it up with him." Blesse, "No Guts, No Glory," p. 15). But I suspect that there is far less divergence of opinion here than may be supposed. Aces like Hartmann and Meyer did not score their kills by going into the arena obsessed with playing it safe; they went in to shoot down enemy machines. At the same time, however, the tactics they employed suggest that they recognized a sharp distinction between being INTELLIGENTLY AGGRESSIVE and merely foolhardy. (Jabara, on the very mission on which he became a jet ace, provided a classic example of the latter by engaging TWICE with a hung drop tank--Captain Stephen O. Manning, "A Race for an Ace", Airman, November 1975, pp. 21-22). Moreover, a careful reading of "No Guts, No Glory" suggests that Blesse himself probably would not disagree with this qualification (despite the fact that he was traditionally read as advocating the kind of unbridled aggressiveness which Jabara exhibited on the occasion just mentioned). For besides saying "...no guts, no glory," Blesse also pointed out that guts cannot consistently make up for a lack of skill (Blesse, "No Guts, No Glory," p. 14).

Section 7, "Two-vs-One-Or-More"--Multiple-Bogeys, Communications-Jamming, and the 1973 Arab-Israeli War

Up to this point the question at issue has been: "Is single-ship truly preferable to the team?" Insofar as these two basic classes of aerial attack systems can be compared as bare concepts, the answer that has now emerged is, very simply, "No." Does it then follow, as you might be tempted to suppose, that one-vs-one-or-more type tactics should be jettisoned altogether? Not at all. As a matter of fact, a most compelling case can be made for the view that we definitely do need to incorporate into our current doctrinal repertoire an aerial attack system which, under certain extreme conditions, would function very much like one-vs-one-or-more. This system I shall call 'two-vs-one-or-more.' The concern of the present section then will be twofold: to develop the case for two-vs-one-or-more, and to distinguish it conceptually from Captain Smith's one-vs-one-or-more approach.

Going at least back to the Korean War period, Air Force literature on air-to-air has not devoted much attention to the possibility of having to face very large, or greatly superior, numbers of enemy fighters in the air combat arena. True, "No Guts No Glory" did contain short discussions of one against two (and four), two against two (and four), and even four-against-four.[49] However, Blesse's treatment of such scenarios, as well as that given in what subsequently became the definitive U.S.A.F. documents on air-to-air, largely presupposed isolated engagements involving fixed numbers of airplanes.[50] The broader problem of "multi-plane" (or "multi-bogey") situations, in the specific sense of facing massive, rapidly changing numbers of enemy fighters, simply was not addressed.

The failure to come to grips with such possibilities in the post-Korean War period can be explained by a variety of circumstances. Although ACM (Air Combat Maneuvering) training and experimentation did flourish in T.A.C. during the late 1950's, after that time activity in these areas was sharply curtailed (due, primarily, to a burgeoning emphasis on flying safety and nuclear weapons).[51] Moreover, the little ACM taining that did continue within T.A.C.'s line fighter units after 1960 was increasingly confined to the learning and practice of such rudimentary skills as one-versus-one maneuvering and "fighting wing." "Flight" or "system" tactics, in contrast, were practiced less and less. Thus both the quantity and quality of T.A.C.'s air-to-air training declined sharply during the early 1960's. At an operational level this development inevitably had its effects. Although some evolution in Air Force doctrinal thought on fighter-versus-fighter combat did continue to take place during the Vietnam era--at least within the U.S.A.F. Fighter Weapons School at Nellis--the advances that were made came to be felt less and less at the level of line aircrews as realistic training declined.[52] Consequently, little genuine consolidation appears to have occurred. Indeed, even when the harmful effects of these trends on the air-to-air prowess of U.S.A.F. fighter crews became painfully evident in the skies of North Vietnam, little was done to reverse the situation (and, concurrently, pressure within the Air Force fighter community to explore new doctrinal territory largely evaporated). For example, the Air Force's kill-ratio against North Vietnamese MIGs dropped from 2.62-to-1 (in 1967) to only 1.14-to-1 (in 1968) without precipitating any serious

49 Blesse, "No Guts, No Glory," pp. 11-13 & 22-24

50 See Boyd, "Air Combat Maneuvering," pp. 26-30; also "Air Combat Maneuvering--Part III," Fighter Weapons Newsletter, March 1963, pp. 27-28. These two articles are, if anything, even sketchier on the subject of multiple-bogeys than Blesse had been.

51 The view which came to be accepted in many places within the Air Force during the early '60s was that the air-to-air combat which had taken place in MIG Alley was a historical aberration that would not be repeated in future conflicts. Indeed, even within the T.A.C. fighter community, the feeling appears to have been widespread, as early as mid-1961, that aerial combat was a thing of the past, and that the only job left for the fighter pilot was "nip-ups"--that is, nuclear weapons deliveries (Captain Ralph L. Brooks, "The Acid Test-Combat Performance," Fighter Weapons Newsletter, June 1961, p. 11). Ultimately, so entrenched did this perspective become that between 1968 and 1973, for example, a "combat ready" T.A.C. F-4 pilot was only required to average one ACM hop per month. (My personal experience in PACAF was that few pilots in line squadrons managed to get much more than that. Moreover, PACAF was not the worst place in the Air Force for ACM training during the Vietnam era. It has recently been reported that "One fighter wing in England did not fly a single air-to-air training mission for three years"--Major Donald L. Gish, "F-4 Air-to-Air Training, USAF Fighter Weapons Review, Fall 1975, p. 2).

This decline in Air Force ACM training after 1960 was in clear opposition to Blesse's opinion that "Two good aerial training flights a week are (the) minimum number necessary to stay in practice" (Blesse, "No Guts, No Glory," p. 13). However, it was not until late 1972, with the institution of an air-to-air "Top Off" school at Nellis, that the situation began to improve. (The Top Off syllabus heralded the advent of "dissimilar aircraft" ACM training. This advance was further consolidated in mid-1973 with the formation of the 64th Fighter Weapons Squadron, whose "Aggressor" T-38s were intended to provide a permanent adversary service. Then, the following year, T.A.C. began designating certain F-4 units as air-to-air specialists. This device raised the minimum number of ACM hops required semi-annually in air-to-air at least for pilots in the designated squadrons, from six to over 40. (For a comprehensive account of the genesis and current status of ACM training within the U.S. fighter community see Philippe Grasset, "Dissimilar Air Combat Training--a revolution in realism," International Defense Review, Vol. 8, No. 6, December 1975, pp. 823-27. For further details on actual training techniques see George Haering, An Introduction to Air Combat Manuevering (ACM), Joint Tactical Coordinating Group for Munitions Effectiveness, 61 JTCG/ME-76-4, 21 March 1976).

52 For a detailed account of the evolution that occurred in classical Fluid-Four tactics after 1954, see footnote 83. The relevant point here is just that the doctrinal refinements which took place between (roughly) 1955 and 1971 were largely aimed at the problem of fighting "dissimilar" performing aircraft, rather than at that of dealing with multiple-bogey situations.

For more on the linkage between realistic air-to-air training and aircrew performance in actual combat, see footnote 88. Note that the Navy fighter community, whose air-to-air record over the North in 1967 was only marginally better than the Air Force's, did radically revise its approach to air combat training in 1968 and, during the "Linebacker" operations of 1972-73, this renewed emphasis on sound training paid off dramatically: for the years 1972-73 Navy fighter crews posted a kill-ratio which eclipsed that achieved by the F-86 wings in MIG Alley (see footnotes 27 & 88; also Armed Forces Journal International, May 1974, p. 34).

rethinking of U.S.A.F. ACM training practices (or of associated air-to-air doctrine).[53]

But, however explicable this lack of a doctrinal response to the possibility of multi-bogey situations may be, the fact remains that the problem posed by such environments was not dealt with by orthodox thought within T.A.C.[54] Was the failure to do so an oversight? In retrospect it would certainly seem so. After all, what reason could possibly be given to justify the presumption that in all future air battles only airplane-limited scenarios will be encountered? Yet, tacitly at least, this longstanding presumption is evident in T.A.C. even today: outside the U.S.A.F. Fighter Weapons Center, current ACM training within the command focuses almost exclusively upon such manifestly airplane-limited scenarios as 2-versus-1. Now, this observation is not meant to impugn the

53 Armed Forces Journal International, May 1974, p. 38. Not until December of 1966 did the North Vietnamese Air Force begin mounting aggressive attacks against American fighter-bomber formations enroute to targets within the Hanoi-Haiphong region (Major John T. Correll, "MIG Sweep," Airman, June 1975, pp. 41-42). This activity was countered on 2 January, 1967, with an offensive MIG sweep (code-named "Operation Bolo"). On that day, F-4s from the 8th tactical Fighter Wing downed seven of the fifteen MIG-21s then possessed by the North Vietnamese (without a single friendly fighter being lost -- Correll, p. 47). Bolo pretty well set the tone for the rest of 1967. By September, for example, Time magazine reported that half of North Vietnam's 110-MIG air force had been destroyed and most of the rest withdrawn into China (Time, 8 September 1967, p. 20). However, despite the fact that U.S. pilots downed a total of 69 MIGs in 1967 (for 25 losses), by the end of the year the MIG losses had been largely made good and the North Vietnamese began coming back with better tactics (see "Improved North Viet Air Capability Cited," Aviation Week and Space Technology, 4 December 1967, p. 32). As a result the MIGs did considerably better in 1968, downing seven U.S.A.F. fighters for only eight losses (Armed Forces Journal International, May 1974, p. 38). Of course, with the termination of American bombing in North Vietnam above the 19th parallel on 31 March 1968, MIG encounters, especially on the part of Air Force pilots, virtually ceased. (The last U.S.A.F. kill of 1968 occurred on 14 February of that year; Navy pilots, however, got MIGs in June, July, August and September--Armed Forces Journal International, July 1972, the box on page 34). Thus the alarming trend towards increased MIG success which the Air Force began experiencing in late 1967 probably did not persist long enough, due to the bombing halt, to make a genuine reassessment of existing training practices unavoidable.

54 From a historical perspective, Smith's 1975 article ("One vs One or More") can be viewed as an attempt to broach and solve the doctrinal problem of fighting superior numbers of enemy fighters for control of the air. However, he is not the first to have raised this problem. Riccioni, for example, mentioned it as early as 1957 (Riccioni, "A Proposed New MEthod of Employing the F-100C in Combat," p. 2), and, subsequently, treated it at some length in the context of N.A.T.O. Europe (see Lt. Col. Everest E. Riccioni, "The Air Superiority Fighter--A Modern Analysis," Air War College Report No. 3671, April 1968, pp. 52-58).

two-vs-one (Fluid-Two) team tactics presently in vogue throughout the T.A.C. fighter community.[55] Rather the point is just to raise the more fundamental question: Can team approaches ALWAYS be sustained in the face of very large, or greatly superior, or rapidly changing numbers of opponents? Unhappily, as I shall now show, the answer would seem to be that they cannot.

In the first place, the isolated 2-on-1 scenarios now in wide use (both within the Air Force and the Navy) as a means of teaching mutual support are creatures of the training environment only. After all, on any standard 2-versus-1 training hop everyone involved knows, right from the moment the flight briefing begins, exactly how many fighters, and how many bogeys, there are going to be out in the ACM area. But when a pair of friendly fighters runs across a single MIG in actual combat, the possibility

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55 The basic viability of Fluid-Two as a workable approach to fighter-versus-fighter combat cannot, I think, be seriously challenged. In fact, given aircrews trained and proficient in Fluid-Two, there are good reasons for thinking that it offers a genuine advance--both offensively and defensively--over, say, Blesse's original version of Fluid-Four. Specifically, from a defensive standpoint, the theoretical superiority of Fluid-Two centers on the difficulty (mentioned in footnote 38) which the "fighting wingman" has covering either his leader's six, or his own, under heavy maneuvering. On patrol, of course, both the Fluid-Four element and the Fluid-Two pair spread out line-abreast to achieve visual cross-coverage to the rear. However, once the fight begins the two systems cease to be comparable in terms of defensive lookout. Why? In classical Fluid-Four the harder the element is forced to maneuver, the more the line-abreast spread will be lost as the fighting wingman is forced closer and closer toward a trail position. Naturally, when the wingman is deep in the "maneuvering cone" (45 to 60° aft), his tail cannot be covered by the element leader (who is concentrating on the bogey anyway). Further, near maximum performance the sheer difficulty of just hanging on the leader's wing will effectively prohibit thewingman from performing this function for himself. With Fluid-Two, on the other hand, the line-abreast spread is in general rotated into the vertical during the engagement. As a result, one fighter ends up displaced vertically relative to his "engaged" partner and the bogey. From this vantage point, whether high or low, the "free" fighter is in the best position imaginable from which to cover his teammate. And since he is not required to stay on anyone's wing, he is able to check his own six as well. (Note: In Fluid-Two a team member is considered "engaged" anytime a bogey is reacting to him; otherwise he is "free.")

As for the offensive superiority of Fluid-Two, perhaps the easiest way to make the main theoretical point is by considering a 2-versus-2 situation in which one side uses Fluid-Two type tactics while the other operates as a "fighting wing" element. The classical fighting wing element functions essentially as a "shooter-cover" team (see footnote 38). In contrast, each member of the Fluid-Two pair maneuvers and attacks separately. Thus, so long as the fighting wing element stays together, it will be outnumbered 2-to-1 and, whenever it maneuvers to counter either member of the Fluid-Two pair, must give the other the opportunity to move to a more offensive position.

Both of the above arguments for the theoretical superiority of "double attack" type systems to Blesse's Fluid-Four were originally given by Riccioni in 1957 (see Riccioni, "A Proposed New Method of Employing the F-100C in Combat," pp. 10-11). For later versions, see Major Everest E. Riccioni, "The Double Attack System," Fighter Weapons Newsletter, December 1963, pp. 22-23.

always exists that the bogey has companions lurking somewhere nearby.[56] Consequently, some of the attention which a two-ship team employing Fluid-Two could devote exclusively to killing the bogey in training must, in combat, be applied to checking six. Inevitably, this requirement complicates the application of Fluid-Two tactics to real-world situations (no matter how many MIGs you and your teammate spot initially).

Moreover, additional complications crop up if the scenario involves more than one bogey. Suppose, for example, that at the start of the engagement you and your partner pick up two MIGs instead of one. Then you face a further problem. As mentioned on page 27, against two bogeys you cannot concentrate your attacks exclusively on either opponent until the other has been driven out of the fight. Only when one bogey has been isolated can the two of you safety revert to pure two-vs-one tactics (and, even then, just for the 20 or 30 seconds it will usually take the separated adversary to pitch back into the engagement). The rest of the time, you and your teammate are going to be compelled to maneuver against BOTH of your opponents and, especially if they are wiley, this constraint is probably going to preclude being able to sustain a coordinated series of attacks against either adversary long enough to produce a kill.

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56 This point is particularly relevant in light of the air combat tactics generally manifested by Communist-bloc air forces in the past. During the Korean War, for instance, MIG tactics (against bombers as well as fighters) were observed to have been closely modeled after those used by the Luftwaffe during World War Two (Jabara, "We Fly MIG Alley," p. 65; Hotz, "Can We Win in MIG Alley?", p. 27; Sims, The Aces Talk, p. 247). And some Communist oriented nations--the Egyptians for example--were still flying classic Finger-Four as late as 1973 (Robert Hotz, "Offense, Defense Tested in 1973 War," Aviation Week and Space Technology, 7 July 1975, p. 20). Further, while North Vietnamese MIG drivers tended to prefer tightly controlled GCI style intercepts to trolling about the skies in fluid-four, even they normally retained a minimum of two fighters for air-to-air engagements. In addition, note that in MIG Alley, as well as over North Vietnam, Communist pilots were often observed to use a fighter or two to decoy American aircraft out in front of other MIGs in hopes of getting some easy kills (Major Gene Gurney (editor), Great Air Battles, New York, Franklin Watts, 1963, p. 279; Drendel, ...And Kill MIGs, pp. 20 & 54). Thus, not only has the doctrinal commitment of Communist pilots to team systems been as deep-rooted as our own on past outings, but the isolated MIG has typically been used to bait traps. There seems little reason, then, to suppose that we would be likely to encounter "lone wolf" MIGs as a widespread phenomenon in the air combat arena of tomorrow.

What then happens if the numerical odds, rather than lying with the Fluid-Two pair, or being even favor the bogeys? Presumably the friendly fighters will find it all the harder to work classic Fluid-Two tactics. Faced with four independently maneuvering MIGs, for instance, the Fluid-Two team cannot even start a straight double attack until three of their opponents have been SIMULTANEOUSLY driven out of the fight--a rather tall order if the MIG pilots possess just average competence at air-to-air. On top of this problem, there remains the possibility that, at any instant, the numerical odds with which the engagement began may be abruptly changed by the appearance of yet more bogeys. These points suggest, therefore, the general relationship that, as the number of bogeys goes up, the Fluid-Two pair will find it harder and harder to sustain effective teamwork. Indeed, given the degree of difficulty commonly experienced in working Fluid-Two type tactics against just two or three smart bogeys, I would think that a numerical ratio in favor of the bogeys will always exist which would give them the potential at least to break down the friendly fighters' mutual support. Weight of numbers, in short, does appear to afford a means of negating the great advantages which the Fluid-Two team would otherwise enjoy over individual opponents operating autonomously.

Is this conclusion also true for other team systems such as classical Fluid-Four? If anything, mutual support in Blesse's system seems even more susceptible to being broekn down by enemy numbers than it does in Fluid-Two. Consider, after all, what the support element is supposed to do in classic Fluid-Four. Its function , first and foremost, is to ensure that the attacking element can "...complete successfully any attack begun."[57] Hence, with either element engaged offensively, if just one additional bogey appears and makes a determined effort to interfere, the support element is bound by the logic of the system to engage the interloper. But experience with Fluid-Four (both in training as well as in actual combat) indicates that, if the second element does in fact engage, the result will usually be two separate fights, with neither element supporting the other. Thus, given the presence of just one or two extra bogeys, the engagement logic of classical Fluid-Four itself tends to fragment the four-ship flight into isolated elements. Furthermore, mutual support within the individual element, once separated, seems equally vulnerable. Consider in this regard a 2-versus-2 scenario in which one side operates as a fighting wing element while the opposing aircraft act in concert with one another through individual maneuvering (as is done, for example, in Fluid-Two). In effect, so long as the fighting wing element stays tightly together, it will be outnumbered 2-to-1 and, all other things being equal, ought to lose sooner or later. In this situation the only real alternative for the "welded wing" pair is to perform a fluid-separation or a defensive split. But the moment this happens, mutual support between the "welded wing" element leader and his "fighting" wingman will be lost (unless the wingman is capable of fighting in a fluid mode). Consequently, in principle as few as four or five individually maneuvering (but wiley) bogeys can fragment a classically trained Fluid-Four flight into four separate and isolated ships. Moreover, since we have already seen that two-versus-one type systems can be broken down by superior numbers of skilled opponents as well, we seem driven to the conclusion that sheer weight of numbers, if sufficiently overwhelming, can break down the mutual support of virtually any team system. (Granted, this effect will not always come about strictly as a function of how much one side's fighter force outnumbers the other's overall. Rather it will depend more immediately on how many aircraft each side is willing to throw into the air battle on a given day. Still, the theoretical point to be made here is that for the numerically superior side the option will always be open to attempt to dominate the air combat arena

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57 Blesse, "No Guts, No Glory," p. 8.

by weight of numbers. Indeed, if the numerically superior side wanted some measure of air superiority badly enough, and if it believed its pilots were less capable than those if its adversary, flooding the air combat arena with large quantities of fighters might seem a natural stratagem.)

Being outnumbered by opponents able to exploit their numerical strength, then, constitutes one major weakness of the team. Are there any other ways of breaking down teamwork? Analysis of the role played by radio communications between aircraft in all known team systems suggests a second. The principal defensive merit of having two or more airplanes operate together is, once again, that what one member of the team misses, another may see. But when you glance back and suddenly notice a MIG at your buddy's six o'clock firing a missile, how are you going to help him without a radio? If he has not seen the attacker himself it will be entirely up to you to get him maneuvering his machine in the right direction about as fast as you can say, "Buick Two, Atoll! Break right!" Thus, at least in life-and-death defensive situations, the dependence of the team upon radio communications for survival appears unquestionable.

What about on offense? Is the radio in any way necessary for the team there as well? With Fluid-Two type approaches there seems no real doubt as to its offensive importance. Historically, even the most adamant proponents of such systems conceded that with two fighters maneuvering separately, the radio would be indispensable for organizing the fight if anything resembling a coordinated series of sequenced attacks on the bogey was to be achieved.[58] Moreover, aircrew experience with them has consistently verified this judgment.[59]

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58 Riccioni, "The Double Attack System," p. 26; Captain Richard E. Guild, The Double Attack System: A Formalization, HQ 347th Tactical Fighter Wing, Yokota Air Base, Japan, May, 1968, p. 17; Major Vicent P. Roy, "Double Attack Revisited," USAF Fighter Weapons Review, Spring 1971, pp. 28-29. The three pieces just cited constitute, by the way, the classic expositions of the Double Attack System in the tactical literature. Riccioni's 1963 article offers essentially a condensed version of his original 1957 paper "A Proposed New Method of Employing the F-100C in Combat." Both of these Riccioni pieces were based on F-100 experience. Guild's 1968 manual is an adaptation of the system for the F-105, and Roy's 1971 exposition represents, "...over two years experience and approximately 500 sorties..." flying Double Attack in the F-104 (Roy, p. 28).

59 Instructors at the Navy's "TOPGUN" Fighter Weapons School put it this way: their experience with aircrews going through the TOPGUN course has consistently been that the cessation of radio conversation--even for as little as 30 to 40 seconds--within a fighter "section" almost always indicates a breakdown in the fighters' mutual support. Since most of the TOPGUN graduates over the years have come to the school with extensive air-to-air experience, it would appear that a fairly steady stream of conversation is generally necessary to work the Loose Deuce System effectively. Moreover, Air Force experience with Fluid-Two has confirmed this conclusion so extensively (see, for example, footnote 61) that TACM/PACAFM/USAFEM 3-1 currently states: "Effective employment of the fluid attack system is based on coordination and mutual support. The primary effect of communications jamming on the system is to disrupt the capability to coordinate and thereby break down mutual support." (TACM/PACAFM/USAFEM 3-1, Volume II, April 1976, pp. 2-32). It is unlikely, therefore, that aircrews of average proficiency could go completely radio-out and still be successful double attackers. Admittedly, if you allow the same individuals to practice together as a section long enough, and often enough, eventually they will become so familiar with one another in the

With classic Fluid-Four tactics, however, the radio is probably not as vital on offense as it is with Fluid-Two and Loose Deuce. After all, in Blesse's system only one aircraft, normally the flight lead, attacks while the rest of the flight covers and supports that one attack. Needless to say, this "single" or ("shooter-cover") engagement concept will not normally demand the degree of coordination, and therefore, the degree of radio utilization, necessary with "double attack" type systems. In addition, as Air Force pilots actually practiced Fluid-Four tactics after 1960, situations requiring any extensive amount of coordination between the elements were generally ignored.[60] Hence the need for offensive reliance upon the radio tended to appear relatively non-existent. (Indeed, during the 1960s some T.A.C. fighter pilots came to view radio silence during aerial combat as the epitome of good radio discipline.[61] This attitude, however, should not be attributed to Blesse.[62])

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air that their original dependence on the radio will taper off considerably. However, at present the Israeli Air Force is about the only outfit in the world that regularly gives its line aircrews enough ACM practice with the same teammates to maintain this level of proficiency. (In our own case, current Air Force manning policies have reduced the overall experience level of T.A.C.'s aircrews to the point where it would probably take months, if not years, to produce any large reservoir of line fighter units with air-to-air savvy comparable to the typical Israeli Mirage or Kfir squadron.)

60 As mentioned earlier (in footnote 38), F-86 pilots in MIG Alley found it extremely difficult to sustain coordination (of any sort) between Fluid-Four elements. Their experience indicated that once maneuvering began in earnest, it would soon be every element for itself. Moreover, after 1960 ACM training missions involving entire flights (that is, scenarios such as 4-vs-2, 4-vs-4, etc.) became extremely rare among line aircrews. Personally, for example, during five years of operational service in the F-4 (beginning in 1967 and including MIG CAP missions over North Vietnam), I cannot recall even a dozen occasions on which working the elements together was practiced. Thus, in my experience at least, offensive coordination between the elements--and with it any pressing need for appreciable offensive reliance upon the radio--was almost totally neglected. Few pilots I served with seemed inclined to grapple with the problem of effecting such coordination, and even fewer actually worked on it in the air.

61 Riccioni, "The Double Attack System," p. 26; Roy, "Double Attack Revisited," p. 29. Air Force experience over the past few years with Fluid-Two tactics has consistently taught that the ability to make the kinds of concise, timely and informative radio calls essential to offensive (or defensive) teamwork is a complex skill which does not come naturally to most pilots. Of particular note in this regard is data gleaned from T.A.C.'s adversary (or "aggressor") program (for an introduction see Captain Mike Press, "Meet the Aggressors," USAF Fighter Weapons Review, Fall 1973, pp. 30-33). In summarizing over 2,600 dissimilar aircraft ACM sorties flown against T.A.C. aircrews across the United States, the "Aggressor" pilots noted that 82% of the crews they had fought judged their own radio communications "poor" ("Aggressively Speaking," USAF Fighter Weapons Review, Fall 1974, p. 2). At the same time, however, most of these same aircrews considered the radio "...a key factor in maintaining mutual support." (Ibid.) These statistics accurately reflect, I think, just how hard it really is to use the radio effectively under the stresses of aerial combat (even in training).

62 Although the idea that radio discipline means talking as little as possible became widespread in T.A.C. during the 1960s, Blesse's ideas on the matter of radio utilization in fighter combat appear to have been markedly different. For example,

So, as long as you do not insist upon any great amount of coordination between the elements in Fluid-Four, a plausible case can be made for the position that Blesse's system does not require the degree of offensive reliance upon the radio necessary in Fluid-Two and Loose Deuce. This point, however, in no way alters the fact that in life-and-death defensive situations, all known team approaches are critically dependent upon radio communications. Moreover, the tactical systems now in vogue throughout the American fighter community are all "double attack" approaches which demand extensive radio utilization on offense as well. Thus the two-way radio would appear to constitute a vital link, both offensively and defensively, in the team systems presently being used in the United States. But can this vital link be denied the team? Most certainly it can be. Only one person at a time can talk on a two-way radio net. If two individuals try to transmit simultaneously they simply cut one another out, garbling everything that was said. The means of denying this vital link to opponents employing team tactics, then, is obvious: jam their tactical radio frequencies.

Looking back, two distinct ways of attacking the mutual support normally available to aircraft using team systems have now emerged: flooding the air combat arena with large, or greatly superior numbers of airplanes, and communications-jamming.[63] As a result, doctrinally speaking, we seem forced to conclude that TEAM TACTICS PROBABLY CANNOT BE SUSTAINED IN ALL TACTICAL ENVIRONMENTS. In particular, teamwork appears likely to break down in situations where the opponents can, at their option, employ either superior quantities of fighters or comm-jamming. Of course, these conclusions have been developed strictly from theoretical considerations. Consequently, the next logical question is: Would team systems really be degraded all that much by "multi-bogey" or "comm-jamming" environments?

During the Mideast War of October, 1973, Israeli fighter pilots found themselves frequently forced to operate in a communications-jamming environment.[64] At the same time, the major engagements during this 18-day conflict were "multiple-bogey" in the fullest sense of this term; characteristically, the air battles which occurred over the Golan Heights, the Sinai Desert, and the west bank of the Suez Canal involved from 40 to 60 fighters, mostly Arab.[65] How did Israeli teamwork fare in these circumstances? As theory would predict, it broke down. A fair indication of just how far can be seen in Israeli gun-camera film from the '73 war. It is not uncommon in the Israeli footage to see both Arab and other Israeli fighters flashing through the camera focus while the

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he wrote that "wingmen should be trained to put out a call to their leaders about every 20 seconds once enemy aircraft are sighted and it is evident that the leader's attention is required offensively" (Blesse, "No Guts, No Glory," p. 26). While such transmissions would be fundamentally defensive in nature (their main intent being to keep the leader advised that the fighting wingman was still there, clearing six o'clock), evidently Blesse himself was not reluctant to recommend extensive use of the radio in aerial combat.

63 The linkage between communications-jamming and the breakdown of mutual support in team systems was originally pointed out to me by Captain A. Lee Harrell in November 1974. As noted in footnote 59, the current U.S.A.F. counterair employment manual explicitly mentions this linkage as a limitation of Fluid-Two tactics (see TACM/PACAFM/USAFEM 3-1, Volume II, 1 April 1976, pp. 2-32).

64 "Anything Else is Rubbish," USAF Fighter Weapons Review, Summer 1975, p. 11.

65 Robert Hotz, "Israeli Air Force Faces New Arab Arms," Aviation Week and Space Technology, 10 March 1975, p. 16.

pilot fires at his specific target.[66] Indeed, so pell-mell and confused was much of the air combat during this war that in nearly 70 of the roughly 370 victories claimed by Israeli aircraft over Arab pilots,[67] it was not subsequently possible, even with the gun-camera film in hand, to sort out which weapon--cannon, infra-red missile, or radar-guided Sparrow--actually made the kill.[68] Evidently then, under the tactical conditions which characterized the air-to-air combat in this conflict, even veteran Israeli Mirage pilots could not always maintain mutual support and, as a result, were often forced to fight one-vs-one-or-more (usually versus the "more").

This Israeli experience would appear to show that the theoretical problem of comm-jamming/multi-bogey environments is a real one for any air force committed to team tactics, especially if that air force anticipates having to achieve air superiority in the face of such conditions. Is this propsect one which the American fighter community ought to anticipate? I would maintain that it is for two reasons. First, the actual combat employment of communications-jamming and multiple-bogeys to undercut Israeli teamwork was made by air forces largely outfitted with Russian weaponry and steeped in Soviet air defense doctrine. Hence, in any future conventional conflict we might reasonably envision with Communist countries--particularly in Europe against the Warsaw Pact nations--these methods are likely to be seen again. Second, the structure of American conventional forces is so heavily predicated upon the (relatively unlimited) availability of tactical airpower that, if confronted with large numbers of enemy fighters and comm-jamming, it seems altogether unrealistic to expect that we would be able to put off the task of winning air superiority for a better day. This second point involves, of course, considerations which go well beyond the scope of air combat doctrine per se. But since they rule out one logically possible response to comm-jamming/multi-bogey situations--namely that of simply refusing to contest control of the air under such conditions--they do merit discussion here.

Broadly speaking, conventional air superiority is sought for two reasons. First, control of the air allows you to employ your own air arm as an offensive weapon for

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66 Hotz, "Israeli Air Force Faces New Arab Arms," p. 16. This article was filed from Tel Aviv and, apparently, Mr. Hotz had personally examined some of the Israeli gun-camera film from the October War when he wrote it. I would add that the footage I have seen confirms his observations.

67 The official Israeli Air Force claims for aerial combat during the October 1973 war were no less than 370 Egyptian, Syrian, and Iraqi fighters downed for only 4 Israeli losses (Herbet J. Coleman, "Israeli Air Force Decisive in War," Aviation Week and Space Technology, 3 December 1973, p. 18; David Nicolle, "The Holy Day War," Air Enthusiast International, Vol. 6, No. 5, May 1974, p. 248). Three of the Israeli losses and over 200 of their kills were supposed to have occurred against the Egyptian Air Force (Coleman, Israeli Air Force Decisive in War," p. 21). However, the Egyptians have recently disputed the Israeli figures. In fact a single Egyptian MIG-21 regiment (three squadrons) now claims to have downed no less than 22 Israeli fighters in air combat during the '73 war, and gun-camera film to back up at least some of these claims has been made available to western observers (Robert Hotz, "Egypt Plans Modernized Air Arm," Aviation Week and Space Technology, 30 June 1975, pp. 14-15). Thus, for the present at least, it would appear that definitive figures for the aerial combat which took place during this conflict simply are not available. (For additional analysis of the data at hand, see footnote 91.)

68 "Israelis Scored About 335 Air-to-Air Kills," Armed Forces Journal International, April 1974, p. 32.

striking directly against the enemy's war machine. Second, it enables you both to shield your surface forces against enemy air attack and to use your attack aircraft as "flying artillery" in close support of the ground battle.[69] Naturally the value to any belligerent of being able to capitalize on airpower in these ways depends upon the overall structure of that combatant's military forces and, even in recent decades, some military organizations have managed to achieve significant successes without any great reliance upon tactical airpower.[70] American military forces, however, are fundamentally built around mechanized mobility and firepower (in the sense of substituting technologically advanced weapons systems like modern warplanes and armor as much as possible for human bodies). In fact, the last time an American field army attempted a major campaign without

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69 To date, the most unambiguous illustration of the enormous potential of tactical airpower to influence, if not determine, the outcome on the ground has undoubtedly been the Arab-Israeli War of 1967. In that conflict the massive interdiction and close air support efforts of the Israeli fighters in the Sinai, for example, proved so devastating that, by the morning of the fifth day of fighting (Friday, 9 June 1967), hardly a single Egyptian unit out of an original force of seven divisions remained intact (Michael Howard & Robert Hunter, "Israel and the Arab World: the Crisis of 1967," Adelphi Papers No. 41, The International Institute for Strategic Studies, London, pp. 35 & 37). Indeed, at that point the Sinai Desert was virtually littered with the debris of thousands of vehicles, including over 700 Russian-supplied tanks, and Egyptian soldiers in tens of thousands were making their way homeward across the waterless desert on foot (Howard & Hunter, p. 37). This striking success was not, of course, accomplished by the Israeli Air Force single-handed. The basic tactical instrument employed consisted of armor and fighters in tandem--a combination which originated in Britain during the 1930s (as a new theory of mobile warfare), and which first proved itself in the Nazi conquest of Poland (B.H. Liddell Hart, History of the Second World War, New York, G. P. Putnam, 1971, p. 27). Nevertheless, it was unquestionably the total air superiority achieved by the preemptive Israeli air strikes during the opening minutes of the war which shut off all possibility of an Egyptian victory in the Sinai and, in the final analysis, opened the door to what quickly became one of the most crushing military defeats in modern history. (The Israeli Air Force subsequently estimated that in the first 170 minutes of the war its fighters "... destroyed over 300 out of 340 serviceable Egyptian combat aircraft." (Randolph S. & Winston S. Churchill, The Six Day War, Boston, Houghton Mifflin, 1967, p. 85). This effectively broke the back of the Egyptian Air Force as a fighting unit and left the Israeli warplanes free to strike at will throughout the Sinai).

70 A classic example of such a success is the victory of the Viet-Minh over the French Union Forces at Diem Bien Phu. By 1953 the guerilla infantry of the Viet-Minh was exquisitely adapted to the jungle terrain and political context in which it fought. As a result, the Viet-Minh were able to prevail over the French in the battle of Diem Bien Phu without airpower of any sort. In fact, they managed to do so in the very face of round-the-clock supply and close-air support missions by (during the height of the seige) over 200 French aircraft (Bernard B. Fall, Street Without Joy, New York, Schocken Books, 1972, p. 263).

overwhelming control of the air was during the tactically ill-fated race for Tunis in 1942.[71] *Thus, given the structure and history of U.S. military forces since World War Two, it seems highly doubtful that they could expect to function successfully without a fair measure of air superiority. For us, *control of the air is more likely to be something we will have to achieve early in the battle and on the enemy's terms, even if those terms include superior numbers of fighters and communications-jamming.

The view that we need some positive doctrinal solution to comm-jamming/multi-bogey environments is equally compelling at the level of individual engagements. (Emphasis Editor's). Consider, for example, the following situtation:

You and your wingman chance across a seemingly isolated MiG. You elect to engage. As Wingie is in the best position to do so, he makes the initial attack while you pull up into the vertical. The bogey then begins a left defensive turn into Wingie's attack. Ninety degrees of turn later Wingie is approaching missile range. At this juncture you roll back right to check your bellyside. This reveals a pair of MiGs just sliding into gun range from underneath. Consequently you continue rolling away from the direction of the fight and make a slicing break down into their attack. MiGs Two and Three, however, do not wildly overshoot; instead they yo-yo deftly out of the plane of your break. While this maneuver keeps them from firing at you, they nevertheless remain well aft of your wingline and start cranking their noses back towards your tail. You, therefore, continue heading downhill, unloading in afterburner to gain some separation. At the same time you roll on around towards Wingie and try to give him a quick call over the radio. Your transmission, however, only served to trigger a bedlam of noise-jamming which obliterates your voice. Worse, yet, you see that although Wingie is still turning left, he is no longer pursuing the first MiG. Instead his nose is now coming up hard in response to the three MiGs which have suddenly appeared at his six o'clock. The lead MiG of this new trio reacts by opening fire with his gun while the trailing two begin barrel-rolling right.

The question at this point is, of course: What next? You and your wingman are headed in opposite directions, 180° phase. In addition, you can no longer talk to one another above the comm-jamming. Thus your mutual support has all but vanished. Moreover, you are both defensively engaged against superior numbers and, worst of all, the bogey pilots are giving no indications of being novices at fighter-versus-fighter combat. Faced with such a situation, what should you do? A tempting option would be to disengage. Unfortunately, that may be easier said than done:

> Lessons learned in Vietnam, the 1967 Mideast war and in current simulated training indicate there are only two ways out once engaged: win or get killed. There is generally no way one of the combatants can break off should he run low on fuel or the like.[72]

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71 Hart, History of the Second World War, pp. 338-39. The Allied failure to capture Tunis in December if 1942 was followed by the bitter American defeat at Kasserine Pass in February of 1943. In this second setback the piecemeal employment of Allied tactical aircraft was seen as a major factor in the German victory. This perception then led to the reorganization of all Allied tactical aircraft in North Africa on a coequal basis with the ground forces (see "Goddammit, Georgie!", Gen. Laurence S. Kuter, Air Force Magazine, February 1973, p. 55).

72 Michael L. Yaffee, "J101 Keyed to Design-to-Cost Approach," Aviation Week and Space Technology, 18 November 1974, p. 41

In other words, *once the individual pilot is engaged against multiple-bogeys (with or without comm-jamming), air combat experience over the past decade suggests that statistically speaking, he will have to win under such conditions just to survive. The option of avoiding combat is no longer readily available.[73] Hence it is thoroughly doubtful, both from the standpoint of individual engagements as well as from that of the present composition of U.S. military forces, that refusing to fight until the tactical situation improves could possibly provide a satisfactory doctrinal solution to the challenge posed by multiple-bogeys and communications-jamming. Quite to the contrary, it appears imperative that the American fighter community devise tactics for winning even under these extreme circumstances.

What sort of tactics then recommend themselves? One answer would be that proposed by Captain Smith in "One vs One or More". If you and your wingman find yourselves outnumbered, immediately abandon teamwork and begin fighting single-ship.[74] This suggestion does have a certain plausibility. Should the opponents be willing to pay the price, they probably can impose conditions on the air battle which will tend to break down your teamwork. Thus, you cannot always count on having mutual support with other friendly aircraft. But does this fact entail, as Captain Smith seems to feel, that anytime you encounter superior enemy numbers the best approach will be one-vs-one-or-more? I do not think so. Agreed, given the vulnerability of team systems in multi-plane or comm-jamming situations, it is imperative for each pilot to be prepared to survive as a single. Nevertheless, *the inherent defensive superiority of the team argues in favor of retaining mutual support whenever and wherever possible.[75] Single-ship tactics, therefore, should be considered a last resort, not the preferred approach.

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73 This conclusion is, as I say, a statistical result only and does not mean that disengagement is impossible (even against opponents determined to continue the fight). However, it does accurately reflect the difficulty of getting out of a fight once engaged--especially against skilled adversaries or superior numbers. *Indeed, many veteran Israeli pilots (among others) consider disengagement to be hardest (and least practiced) phase of fighter combat.

74 Subject, once again, to the proviso that if, while fighting as a single against one or more bogeys, you happen to see another friendly in trouble--and if you also happen to be in a position to help out--then you would (Smith, "One vs One or More," p. 25).

75 The question has recently been raised as to whether you should pass up a position of advantage just to maintain mutual support (see "Anything Else is Rubbish," USAF Fighter Weapons Review, Summer 1975, p. 11). From a doctrinal perspective I would answer, "Yes, in most cases you probably should." Granted, even against multiple-bogeys in a comm-jamming situation, you may well be able to score some kills you would otherwise have missed by forsaking mutual support. But it seems relatively clear that each time you do so, the chances of your being shot down in the process increase considerably. As TACM/PACAFM/USAFEM 3-1 observes (in the context of fighting as a single with an aircraft like the F-4). "The overriding consideration when engaged in single aircraft operations is that the advantage of mutual support is lost. The aircrew must be constantly aware that any maneuver performed against an individual enemy may prove disastrous if additional threats have entered the arena undetected." (TACM/PACAFM/USAFEM 3-1, Volume II, 1 April 1976, pp. 2-31)

These thoughts appear especially germane when you begin reflecting upon Egyptian SAM (surface-to-air missile) tactics during the October '73 war. On at least some occasions the Egyptians allowed their SAM batteries to engage Israeli fighters even though the Israeli aircraft were intermixed with Egyptian MiGs (Hotz, "Offense, Defense Tested in 1973 War," pp. 17-18). This innovation marked

These conclusions can be used to generate a fairly specific doctrinal response to those tactical situations in which team mutual support tends to break down. The basic idea would be simply to retain teamwork as much as possible rather than jettisoning it. A tactical system predicated on this principle might work essentially as follows. Patrol would be conducted in elements of two using current combat spread formations. Upon engaging the two-ship element[76] would employ standard Loose Deuce tactics,[77] fighting as a team as long as local conditions permitted. Positions of advantage, even shots, would be passed up to maintain mutual support. When forced to separate, however, neither team member would hesitate to adopt one-vs-one-or-more tactics and continue fighting single-ship.

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a sharp departure from American experience in Southeast Asia where, in general, SAMs and MIGs were not employed in the same piece of sky simultaneously for fear that the SAM sites might shoot down some of their own fighters. By October 1973, however, the Egyptian MIGs were equipped with an IFF ("identification friend or foe") system which it was hoped would enable the SAM operators to distinguish their fighters from the enemy's. Unfortunately this solution did not prove 100% effective. As the Egyptians themselves later admitted, they shot down some of their own fighters despite the IFF capability (Hotz, "Offense, Defense Tested in 1973 War," p. 17). Nevertheless, Egyptian air force and air defense commanders have insisted that the tactic of using both interceptors and surface-to-air missiles in the same airspace was proven operationally sound and militarily effective in '73 since the "...losses from friendly missiles were so relatively small..." (Hotz, "Offense, Defense Tested in 1973 War," p. 18). Naturally you tend to suspect that some of the Egyptian MIG drivers who saw their buddies killed by "friendly" SAMs may disagree with this assessment. Still, the point for us is that the next time American fighters are committed to battle it is not only a foregone conclusion that they will have to face a variety of advanced SAM systems, but there is also a distinct possibility that they will end up having to fight SAMs and MiGs at the same time. Survival in such an environment is going to be a tough proposition, but I would argue that the team will tend to survive better than the single pilot fighting alone.

76 For purposes of exposition I have specified a formation size first. This ordering, however, does not accurately reflect the logical and conceptual priorities of the situation. The choice of the two-ship element was in fact, driven by the prior selection of an engagement concept designed to deal with multi-bogey/comm-jamming environments. I mention this point because, traditionally, the selection of a formation often appears to have preceded the selection of a system logic (that is, of appropriate patrol, attack and disengagement concepts). Blesse, for instance, justified the four-ship team prior to and independently of the system logic underlying Fluid-Four (see Blesse, "No Guts, No Glory," p. 4). I would suggest, however, that this ordering puts the cart before the horse; in the design of tactical systems for air-to-air, the selection of a system logic should come first.

77 I specify Loose Deuce here rather than, say, Double Attack because in its full-blown form Loose Deuce is a somewhat more flexible and complete system. As mentioned in footnote 43, Loose Deuce is not tied as rigidly as classic Double Attack to a strict series of sequenced passes. In addition, Loose Deuce, at least as it is currently flown within the Navy fighter community, exhibits a well-developed "double defense." (Historically, perhaps the greatest single drawback to Double Attack was its overconcentration upon offense. Riccioni, in particular, was quite open in expressing this tendency. For example, 1957 he wrote that Double Attack "...is the literal manifestation of the concept -- Attack, attack, then attack, attack, attack" (Riccioni, "A Proposed New Method of Employing the F-100C in Combat," p. 12). In light of such attitudes, it is easy to see why the proponents of Double Attack type systems tended to overlook the need for a sound "double defense.")

But if either man was later to find another friendly (or pair of friendlies) with whom he could team up, he would do so. The newly formed team would then revert to Loose Deuce (or a three-ship variant of Loose Deuce) and again strive to preserve element integrity. Lastly, all friendly fighters would attempt to disengage with at least one other ship whether appreciable team fighting had been possible during the engagement or not.

I shall call the aerial attack system just described 'two-vs-one-or-more.' It is fundamentally a team approach. Its engagement concept, however, incorporates a single-ship mode for those extreme circumstances in which team mutual support tends to break down. The major doctrinal difference between this system and Captain Smith's one-vs-one-or-more stems from divergent attitudes regarding the value of teamwork: whereas in two-vs-one-or-more mutual support is sought throughout the fight, in one-vs-one-or-more it is abandoned from the outset.

Is two-vs-one-or-more truly a more satisfactory doctrinal response to the sorts of tactical conditions which communications-jamming/multiple-bogey environments could potentially create than either the team or single-ship? I think that it is. If team tactics can be used, they generally offer a better way of fighting than single-ship. (Establishing this proposition, once again, was the main point of sections 2 through 6.) But, at the same time, circumstances plainly exist in which team systems tend to fall apart. (This proposition, of course, has been the central theme of the present section.) The problem which has emerged then, with respect to the air combat arena of tomorrow, is that of devising an aerial attack system which can take into account both of these conclusions. I would submit that two-vs-one-or-more does this better than either Captain Smith's essentially single-ship proposal, or the "double attack" type team systems currently in use throughout the American fighter community. For by avoiding complete allegiance to the team, or to single-ship, two-vs-one-or-more avoids the theoretical limitations of both.

As obvious as this solution may be once it has been stated, it nevertheless does not seem to have occurred to either side in the doctrinal debate which has followed the publication of Captain Smith's "One vs One or More." On one side of the controversy, (Navy) Lt. Stuart McFarland, articulating much the same objections to Captain Smith's single-ship proposal that I have posed, has argued:

> Although visibility, ECM and RHAW gear, GCI and aircraft performance have all been greatly improved over the years, none can provide the degree of mutual support gained by the presence of an aggressive and responsible wingman. While AWACS and/or GCI <u>may</u> warn you of a threat at six o'clock, neither can shoot him off of your tail. The problem of "execution relative to your leader" restricting maneuverability and flexibility is non-existent in properly flown "loose deuce," and verbal coordination between a section, when used correctly, enhances both survivability and lethality.
>
> .....
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> We have all, at one time or another, fought as a single against more than one bogey (e.g., as the one in a 2 v 1), and I must admit that it is easier. Not easier to WIN, but easier to fly. It takes practice and discipline to fight as a section; keeping track of your wingman, coming up with a plan, and talking that plan to a kill against your enemies. But the best one-on-one driver flying the best fighter money can buy will consistently lose when pitted against a well tuned section of even inferior aircraft. That has been my experience.[78]

78 Lt. Stuart E. McFarland, "Opinion on Opinion," USAF Fighter Weapons Review, Summer 1975, p. 37. 'ECM stands for electronic countermeasures,' 'RHAW' for

In defense of his proposal, Captain Smith has replied:

> There are three points in Lt McFarland's critique that I would like to comment on. The first is his mention of "verbal coordination between a section." In a comm-jamming environment, such "coordination" will not be available. The tactic of "splitting, isolating, and killing" requires time and local numerical air superiority. In the European theater, we will not have that time or superiority, as projected by our planners.
>
> The last point is that although "loose deuce" is an excellent option for certain airplane limited scenarios, I think each time a new scenario presents itself, a total reassessment of tactics is required, not necessarily the readaptation of existing tactics.[79]

Now the puzzle in these two passages is figuring out exactly where the source of the disagreement between Captain Smith and Lt McFarland lies. After all, Lt McFarland is surely on solid ground in maintaining that, generally speaking, the team is the better way to go (assuming that a genuine choice between it and single-ship exists). Similarly, despite the overall superiority of the team, Captain Smith appears equally justified in his insistence that the next time we have to engage in fighter-versus-fighter combat to attain air superiority, there are almost certainly going to be occasions when single-ship will be the only option available to our aircrews. Thus, although Lt McFarland and Captain Smith obviously want to emphasize different aspects of the problem, it is hard to see the sort of substantive conflict between the points they do stress which would suffice to entail the totally opposed approaches to multi-bogey/comm-jamming environments they ultimately recommend. Where then do they part company?

The answer is to be found, ironically enough, not in anything Captain Smith and Lt McFarland disagree upon, but in a tacit assumption they both appear to accept--namely, that in each and every engagement the fighter pilot MUST make an either-or choice between some team system and single-ship. What they both apparently fail to see, therefore, is that even within the limited scope of a single engagement, you need not fight exclusively single-ship, or exclusively as a team. There is a third alternative. Fight single-ship when necessary, but revert to team tactics whenever and wherever the opportunity presents itself. It is, once again, seizing upon this third alternative that constitutes the heart of my two-vs-one-or-more proposal.

The basic argument for two-vs-one-or-more then rests upon the inherent desirability of mutual support. This line of argument, however, still leaves one question unanswered: Is the wingman the best source of mutual support? Captain Smith's proposition is that in the future "...external means, such as AWACS or GCI," could be substituted for the mutual support which has traditionally been supplied by other aircraft.[80] But, as I suggested in Section 6, the preeminent problem with this view is reliability. If you were, for example, roaring about the air combat arena in your highly visible F-15 depending strictly on the AWACS to cover your six o'clock, you would surely be betting

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'radar homing and warning,' and 'GCI' for 'ground controlled intercept.' GCI was originally introduced into aerial warfare during the Battle of Britain. It was later used extensively against American pilots both in MIG Alley and Viet Nam (Johnson, Full Circle, p. 261). Fighter RHAW gear was developed during the Viet Nam era to provide U.S. aircrews with real-time warnings against the Soviet-built SA-2 system.

79 Captain Dave Smith, "Opinion on Opinion," USAF Fighter Weapons Review, Summer 1975, p. 37.

80 Smith, "One vs One Or More," p. 25.

a lot of marbles on the voice in your headset. So many of the marbles, in fact, that a large dose of out and out skepticism seems in order. For instance, what might happen to you if the enemy possessed a way to jam or deceive the AWACS' radar systems? (The Russians, after all, are very big on electronic warfare.) Or what if a transistor in your radio suddenly went and you could not longer receive the AWACS' warnings? Or what if the AWACS was forced far enough back from the battle area that it lost the resolution necessary to pick you out of the fight? (Given, say a 50-airplane melee riddled with SAMs, chaff, and assorted jamming, this circumstance does not seem beyond the realm of possibility.) In each case, the answer is that you may very well find yourself taking hits before you even realize that something has gone wrong. (Recent F-15 experience suggests that in dense, multi-plane engagements it only takes about 15 seconds of looking in the wrong direction to get yourself shot down.)

From the standpoint of reliable mutual support, then, the wingman still has a lot to offer. His eyes can usually be depended upon even in those situations in which radar warning and control systems (airborne or otherwise) fail. Also, your wingman's stake in your personal part of any air battle will necessarily be more intimate than a controller's. Finally, as Lt. McFarland has so succinctly pointed out, a good wingman can do a bit more than just scream "BREAK!!!" when you are about to be nailed; he can shoot at the bogey as well.

Of course, the viability of the wingman does not mean that systems like the AWACS should be disdained. The smart fighter pilot is going to take full advantage of anything and everything he has available to him. But, at the same time, I would argue that abandoning teamwork altogether just because the AWACS happens to be up on a given day is simply begging for trouble. To substitute a system like AWACS for the well-trained and aggressive wingman is to multiply considerably the complexity and sheer number of things on which your survival hangs.

***Yet there is one relatively viable alternative to the wingman--the backseater. With a two-place fighter you can, in essence, take the wingman's eyes out of his airplane and put them inside your own. In terms of "worst case" scenarios, this approach to mutual support would appear far preferable to either AWACS or GCI. While the wingman's ordnance would be lost, and while the backseater (even in modern fighters like the F-14) cannot see into the blind area below your airplane as a wingman normally can, "mutual support" with your backseater can be counted upon no matter how badly outnumbered, or how successfully comm-jammed you happen to be. Moreover, a properly used backseater can also absorb enough of the frontseater's defensive workload so as to free him to concentrate almost exclusively on the kill. Thus, the backseater clearly offers impressive defensive capabilities. *(Indeed, looking at the kinds of conventional scenarios our planners anticipate, for example, in N.A.T.O. Europe, the optimum approach would undoubtedly be to employ two-vs-one-or-more tactics with two-seat fighters.)

At present, however, the two-seat fighter appears to be on the way out insofar as the Air Force is concerned. As the F-15 and F-16 come into the inventory, T.A.C. will be increasingly committed to one-place aircraft for the air superiority mission. Very likely, this trend can be justified in the case of the F-16. Given the small size of the F-16, the added weight of a second occupant together with his ejection seat and other assorted equipment would probably entail an unacceptable degradation in the airplane's basic performance.[81] But, in the case of the F-15, the decision to go

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81 *I think the proper way to formulate the trade-offs here is as follows: Given a choice between a two-place machine which could be beaten by its likely

single-seat is much harder to defend. As a matter of fact, I would suggest that it flatly flies in the face of extensive F-4 combat experience from Southeast Asia where, time and again, the extra eyes in the backseat proved their defensive worth.[82] Nevertheless, as valuable as the backseater appears to be, I would still argue that the wingman is the more desirable alternative on the grounds that two (2) shooters are almost always going to be better than one. At best, the backseater only provides DEFENSIVE mutual support whereas the wingman can make great contributions on offense as well.

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opponents and a single-seater which could stay even (or win), you would have to go with the single-seater. But, given a choice between a superior single-seater and a two-place machine which could at least stay neutral with any adversary, you would undoubtedly be better off with the extra eyes. (Also, if the rationale for the backseater lies primarily in the rearward visual lookout he can provide, then why not put the second seat in facing backwards?)

82 One indication of the backseater's worth is the claim that, over North Viet Nam, a substantial portion (around 40%) of the initial tallyhos (eyeball pickups) against MIGs by Navy F-4 crews was from the backseat. Moreover, training since the Viet Nam War has consistently confirmed the implications of Southeast Asia experience with two-seaters such as the F-4. Of particular note in this regard is a 25-ship everybody-against-everybody fight which "TOPGUN" ran out of Miramar Naval Air Station in May of 1975. The object of the exercise was to simulate the tactical environment which the Israeli fighter pilots faced in the 1973 Mideast War. Highly experienced aircrews and a variety of aircraft types (the F-14, F-5, F-4, A-4 and F-8) were used to try and determine now best to survive when you are without a partner and everybody else in the sky is trying to shoot you down. Without exception, the two-place fighters did the best. Starting with the aircraft that survived better than any of the others and working down, the top performers were the T-38, the F-14 and the F-4. At the bottom of the heap was the F-8 which got hammered by everybody. As a result of such experiences, staff-members at TOPGUN generally prefer the T-38 to the F-5 for multi-plane engagements on the grounds that the extra eyes more than compensate for the loss in performance. (Incidentally, the F-14's short-coming relative to the T-38 in this experiment was felt to be its great size. The F-15, of course, shares this same liability--an enormous visual profile anytime it throws up a wing to maneuver. Such size is a real drawback--especially in multi-bogey environments against significantly smaller opponents. As one veteran Israeli ace commented in 1975, "I don't want to be the biggest target in the sky. The biggest target draws all the fire first." (Hotz, "Israeli Air Force Faces New Arab Arms," p. 17). The F-15, then, has two substantial liabilities in multi-airplane situations: it is a one-place machine, and it is very easy to see relative to many other fighter aircraft.)

Thus far, the focus of this essay has been upon three principal issues. Are team approaches to aerial combat superior to single-ship? Can the mutual support of team systems be broken down? And, lastly, is my two-vs-one-or-more proposal a better solution to multi-bogey/comm-jamming environments than either Loose Deuce or one-vs-one-or-more? The reasoning and evidence which have led me to answer all three of these questions affirmatively constitute, of course, the doctrinal case forexpanding current air-to-air tactics in the direction of two-vs-one-or-more. Having formulated this case as persuasively as I can, I now want to take up the opposite side of two-vs-one-or-more: its weaknesses and limitations.

Delineating the shortcomings of the very system which I have been laboring to justify may seem a bit self-defeating. Nevertheless, doing so is necessary. For one thing, this enterprise furnishes an important word of caution about two-vs-one-or-more: namely, that it is no more a final solution to aerial combat than, say, Blesse's Fluid-Four was. At the same time, however, the various weaknesses of two-vs-one-or-more which substantiate this point also suggest the considerably more far-reaching conclusion that, in all likelihood, a final answer to the problem of fighter-versus-fighter combat does not exist.

The greatest drawback to my two-vs-one-or-more proposal as compared with any prior system for air-to-air, lies in the fact that it adds yet one more burden to the maniford demands already imposed upon the aircrew by the realities of contemporary aerial combat.[84] The system's engagement concept has, after all,

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83 A preliminary piece of evidence for this second conclusion can be seen in the evolution which mutual support between Fluid-Four elements underwent after the Korean War. In Blesse's original formulation of the system, "shooter-cover" was the preferred engagement strategy not only WITHIN individual elements, but BETWEEN them as well. (Blesse, "No Guts, No Glory," pp. 4 & 8). In this "tight" (or classical) version of Fluid-Four, three flight members were normally to be used to cover the fourth. (Of course, Blesse did recognize the need for occasional deviations from a rigid "shooter-cover" approach. For examples see footnote 118.) However, while most Air Force pilots subsequently retained "shooter-cover" WITHIN the two-ship element, it was gradually dropped BETWEEN elements. Indications of this trend appeared as early as 1957. Where Blesse had insisted that the primary function of the second element lay in "...allowing the lead element to complete successfully any attack begun,"and that splitting the elements prior to fulfilling this function was not generally to be condoned (Blesse, "No Guts, No Glory," p. 8), Boyd dropped all mention of the second element as a "cover" and instead argued, prior to the advent of Double Attack, that both elements could be employed as attackers. For instance, in discussing how a flight of four should attack another four-ship flight, Boyd suggested performing "...the attack in staggered trail" in the hope that if the defenders managed to elude the lead element, they would simply set up the support element (which, by this time, was being referred to as the 'fluid element', Boyd, "Air Combat Maneuvering," p. 29). And in a subsequent reworking of Boyd's 1957 piece, this line of thought was carried even further. Specifically, it was suggested that in a situation such as four friendlies attacking four bogeys, the elements would have to press the attack "...as separate elements." ("Air Combat Maneuvering--Part III," Fighter Weapons Newsletter, March, 1963, p. 29).

The overall drift of these alterations in Blesse's original formulation of Fluid-Four should be obvious. As time went on, "shooter-cover" between the elements was gradually replaced by a much more co-equal relationship: Increasingly the tendency was to view the lead and fluid elements as equal partners, each of which would support the other as necessary. This basic attack strategy sounds, of course, quite close to that used in contemporary Loose Deuce, and in fact it is. By the summer of 1971, the Aerial Attack Section at Nellis had become quite adamant on this point, explicitly describing Loose Deuce as:

> ...a very well thought out tactical doctrine which resembles the concept of employment taught at the USAF Fighter Weapons School,with the exception of the use of wingmen. (USAF Fighter Weapons Review, Summer 1971, p. 34.)

This evolution in Fluid-Four suggests several points. To begin with, at lease the distinct versons of the Fluid-Four System can be distinguished: Blesse's original version in which a "shooter-cover" approach was used both within and between elements; and a later, Vietnam-era version (for lack of any other label), in which "shooter-cover" was retained within the elements while a "double-attack" approach was advocated BETWEEN them. Note, regarding this later version of Fluid-Four, that it reduces to pure "shooter-cover" any time the elements become separated (or unable to assist one another). Thus, given how difficult coordination between Fluid-Four elements proved to be in MIG Alley (see footnote 38), and the fact that such coordination was seldom practiced during the 1960s (see footnote 51), the actualization of this later version as a widely consolidated departure from Blesse's straight "shooter-cover" approach may be questioned on the grounds that, during the Vietnam era, few line aircrews had the skill to exploit it. Nevertheless, from the standpoint of my contention that a final system for air-to-air appears altogether unlikely, the evolution of mutual support between Fluid-Four elements does show that within modern Air Force experience air-to-air tactics have always tended to evolve. Reasons as to why such evolution may be inevitable are suggested in Section 9.

84 Although the airplanes and weaponry used in fighter combat have undergone enormous technological evolution since the First World War, the fundamentals of the air-to-air engagement itself have changed little, if any, right down to the present day. The fundamental goal continues to be what it always has been: to shoot down the opponent's machine. Moreover, the physics of the air combat arena seem to set a relatively small upper bound on the number of truly different "basic fighter maneuvers" which can be employed to reach a firing position against your adversary. (John R. Boyd's 1960 Aerial Attack Study constituted the first systematic attempt to specify every move and counter-move possible between single fighters, pairs of fighters, and four-ship flights of fighters. His effort appears to have been successful: despite much subsequent analysis and experimentation in the area of basic fighter maneuvers since 1960, not one genuinely new maneuver has been discovered.) Finally, I would argue that since the days of Boelcke and Immelmann only three distinct employment concepts have seen widespread use in the air combat arena: the "lone wolf" (or single-ship) approach pioneered by individualists like Ball and Guynemer, the "shooter-cover" approach first definitively formalized by Werner Moelders, and the "double-attack" approach currently being used in Loose Deuce and Fluid-Two.

two modes: Loose Deuce and single-ship. Consequently, aircrews employing the system--particularly in the sorts of situations which led me to propose it--will be constantly faced with the problem of discerning those precise circumstances which warrant shifting from one mode to another. To pose a specific example, should you, operating as a single, break off an attack 1000 feet outside of effective firing range just to join up with another stray friendly? Probably few fighter pilots would. Nevertheless you certainly can imagine tactical environments in which that would be the prudent course. Or, to cite a different kind of situation, if it appears that section integrity will soon be lost anyway, should you and your partner go your separate ways then and there (rather than waiting for your opponents to force you to do so)? Again, while the engagement concept of two-vs-one-or-more does specify staying together as long as practicable (as well as regaining mutual support anytime the opportunity presents itself), this general prescription is not all that helpful in deciding what to do in specific situations.

How then are actual cases to be decided? I am not even going to attempt a detailed answer to this question. For one thing, such matters as what to do if you happen to be 1000 feet outside of firing range when you spot another stray friendly can only be resolved if you first completely spell out the actual situation. (For instance, if you were closing with 100 knots of overtake on an unsuspecting bogey, you might reasonably decide differently than you would if you were stagnated behind a wiley defender who had already seen you.) For another, such situations concern life-and-death choices which are properly left to the individual crew member as the one who will have to pay the price for any serious misjudgments. Still, some general guidelines can be indicated as to how answers to such explicit applications of two-vs-one-or-more might be best worked out. I would suggest two precepts. THINK about two-vs-one-or-more, and PRACTICE with two-vs-one-or-more.

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84 (cont) Nevertheless, as Major Gail Peck pointed out in 1973 (see "Enemy Weapons and Tactics: An Introduction," USAF Figher Weapons Review, Fall 1973, p. 27), technology has substantially altered one facet of air-to-air combt: since the Second World War it has increased both the number and complexity of the tasks demanded of the aircrew. For example, surface-to-air missiles have added a whole new dimension to the air defenses which the fighter crew must be able to handle (see footnote 75). Simultaneously this same technology, in the form of the air-to-air missile, has multiplied the weapons options available to the fighter pilot for shooting down his adversaries. (The F-4E, for instance, can carry three types of air-to-air armament: an internal 20 mm cannon, infrared Sidewinder missiles, and the radar-guided Sparrow.) The addition, the kinetic energy levels of jets in general have made vertical maneuvering far more practical (and hence obligatory) than it was (say) in World War Two (where most of the fighting tended to occur in single horizontal planes). As a result, it is now fairly important for line fighter crews to have some insight into energy-maneuverability concepts (for an up-to-date exposition of energy-maneuverability, see John R. Boyd, Thomas P. Christie and Robert E. Drabant, Maximum Maneuver Concept, a classified technical report dated 25 September 1972). Finally, the transonic characteristics and great energy-addition rates of the newest fighter aircraft (the F-14, F-15 and F-16) have palpably shrunk the minimum times in which kills can be achieved, thus compressing further the already split-second pace of modern aerial combat (just as the higher sustained G loads permitted by these latest machines have increased the physical stresses imposed on the aircrews during maximum performance maneuvering).

Regarding the injunction to think about the system, even the most cursory analysis of engagements in which American fighters were downed by MIGS during the Vietnam War tends to confirm a point which perceptive veterans of aerial warfare have always known: THE REASON MOST INDIVIDUALS WIND UP BEING SHOT DOWN IN AIR-TO-AIR COMBAT IS THAT THEY MAKE ELEMENTARY ERRORS WHICH THE EXPERIENCED, WELL-TRAINED PILOT WOULD BE UNLIKELY TO COMMIT.[85] Furthermore, in a good portion of our Southeast Asian losses the actual mistakes which proved fatal can be traced to little more than a lack of mental preparation on the part of the aircrews involved. To be specific, many of them simply had not thought through the sorts of easily foreseeable contingencies[86] in which they ultimately found themselves enmeshed and, as a result, made gross errors which led directly to their being shot down. The implications of this fact relative to the practical problem of delineating the interface between the team and single-ship modes of two-vs-one-or-more should be obvious. Aircrews who intend to use the system must spend time thinking through scenarious involving transitions from one attack mode to the other. Granted, you are probably never going to be in the ideal position of having worked out in

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85 In March of 1975, Lt. Col. Jerry H. Nabors summarized the Air Force's reasons for having established the 64th Fighter Weapons Squadron to the Senate's Tactical Air Power Subcommittee as follows:

> During the Southeast Asia conflict, an extensive study was accomplished to reconstruct each MIG encounter that occurred in the war. The objective was to determine the reasons for success or failure in the encounter and to identify problem areas...
>
> The most common problem found could be summed up in the words 'insufficient training and experience in air-to-air combat.' The air-to-air training that had been conducted was conducted against similar aircraft using USAF tactics. Yet most of the maneuvers and tactics employed in attacking or defending in aerial engagements depend upon performance characteristics of your aircraft versus your adversary's aircraft, correct estimation of his range, and knowledge of his tactics. It was determined that similar aircraft training--for example F-4 versus F-4--was unsatisfactory when engaging better turning MIG aircraft. Visual lookout procedures and training were adequate to acquire an aircraft of similar size to yours, but grossly inadequate to detect the smaller MIG's. As a result, many kills were obtained by the enemy totally undetected until it was too late to react. (Quoted from Grasset, "Dissimilar Air Combat Training--a revolution in realism," p. 825).

86 For instance, what should you and your partner do during a "hot" intercept when the GCI controller reveals that your radar return has merged with the bogey's? One thing you definitely would be ill-advised to do is to turn on the "merge plot" call since you may, as happened on at least one occasion over North Vietnam, roll out right in front of a hostile fighter rather than behind it. Or, to mention a really basic example, what should you do when you see an Atoll headed at your airplane? Clearly you need to do a bit more than just make a radio call to tell yourflight leader about it. (By way of trying to get aircrews to consider such situations in advance, TOPGUN currently devotes one lesson in its academic syllabus to analyzing each of the Navy's 14 losses to MIGs during the Vietnam war. The lecture is quite striking: in each engagement the aircrews involved committed at least one, and often several, elementary errors.)

advance viable responses to every possible contingency you might someday run across in combat. Still, the more time you have invested in thinking and talking about the system prior to takeoff, the better prepared you will be to employ it in the air without committing any gross mistakes.

As for the injunction to practice with two-vs-one-or-more, the point I would make here is just that in conjunction with rigorous mental preparation on the ground, you also need to go out and actually fly with the system under reasonably realistic conditions.[87] The accumulated evidence linking success and failure in the air combat arena directly to such training--no matter what system of tactics you adopt--is enormous.[88] Hence with an attack system of two-vs-one-or-more's sophistication,

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87 As suggested in footnote 85, the backbone of current ACM training programs in the U.S. is the use of "adversary" aircraft which simulate, as closely as possible, the performance, visual profiles, and tactics exhibited by Soviet fighters. The efficacy of this kind of training is simple. As Captain Charles B. DeBellevue (credited with six MIG-21 kills in Southeast Asia as an F-4 backseater) aptly put it: "the first time you see another type airplane should not be in the combat arena, and it definitely should not be a MIG" (Captain Donald D. Carson, "Dissimilar Aerial Combat Tactics--New Techniques in Battle Training," Air Force Magazine, March 1973, pg. 59). (For detailed information on how dissimilar ACM training is presently being conducted in T.A.C., see Captain Richard Hardy, "Aggressively Speaking," USAF Fighter Weapons Review, Summer 1975, pp. 3-9; also, Grasset, "Dissimilar Air Combat Training--a revolution in realism," pp.826-27.)

88 A particularly striking piece of testimony regarding the importance of prior ACM experience to success in aerial combat can be found in Lt. Franz Stigler's analysis of Jagdgeschwader 27's losses to Allied fighters during the winter of 1944-45:

> During this time, most of the pilots shot down by Allied fighters were inexperienced recruits. Once in a while an old hand's luck would run out, usually when we tried to go to the aid of a newcomer who was already hopelessly lost, but the ratio was about 25 or 30 novices for every veteran. (Joseph V. Mizrahi, "Defending the Reich - Part I: Intercepting the American Bomber Streams," Airpower, Vol. 5, No. 5, September 1975, pp. 36-37.)

Moreover, this same overall pattern has persisted since World War Two. The considerable air-to-air experience of the more successful Sabre pilots in MIG Alley has already been discussed (see footnotes 33 & 34). As for Southeast Asia, the sort of systematic analysis referred to by Lt. Col. Nabors in footnote 85 has documented in detail that how well an aircrew did over North Vietnam against MIGs was, in general, a function of one thing: the quality and quantity of air-to-air experience which the aircrew took with it into the fight. By and large prior flying time (including combat time) which did not involve ACM was irrelevant.

You can begin to understand, then, why the Israelis, for example, devote so much time and energy to realistic ACM training. Simply put, it pays off (see, for instance, "Mock Dogfights Sharpened Israeli Pilots," Aviation Week and Space Technology, 3 July 1967, pp. 24-27). The classic illustration of thedirect connection between realistic training and combat success in recent American experience, however, is to be found in the impact which the TOPGUN Fighter Weapons School is perceived to have had on the Navy's success-rate against MIGs in Southeast Asia. Prior to the founding of TOPGUN in late 1968, Navy air-to-air

regularly practicing with your wingman against superior numbers of threat-like bogeys would seem all the more obligatory. Indeed, it will probably constitute the only way in which viable rules-of-thumb are likely to be hammered out concerning transitions between the engagement modes of two-vs-one-or-more. Thus, if the intimate linkage--between well-conceived precombat training and combat success is accepted, then such practice would appear to offer a fairly plausible way of dealing with the inherent complexity of two-vs-one-or-more. However, having seen one major weakness in this system, the natural thing to wonder is whether it has others.

Given all that has been said in earlier sections about the defensive shortcomings of single-ship, it is not difficult to locate a second. A large part of the rationale for two-vs-one-or-more lay in its recognition of thefact that team systems cannot be

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results over North Vietnam were basically similar to the Air Force's. In particular, 1968 was as dismal a year for the Navy as it was forthe Air Force. Through the end of May 1968 Navy fighters shot down only 9 MIGs while sustaining 10 losses; moreover, in the last months of "Rolling Thunder" (terminated in November 1968) Navy pilots fired over 50 missiles in anger without obtaining a single kill (Grasset, "Dissimilar Air Combat nraining--a revolution in realism," pp. 823-24). However, after TOPGUN the Navy's results diverged dramatically from the Air Force's. First, half of all the MIGs shot down by Navy aircrews after 1968 fell to TOPGUN graduates. At the same time,

> ...the Navy air-to-air record over North Vietnam improved by a factor of 5, from 2.42 kills for every loss in 1965-1968 to 12-1/2-to-1 for 1970-1973. And in 1972, the last full year of the Vietnam air war, Navy pilots scored 1.04 kills per engagement--every time they sa MIGs, they killed at least one. This is roughly 5 times better than the average for all fighter forces during the war, with somethingunder 0.20 kills per engagement." ("'You Fight Like You Train' and TOPGUN Crews Train Hard," Armed Forces Journal International, May 1974, p. 25.)

Further, not only is there extensive empirical support for the connection between prior air-to-air experience and how individuals do in the air combat arena, but statistical analysis of pilot losses in certain units even suggests that the goal of ACM training programs can be approximately quantified. Specifically, among American pilots who served with the French in World War One (including the Lafayette Escadrille), those who flew with Richthofen's Jagdgeschwader 1 (in World War One), and those who served with Jagdgeschwader 26 during World War Two, the probability that a given individual would be downed in fighter combat decreased by a factor of TWENTY over his first five combat trials (Herbert K. Weiss, "Systems Analysis Problems of Limited War," originally published in Annals of Reliability and Maintainability, Vol. 5 -- Achieving Systems Effectiveness, AIAA, New York, 18 July 1966). Evidently, if a training program could provide the tactical savvy necessary to survive about five average air-to-air engagements (or if, failing this, it screened out those individuals not trainable to such a level), it would almost certainly produce aircrews capable of sustaining heavily favorable exchange-rates--perhaps of 10-to-1 or better--over opponents lacking such precombat preparation and screening (Ibid.).

sustained universally. Temporarily at least you can always be isolated and forced to fight as a single.[89] But with an eye towards "worst case" scenarios (for example, trying to fight with one-seat aircraft in a multi-bogey/comm-jamming environment which tends to strip away all external forms of mutual support), how do you survive? As has already been mentioned, during the Mideast War of October 1973 many Israeli pilots--particularly those who flew the Mirage and Nesher aircraft[90] which bore primary responsibility for air superiority--were confronted with just such an environment.[91] Naturally, since similar sorts of conditions must now be anticipated in all future conflicts, at least as a possibility, this Israeli

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89 One consequence of this fact which I did not explicitly draw out in Section 7 is that the ability to fight one-versus-everybody appears likely to be a sine qua non of air superiorty for U.S. fighter forces in future wars. In light of this propsect, it seems essential that our fighter community teach single-ship tactics, train with them, and be mentally prepared to use them. (These points are paraphrased from a December 1975 letter which Captain A. Lee Harrell wrote to me after reading an early draft of this essay.)

Notice, moreover, that this perspective is quite compatible with the various claims I have made concerning the inferiority of single-ship tactics to team approaches. As was brought out at the end of Section 4, the theoretical inferiority of a given aerial attack system relative to another does not necessarily show that the weaker system is unworkable. While "lone wolf" tactics, for example, are defensively weak compared to most team systems, this fact does not mean that you absolutely cannot survive on your own. Instead, it simply implies that consistently winning as a single will generally be much harder than it would be with a well-trained wingman along to furnish mutual support. In fact, to carry this line of reasoning a bit further, in some situationsyou would probably be wise to choose an "inferior" system. Take, for instance, Blese's Fluid-Four and Fluid-Two. The various arguments given in footnote 55 seem to establish beyond reasonable doubt that the former is the inferior system of the two. But now suppose, as was often the case in the U.S. Army Air Force during World War Two, that your unit happened to be saddled with half novice pilots who lacked any appreciable air-to-air experience. True, Fluid-Two is the better system. But if you attempt using it with a green wingman, chances are that in any hard fight your section will not stay together very long. It simply takes far more practice and tactical experience to be able to hold a Fluid-Two section together than the novice can be expected to acquire in combat prior to being separated and shot down. On the other hand, if yournovice pilots at least possess the basic stick-and-rudder skills needed to handle their machines competently, it will probably not take all that long to train them to the pointwhere they can hang on as fightingwingmen. Admittedly, the mutual support you can expect from inexperienced "fighting" wingmen would not be great in comparison with that potentially available in Fluid-Two. Still, compared with the alternative--winding up single-ship--Fluid-Four is probably the wiser choice in this particular set of circumstances on the grounds that some mutual support, however marginal, is better than none at all.

90 Coleman, "Israeli Air Force Decisive in War," p. 18. The Nesher aircraft consists of an Israeli-built airframe, similar to that of the Mirage III/5, fitted with the French Atar 9C turbojet and Israeli electronics; about 40 of these planes are said to have taken part in the October 1973 war ("Jane's All the World's Aircraft Supplement," Air Force Magazine, October, 1976, p. 41).

experience has generated much concern within the U.S. fighter community over how to survive under such conditions and, as it turns out, many of the suggestions that have been made directly address this secondweakness of two-vs-one-or-more. What I will do now, therefore, is simply list the more important pilot rules-of-thumb currently being offered as techniques for staying alive in multi-bogey/comm-jamming environments.[92]

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91 As I pointed out in footnote 67, official Arab and Israeli air-to-air claims from the 1973 war are still quite disparate. However, less committed sources than the belligerents themselves have estimated Israeli losses in air combat at around 10% of the 108 fighters which Israel is believed to have lost during the fighting (Nicolle, "The Holy Day War," p. 248). Assuming that neither of these statistics is wildly wrong, it would then follow thatthe Israelis lost roughtly 11 fighters to MIGs in October 1973. If so, you wouldhave to presume, given the scope and intensity of the air battles reported to have taken place, that the Israeli pilots managed to adapt themselves fairly successfully to the multi-bogey/comm-jamming environment in which they had to fight. After all, using my speciulative figure of 11 air-to-air losses and a low estimate of 335 for the Israelis' kills (Grasset, "Dissimilar Air Combat Training--a revolution in realism," p. 823; Armed Forced Journal International, April 1974, p. 32), their kill-ratio still exceeds 30-to-1.

What sort of specific tactical adjustments did the Israeli pilots make? In general they pretty much limited themselves to the quick, high angle-off shots and then broke away before anyone could get behind them (Hotz, "Israeli Air Force Faces New Arab Arms," p. 16). In contrast to 1967, the Israelis did not insist on maneuvering with their opponents long enought to close to gun ranges (Ibid.). Instead they took the easy infra-red missile shots and just kept on going.

Significantly, however, both Israeli and Egyptian pilots have stated since the war that there were occasions when Egyptian fighters managed to reach valid firing positions on Israeli aircraft and yet were unable to convert these opportunities into kills (Hotz, "Israeli Air Force Faces New Arab Arms," p. 17; Hotz, "Egypt Plans Modernized Air Arm," p. 18). These missed opportunities have been mainly attributed to inadequacies in the Russian-supplied K-13 Atoll missile and the tendency of the MIG-21 gunsight to tumble beyond about 2.75 Gs (Hotz, "Egypt Plans Modernized Air Arm," p. 18). It therefore, appears that the Israelis were correct in saying that the "...most significant factor..." in their ability to dominate four Arab air forces as dramatically as they apparently did in the 1973 war was the superiority of their air-to-air armament (specifically of the Israeli-built Shafrir and late-model U.S. Sidewinder missiles--Hotz, "Israeli Air Force Faces New Arab Arms," p. 16). The obvious implication of these facts is that if the Arab pilots had possessed a good infra-red missile in 1973 they undoubtedly would have downed more Israeli fighters than they did. How many more? You can only speculate. Still, despite the high caliber of the front-line Israeli pilots it is conceivable that WITH A FIRST-CLASS MISSILE THE ARAB AIR FORCES WOULD HAVE BEEN ABLE TO IMPOSE AN UNACCEPTABLE EXCHANGE-RATE ON THE ISRAELI AIR FORCE.

92 This particular set of tactical principles for multi-bogey/comm-jamming environments was largely culled from a "two-versus-many" lecture given by LCdr. Alex Rucker as part of the "TOPGUN" syllabus for Class 04-75. The specific phrasing of most all of these rules goes at least back to the time of the "Linebacker" operations. For example, the expressions 'Your fight like you train' and 'Speed is life' were used by Lt. Randy Cunningham duringthe intelligence debriefing of the 10 May 1972 engagement in which he and his backseater, Lt. Willie Driscoll,

1. BE READY FOR THE ENVIRONMENT. In one-versus-everybody situations, the more attention you can devote to the fight itself, the more likely you are to survive. Hence it is imperative to enter the air combat arena fully prepared. In particular:

1a. KNOW YOUR AIRPLANE. The pilot must be able to judge his airspeed, angle-of-attack, and energy-state without looking inside the cockpit. In addition, he has to be up on such things as his machine's stall indications, corner-speed, and optimum altitude/airspeed regimes for fighting each possible threat aircraft.

1b. KNOW YOUR WEAPONS. The "switchology" for getting ordnance off must be down cold. Similarly, the pilot has to be able to recognize visually firing parameters for all the weapons he happens to be carrying. After all, when the sky is black with MIGs you don't want to waste either bullets or missiles.

1c. STUDY THE PERFORMANCE CAPABILITIES OF POSSIBLE THREAT AIRCRAFT AS WELL AS THE WEAPONS ASSOCIATED WITH EACH. The other guy's limitations tell you how to set about killing him. Conversely, his capabilities reflect how he can get to you.

1d. TRAIN!!! Since most pilots tend to fight like they train, PRACTICE AS OFTEN AND REALISTICALLY AS YOU CAN. The place to begin working out crew coordination and support tactics for multi-plane/comm-jamming environments is not the combat arena. Do that in training where you can safely learn from your mistakes. In particular, practice fighting both as a single against two or more bogeys, and as a section against two or three times your number.

2. SURVIVE FIRST, KILL BOGEYS SECOND. True, your job is to shoot down bad-guy airplanes. But if you plan on staying alive, it is essential to temper aggressiveness with intelligence. For instance, you must be willing to give up shots to avoid being shot down yourself.

3. WHILE MUTUAL SUPPORT WITH OTHER FRIENDLIES MAY BE ACCIDENTAL AT BEST, GET AS MUCH OF IT AS YOU CAN.

4. STAY FAST--SPEED IS LIFE. The faster you go, the longer it will take bogeys to close to lethal ranges from behind. So gain energy whenever you can and don't waste it with unnecessary maneuvering.

5. BE UNPREDICTABLE! This precept, like Rule 1, has a host of ramifications. Among them are:

5a. AVOID THE TURNING FIGHT. If you do any great amount of turning in this environment, you are bound to give some of the bogeys shots. Thus you must resist the temptation to start turning. At the same time, when you do turn, TURN HARD. (The rest of the time go as fast as you can.)

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scored their third, fourth, and fifth kills. The substance of these rules, however, can be traced back much further. See, for instance, (then Captain) Duane W. Beeson's discussionof the "Speed is life" concept in Kepner's 1944 compilation of air-to-air experience within the Eighth Air Force (Kepner, The LongReach - Deep Fighter Escort Tactics, p. 70).

5b. TAKE SHOTS OF OPPORTUNITY ONLY. If you chase any one bogey for more than 10 or 15 seconds, you can count on having some other bogey on your tail. Why? Because while you're chasing the first bogey you're predictable. Avoid this by simply waiting for someone to fly out in front of you to shoot. There will be plenty of opportunities.

5c. DON'T FOLLOW YOUR KILLS. Again, while you're circling the bogey you've just nailed you're predictable. Besides, you can't watch the bogey burn and properly clear yourself at the same time.

6. YOU AND YOU ALONE ARE RESPONSIBLE FOR CHECKING YOUR OWN SIX O'CLOCK. So keep your head on a swivel and make frequent belly checks.

7. EXPECT THE UNEXPECTED. Count on things going wrong. For example, how are you going to handle an aircraft emergency in this kind of environment?

8. KEEP IT SIMPLE. Stick with straightforward tactics and easy plans--things you know. Avoid being fancy (it probably won't work anyway).

9. PLAN YOUR BUGOUT EARLY. Don't wait until you're running out of gas, or about to be shot down, to start thinking about leaving the fight. Also, when you do disengage, try to go with a buddy and avoid leaving anyone behind in the fight by himself.

These maxims summarize the principal suggestions presently being made for fighting superior enemy numbers in conjunctionwith the degradation (or loss) of external mutual support. None of them are especially new. In fact, most of these tactical precepts have been around for decades. Rules 1a and 5b, for instance, can be found almost word for word in Bishop's 1918 book Winged Warfare.[93] Or take Rule 5a (AVOID

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93 Rule 1a says basically that you should know your own airplane. In 1918 Bishop observed that

> To be able to fight well, a pilot must be able to have absolute control over his machine. He must know by the "feel" of it exactly how the machine is, what position it is in, and how it is flying... (Sims, The Aces Talk, p. 88.)

This injunction is, in essence, the illustration I gave in Rule 1a. Moreover, the rationale which Bishop cited for it turns out to be nothing other than that when the fight comes along the pilot cannot afford to be worrying about flying his machine; instead he needs to be able to "...devote all his time to fightingthe other fellow..." (Ibid.). This point, of course, articulates the more comprehensive precept which I formulated as Rule 1 (BE READY FOR THE ENVIRONMENT).

As for Rule 5b, here Bishop wrote: "It is well if you are against odds never to stay long after one machine. If you concentrate on him for more than a fraction of a second, some other Hun has a chance to get a steady shot at you, without taking any risks himself." (Ibid., p. 89).

THE TURNING FIGHT); it turns out to have been a cardinal principle of Richthofen in the First World War and of Erich Hartmann in the second.[94] Similarly, the injunction to get all the mutual support you can (Rule 3) became part of the conventional widsom during the First World War and was subsequently accepted in both World War Two and the Korean conflict.[95] Thus, some of the principles in my list were known as early as World War One, and, by the mid-1950s, virtually every one of them had been explicitly stated by somebody. For example, counting Rule 3 no less than seven of these precepts can be readily identified in Blesse's 1954 "No Guts, No Glory."[96]

Clearly, then, the tactical rules-of-thumb listed above have enjoyed considerable longevity. Indeed, in wouldappear that neither the passage of time nor the advance of

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94 Sims writes, near the end of The Aces Talk:

> In the intensified air fighting towards the end of the Second World War it is significant that the most successful pilots generally avoided the classic dogfight. Instead, they developed specialized attack patterns, usually a fast pass from above taking opponents by surprise, a close-in burst, then disengagement by diving or climbing out of range with a speed advantage. . he classic dogfight, featuring turns and just about every maneuver, which thousands of pilots had believed standard combat procedure, was rejected by these fighter leaders as excessively dangerous. Some of the aces using these tactics taught replacement pilots their philosophy of fighter combat, though many flew to the end of the war without being aware of the trend. It was not, of course, a new approach. Richthofen, in he First World War, and others had adopted similar, cautious tactics and had been highly successful pursuing them. (Sims, The Aces Talk, p. 205.)

Among the World War Two aces Sims specifically had in mind as representing the trend away from the classic dogfight were John C. Meyer and Erich Hartmann (Ibid., pp. 205-06 & 236). For example, Sims quotes Meyer as saying (during a Pentagon interview): "I didn't turn with enemy pilots as a rule. I might make one turn--to see what the situation was--but not often. It was too risky..." (Ibid., pp. 205-06).

95 As I discussed at length in Section 3, the popularity of single-ship tactics began to decline in the fall of 1916 when Boelcke's Jagdstaffel 2 gave the first convincing demonstration of the advantages of teamwork. As a result, by 1918 single-ship tactics had been abandoned by the vast majority of combat pilots (see page 5). Further, this general lesson regarding the greater risks of single-ship was subsequently borne out by air-to-air experience in both World War Two and MIG Alley (see footnotes 7 & 39). Blesse, then, was simply articulating the majority opinion when he wrote, in 1954, under the heading 'Basic Principles of Defense': "If you lose your wingman, both of you should leave the combat area." (Blesse, "No Guts, No Glory," p. 24).

96 The other six rules are 1a, 1b, 1c, 1d, 6 and 9. On Rule 1a (KNOW YOUR AIRPLANE) Blesse wrote: "Know the low speed characteristics of your aircraft. If you are fighting aggressive pilots, you'll need all the know-how you can lay your hands on." (Blesse, "No Guts, No Glory," p. 24). Along the lines of Rule 1b (KNOW YOUR WEAPONS), he gave a number of maxims concerning air-to-air gunnery in the F-86 (Ibid., pp. 14, 15 & 27). He expressed Rule 1c

technology have appreciably undercut their fundamental validity. But the question is, of course, to what extent might adherence to such rules actually enhance aircrew survivability when fighting single-ship? A fairly plausible answer to this question can be development by recalling, once again, that most air-to-air kills have been immediately preceded by gross mistakes of one sort of another on the part of the victims.[97] For what this statistical result suggests is that my sixteen rules-of-thumb for operating as a single in multi-bogey/comm-jamming situations essentially catalog basic errors which, over the years, haverepeatedly gotten people shot down. If so, the longevity of any individual aircrew in the air combat arena can be understood as a function of the extent to which that aircrew avoids such mistakes.

Convincing substantiation of this last point can be found in the record of Baron Manfred von Richthofen. As Sims and other commentators have pointed out, the "Red Baron" came to be very selective in choosing both his victims and the tactical conditions under which he was willing to engage.[98] For example:

> The Red Baron never attacked through the clouds or when visibility was restricted. Too chancey.
>
> He always attacked the lame duck or trailing enemy. Easy kills.
>
> He never planned his final attack until he had positively identified his quarry. No wasted motion. No chance-taking.
>
> He never attacked head-on. Loss of surprise. Terms too even.

(STUDY THE PERFORMANCE CAPABILITIES OF POSSIBLE THREAT AIRCRAFT AS WELL AS THE WEAPONS ASSOCIATED WITH EACH) in virtually the same words I used: "Know the performance data on all aircraft you are apt to be fighting." (Ibid., p. 14). Regarding Rule 1d (TRAIN!!!), his opinion was, once again, that you need two good aerial training flights a week just to stay in practice (Ibid., p. 13). The injunction to keep your head on a swivel and never neglect checking your tail--basically my Rule 6--is repeated throughout "No Guts, No Glory" (see, for example, pp. 14, & 18-19). Finally, just as I did in Rule 9, Blesse emphasized the importance of keeping track of your fuel--in offensive as well as defensive situations (Ibid., pp. 10-11 & 24). (Incidentally, several months after I wrote this footnote I finally received a complete copy of Kepner's The Long Reach - Deep Fighter Escort Tactics. A brief reading of this extensive record of World War Two battle experience over Europe uncovered correlates to every one of my sixteen pilot rules-of-thumb).

97 See pages 18-19; also footnotes 46 and 85. I would emphasize in this regard that the pilot who allows himself to be caught by surprise has, virtually by definition, committed a gross error. True, this general circumstance covers a variety of sins: inadequate visual lookout (whether within a flight or as a single), the loss of mutual support, becoming fixated on a particular opponent, etc. But beingsurprised by the bogey is almost always avoidable. Therefore, anything that brings this situation about must be viewed as an elementary mistake.

98 Sims, The Aces Talk, p. 232; Johnson, Full Circle, pp. 55 & 271.

> The Baron broke off an attack if visual contact was lost. Discretion is the better part of valor.
>
> His best friend was the sun.
>
> The Baron made a fast exit when he reached a stalemate, lost an advantage, or reached a low fuel state; and when he made a kill, he didn't stay to watch the finals.[99]

On the one hand, Richthofen's overall adherence to such common sense "rules of engagement" largely explains how he managed to so far exceed the average life expectancy of his contemporaries.[100] On the other, his failure to observe them on at least one occasion apparently explains his death:

> On April 21, 1918, he violated two of his own rules of engagement. He attacked a loner for what appeared to be an easy kill without mutual support at low altitude. His decision proved fatal. It becomes academic whether Captain Roy Brown's "Camel" or an Austrailian sergeant's machine gun fired the bullet.[101]

What the example of Richthofen appears to confirm, then, is that individual survivability in the air combat arena can be pretty much equated with the minimzation of gross mistakes. He who makes fewer mistakes than his opponent--or less serious ones--will probably win, and he who consistently avoids gross

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99 Colonel William D. Mol, "Rules of Engagement," USAF Fighter Weapons Review, Spring 1973, pp. 29-30.

100 Colonel Mol states that, at worst, the life expectancy among Richthofen's comrades in the "Flying Circus" (Jagdgeschwader 1) was six sorties or 22 days, whichever occurred first (Mol, "Rules of Engagement," p. 29). Richthofen in contrast survived long enough to amass 80 official kills. His first (for which he did not receive credit) is believed to have taken place in September of 1915; his last was scored on 20 April 1918, the day before he died (Taylor, Taylor & Mondey, Air Facts and Feats, pp. 61-62).

101 Mol, "Rules of Engagement," p. 30. Whether Brown or someone in the Australian artillery battery below fired the shot which killed Richthofen has not been settled to this day despite prolonged research by many amateur and professional historians (Taylor, Taylor & Mondey, Air Facts and Feats, p. 62).

errors altogether is unlikely to lose.[102] Or at least this has certainly been the overall pattern to date[103] and, in light of this fact, I would argue that there is every reason to think that the pilot rules-of-thumb I have laid out for the single-ship mode of two-vs-one-or-more will, if conscientiously observed, substantially enhance aircrew survivability.[104]

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102 This conclusion, though generally valid, is not without exceptions. An obvious example would be a one-vs-one scenario in which one fighter was overwhelmingly superior to its opponent. For instance, starting from a tactically neutral situation you would expect that a single F-16 could advance to a firing position against a lone MIG-21 even if the MIG pilot maneuvered his airplane flawlessly. But the more evenly matched the opposing machines are in terms of performance and weaponry, or the greater the total number of fighters present in the air combat arena, the more dominant will be the role played by aircrew mistakes in determining who gets shot down and who does not.

103 Bishop perceived this pattern way back in World War One. Specifically, regarding engagements involving the full gamut of turns and maneuvers, he made the following observation:

> An extraordinary feature of these fights which occupied any length of time, and entailed such maneuvering, was the fact that they were generally indecisive, one machine or the other finally deciding that for some reason or other it must quit and make good its escape. In nearly all cases where machines have been downed, it was during a fight which had been very short, and the successful bursts of fire had occurred within the space of a minute after the beginning of actual hostilities. (Sims, The Aces Talk, p. 91.)

Why were lengthy dogfights seldom decisive? Again, the crux of the matter appears to lie in the role which mistakes play in most air-to-air encounters. The opponent who can hold his own against you for (say) three straight minutes of hard maneuvering is not likely to commit the kinds of gross errors that will allow you to shoot him down. Or, equivalently, if a pilot is inexerpienced enough to make serious errors, he will probably commit them early in the fight.

104 The case for two-vs-one-or-more set out in Section 7 was fundamentally a theoretical one. However, some empirical support for this general approach to multi-bogey/comm jamming situations can be found in Navy air-to-air experience from Linebacker 1. I mention this evidence now because it also appears to support my suggestionthat survival under such adverse conditions is possible using two-vs-one-or-more tactics together with the sort of time-tested pilot rules-of-thumb given on pages 62 and 63. What I would specifically point out here, as an actual instance in which this combination apparently worked, is the famous 10 May 1972 engagement in which seven F-4Js of VF-96 ran up against 20 North Vietnamese MIGs (14 MIG-17s, two MIG-19s, and four MIG-21s according to the "after action" report). Lt. Randy Cunningham described the approach which the navy aircrews ultimately found themselves forced to adopt on that particular day as follows:

> It was difficult to give section mutual support because of the great number of MIGs, but what seemed to work was that whenever one F-4 would get into trouble another F-4, no matter what section, would help. (Quoted from an unpublished "after action" report of VS-96's 10 May 1972 encounter. One copy exists in the U.S.A.F. Academy Library.)

The qualification that individual aircrews be conscientious in avoiding known (or suspected) high risk situations, however, brings up a further limitation of two-vs-one-or-more: the system's sensitivity to aircrew discipline. Aircrew discipline, of course, has long been a critical element in aerial combat. Consider, once again, Richthofen's fatal decision on 21 April 1918 to go after what looked like an easy victory without mutual support and at low altitude. In retrospect this decision appears to have been nothing more or less than a simple breach of self-control and common sense. The normally wiley Red Baron, disregarding the caution that had so often stood him in good stead, gave in to the lure of an "easy" kill and it cost him his life.

An even more explicit illustration of beingtempted into a high risk situation by the promise of a score can be found in the air battle from which James Jabara emerged as the first American jet ace of the Korean War. The date on this occasion was 20 May 1951. By then almost a month had elapsed since Jabara had posted his fourth kill, and in the interim, the MIGs had been unwilling to do any real fighting with the F-86s. Thus, you can well imagine Jabara's eagerness when, late in the afternoon of the 20th, around 50 MIGs appeared over Sinuiji ready to mix it up. But when Jabara turned his flight towards the scene of the action and tried to jettison external fuel tanks one of his "drops" hung up, leaving his Sabre skidding partially sideways through the air in a giant crab.[105] Now, the 4th Fighter Interceptor Wing had a standingpolicy to cover thiscontingency: "...get the hell out of there and go home."[106] Nevertheless, Jabara decided to engage anyway. Obviously in doing so he was betting that he would not run up against any really competent MIG-15 pilots that day and, as things turned out, he did not. But, at the same time, it is evident that in electing to enter the air combat arena with his

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This strategy proved highly successful: six of the MIGs (all 17s) were downed while the F-4s got away without suffering any air-to-air losses.

Three aspects of this engagement have a direct bearing on the viability of two-vs-one-or-more. First, the fundamental engagement strategy described by Cunningham is essentially that I developed on theoretical grounds in Section 7. Second, in this fight at least the feeling among the friendly aircrews involved was that this tactic constituted the most practical solution to the multi-plane environment in which they were so abruptly thrust (and the fact that, collectively, they managed to bag six of the MIGs without a loss lends considerable credibility to their assessment). Lastly, regarding the six kills themselves, you can identify rules in my list which were violated by the MIG pilots downed during this action. For example, it was noted by the Navy aircrews that the MIG-17s were willing to "grovel and turn" whereas the 19s and 21s generally kept their energy up and stuck with slashing attacks. Thus the 17s ignored my Rule 5a (AVOID THE TURNING FIGHT) while the 21s and 19s observed it. Here again, the outcome of the engagement would appear to speak for itself: six of the 17s were shot down while all of the 19s and 21s survived. ("Groveling and turning," of course, did not constitute the only error made by the unsuccessful 17s. For instance, in at least two cases it was felt by the Navy aircrews that the MIG pilots lost sight of F-4s just as the U.S. fighters reached AIM-9 firing parameters).

105 Captain Stephen O. Manning, "A Race for an Ace," Airman, November, 1975, pp. 21-22.

106 Manning, "A Race for an Ace," p. 22.

aircraft in such a state, Jabara needlessly put himself into a known high risk situation.[107] Admittedly, unlike Richthofen, Jabara won his gamble. Whereas the Baron wound up with a bullet in the chest for his indiscretion, Jabara not only got away with his skin but acquired two kills in the process. Still, aside from such contingent differences in outcome, Jabara's lack of discipline on 20 May 1951 is indistinguishable from Richthofen's on his last sortie over three decades earlier.

Historically then, aircrew discipline, in the specific sense of avoiding unnecessary risks,[108] has always been a precious commodity in fighter-versus-fighter combat. Moreover, I see no reason to suppose that it will be any less important in the foreseeable future. As a matter of fact, since the Korean War the trend here, if there has been any at all, has surely been in the direction of aircrew self-control and intelligence becoming more, not less, important in the air combat arena. Certainly technological advances in the hardware of aerial warfare during this period have not served to decrease either the number or the complexity of the tasks demanded of the aircrew.[109] Further, the advent of the air-to-air missile, which can kill at slant ranges many times those practicable with guns, has made it harder

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107 As John C. Meyer, who was the commander of the 4th F.I.W. when Jabara got his fifth kill, later remarked, Jabara's decision to engage with the hung drop tank "...was stupid, and he was just lucky as hell that he didn't get killed..." (Manning, "A Race for an Ace," p. 22).

108 Aircrew discipline, in the specified sense, constitutes the underlying principle which unifies the various combat rules-of-thumb which can be gleaned from the body of past air-to-air experience. In other words, the whole point of aircrew discipline lies in the realization that, over the long haul, it pays to fight by the "rules" (that is, to avoid unnecessary risks). Methodologically thisunifying principle, as well as the specific rules-of-thumb listed on pages 62 and 63, spring from the same basic pattern of analysis: that of searching for general precepts which have shown themselves to be valid over the widest possible range of past combat experience. Thus the methodology which forms the backbone of the present section (and, ultimately, of this entire essay) is identical to that employed by B. H. Liddell Hart in Part I of his classic work Strategy. Of course, Hart, in using thisline of investigation to develop his theory of the "indirect approach," was able to draw upon military campaigns spanning 25 centuries. In contrast, any attempt to conduct a similar analysis of fighter-versus-fighter warfare must be limited to the twentieth century (although the exponential advances in the technology of aerial combat since World War One undoubtedly offset this temporal narrowness to some extent).

109 See footnote 84 for detailed discussion of the impact of technology on aircrew tasks since World War Two.

to survive, not easier. Take, for instance, the classic situation of an attacker closing from six o'clock. In MIG Alley failing to spot him visually by the time he had closed to 8000 feet slant range would not, in general, have been all that dangerous since most kills during the Korean War occurred inside 1500 feet.[110] Currently, however, 8000 feet is a lethal range for Soviet infra-red missiles; a MIG-21 driver closingfrom six o'clock will be in the very heart of his Atoll envelope at that distance.[111] Adequate visual lookout, consequently, is far tougher today than it was in the early 1950s, and the next generation of air-to-air missiles is not likely to make this premiere defensive problem any easier. The pilot who wants to stay alive in the modern air combat arena must be utterly unflagging in his efforts to see everything in the visual sphere surrounding his airplane.

Of course, statistically at least, a P-51 pilot flying Finger-Four over Europe in 1944 also needed to be unflagging insofar as visual lookout was concerned. What makes aircrew discipline far more critical with my system than it is with conventional team approaches, therefore, is the range of tactical environments which two-vs-one-or-more tries to address. In both World War Two and the Korean conflict, American fighter pilots usually operated under conditions in which teamwork could be sustained. The whole pointof two-vs-one-or-more, however, is to encompass certain "worst case" scenarios--multiple-bogeys, comm-jamming, etc.--which the traditional team approaches did not envision, and in these sorts of situations, the margin for serious aircrew error is considerably smaller than it is in environments which permit teamwork.

The scant margin for aircrew error available in the single-ship mode of two-vs-one-or-more is perhaps most apparent in Rule 5b. What this stricture basically warns against is concentrating too long on any one opponent. Obviously, doing so would be most hazardous for the pilot of a one-seat fighter. So long as he is chasing any one bogey, he is predictable and, hence, an easy target for every other bogey in the immediate vicinity. If he persists, even for just 30 or 40 seconds, and if any of the other bogeys choose to take advantage of the mistake, he is probably going to get shot down. In contrast, within the restricted range of tactical environments envisioned by team systems like Fluid-Two there will normally be a second man clearing for both fighters. Thus, if either team member does, for example, become "padlocked" on the bogey for any length of time, the other can still furnish the two of them a substantial margin of defensive safety which would be unavailable when fighting as a single (again, particularly in a one-seat airplane).

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110 Regarding typical slant ranges for gun kills in MIG Alley, Blesse states: "Contrary to much that has been published, the fighter pilots who shot down more than an occasional Mig or two, got them around 400 - 1200 feet just like they did in Europe and the Southwest Pacific during World War II." (Blesse, "No Guts, no Glory," p. 28). Interestingly, the Vietnam era did not witness all thatmuch improvement in representative gun-kill slant ranges over those observed in World War Two and the Korean conflict. Despite the fact that many of our fighters were equipped with cannons capable of firing 6000 rounds per minute and lead-computing gunsights fed by fairly powerful fire control radars, only 25% of all U.S. gun kills in Southeast Asia occurred outside 2000 feet (Captain Gerald D. Hugg, "Combat Dart II," USAF Fighter Weapons Review, Fall 1973, p. 10).

111 John W. R. Taylor, "Gallery Aerospace," Air Forces Magazine, March 1975, p. 74; also see "Aggressively Speaking," USAF Fighter Weapons Review, Fall 1974, p. 2.

The implication of this example is clear. In the single-ship mode of two-vs-one-or-more it will be imperative for the aircrew to resist altogether the temptation to bend the "rules" even slightly. The difference between breaking off an attack after 15 seconds to clear and pressing on for an extra five or ten in order to score a kill is not great. But in multi-plane engagements such as those experienced by the Israelis in the October 1973 Mideast War, those few seconds can literally spell the difference between surviving and being shot down.

I would emphasize, moreover, that it is one thing to grasp this point on an intellectual level and quite another to actually possess the self-control necessary to abide by it under the extreme psychological pressures of air-to-air combat. As I have tried to drive home with the examples of Richthofen and Jabara, some highly experienced combat veterans have yielded to the temptation usually referred to in the American fighter community as "MIGitis"--that is, the tendency to become fixated on a prospective kill--and, in many instances, this has gotten them shot down.[112] Similarly, even pilots who are intimately aware of the dangers involved report that, in multi-plane situations, the temptation to start turning with the first opponent who looks like an easy mark is all but overwhelming.[113] I would suggest, therefore, that discipline of the sort demanded by the single-ship situation may not be as natural and easy to come by as some in the American fighter community seem inclined to think. Granted, you do not meet many fighter pilots who admit to frequently ignoring established combat "rules of engagement," and it is tempting--to say nothing of comforting--to presume that American aircrews are highly disciplined. Nevertheless, there is room for some real doubt on this score, as the following two tales make abundantly clear.

It was recognized quite early during the "Rolling Thunder" phase (1964-1968) of the U.S. air operations over North Vietnam that most of our losses to ground fire occurred in the daytime below 4500 feet AGL (above ground level).[114] This observation was not merely an aircrew fantasy culled from the seat of someone's flight suit after a particularly tough mission. It was an empirical fact which, as time went on, was increasingly bolstered by hard data. As a result, this fact was incorporated into our tactical doctrine as the so-called "4500 foot rule" (for high threat air defense environments). What it said was: do not go below 4500 feet AGL during the daytime in areas defended by heavy concentrations

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112 For those inclined to scoff and insist that they would never succomb to "MIGitis," I recommend a reflective reading of Events 20 and 21 in Project Red Baron III (Air to Air Encounters in Southeast Asia), AD 530311, Volume II (Event Reconstructions), Part I (Events 1 through 58: 18 December 1971 - 27 June 1972), June 1974, beginning on page 98.

113 Staff members at TOPGUN stress this point heavily in the context of both one and two-vs-many scenarios (see footnote 92). They cite, among other things, the 26-ship "everybody-against-everybody" engagement mentioned in footnote 82 as evidence. Apparently most all the crews who participated in this exercise found the temptation to start turning very hard to resist, and those who gave in to it almost invariably got hammered.

114 As the following remarks by John C. Meyer concerning tactics against AAA defenses in Europe during World War Two point out, the vulnerability of

of small arms and light AAA (anti-aircraft artillery). Obviously the intent of the rule was to delineate the statistically lethal small-arms/AAA envelope into which the smart money did not venture. Nevertheless, despite the extensive publicity given this rule throughout the T.A.C. fighter community as early as 1966, even as late as the summer of 1968 I can recall individuals being shot down while in the process of making multiple passes, almost down to the deck, in known high-threat small-arms/AAA areas during broad daylight.

Virtually the opposite side of the coin can be seen in Israeli air operations during the Six Day War of June 1967. The fighting began with a preemptive Israeli air strike against the Arab air bases. At this point the strategy of the Israeli Air Force was to try and take out the opposing air forces--particularly Egypt's--on the ground rather than in the air. Thus, on the opening day of hostilities, the Israeli pilots were under orders to avoid engaging enemy fighters except when they directly interfered with the Israeli air strikes.[115] These instructions were obeyed to a remarkable degree. To cite perhaps the most striking example, even when Israeli pilots (during the first minutes of the war) saw Jordanian Hawker Hunters bombing the Israeli coastal city of Natanya, instead of engaging the enemy fighters they continued with their bombing mission (which, ironically enough, turned out to be against the runways at the Hunter base from which the Jordanian pilots had taken off).[116]

These two tales pretty much speak for themselves in terms of exemplifying what real discipline is--and is not--relative to the fighter business. Moreover, since the first story reveals that at least some U.S. pilots who flew in Southeast Asia evidently lacked the discipline to stay out of recognized high risk situations, the contrast between the two of them ought to provoke some serious soul-searching on

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fighters concentrated ground fire at the lower altitudes probably should not have been the revelation that it was:

> Our (fighter) group was the first to attempt a penetration in force on the deck for a strafing mission. Out of this experiment I have these recommendations to make: That penetration to within ten miles of the coast be made on the deck, then the force zoom to 8000 - 12,000 feet, navigating at that altitude, penetrate beyond the target, hit the deck at some prominent point a short distance from their target and then proceed to it. This, rather then penetration all the way on the deck where the enemy small arms fire is intense and pin point navigation impossible. That when an aircraft is below 8000 feet over enemy territory it be as low as possible. Twenty feet above the ground is too high. (Kepner, The Long Reach - Deep Fighter Escort Tactics, p. 41.)

115 Warren C. Wetmore, "Israelis' Air Punch Major Factor in War," Aviation Week and Space Technology, 3 July 1967, p. 21; also "Mock Dogfights Sharpened Israeli Pilots," Aviation Week and Space Technology, 3 July 1967, p. 25.

116 "Massive Resupply Narrows Israeli Margin in Air Power," Aviation Week and Space Technology, 19 June 1967, p. 18.

this issue by everyone within the American fighter community. For if, as I have argued at length, we do need to be ready to handle single-ship air combat the next time out, then the very nature of the tactical conditions associated with that contingency will demand a high order of self-control and intelligence on the part of every aircrew. Indeed, the discipline necessary to adhere scrupulously to the conceptual limitations inherent in two-vs-one-or-more tactics may well prove every bit as critical to our ultimate success--or failure--as basic aircrew skills and the technical quality of our weapons systems.

Section 9. Concluding Reflections.[117]

The thought with which I prefaced this essay was that in tactics, as in doctrine generally, final answers do not exist. Looking back I would submit that I have substantiated this thesis insofar as all extant systems for air-to-air are concerned (including my own two-vs-one-or-more proposal). To reiterate briefly what has already been argued at length, both single-ship and the known team approaches exhibit definite limitations. Single-ship is principally flawed by an inherent defensive weakness, while no team system can be sustained under all tactical conditions.[118] Although two-vs-one-or-more circumvents these limitations up to a point, it does not do so entirely. Whenever the tactical environment manages to break down team mutual support, two-vs-one-or-more reduces to one-vs-one-or-more, and, until teamwork can be regained, suffers from the same defensive weakness that has always plagued single-ship. Besides, the dual-mode engagement strategy of two-vs-one-or-more incurs a further weakness: increased system complexity.

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117 The line of thought pursued in these concluding reflections was deeply influenced by recurring discussions, over a period of months, with (now retired Colonel) John R. Boyd. As a result many of the ideas contained in this final section are undoubtedly as much his as mine. Moreover, I think it should also be pointed out that in his 1960 Aerial Attack Study, Col. Boyd largely anticipated the sorts of misgivings concerning the ultimate limits of ALL aerial attack system which I began to have by the fall of 1975, and which I have tried to articulate here. I wouldspecifically emphasize that Col. Boyd's 1960 study did not advocate Fluid-Four, despite much subsequent misinterpretation to the contrary. In fact, the thrust of his lengthy work was to REJECT ALLEGIANCE TO ANY ONE AERIAL ATTACK SYSTEM ALTOGETHER. Instead, Col. Boyd's intent was to replace explicit systems with an exhaustive array of maneuvers and counter-maneuvers from which the pilot could choose the move best suited to his immediate situation. (The sections which substantiate this reading of Col. Boyd's paper are the last two: 'TACTICAL FORMATION' and 'FLIGHT TACTICS'-- Captain John R. Boyd, Aerial Attack Study, Fighter Weapons School Publication 50-10-6C, 1960, pp. 114-123 and 124-149 respectively.

118 In fairness to Blesse, who was, after all, the first person ever to formulate on paper an entire system for air-to-air, I shouldmention that even in "No Guts, No Glory" there is awareness of the fact that team systems cannot always be sustained. For example, in a paragraph labeled 'TWO ATTACKED BY TWO,' Blesse describes a situation in which he felt the intentional splitting of the two-ship element--that is, going single-ship (at least temporarily)--to be advisable, if not unavoidable (Blesse, "No Guts, No Glory," p. 23). Also, in discussing four attacking four he points out that in some circumstances it would probably be best for the elements to attack in "train" (Blesse, "No Guts, No Glory," p. 13).

It may therefore seem somewhat ironic--if not inconsistent--that I have argued for the engagement concept of two-vs-one-or-more at all. The point I would make in reply, however, is that in proposing two-vs-one-or-more I really have not advocated any single conceptual approach to fighter-versus-fighter combat. Rather, the substance of my proposal has been to avoid choosing any one attack concept by instead embracing two: the team approach of Loose Deuce and, when necessary, single-ship. Moreover, the rationale for this doctrinal stance should not be mysterious. If there is any theme which truly runs the length and breadth of this essay it is that, given the great diversity of tactical conditions which the fighter pilot can encounter, NO KNOWN ENGAGEMENT CONCEPT IS THEORETICALLY CAPABLE OF SUFFICING AS A UNIVERSAL SOLUTION TO THE PROBLEM OF DOMINATING THE AIR COMBAT ARENA. True, this conclusion still falls far short of the stronger claim that a final answer will NEVER be found for air-to-air. The imperfections of existing systems do not show that an approach without limitations is impossible. Nevertheless, as I suggested at the beginning of Section 8, arguments can be given for this stronger position by pursuing the train of thought which generated both the justification for and the limitations of two-vs-one-or-more.

Over the course of this essay we have looked at only three engagement concepts which are conceptually novel: the "shooter-cover" approach dominant in Fluid-Four, the "double attack" approach used in Fluid-Two and Loose Deuce, and "single-ship." In addition, weaknesses have been exhibited in each of these basic attack/defense strategies. What, however, does the existence of such weaknesses imply? I would suggest the following answer. If we limit ourselves to just those scenarios in which neither disparities in the skill levels of the opposing pilots, nor differences in the performance capabilities and weaponry of their opposing aircraft, are so overwhelming as to dominate the air battle altogether, then PILOTS WHO ADHERE TOO RIGIDLY TO ANY ONE OF THE THREE KNOWN ENGAGEMENT CONCEPTS CAN GENERALLY BE BEATEN. All you need to do is first identify, and then exploit, the weaknesses of the particular strategy they happen to be employing. This fact leads at once to a prima facie argument against the possibility of a final solution to aerial combat. For such a solution would be tantamount to have an engagement concept without weaknesses, a system which could not be beaten. But the possibility of such perfection seems highly unlikely. Admittedly, you can point to many strategic and tactical principles of warfare which have stood the test of time. The pilot rules-of-thumb for single-ship given in Section 8 are examples. Nevertheless, I do not know of any which are without limitations in the sense of being inviolate across all possible tactical situations. Even the most tried and true battlefield principles fall short of being absolute. Consequently, I see no historical precedent to support the belief that a perfect engagement concept will someday be forthcoming. The evidence all points the other way.

Moreover, this argument can be substantially strengthened by considering the fact that, in the real world, the three principal engagement concepts which have been discussed in this essay--"shooter-cover," "double attack," and "single-ship"-- are not at all as disjoint as I have portrayed them to be. In the fluid, rapidly changing conditions typical of actual air combat there is a point, for example, at which a lethargic double attack merges imperceptibly into a dynamic application of "shooter-cover." Similarly, there is a point at which a loose double attack becomes

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119 Classical Loose Deuce tactics appear to lie somewhere in the "gray area" between pure double attack, in which two fighters mount a series of alternating passes against the bogey, and classical "shooter-cover" between a pair of fighters. Granted the system's theoretical emphasis leans in the direction of Double Attack. Nevertheless, it has been estimated that in only 15%

indistinguishable from two fighters operating as "singles" in close proximity to one another. "Double attack," "shooter-cover," and "single-ship" may be clearly separable as theoretical constructs, but their real-world applications are not. Hence I would suggest that these notions, if defined tightly enough to be of theoretical use, are best thought of as simply marking widely separated points on an essentially continuous spectrum.

If you are willing to adopt this perspective, then the possibility of a final system for air-to-air becomes even more dubious than before. The reason is that any well-defined engagement concept, as a singular point on a continuous spectrum, represents at best a compromise. Or, equivalently, each individual point is in one way or another an optimization for a limited class of tactical scenarios. Loose Deuce, for example, is skewed towards maximizing mutual support by holding to a bare minimum the sacrifices which the team must make in terms of mobility, surprise, and flexibility. Inevitably, however, this optimization exacts a price. In the case of Loose Deuce that price is the system's heavy dependence upon the skill and proficiency of the aircrews flying it; Loose Deuce is not the kind of system that can be successfully worked by novices. Evidently, then, what entails limitations in any given aerial attack system is not the selection, for example, of the "wrong" engagement concept, BUT THE ACT OF SELECTING AN ENGAGEMENT CONCEPT AT ALL. Any engagement concept strong enough to guide the pilot in making selections from the array of maneuvers and counter-maneuvers available to him is going to be better in some situations than in others. Thus, the imperfection of aerial attack systems generally appears to grow from the very act of creating such systems. If so, it follows that an unbeatable system for air-to-air will forever elude us.

An obvious corollary to this conclusion is that, with the passage of time, any well-defined aerial attack system will tend to be antiquated. The evolution of classical Fluid-Four (originally Finger-Four) provides an archetypal case in point. In 1944, with "similar" performing fighters on both sides and large percentages of green pilots in the American fighter groups, the pure "shooter-cover" form of Fluid-Four was a fine system. In the hands of experienced pilots, it worked even better in MIG Alley. But conditions eventually changed. From the late 1950s on the aircraft which formed the mainstay of T.A.C.'s line fighter units (in turn, the F-100, F-105, and the F-4) could not match the turning performance of their prospective opponents (the MIG-17, 19 and 21). The altered situation consequently presented the Air Force fighter community with a new problem--that of having to fight substantially dissimlar aircraft. And, because existing "shooter-cover" tactics could not readily cope with this prospect, doctrinal evolution began to take place. At the U.S.A.F. Fighter Weapons School, orthodox mutual support between Fluid-Four elements began evolving in the direction of a Loose Deuce or "double attack" engagement strategy; shortly thereafter, Riccioni formalized his Double Attack System.[120]

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of the Navy's MIG kills in Southeast Asia were classical applications of Loose Deuce made. The rest of the time, the maneuvers actually employed by the aircrews involved could be just as easily subsumed under a "shooter-cover" concept. (For a specific instance of a distinctly "shooter-cover" application of Loose Deuce from the Vietnam era, see Drendel, ...And Kill MIGs, pp. 44-45.)

120 Historically, both these lines of development appear to have sprung from the same basic limitation in Blesse's "single attack" engagement strategy--namely, the inability of classical Fluid-Four tactics to provide any viable means of effecting sustained maneuvering against substantially better-turning opponents. From this perspective it is ironic, therefore, that after about 1962 the advocates of Double Attack and Fluid-Four became so bitterly opposed to one another. However, both sides seem to have grown so caught up in championing one system

Similar evidence of doctrinal evolution can be seen in current perceptions within the Navy fighter community regarding Loose Deuce. Staff members at the Navy's "TOPGUN" Fighter Weapons School, for example, appear to regard classical Loose Deuce principally as a device for teaching aircrews how to support one another. For them, TACTICS (meaning applications of this building block, together with an intimate knowledge of the basic figher maneuvers, to real-world situations), are taken to lie on a somewhat higher level than Loose Deuce.[121] Why has classical Loose Deuce been relegated to a "building block" status? Again, conditions have changed. Three years after the last Arab-Israeli War virtually no one in the Navy fighter community seriously expects to see much of stock 2-versus-1 scenarios the next time out.

This historical pattern suggests one last point. It is that system advocacy self-defeating insofar as it leads you to rigidify your tactics. The more set you become in yourtactics, the easier it is for youropponents to find new ways of beating you. Hence the sooner you are likely to be presented with new scenarios. Yes, it may be appropriate--even necessary--to introduce inexperienced pilots to aerial combat tactics by starting them within the conceptual boundaries of a tightly defined system. But to go on to insist that they forever after do all their fighting within the confines of that one system makes no sense whatsoever in light of the inherently dynamic nature of fighter-versus-fighter combat.

BARRY

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at the expense of the other, that neither was able to see the extent to which both of them were offering similar solutions to the same problem. Instead, each fundamentally misunderstood the other. Riccioni, for example, continued to maintain into the late 1960s that Fluid-Four had not evolved beyond Blesse's original formulation of the system (Riccioni, "The Air Superiority Fighter - A Modern Analysis," pp. 61-62; also, see Guild, The Double Attack System: A Formalization, p. 2). On the other side of the coin, the proponents of Fluid-Four at Nellis argued, as late as 1971, that Double Attack and later versions of Fluid-Four had no conceptual similarities whatsoever while, at the same time, insisting that the employment concept of their system RESEMBLED that used in Loose Deuce, with the exception of the use of wingmen (USAF Fighter Weapons Review, Summer 1971, p. 34).

121 This notion of tactics is, of course, quite close to the maneuver/counter-maneuver (or decision/counter-decision) idea articulated in Boyd's 1960 Aerial Attack Study. From this viewpoint--and I think it is a legitimate one--aerial combat can be understood as a game in which the opposing "players" try to defeat one another by making more optimal choices than their adversaries from among the physically possible maneuvers and counter-maneuvers available to them. Notice that, as Col. Boyd has emphasized to me on several occasions, if this characterization is valid, then to talk of formations, maneuvers, and even of engagement strategies without reference to a specific contextual situation (or class of situations) HAS LITTLE MEANING. And while Col. Boyd was undoubtedly the first to substantiate this thesis formally, the basic insight involved appears to go back a long way historically. Witness, for example, the following statement by (then Captain) Duane W. Beeson (written sometime in 1944):

> Probably the best thing to say on tactics is that they do alter and depend entirely on each situation as it exists at the moment. The only rules that can be laid out for actual combat are pretty general and it just takes plain common sense to apply them at the right time. (Kepner, The Long Reach - Deep Fighter Escort Tactics, p. 70).

NO VOICE VID

Capt. Bill Moore
MAWTUSOUTH

"What we have is a failure to communicate." So said Strother Martin to Paul Newman in the flim, Cool Hand Luke. Martin, playing the prison camp warden, is instructing Luke in proper prisoner etiquette, telling him that he wouldn't be in such a bad situation if he knew what to say and when to say it. Communications, or the lack of it, caused Cool Hand Luke's demise and it is going to be ours if we don't become a lot more articulate in our Fighter Weapons Intercept Training.

However, what I am suggesting is not that we need to talk more; just the opposite, LESS.

Recent air combat in the Middle East has demonstrated the capability of the threat to COMMJAM any and all fighter air direction nets. Consequently, to continue to prepare for visual air combat with our usual dependence upon two-way communications for airborne tactical planning and mutual support, is both unrealistic and dangerous. The solution to this problem is planning and realistic training. We must face the fact that we will not be allowed to use our radio (note the singular case of the noun, 'radio'--unfortunate, isn't it??) at will to discuss our VID game plan, decide on the appropriate tactics and provide mutual support from vector to bug out. This lack of communications should force us finally to achieve what we have been trying to accomplish for so long: Reliable, predictable reactions by each member in the section to any forseeable situation with a minimum of dependence on voice comm.

As it stands now, we brief voice communications in the VID as a rule instead of the exception. We must reverse this trend. I don't pretend to have any final answer--the fluidity of combat will deny that. Nevertheless, we must force ourselves to train as we surely will fight (to borrow a phrase).

Remember, we are discussing clear air, VMC, visual identification VID tactics. We've said before, the decision to VID a bogey will be made for us. HOW we do it is up to us. Also, the purpose of VID maneuvers is not solely for the identification of the bogey. The purpose of these maneuvers is to arrive at the moment of identification in a position to employ immediately one or both types of missiles--not to engage the bandit(s) in ACM. We don't have enough fighters to do this.

The intercept can begin in one of several ways. We are vectored by GCI, or we are autonomous with a radar contact. Either way, one aircraft has the lead and must assume the responsibility for analyzing the intercept geometry and initiating the intercept. Rapid and decisive action is the key to success. This is where the brief and previous practice pays off. My wingman knows that with whatever information I have available, I will be making hard turns to establish myself on the bogey's flight path. These hard turns MAY require the wingman to cross my flight path as in a Tac Turn or Shackel. But, he is, in essence, flying on me and the cross is only to keep him from becoming sucked. Once the bogey's flight path has been reached, my wingman resumes his position on the original side. This forces me to be exactly on the bogey's flight path or slightly across it--away from my wingman. This not only ensures the bracket, but it also makes the direction of pass obvious to the wingman from the initial hard turn for the bogey's flight path.

One radio call which is hard to dispense with is that of the bogey's altitude. Simply, your flight call sign and a number which corresponds to the target's altitude in thousands of feet is short enough that it should get through. The wingman must acknowledge in some manner. This information is critical to the shooter in setting up the required vertical split from the bogey's altitude, as well as in telling the RIO in that aircraft where to search with his radar. Burner is selected at the appropriate range. If no transmission is made for burner, or if made, but jammed, it should be obvious to my wingman, since he is in effect, flying on me. Remember, if your F-4 still smokes, no altitude changes until you get rid of the smoke. As the range decreases, some transmissions may be necessary, but with practice, they can be reduced. In the case of the Hook, a "pull" call by the eyeball is desirable only if the shooter has no radar contact. Basically, each F-4 strives for radar contact with the bogey and each flys an intercept while maintaining formation.

Contacts inside 15 NM may or may not allow a chance for the fighters to reach the bogey's flight path. If this is impossible, TAC lead may go to collision bearing but more than likely, will have to hold the bogey on his nose. This will result in a constant turn and cause TAC wing to fly on the leader while looking for a talley-ho on the bogey. Whatever radio calls that can be made here with regard to bogey location will be invaluable.

One thing I find noteworthy from my talks with Israeli aces is their reluctance to take any split in altitude or lateral displacement between the two (2) fighters until inside 10 NM. They say that this denies the enemy PCI the capability of calling their formation to the enemy fighters. The Israelis favor making the ID with a bracket, but it is achieved at the terminal stage of the intercept by either or both of the fighters. Again, it is the same concept as we discussed earlier: in many flies on lead in combat spread until both aircraft have a lead. Then the both fly their own intercepts, maintaining a loose combat spread, looking for an early talley-ho and working to be in a firing position when they get it. Care is taken not to allow the separation between their intercepts become excessive. A turn away from the bogey to the eyeball in order to counter a bogey break could result in a lost visual.

Obviously this brief article is not going to prepare anyone to fly successful ID tactics in a F-4 or C-130 ECM environment. It is going to require some careful planning and practice. But it can make things safer for the crew.

ACM AND SAFETY

Major Chuck Geiger
MAG-31 Safety

Many of us still have the attitude that ACM and Safety are mutually contradictory terms or, at best, the two (2) philosophies have reached only a shakey compromise. Virtually every ACM requirement from the Rules of Engagement to the Face-to-Face brief are safety oriented. Both those of us that decry the restrictions and those of us who enforce them tend to forget the basic purpose of ACM--Survival--or, safety at the expense of the enemy.

A safe fighter pilot is a mature, responsible Professional. He is current, qualified and realizes he must continually practice his trade to maintain and improve his skill. Experience is what will save him when he must play the game "for real." A safe fighter jock is one who accomplishes his combat mission and returns EVERY TIME.

Experience and currency can only be gained through realistic training. Realisitc rather than real, only in the sense that training must be non-destructive. If the rules chance when the "balloon goes up," then our training is not realistic and in the long run it is destructive. Flying what we teach and training what we fly in a demanding, realistic, professional ACM program will minimize our losses in peace time as well as in conflict.

ACM and Safety are not contradictory terms; they are, in fact, mutually inclusive. A professional fighter pilot is a safe pilot.

TROLL

YEA, FIGHTER TOWN EAST LOGISTICS

Major Pleas Davis
MAG-31, S-4A

In a fighter squadron or group, the most sought after billets are those in operations. Once having made it to this position, most fighter people feel that they have finally arrived and that it is all downhill from there on in. Since Ops has complete control of flight scheduling and decides who gets the good deals (WTI, TOPGUN and ACTI), it is sometimes difficult to argue with this orientation. Operational strategy, tactics, flight plans and who flies where, is and has been, the driving force in every fighter organization I have been in for the past eleven (11) years.

This particular driving force is necessary and to those who presently hold the power, I salute you. Make plans, create new strategy, innovate new tactics, invite dissimilar fighters down, go to other bases, write the flight schedule, and when you have done these things, remember that they are to no avail if aircraft don't fly, if people can't be moved, food can't be obtained, or if there is no place to live once there. The word to always remember in planning is logistics.

As Operations is the driving force, Logistics is the moving force. If there is no feel for this fact, then confusion and disorder are surely to prevail. Although military logistics is defined as including all activities not directly involved in strategy and tactics, it has somehow taken on a negative connotation with most fighter people. This was readily apparent when someone asked me what my job was in "The Fighter Group," and when I told them it was the assistant logistics Officer, among some other things, they said, "Oh! You poor _____, I know you must be disappointed!" When another officer was assigned to Operations, the response was, "Not as good as being Ops in a squadron, but one of the best jobs in the Group." This attitude prevails at the squadron level as well. Usually the thought or unspoken assessment is that the logistics officer either made the Skipper mad or is too senior and incompetent to do anything else, and is put in a place where he can't mess things up. This is incorrect and after examining the definition, one sees that everything comes under logistics (i.e., maintenance, supply, mess hall, ordnance, people, fuel, bases, hangars, pens, paper, toilets, transportation--air and ground--, barracks, runways, procurement of flying machines, etc.)--everything except strategy and tactics. So, it is my contention that logistics is on an equal footing with operations and should be one of the first considerations when making plans. This means that the logistics officers in both the squadrons and the Group should be among the best. Too many things depend on the moving force of logistics not to have the best handling it. If this isn't proof enough, one has only to look at the history of war in this century to see that logistics has been the deciding factor of the conflicts fought. In WWI, 2.7 tons of material was shipped for every soldier overseas; in WW II, it was 7 tons; in Korea it was even more; and the stats still haven't been compiled for Viet Nam. Generals often consider the best strategy to defeat an enemy is to deny him the logistics necessary to function or literally, starve his war machine.

If logistics is not understood and used properly, then the best of plans are of little value. Logistics should be taught at the lowest level and should be encouraged as a most honorable task---A job that requires great skill, personality and an aptitude for getting things done in a timely and efficient manner. Making plans and trying to execute them without the logistics officer's input and knowledge is a case of letting the tail wag the dog.

To the officers and men who comprise the logistics effort of Fighter Town East, I salute you and the superb job you have done and your tireless efforts to make this the best fighter group in the Corps. Praise at times is forgotten when the lawn mower breaks, parts don't come on time, aircraft aren't parked straight, or the fuel pit cables are accidentally cut, but overall, you do a hell-of-a-fine-job. Keep working hard and you may one day be able to take the place of Fighter Parrot; but remember, that only the best will be chosen.

FIGHTER PARROT

P.S. To save Lee the time -- "In the world of the birds, the parrot is the best talker, but the worst flier, with the exception of Fighter Parrot."