8

Unlimited-Aircraft Tactics

> Of course, with the increasing number of aeroplanes one gets increased opportunities for shooting down one's enemies, but at the same time, the opportunity increases of being shot down one's-self.
>
> Baron Manfred von Richthofen

In previous chapters there has been at least an implied assumption that the number of hostile fighters involved in the action was known to the friendly forces, although frequent references have been made to additional, unseen, wild-card bogeys. Assumptions such as this are necessary in order to allow investigation of some of the fine points of ACM; but anyone who has ever been involved in actual combat will realize that total confidence in one's perception of a given situation is rarely, if ever, achieved. The great Prussian strategist Karl von Clausewitz referred to this phenomenon as the "fog of war," a fog that obscures reality from the combatants. In the air-to-air arena this can mean imperfect knowledge of an opponent's energy state, or uncertainty as to the type of weapons or tactics he might employ. It can also mean that friendly fighters can almost never be absolutely sure of the number of enemy aircraft they will face, either prior to or during engagement. Is that enemy section really alone, or is the entire enemy air force lurking undetected in the sun?

> Any soldier knows that during a war it is not always the ponderables that count, but that a great deal depends on luck.
>
> Lt. General Adolph Galland, Luftwaffe

Obviously, if the friendly fighters always chose to assume the worst case, they probably would never engage and therefore be of little use. So the standard procedure adopted by most combatants is to gather and analyze all the information available about the tactical situation from every possible source, and then employ tactics accordingly. In the early days of air warfare, knowledge was limited to that supplied by intelligence reports on the numbers and types of enemy aircraft and ground defenses in the area,

previous enemy tactics, and whatever could actually be seen by the pilots in the air. World War II saw the first large-scale use of ground-based radar stations, IR sensors, data link, and radios for passing information to and among airborne forces. Airborne radars also came into use during this conflict, but they were useful primarily for night interceptors and in poor visibility conditions. Inevitably, the advances in sensor and communications technology were closely followed by techniques for neutralizing or limiting their value, such as jamming and deception. All this electronic technology is intended to increase the situational awareness of friendly forces in battle and to deny such valuable information to the enemy. The incredible attention electronics technology has received in recent years is a clear indication of the importance of situational awareness in air combat.

The task of the fighter pilot is to obtain as much tactical information as possible from every available source and then to filter and analyze this information based on knowledge of its source and his best estimates of its timeliness, accuracy, and reliability. Some of the information received may be conflicting, and pilot judgment is required to separate the wheat from the chaff. The necessity of making such judgments is one reason training and experience on the part of the fighter pilot are so important. Many of these information-gathering and -analyzing functions may be performed by the flight leader in multi-plane scenarios, but individual pilot experience and ability in this area contribute greatly to overall success, as tactical judgments must be made, on a larger or smaller scale, by each pilot during combat. The ability of each member of a flight to gather and analyze electronic and visual information, and to pass critical information to other members of his flight, plays a significant role in overall flight efficiency and mission success.

Overreliance on any one source of tactical information is a common problem and often leads to disaster. This condition can be the result of actual lack of available informational sources, loss of some sources (through jamming, for example), or simply ignoring available inputs. The disregard of some available information can be fostered by a tactical doctrine that relies heavily on one source to the exclusion of others, or it may be caused by sensory overload resulting from too much information being fed to the pilot at critical moments. This latter condition can be likened to drinking water from a fire hose. Strict radio discipline, practiced by controllers as well as pilots, is vital to avoid sensory overload. It is normally impossible for every participant involved in a mission to relay everything he knows, sees, or thinks to everyone else. Each individual must analyze his information and assess its importance at that moment before adding to the "water pressure in the fire hose." The ability to perform these tasks effectively requires considerable training and experience at every level.

One-versus-Many

> Good airplanes are more important than superiority in numbers.
>
> Air Vice-Marshal J. E. "Johnnie" Johnson, RAF

Previous chapters in this text have expounded the virtues and benefits offered by employment of multiple fighters, usually pairs or flights of

several pairs, in air combat scenarios. The many advantages provided by tactical doctrines that rely on mutual support have been sufficiently detailed and will not be repeated here, but the tradeoffs involved deserve additional attention. Remember, there is no free lunch in either economics or air combat.

> The fighter pilot is an independent character. He doesn't like too many people around him. He is an individualist.
>
> Colonel Erich "Bubi" Hartmann, CAF

For example, it is more difficult to hide multiple fighters than it is to hide a single aircraft, both from visual detection and from electronic sensors. This is a critical factor, since surprise has been shown to be roughly nine-tenths of air combat success, both offensively and defensively. Coordinated tactics also force the pilots involved to divide their attention. Considerable time can be required to keep track of wingmen and to maintain a proper formation. This is time that is not available for visual lockout, monitoring radars, analyzing tactical situations, making plans, etc. The attention required for this purpose will also contribute to earlier task overloading and breakdown in situational awareness.

> It is difficult for large numbers of men to change position, so their movements can be easily predicted. An individual can easily change his mind, so his movements are difficult to predict.
>
> Miyamoto Musashi

In addition, formation tactics usually result in reduced effective aircraft performance relative to a single fighter. Leaders cannot use maximum speed, power, or maneuvering potential because of the probability that wingmen will be unable to maintain position. Small individual variations in performance, even among aircraft of the same type, contribute to this problem, as does the normal reaction time of a wingman who is maneuvering in response to his leader's actions. Maintaining position will usually require excess maneuvering by the wingmen, which reduces their energy potential, decreases combat fuel endurance, and makes them easier to spot visually because of "wing flashes" and the inability to use profiling effectively. Coordination of multiple fighters also requires increased communications, with the attendant task loading and greater probability of electronic detection.

The following excerpt from *Full Circle* by Air Vice-Marshal "Johnnie" Johnson, RAF, describes the tactical thinking of Captain Albert Ball, RFC (47 victories in World War I). These are some of the reasons Ball preferred his famous solo "lone-wolf" methods to leading a division of fighters (scouts) in combat. Ball disappeared mysteriously in May 1917; Lotharvon Richthofen, brother of the "Red Baron," was credited with shooting him down, but most historians believe he was the victim of ground fire.

> A formation of four or five airplanes was far harder to hide against earth, cloud, or sun than a solitary machine, and therefore surprise, the essence of a successful attack, would be more difficult. He would have to wait for stragglers and inexperienced pilots who could not hold a steady formation; when

> attacking from a diving turn or a wide curve of pursuit he would have to throttle back so that his flankers would have sufficient power in hand to keep abreast. This meant that a team attack would take far more time than the flat-out, stooping dive of a single scout. More time usually meant less surprise. . . . The bigger the [German] formation, the better as far as he was concerned. Such tactics would concentrate the [enemy] into large, unwieldy, conspicuous gaggles, and they would be so busy watching each other that a man could be in and away before they knew what had hit them![1]

With these factors, as well as the advantages of mutual support, in mind it is not difficult to develop scenarios for which single-ship, autonomous fighter operations might be optimum. One of the most obvious of these operations takes place at night or under poor visibility conditions, when it may be impossible to maintain an effective formation or to provide useful visual mutual support. The tactics applicable to such operations are highly aircraft and weapons-system dependent and do not lend themselves readily to generalization; therefore, they are beyond the scope of this text.

Another factor that reduces the importance of mutual support and makes autonomous operation more practical is a highly effective and dependable system of internal or external surveillance and control. This capability might be provided internally by sophisticated electronic means such as radar, IR sensors, and/or RWR systems, which can be depended on to give adequate warning of attack from any direction. Such internal systems may be supplemented or replaced by external sensors and control networks like ground-controlled-intercept (GCI) stations or airborne-intercept-control (AIC) aircraft, which can provide defensive warning to the single fighter while assisting in locating and identifying the enemy for attack purposes. In effect, the visual mutual support function of a wingman can be replaced electronically. Factors to be considered here include the reliability and effectiveness of such systems under the expected environmental and EW conditions, possible enemy countertactics, and the relative capabilities of friendly and enemy surveillance and control systems.

> The strong man is mightiest alone.
>
> German Proverb

Weapons capabilities also have significant bearing on the practicality of single-fighter operations. Friendly all-aspect weapons capability, and the absence of it in enemy fighters, greatly enhances the prospects of success for a single. The reduced maneuvering required to satisfy all-aspect-missile-firing parameters limits the single's exposure to detection and its vulnerability to threat weapons. Conversely, the lack of all-aspect missile capability by the enemy makes surprise attack on the single fighter more difficult and increases the single's attack and escape options. Particularly when both sides are all-aspect capable, missile maximum range and guidance type can be critical. If the single is able to fire at the enemy while remaining outside his firing range, obviously the single's survivability is enhanced. Active or passive guidance, which enable the single to "launch and leave" or to fire and then defend against an enemy weapon, may offset

the longer range that may be provided by weapons that have more restrictive semi-active guidance. A means of identifying a target as hostile at long range, either optically or electronically, is another valuable aid in providing first-shot capability. Long-range target identification is essential when a pilot is facing an all-aspect-capable threat, or it must be replaced by very permissive rules of engagement (ROE) which allow the fighter to fire on targets beyond visual range (BVR). Such ROE are often easier to implement when the single fighter is known to be the only friendly aircraft in the combat arena, but they may not be possible when several fighters are operating autonomously in the same area.

> In aerial warfare the factor of quality is relatively more decisive than the factor of quantity.
>
> Major Alexander P. de Seversky, USAAF
> 13 Victories with Russian Imperial Naval Air Service, WW-I

A significant performance advantage by the single fighter over enemy aircraft is another factor that favors autonomous operations. A substantial speed advantage and the ability to use this speed when it is required and still complete the mission (combat endurance) are probably the most valuable qualities for the single fighter. This speed improves the chance of surprise by reducing attack time, greatly decreases the likelihood of being caught from behind by the enemy, shrinks the enemy's rear-hemisphere missile-firing envelope, and greatly facilitates the friendly fighter's escape from disadvantageous situations. A significant speed advantage can allow the pilot of a single fighter to establish a sanctuary from which he can attack and withdraw at will without fear of attack from the rear. Obviously, the greater the range of enemy rear-hemisphere weapons the greater the friendly's speed advantage must be to provide this sanctuary. Enemy all-aspect missiles, off-boresight capability, and very high turn rate may also offset the defensive value of a single fighter's speed advantage.

> Speed is the cushion of sloppiness.
>
> Commander William P. "Willie" Driscoll, USNR
> 5 Victories as Radar Intercept Officer, Vietnam Conflict

A maximum-altitude advantage can also be valuable, to a single, especially against an enemy equipped only with guns or short-range missiles. This altitude sanctuary may allow the single fighter to choose his attack opportunities carefully and then fire at the enemy with long-range look-down, shoot-down weapons, or dive down for a surprise high-speed attack followed by a zoom climb to a safe altitude. The altitude margin provides the single with adequate defense and allows the pilot to concentrate on offensive matters. Important considerations here include weapons-system capabilities (Can the target be detected and attacked from above?), environmental conditions (Will the attack be highlighted by a higher cloud layer or contrails?), and possible threats other than enemy aircraft (e.g., SAMs).

> Take up an attitude with the sun behind you. . . . You must look down on the enemy, and take up your attitude on slightly higher places.
>
> Miyamoto Musashi

Other design factors that contribute to single-fighter survivability include small aircraft size, reduced aircraft detectability, and multiple crew members with wide fields of view. A significant maneuverability and/or weapons advantage over the enemy is also of some value, since these factors improve the single's defensive capability and reduce the time required for it to reach a firing position.

Another factor that may favor single-ship operations is the existence of an extremely lethal enemy weapon that is not likely to be defeated once it is fired within parameters. Defense against such a weapon depends on avoidance of the firing envelope rather than post-launch maneuvering, etc. The reduced probability of detection, higher possible speeds, and decreased maneuvering requirements inherent to autonomous fighters all contribute to avoiding the enemy's firing envelope, while the increased visual mutual support of a wingman probably would not be sufficient to overcome the disadvantages of multiple-aircraft flights.

A severe comm-jam environment can also detract from the advantages of mutual support. The inability to communicate freely increases the attention necessary to maintain formation integrity and decreases the ability of one pilot to provide support to another. Such conditions quite often lead to inadvertent single-aircraft operation because of a breakdown in mutual support, a situation that is usually more hazardous than preplanned autonomous operation.

Preplanned single-plane operation may be desirable whenever its advantages, as enumerated above, outweigh the benefits of mutual support. The number of hostile fighters should also be factored into the equation, with greater numbers generally working to the disadvantage of autonomous operation. Single-ship operation may be required even under less than optimum conditions if only one fighter is available for a critical mission. Whenever there is a choice, however, mission priority and the chances of the mission's successful completion should be weighed against the probability of single-plane survival. It may be wiser to wait for reinforcements than to "hog" all the bogeys alone. Preparation for multi-plane combat should include contingency planning for inadvertent single-plane operation in case the wingman is shot down or the fighters in the formation become separated and mutual support is lost. It is much easier to decide before takeoff whether a particular mission and the prevailing conditions warrant continuing as a single ship or calling for an abort.

Offensive One-versus-Many

> In my opinion the aggressive spirit is everything.
>
> Baron Manfred von Richthofen

Once the decision has been made to continue operation under one-versus-many conditions, the pilot of the single fighter should plan his tactics to make use of every advantage available to him. In order to be successful offensively, however, the singleton must avoid becoming defensive. Defense, therefore, should be the primary concern. To take advantage of a speed sanctuary, the single should normally maintain near maximum speed in hostile airspace. The lowest possible altitude is often optimum

because of its "shrinking" effects on threat missile envelopes. Against bogeys carrying only guns or very short range AAMs, higher altitudes may offer a greater speed margin. This is particularly likely when a single supersonic fighter opposes subsonic bogeys. High altitude allows the supersonic fighter to attain higher Mach than, and therefore greater speed advantage over, a bogey restricted to subsonic speeds. This greater speed advantage may offset increased threat missile range at high altitude. Combat endurance is another consideration when choosing an operating altitude. Low-altitude high-speed flight is very inefficient, particularly for jet fighters, and high fuel consumption may reduce the chances of completing the mission. Operation at higher altitudes normally results in increased range and endurance at near maximum speed. Other considerations include the threat of hostile ground fire; effectiveness of the single's weapons system at low altitude and in look-down situations; effectiveness of the enemy's weapons and sensors in look-up, and in look-down, situations;
and whether the single is likely to be harder to see looking up or looking down. This last factor varies with cloud conditions, sun position, and aircraft coloring. The possible effects of altitude on friendly and enemy GCI is a further point to consider. Very low altitude operation can enable the single to avoid enemy detection, but it may also deny the pilot the valuable offensive and defensive support of friendly controllers.

> The effect of superior numbers in a decision to attack is small. The tactical advantage of position—altitude—sun—and direction of attack are the influencing factors. With these factors in my favor the number of enemy aircraft is irrelevant.
>
> Lt. Colonel John C. Meyer, USAAF

Quite often when he is selecting an operating altitude the pilot is faced with conflicting choices. These most often involve the interaction of radar and other factors, as in the GCI conflict above. Another example is the choice between staying high to take advantage of the sun or a speed/altitude sanctuary or a low undercast, and degrading the fighter's radar capability by placing it in a look-down condition. Going in at lower altitude in this case probably would enhance the fighter's offensive potential by optimizing its radar operation, but it would leave the singleton more vulnerable to detection and attack. Such choices can be tough to call, and they require careful analysis. Just how much is the radar likely to be degraded looking down? Can GCI supplement the fighter's own radar? How likely is it that the single will be detected at low altitude? If it is attacked at low altitude, what are the chances of escape, considering bogey numbers and relative aircraft and weapons-system performance? Questions like these must be answered as accurately as possible in order to weigh the probability of mission success against chances of survival. Except for very critical missions, where success is absolutely essential, it is usually wiser in one-versus-many scenarios to opt for the safest approach. The pilot who saves his hide today can return tomorrow under more favorable circumstances, unless of course his heart is set on the Medal of Honor.

> We never flew on top of clouds because we were all silhouetted against them; we flew underneath them.
>
> Air Vice-Marshal J. E. "Johnnie" Johnson, RAF

The choice between optimizing offensive or defensive potential can often be reconciled by assessing the likely results of being attacked. If the pilot is confident that he can detect and neutralize a hostile attack and either escape or defeat the enemy quickly, before he is overwhelmed by numbers, then optimizing offensive potential might be a reasonable choice. Otherwise it is probably prudent to assume a more defensive posture.

Chapter 5 ("Section Tactics, Two-versus-One") included a section on one-versus-two offensive attacks and maneuvering. Many of the techniques described in that section are relevant to the one-versus-many scenario and would be worth reviewing at this point. There are also some significant differences, however.

When faced with a known one-versus-two situation, an undetected fighter pilot can stalk his victims and position for an optimum attack at his own discretion. This luxury is not generally available in the one-versus-unknown environment, since prolonged time in the combat arena and the attention that must be devoted to the intended targets leave the single fighter vulnerable to attack by other hostile forces. The single fighter must, therefore, operate primarily in a defensive mode, devoting only the attention and time which are absolutely necessary to prosecute attacks of opportunity.

> I attempt to attack out of the sun. If the enemy aircraft is surprised, he's duck soup, but time is an important factor and it should not be wasted in securing position.
>
> Lt. Colonel lohn C. Meyer, USAAF

Forward-hemisphere gun and missile attacks are often ideal for this scenario, since high target closure limits the time required to complete the attack and therefore reduces the time that must be devoted to offensive functions. Such attacks also tend to reduce the amount of maneuvering required of the attacker, which contributes to higher energy levels and makes it more difficult for undetected enemy fighters to overhaul the single from behind. As is discussed later in this chapter in regard to defensive maneuvering, a single is often most vulnerable to attack during protracted turns. As a general rule, the pilot should plan his attack so that turns of more than about 90° are not required without an opportunity for a roll reversal and a belly-check. Targets that cannot be attacked while adhering to this rule should whenever possible be abandoned in favor of more vulnerable victims. The sooner this decision can be made the better, since attacks aborted in the last moments are more likely to be detected. When disengaging from a position in a bogey's rear hemisphere, a lag-pursuit heading and a slight turn in the nose-to-tail direction allows the single fighter to gain the most separation before the bogey pilot can bring his aircraft's nose to bear. (This nose-to-tail extension technique was introduced in Chapter 2.)

> I decided to make a run on this [Japanese Zero]. He never changed his course much, but started an ever-so-gentle turn. My Corsair gradually closed the gap between us. I was thinking: "As long as he is turning, he knows he isn't safe. It looks too easy."
>
> Then I happened to recall something I had experienced in Burma with the Flying Tigers, so I violently reversed my course. And sure enough, there was his little pal coming along behind. He was just waiting for the sucker, me, to commence my pass on his mate.
>
> Colonel Gregory "Pappy" Boyington, USMC

The fighter's internal radar and GCI/AIC support should be used to identify likely victims at long range and to aid in early positioning to optimize the final attack geometry. Defensive procedures (i.e., high airspeed, optimum defensive altitudes, etc.) are usually employed early in the attack phase, with a transition to a more offensive posture, if necessary, delayed until the last practical moment. Search modes of airborne radars are usually optimum during preliminary attack positioning to sort out the hostile formation and to clear the area of other bogeys. Once the fighter takes a radar lock on a single target, which may be necessary for final attack maneuvering, visual acquisition, or weapons guidance, the attacker is likely to lose track of the big picture, such as enemy formation changes, and he is also more susceptible to detection by the bogey's RWR equipment. The point at which this radar lock is taken normally corresponds to the fighter's shift from a defensive to an offensive posture, and taking it likewise should be delayed as long as practicable. Somewhere around one minute to the point of merging with the hostile formation is generally a useful reference for planning this transition. An even longer delay is desirable if weapons-system performance and maneuver requirements allow. "Track-while-scan" radars, which allow search for and track of multiple targets to be performed simultaneously, can be very valuable in this environment.

When the single fighter's weapons require conversion to a stern attack, radar and GCI should be used to position the fighter with ample lateral and vertical separation to allow the final conversion turn to be limited to approximately 90° or less. Figure 8-1 is an example of this technique.

In this example the single fighter detects a possible hostile formation approaching nearly head-on at time "1." The fighter quickly assesses the situation, determines that there is sufficient range to position for a stern attack, and takes a cut to one side to build lateral separation. Altitude and speed are maintained at this point consistent with best defense against attack by other enemy threats. The direction of the offset should be based on environmental conditions to optimize either the attack or the escape following the attack, whichever appears to be the more critical phase. This could mean offsetting toward the sun side to mask the attack, or toward the opposite side to facilitate a retreat toward the sun after a hit-and-run attack. An offset toward friendly airspace makes escape easier should the fighter be detected at long range and the bogeys begin to react offensively, while a cut to the opposite side provides a shorter route of escape following

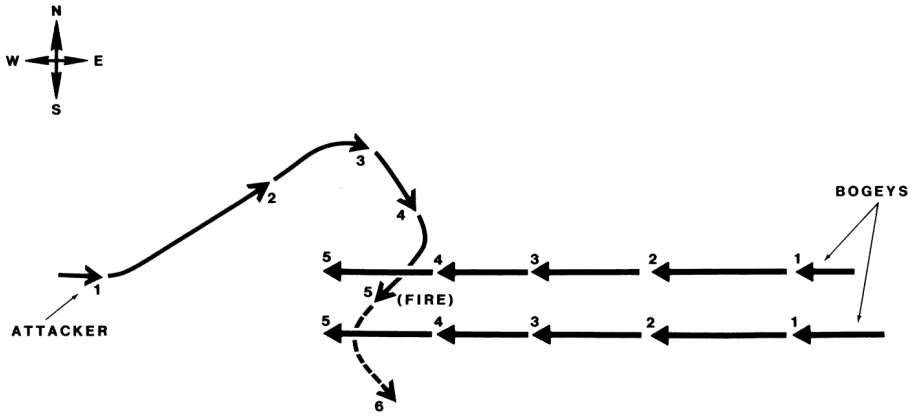

Figure 8-1. Stern Conversion in a Hostile Environment

an attack. These factors and many others affect probability of mission success as well as survival, and they should be considered carefully.

> Concealment and swiftness are the two principal elements of closing.
>
> Colonel V. Dubrov, Soviet Air Force

The number of degrees of offset taken by the pilot at time "1" depends largely on the target range and the fighter's radar limitations. At long range adequate lateral separation can be obtained with smaller cuts. If the fighter is radar equipped it is usually desirable that the displacement turn not be so radical that the targets are placed outside the radar antenna gimbal limits. Generally, the smallest offset that will generate the desired lateral separation is optimum, since this reduces maneuver requirements throughout the intercept.

From time "1" to time "2" the fighter should be concentrating on defense while monitoring the developing situation for changes in intercept geometry, bogey formation, other aircraft in the area, etc. Defensive techniques useful during this phase are discussed later in this chapter. Between times "2" and "3" the fighter determines that sufficient lateral separation exists for an optimum stern conversion. This is also a good point to decide whether to commit to the attack or to abort and escape. The desired amount of lateral separation at this point is a function of target range, offset angle, fighter turn radius, and other factors and should be determined by experimentation. It is seldom less than three or four fighter turn radii, however.

At point "3" the fighter has committed to the attack and performed a recovery turn to a pure-pursuit or lead-pursuit heading. If this turn must be greater than 90° it should be performed in two stages interrupted by a belly-check. In any event, one or more belly-checks should be performed between times "3" and "4." Shortly before or after point "3" is often an optimum time to make the transition from a defensive to an offensive

posture by taking a radar lock, repositioning to optimum attack altitude, attempting to acquire the targets visually, etc. The heading selected at time "3" should be chosen to place the attacker near the target's beam position at time "4," from which a final conversion turn of 90° or less will result in arrival within the lethal firing envelope.

At time "4" the fighter must choose which bogey to attack. The geometry of this particular intercept favors an attack on the far (southern) bogey because of a less radical conversion turn, although slight variations in heading between times "3" and "4" could reverse this situation. Optimum target selection often becomes apparent only at the last moment, and the choice often must be delayed until then. Hard conversion turns can deplete energy and reduce the fighter's chances of escape, but protracted easy turns take longer and leave the fighter more vulnerable to undetected attacks during the conversion. Something in the maximum sustained-G region is usually the best compromise.

Notice that, assuming he is equipped with a RQ weapon, the attacker takes his shot at the first opportunity, on the edge of the envelope (time "5"). A very hostile environment does not allow the luxury of "sweetening" shots by driving to the heart of the envelope. This pilot has been concentrating almost exclusively on offense since time "4" and is very vulnerable at this point to attack from the belly-side (i.e., from the east). After taking the shot, a rapid reversal and turn to the left serves as defense against a possible enemy missile approaching from the belly-side, temporarily foils an impending enemy gun shot, allows the pilot to clear his most vulnerable area visually, and quickly puts distance between the attacker and the known enemy fighters. After clearing his six, the attacker can reverse quickly to assess the results of his shot and to check on the bogeys' reaction. Delaying the defensive turn reversal until after missile impact is a common mistake, and often a fatal one. For this reason semi-active missile guidance, which may restrict the shooter's maneuvers after launch, is an undesirable burden.

> When actually firing at an enemy aircraft you arc most vulnerable to attack. When you break away from an attack always break with a violent skid just as though you were being fired at from behind. Because you probably are.
>
> Group Captain Reade Tilley, RAF

Another difference in attack procedures between sterile one-versus-two and unknown scenarios involves target selection and post-attack planning. In the former situation the recommended approach carried the attacker from one bogey to the other for sequential firing passes and possible engagement of the second bogey one-versus-one in case the first was destroyed. The hostile environment often makes sequential attacks too risky and almost certainly precludes one-on-one maneuvering if it can possibly be avoided. In addition, although only two bogeys are indicated here, these procedures are intended to be applicable to formations of any size. The recommended technique for such situations is to pick a target that will not draw the attacker deeply into the bogey formation, and the far-side rear bogey often fills this requirement. Another point that should

be mentioned is the increased probability of detection inherent to a weapons firing. It is very desirable for the single fighter to be well positioned for escape at the moment of attack.

> Every day kill just one, rather than today five, tomorrow ten . . . that is enough for you. Then your nerves are calm and you can sleep good, you have your drink in the evening and the next morning you are fit again.
>
> Colonel Erich "Bubi" Hartmann, GAP

When attacking bombers it may be necessary to destroy as many as possible during each intercept. In this case the sequential attacks discussed in the one-versus-two section of Chapter 5 may be justified. Consideration, however, should be given to the effects of an attack on even one member of an enemy formation. Such an attack, even if it is unsuccessful, may accomplish the attacker's purpose by breaking up the bomber formation, inducing the enemy pilots to jettison their bombs or abort their mission, etc. When attacking hostile fighters, the single pilot generally should try to control his greed, settle for one victim per pass, and leave some bogeys for his buddies.

Bogeys detected at short range in the forward hemisphere can be attacked if the target appears not to be aware of the fighter's presence, and if the attack can be made without continuous turns of greater than about 90°. The singleton pilot should continuously plan for and assess his chances of escape during an attack. The attack should be broken off as soon as escape avenues appear to be closing or if the target performs an effective defensive maneuver. Prolonged offensive engagement should be avoided.

> Turn to kill, not to engage.
>
> Commander William P. "Willie" Driscoll, USNR

Enemy fighters that appear to be maneuvering offensively or defensively against the single are candidates only for all-aspect missiles or gun snapshots. The pilot of the single fighter should neutralize any forward-hemisphere threat by turning hard into the attack to create a head-on pass with minimum flight-path separation. Depending on the bogeys' speed, weapons, and turn rate, the singleton may then be able simply to continue straight ahead and leave the threat in the dust. Extension distances can be increased if necessary by turning slightly in the nose-to-tail direction after the pass. If the bogey is missile equipped, a dive to low altitude is generally called for to reduce the enemy's maximum firing range. Faster bogeys should be watched carefully during an extension to observe their reaction. The fighter pilot must still consider himself defensive when he is being pursued by faster aircraft.

Fuel state is extremely critical to single-plane operations. Sufficient reserve must be retained for a maximum-speed bugout to friendly airspace at whatever altitude is likely to be required. The pilot of the single fighter must also allow for the possibility of having to fight his way out by defending against hostile fighters, SAMs, etc. Afterburning jet fighters at low altitude can consume an incredible amount of fuel, so prudent penetrations of hostile airspace can be severely limited. In fact, under

many combat conditions, a single fighter may literally be pushing bugout fuel state at takeoff.

Once committed to a bugout, the pilot must again assume a defensive posture. Engagement should be avoided if possible. Only those bogeys in the line of retreat should be engaged offensively, and then only if engaging them does not put escape in jeopardy. The only difference between running out of fuel and being shot down is that some hard-working enemy pilot is denied a well-earned score.

Under most conditions the pilot of the single fighter should not consider returning to the combat arena after committing to a withdrawal. Once he is very close to friendly airspace, however, much of the uncertainty of fuel requirements has diminished, and the singleton pilot may find that sufficient fuel remains for an attack on a known, nearby bogey. Care must be exercised in this case to ensure such an attack does not carry the fighter far from friendly airspace or result in a defensive situation.

Another situation which may call for a return to the fray is when another friendly pilot finds himself in a serious defensive position nearby. If fuel is available, even one high-speed pass through the fight, and a shot of opportunity if it becomes available, often can relieve enough pressure from a hard-pressed defender to enable him to escape. Such assistance would, no doubt, be appreciated, and would probably be worth a beer on return to the pub.

> It is a code of honour to help out any comrade who is in distress, and no matter how serious the consequences may seem, there is only one thing to do—dash straight in, and at least lend moral support to him.
>
> Lt. Colonel W. A. "Billy" Bishop, RAF

Defensive One-versus-Many

In a hostile environment, the pilot of a single fighter should consider himself to be defensive whenever he is not actively engaged in an offensive attack. This ordinarily means that the singleton pilot spends the vast majority of his time in a defensive posture, although, hopefully, not actively defensive. The Chapter 5 discussion of defensive one-versus-two techniques stressed the importance of keeping track of both opponents so that one bogey can be engaged until the other becomes a threat. A switch can then be performed and the process continued until an escape opportunity is presented or until one bogey is destroyed. By definition, in the one-versus-many scenario all the enemy fighters cannot be located or tracked. It must always be assumed that additional bogeys could appear at any moment from essentially any direction. This unknown element normally precludes the prudent fighter pilot in a single aircraft from choosing to engage any number of known bogeys in an extended dogfight. This does not, of course, mean that the single fighter should not attempt to be offensive; but such offense generally must be limited to surprise hit-and-run attacks, as described in the previous section, if the single is to have much chance of survival. For most fighter pilots survival is fairly high on the list of priorities.

Quite often in the heat of battle fighter pilots come up with some fairly novel survival techniques. One of the more bizarre is recalled in *The First and the Last* by Adolph Galland.

> With the first bursts from four Mustangs—I sobered up ... I simply fled. Diving with open throttle I tried to escape the pursuing Mustangs, which were firing wildly. . . . The tracer bullets came closer and closer. As my FW-190 threatened to disintegrate and as I had only a small choice of those possibilities which the rules of the game allow in such embarrassing situations, I did something which had already saved my life twice during the Battle of Britain: I fired everything I had simply into the blue in front of me. It had the desired effect on my pursuers. Suddenly they saw the smoke which the shells had left behind coming toward them. They probably thought they had met the first fighter to fire backward or that a second attacking German fighter arm was behind them. My trick succeeded; they did a right-hand climbing turn and disappeared.[2]

Defense in the unknown one-versus-many environment becomes a statistical problem of how to reduce the probability of being shot by an undetected enemy. This is a major and obviously very difficult dilemma, as evidenced by the fact that about 90 percent of air-to-air combat losses in all wars have been the result of undetected attacks. Some of the techniques that have proven useful to single fighters in this scenario have already been mentioned. These include maintenance of high airspeed, selection of favorable operating altitudes, use of "hit-and-split" attacks, etc. This section goes into a little more detail on the art and science of staying alive in the one-versus-many environment.

> The logic of the theory of probabilities showed us incontestably that one's number was up after a certain amount of sorties. For some it was sooner, for some later.
>
> Lt. General Adolph Calland, Luftwaffe

Probably the greatest amount of time a single fighter spends in this environment will be devoted to cruising, patrolling, or transiting hostile airspace. This includes both pre-engagement positioning and the disengagement, or bugout, phase. The fighter pilot's task at such times is to get from one place to another without being shot. Obviously, maintaining the highest possible speed in these situations, consistent with fuel availability, will limit the fighter's exposure time. An added benefit of speed is the increased difficulty that enemy fighters attempting to reach a rear-hemisphere firing position will experience. Such an attack is generally the most likely to be lethal and is usually the most difficult to detect. A substantial speed advantage for the single fighter can make a rear-hemisphere intercept essentially impossible. In any case, greater speed by the single fighter requires the attacker to employ more lead heading to effect an intercept from a starting position to one side of the fighter's flight path, placing the attacker farther forward relative to the defending fighter during the approach and making the attack easier to detect. Rear-hemisphere attacks also take longer against a faster target, increasing the

possibility that such attacks will be detected. In addition, as has been emphasized before, the size of a target's vulnerable rear-hemisphere missile envelope is reduced by greater speed. Taken together, these factors probably make speed the most important defensive tool for the single fighter in the unknown environment.

Altitude selection is also important. It may be possible for the single fighter to cruise above the altitude capability or normal operating ceiling of enemy fighters. Such an altitude advantage may have to be substantial, however, if the enemy has AAMs, especially since high altitudes give these weapons increased range capability. Whenever there is a possibility of being attacked by either an AAM or a SAM, the fighter should not be so high that it is incapable of achieving at least corner velocity for defensive maneuvering purposes. In addition, if the singleton pilot wishes to avoid visual detection, he should remain clear of the contrail level. Cruising above the contrail layer, however, can aid in detecting an enemy attack from below, while taking a position slightly below the con level can highlight attacks from above.

Very low altitudes can also have advantages in this scenario. Chief among these are greatly reduced range for enemy missiles and, often, decreased enemy radar detection capabilities from both airborne and surface platforms. It should be remembered, however, that a diving enemy fighter may be able to catch even a faster aircraft cruising at low altitude. Generally speaking, depending on the circumstances, either very high or very low altitudes are preferable to medium levels. If nothing else, choosing one of these extremes decreases the probable threat sector by half. Factors that favor high-altitude operation include the need for improved friendly radar coverage, control, navigation, and communications; a high sun; a medium to low cloud layer or light-colored terrain to highlight other aircraft visually; greater required operating range; heavy hostile low-altitude ground defenses, such as AAA and low-altitude SAMs; dependable look-down, shoot-down weapons capability; and enemy fighters equipped only with guns or short-range missiles.

> When flying low over water or desert, adjust your height so that you can see your shadow on the surface; then, in addition to your routine gentle weave, look out, watching the water for other shadows sneaking up behind yours; these may represent unfriendly aircraft.
>
> Group Captain Reade Tilley, RAF

The converse of most of these factors favors low-altitude operation. In addition, low-level tactics may be preferable when the enemy has better radar coverage of the area than does friendly GCI; when the enemy has long-range SAMs; when bogey fighters do not have look-down, shoot-down capability; and when medium to high cloud layers are present. A high dynamic-pressure (Q)-limit advantage (essentially greater indicated airspeed capability) can also be better exploited at low altitude, but a Mach-limit advantage is generally more useful at high altitudes. High-to-low attacks are usually safer because of faster closing and probably greater speed available for escape after the attack. A further consideration with

many fighter radars is decreased effectiveness at very low altitudes, as explained in the first chapter. Many of these considerations often conflict, and it is necessary for the pilot to weigh the importance of each to his survival and to mission success.

> When attacked by much superior numbers I get the hell out of there using speed, or clouds . . . and only as a last resort by diving to the deck. ... I do not like the deck. . . . The danger from small arms ground fire... is great. . . . Two-thirds of our Squadron losses have been from enemy small arms fire.
>
> Lt. Colonel John C. Meyer, USAAF

Once speed and altitude have been selected to optimize the single fighter's survival prospects under a given set of conditions, there remains a choice of technique in transiting from one point to another. This choice is between flying in a straight line and weaving. When the singleton pilot is fortunate enough to have what he believes to be an effective speed or altitude sanctuary, when he is essentially immune from rear-hemisphere attacks, straight-line flight is often preferable. This method maximizes speed over the ground, limiting exposure time, increasing combat radius, and making it more difficult for slower aircraft to close from the rear. When he is at high altitude and worried about attacks from below, the pilot can alternately roll one way and then the other, turning as little as possible, to check blind spots below his aircraft. This technique will, however, increase the likelihood of wing flashes alerting the enemy to the fighter's presence.

> The [MiC-] 21 was so small that each time it ran straight away from us, we lost sight of it. ... Each time he turned, we regained sight of his planform. Commander Randy "Duke" Cunningham, USN

In most situations, however, enemy rear-hemisphere attacks will be a possibility, even when flying at high speed in a straight line. In this case it is usually better to improve the ability to detect such an attack, even at the risk of some increase in attack probability. Weaving does just this. It makes the fighter easier to see and to catch, but it usually improves the chances of successfully defending against an attack. An exception to this generalization might be that "magic missile," mentioned previously, which cannot be defeated once it is launched.

The purpose of weaving is primarily to allow the pilot of a single fighter to cover his rear quarter more easily. The usual blind areas near dead astern, especially the low six o'clock region, can be visually checked intermittently by banking and turning alternately in each direction. On any given heading a fighter will have a blind cone behind and/or below. For most aircraft a turn of 60° to 90° is required to clear this area adequately. The new heading then generates a new blind region, and a turn of like magnitude in the opposite direction can be used to clear six again, and so on. Turns of less than 60° to 90° generally are not effective for this purpose, and turns of greater than about 90° in one direction tend to make a fighter predictable for too long, which aids an unseen bogey in gaining a firing

position. If turns of greater than 90° are required, they should be made in segments of less than 90°, interrupted by a roll reversal and a visual check of the belly-side.

> If it is necessary to fly down sun, do so in a series of 45-degree tacks.
>
> Group Captain Reade Tilley, RAF

The timing of the turns in a weave can be quite important. The object is to check blind areas for attacking fighters or airborne missiles so that they can be detected before they reach a lethal position. In a guns-only environment an attacking fighter must be detected somewhere between the maximum range at which it is likely to be seen under the prevailing visibility conditions from a nose-on aspect, and the range at which its guns become effective. The difference between these two distances, in conjunction with the bogey's probable closing speed, yields the time interval during which all vulnerable areas should be checked.

As an example, consider what might be a typical scenario during the World War II time frame. Assume that visibility on a given day is such that a bogey closing from the rear should be seen at a range of about half a mile (3,000 ft), and it can be expected to open fire at about 1,200 ft. This leaves the defending fighter with about an 1,800-ft detection band. Now assume that the bogey may gain a small speed advantage in a diving attack, and with a little help from geometry could be expected to close at about 60 kts (100 ft/sec). This works out to about eighteen seconds available to the defender to discover the attack. Therefore the weave should be performed so that the blind area is covered every eighteen seconds. If a turn of 60° to 90° is made during each eighteen-second interval, the fighter will be turning at the rate of 3° to 5°/sec. This is a fairly gentle "guns weave" of something less than 2 Gs at typical speeds of the assumed period.

> Check belly because 50 percent of your aircraft is below you.
>
> Lieutenant Jim "Huck" Harris, USN

Now consider a more modern example, of supersonic jet fighters and RQ AAMs. Because of the range of typical missiles, it is quite likely that a rear-hemisphere attack will not be discovered before the weapon is launched, at which time the missile smoke trail, hopefully, will alert the defender. The task, therefore, is to see the missile sometime between launch and impact. Assuming a typical launch range of 6,000 ft, considering the fighter's speed and altitude, and an expected missile closure averaging about 800 ft/sec, the defender's available reaction time (assuming the missile is detected at launch) would be on the order of seven seconds. (To make matters worse, effective detection time may be even less, since a couple of seconds are required for an effective defensive maneuver.) A turn rate of 9° to 13°/sec would be necessary to complete a 60° to 90° turn during this period, requiring 6 or 7 Gs from a fighter at low supersonic speeds. This essentially amounts to continuous break turns for the defending fighter, which would likely result in loss of energy, vastly increasing the chances of being caught from behind, and would be so physically taxing for the pilot that both his offensive and his defensive efficiency would suffer

greatly. It is highly probable, therefore, that such radical maneuvering performed on a continuous and routine basis would be counterproductive.

Obviously, some modification of this procedure is necessary in this scenario. In cases where the single fighter can assume a substantial speed advantage over the bogeys, it may be preferable to rely on this speed to clear the aircraft's tail, as only those enemy fighters with near-perfect position and excellent conversion technique would have a chance to reach a firing envelope. To provide additional peace of mind and insurance against this possibility, the pilot can make short, gentle turns back and forth every few seconds, or simply roll alternately in each direction and possibly kick the tail around with excess rudder. Either of these techniques greatly increases RQ visual coverage without substantially reducing speed over the ground.

A compromise technique that may be useful against faster bogeys or those with long-range missiles, which make a RQ attack more likely, is a combination of the hard turn and the rolling belly-check. The pilot begins this procedure with a hard turn (approximately maximum sustained G) for the usual 60° to 90°, followed immediately by a roll reversal to check for threats approaching from the belly-side. This sequence is followed by straight-line flight for about the same time required for the hard turn, then the turn-and-belly-check sequence is repeated, either in the same or in the opposite direction. The pilot should choose his turn directions for each sequence so that he makes progress toward his objective but does not become too predictable. There are two advantages to this technique. One is that the hard turns may provide an effective defense even against unseen missiles. Another is that an attacker, seeing a hard turn from his intended victim, may assume that the attack has been discovered and break off rather than risk becoming involved in a prolonged fight with an actively defending opponent.

> An aggressive act in the initial phases of the attack will very often give you a breather and a head start home. . . . Showing a willingness to fight often discourages the enemy even when he outnumbers us, while on the other hand I have, by immediately breaking for the deck on other occasions, given the enemy a "shot in the arm," turning his half-hearted attack into an aggressive one.
>
> Lt. Colonel John C. Meyer, USAAF

Whenever an enemy aircraft is detected in a threatening position, the singleton pilot must quickly assess the potential threat and decide on the best course of action. A slower bogey detected near maximum weapons range in the rear hemisphere might be left far behind by turning away, placing the bogey near the fighter's aft visibility limit, and extending away at high speed. Faster bogeys, or those well positioned for a lead turn in the forward hemisphere, generally call for a hard turn to meet the threat as nearly head-on as possible with minimum flight-path separation before attempting an extension and escape. If weapons can be brought to bear during this process, they should be fired. Even with a marginal chance of success, such weapons use can place the bogey in a defensive posture and

may aid the singleton pilot in making good his escape. Remember that in the hostile one-versus-many environment, maneuvering is reserved for defensive purposes and for attack; it is not used for prolonged offensive engagement.

> Fokkers can dive as fast as we can. First you must turn, bank ninety degrees and keep turning. They can't keep their sights on you. Watch the sun for direction. Now there's one on your right—shoot at him. Don't try to hit him—just spray him—for if you try to hold your sight on him you'll have to fly straight and give the others a crack at you. But you put the wind up him anyway and he turns. Quick, turn in the opposite direction. He's out of it for a moment. Now there's another one near you. Try it on him—it works! Turn again, you are between them and the line. Now go for it, engine full on, nose down.[3]

If he is forced into maneuvering defensively, the pilot of a single fighter must react like a cornered animal and attack with all the ferocity and aggressiveness he can muster. Survival at this point depends on how quickly the singleton pilot can destroy his attacker or draw neutral and escape. Time is of the utmost importance here, as every second increases the likelihood of more hostile fighters entering the fight. Fighter pilots generally consider a single aircraft to be easy meat, and the tendency is for them to become careless. This lack of aggressiveness on the part of the enemy can quickly lead to offensive situations for a well-flown and determined defender. Even while fighting with abandon, however, the singleton pilot should watch for an escape opportunity, and if one develops he should seize it rather than prolong the engagement. Air-to-air dogfights tend to draw a crowd very quickly with their wheeling fighters, tracers, missile smoke, flares, explosions, etc. (During World War II the Japanese were notorious for staging mock dogfights just to attract enemy fighters.) This is no place for a singleton pilot in hostile airspace, and he should get as far out of Dodge as possible at the first opportunity. Until that point the singleton should engage in aggressive maneuvering based on the one-versus-one or one-versus-two techniques discussed in previous chapters. During this process the pilot must fight the bogeys he sees, while remaining aware of the possibility of additional, unseen, threats.

> The best individual defensive tactic is a hard and fast offensive, regardless of the odds.
>
> Major William D. "Dinghy" Dunham, USAAF
> 16 Victories, WW-II

Whenever he is trapped in defensive situations, the singleton pilot should yell for help from other friendly fighters that may be closeby. GCI /AIC can be invaluable in directing other friendly forces into the fight.

In past guns-only engagements of this sort, defenders have exploited a dive-speed advantage to separate from enemy fighters. Out-of-control flight has also been useful. The defender enters a spin of some sort at high altitude, then recovers and runs close to the ground. Attackers may assume the defender has been hit and is about to crash, relax their pressure for a moment, and give the desperate loner a chance to escape. Spins are

very effective guns-defense maneuvers, but they offer little protection against AAMs because of low G and low airspeed.

> Cloud ... is of most use to a fighter pilot who is in trouble. . . . It's great stuff to hide in; layer cloud is most useful, as you can pop in, or dive out below for a look, and at the same time maintain a more or less steady course towards home and friends. ... If you are being pursued, turn 90 degrees in every cloud you pop into.
>
> Group Captain Rcade Tilley, RAF

Clouds can also be lifesavers for a defensive single. Ducking into a cloud is a very effective defense against both guns and heat-seeking missiles. In a radar-missile environment, however, whether AAMs or SAMs, prolonged flight in clouds is exceedingly dangerous. Radar can see through clouds, except possibly those containing heavy rain, but the target pilot cannot see the missile to defend against it. When hostile radar weapons are anticipated, the pilot of a single fighter still can jump into a cloud, change direction about 90°, and pop out again for a look. As long as the threat of radar missiles exists, the defender should not remain for long in clouds. Likewise, flying for any period of time close to a cloud layer between the fighter and the radar-missile threat is not wise, since a missile popping out of a cloud layer may not leave adequate time for defensive reaction.

> Clouds are very effective for evasive action. . . . They're a good way to get home when you're alone.
>
> Lt. Colonel John C. Meyer, USAAF

Very low altitude flight tends to complicate an attacker's guns or missiles employment problems. This may allow the defender to drag bogeys toward friendly fighters or friendly airspace. In desperation a defender might even drag his antagonists over hostile surface defenses, as a bogey is not likely to continue an attack through heavy AAA or SAM launches, even if these weapons are fired by his side. The single defender, on the other hand, may prefer defending against surface fire than against threatening fighters.

Few-versus-Many

> Superior technical achievements—used correctly both strategically and tactically—can beat any quantity numerically many times stronger yet technically inferior.
>
> Lt. General Adolph Galland, Luftwaffe

Under most combat conditions the advantages of mutual support will outweigh the advantages of single fighters. This is particularly the case when friendly and threat aircraft and weapons capabilities are such that there is no reliable speed or altitude sanctuary for the singleton. The section of two fighters is considered by most doctrines to be the ideal mutually supporting element. If it is desirable to combine greater numbers in one mission, they can form divisions of several two-plane elements under the overall control of the leader of one section. Once engaged, however, divisions usually attempt to maintain only two-ship section

integrity, since this has been found to be about the maximum number of aircraft which can be closely coordinated at the high speeds and large turning radii of modern fighters. This segment addresses the techniques used by a section of fighters operating in a highly outnumbered hostile environment.

> Fighter pilots don't think of not coming back. They are invincible, or think they are, and they have to be that way. Down in our hearts we may figure that some accident will get us some day, when we are old and gray, when our beards get in the way of the controls, or we get to where we don't see well or react fast—but we know that no enemy fighter is good enough to shoot us down. If that happens it's just an accident.
>
> These thoughts are the "chips" that we carry on our shoulders, and they have to be there—arrogant, egotistical chips mellowed by flying technique and experience and fortified by the motto, "Attack!" Never be on the defensive. Shoot the enemy down before he can shoot you down. You are better than he is, but don't give him a chance. He may get in a lucky shot but you're invincible. Move toward any dot in the sky that remotely resembles an airplane. Move to attack, with switches on and the sight ready. If it's not a ship or if it's a friendly one you'll be ready anyway, and your arrogant luck will last longer.[4]
>
> Colonel Robert L. Scott, Ir., USAAF
> 10 Victories, WW-II

Chapter 6 ("Section Tactics, Two-versus-Two") discussed the merits of various tactical doctrines in the two-versus-two environment and stated that double attack and loose deuce doctrines are probably best suited to this scenario. The strike-rejoin-strike technique described there can be employed with either doctrine, providing credible offensive potential with good mutual support. Like the single fighter in the one-versus-many scenario, the section operating in the few-versus-many environment must be primarily concerned with defense. Prolonged turning engagements should be avoided like the plague, as they tend to attract other hostile fighters, lead to breakdown of mutual support, and foster task overloading, which leaves the fighters vulnerable to unseen attacks. The strike-rejoin-strike system, exemplified by Figures 6-5 through 6-8, allows the section to maintain an effective defensive posture except during brief attack sequences, and discourages prolonged engagement. These qualities are ideal for the unknown few-versus-many scenario.

> In Africa we were outnumbered twenty to one, so it was impossible to get any real success. To get out with your neck, to get home in one piece—that was success.
>
> Major Hartmann Crasser, Luftwaffe
> 103 Victories, WW-II

As in the one-versus-many situation, the section in the hostile unknown scenario spends most of its time transiting hostile airspace during the ingress, patrol, pre-engaged maneuvering, and egress phases of a mission. Combat-spread formation has been shown to be most effective for section defensive mutual support and is recommended. Small divisions operate best in line abreast, or in loose vies (3 fighters) or finger-four

arrangements. High speed and optimum altitude selection, as discussed earlier in this chapter, are again critical elements in the survival equation.

> Surprise is always to be aimed for. ... It is easier to surprise a formation of four or six than it is to surprise one or two. This is probably because the greater number feel more confident in their ability to protect themselves, and also are probably counting upon each other to do a certain amount of looking out. When flying alone or with just one other, it is always a case of constantly turning around in your seat, turning your machine to right or left, looking above and around or below you all the time. It is a very tiring piece of work, so it is but natural that when you have three or four other men behind you, you spend more time looking in the direction where you hope the enemy machines are, if you want to attack them, and to looking at any interesting sights which are on the ground.[5]

In the previous segment on one-versus-many, there was considerable discussion on the merits of weaving. The purpose of this tactic is to allow the pilot of a single fighter better opportunity to cover visually his vulnerable rear quarter. With an effective defensive formation this function is performed more efficiently by visual cross-cover of the wingmen. If the pilots weave in formation, either individually or in unison, their wingman's rear hemisphere will be periodically out of sight and unprotected by mutual support. Considering this fact and the other disadvantages of weaving, it appears that this technique is counterproductive. In most cases it is more effective for the fighters to fly straight and level from one point to the next, maintain strict position and spacing within the formation, and rely on the wingmen to provide visual protection of individual fighter blind areas. An exception to this rule might be when, because of field of view, visibility, threat weapons, etc., the defensive formation is not considered adequate to cover vulnerable areas. The inability to communicate between fighters, because of comm-jamming or radio malfunction, for example, is another possible exception. Obviously this method requires absolute trust in the wingmen.

The tac turn (described in Chapter 6) is an ideal method for maneuvering a section in the hostile unknown environment, and it can also be adapted for use by small divisions (as depicted in Figure 7-5). As recommended for the single plane, section turns should be limited to a maximum of 90°, and smaller turns should be made if possible. A straight-line period should be provided between each heading change to ensure adequate coverage of the rear. Although tac turns offer better visual mutual support than the other methods discussed, there is still some degradation of coverage during the maneuver as compared to straight-line flight in combat spread. Tac turns are also more flexible than other methods, as they can easily be adapted to directional changes of less than 90° with good mutual support throughout, as long as all fighter pilots know the planned duration of the turn at commencement.

> The sun is a most effective offensive weapon and the enemy loves to use it. Whenever possible I try to make all turns into the sun and try never to fly with it at my back.
>
> Lt. Colonel lohn C. Meyer, USAAF

A good defensive formation should be maintained for as long as practical during the pre-engaged maneuvering phase; the fighters can make a transition to a more offensive arrangement in the final stages of attack. When meeting bogeys in their forward hemisphere, bracket and drag attacks, as described in Chapter 6, are useful in this scenario. Because of better mutual support during and after an attack, however, the bracket is probably preferable in the unknown scenario. Whenever possible, missiles and guns should be fired from the target's forward hemisphere during the bracket or pincer attacks, as conversion to RQ firing parameters normally requires turns in excess of 90°. Such turns leave the fighters predictable for too long and vulnerable to attack by unseen bogeys. Figure 8-2 illustrates the recommended bracket attack technique in the unknown scenario.

At time "1" in this example the fighter section, patrolling in defensive combat spread, spots what may be a hostile formation approaching head-on. If the contact can be identified as hostile at this time, and the fighters are equipped with all-aspect missiles, the weapons should be fired at maximum relative range. In this case, however, the bogeys cannot be identified as hostile, so the fighters begin a bracket maneuver to gain more offensive positions. At time "2" each fighter has completed a counterturn to a pure-pursuit or lead-pursuit heading on the nearest bogey. During the turns between times "1" and "2," the attackers should visually clear the

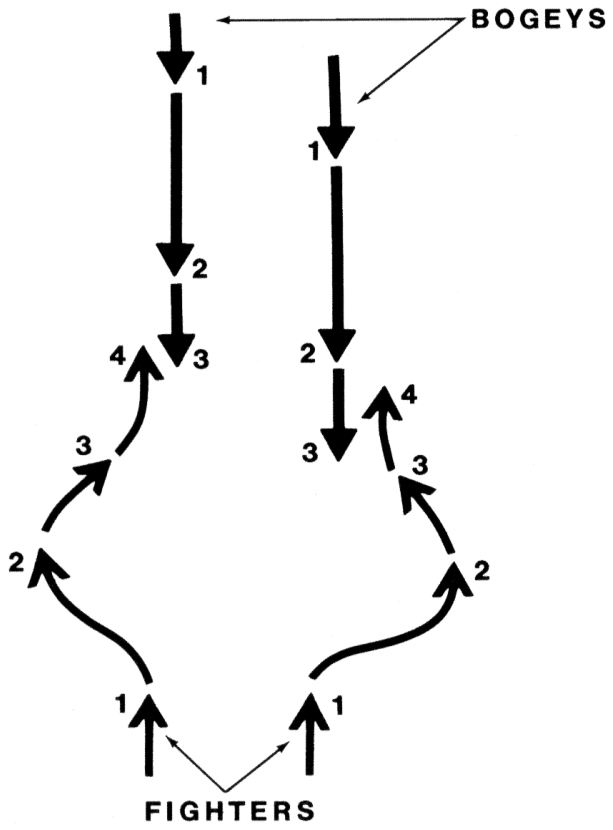

Figure 8-2. Bracket or Pincer Attack, Unknown Scenario

area inside their turns for attacks by other hostile fighters or missiles. At closer range, and with a greater-aspect view of the bogeys, visual identification is more likely. The first pilot to identify the hostile bogeys calls the VID to his wingman, and both pilots are then cleared to fire if they are all-aspect missile equipped. At time "3" both fighters press ahead for forward-hemisphere gun snapshot passes. After prosecuting their attacks, being careful not to turn more than 90° during the pass, each pilot should reverse and break away to check for threats on his belly-side. At time "4" the fighters are again well positioned to rejoin in spread formation and continue their patrol or bugout.

Again, when attacking a hostile formation from the rear hemisphere, a good defensive formation and posture should be maintained until the last practical moment. Then the fighters can shift into a more offensive echelon or trail formation for simultaneous or sequential attacks. Simultaneous attacks on multiple targets are usually preferable, since one pass is all that should be expected or planned in the hostile unknown environment. As in single-plane attacks, each pilot should choose a target that limits the probability of him being drawn deeply into the enemy formation, possibly complicating the prospects of escape. The break-away direction should be established by the formation leader prior to the attack to facilitate rejoining the section as quickly as possible.

> If your attack is sudden and aggressive, the enemy will be at a disadvantage regardless of his numbers and position.
>
> Lt. Colonel Gerald R. Johnson, USAAF

As a rule in the few-versus-many scenario, attacks should not be made without offensive advantage and the prospect of getting off the first shot. The prospects for escape are also critical in the decision to attack. Remember, the object is to attack, not to engage. Escape beyond visual range is often possible even for slower fighters following forward-quarter attacks. If escape is not likely after an attack because of bogey performance or weapons, the fighter section must choose its victims very carefully with a view toward destroying as many as possible in the initial attack and engaging the rest on at least equal terms. Even this prospect, however, is not an attractive one in this scenario because of the probability of intervention by additional enemy fighters during the engagement. Avoiding combat with superior numbers of such bogeys is usually preferable. In the target-rich few-versus-many environment, easier pickings are normally not hard to find.

Ordinarily, extended engagement in this scenario is only justified when mission objectives dictate such engagement, or when the fighters are attacked and are forced to defend themselves. In the latter situation the pilots should employ one of the defenses described in Chapter 5, namely the sandwich or one of the various defensive splits, to neutralize or destroy the attacker as quickly as possible. When a smaller number of fighters are engaged by multiple bogeys, loose deuce doctrine (or gaggle tactics for more than two fighters) seems to offer the best prospects of maintaining mutual support (by presence). By virtue of its high offensive efficiency, this

doctrine also generally provides the quickest kills, which are critical in the hostile arena. When the fighters are committed to engage bogeys of superior speed, it is usually preferable to continue the engagement to its conclusion rather than attempt to escape and risk being caught and re-engaged defensively. The difficulty of escape must be given careful consideration when deciding whether to use strike-rejoin-strike methods against large numbers of superior bogeys.

Although the elements of a section or a division should generally plan to remain together for mutual support in the few-versus-many environment, a high probability exists that breakdowns will occur and pilots will find themselves in a one-versus-many situation. Therefore, this contingency should be preplanned for, and the critical decision of whether to continue the mission under those conditions should be made before takeoff. For the same reason, pilots should be well trained in single-plane attack and survival techniques. GCI/AIC control and prearranged rendezvous points are valuable aids in reforming separated elements.

Many-versus-Many

The many-versus-many scenario denotes large and roughly equivalent numbers of friendly and hostile fighters in the combat area. These fighters may be on coordinated missions or simply be in the same arena by chance. Because large numbers of fighters are difficult to control, they are generally operated in sections or small divisions that are able to coordinate their efforts to achieve a given objective. Each element can therefore operate just as in the few-versus-many case. All pilots should be trained in the same techniques so that they can join with other friendly fighters and operate with undiminished efficiency should they become separated from their own wingmen in the heat of battle. All pilots should monitor the same radio frequency for better coordination, but strict radio discipline is absolutely essential if there is to be any hope of pilots receiving life-or-death transmissions.

> In fighter flying, a panic message is the greatest of all crimes. Practice on the ground the exact words you will use to cover any situation in the air. Say it over and over again until it becomes automatic.
>
> Group Captain Reade Tilley, RAF

Although strike-rejoin-strike methods are still preferable in most many-versus-many scenarios, the presence of more friendly fighters in the general area makes engagement somewhat less risky. In addition, enemy fighters are likely to be less aggressive and less eager for extended engagement than they are under previously discussed conditions. Loose deuce and gaggle tactics continue to be most effective in this environment. Additional elements should refrain from joining a mature engagement of roughly equal opposing forces in which friendly fighters appear to be holding their own. A more effective tactic is to cruise outside the periphery of such a fur ball, remain in a defensive posture, and be alert for bogeys exiting the fight and the arrival of additional hostile forces.

> The man who enters combat encased in solid armor plate, but lacking the essential of self-confidence, is far more exposed and naked to death than the individual who subjects himself to battle shorn of any protection but his own skill, his own belief in himself and in his wingmen. Righteousness is necessary for one's peace of mind, perhaps, but it is a poor substitute for agility . . . and a resolution to meet the enemy under any conditions and against any odds.
>
> Major Robert S. Johnson, USAAF

Notes

1. I. E. Johnson, *Full Circle,* p. 54.
2. Adolph Galland, *The First and the Last,* p. 213.
3. Elliot White Springs, *War Birds: Diary of an Unknown Aviator,* pp. 235-36 (attributed to 1/Lt. John Grider, USAS, serving with 85 Squadron, RAF, 1918).
4. Robert L. Scott, Jr., *Cod Is My Co-Pilot,* pp. 178-79.
5. William A. Bishop, *Winged Warfare,* pp. 177-78.