Pierre Sprey

There is an airplane that would change that situation and, I think, radically. What we really would need to convert that investment into something that could affect the outcome of a war is a large quantity of airplanes that are effective against the kind of targets that we would see early in the war. We need several thousand such airplanes to really make a difference. I mean the U. S. and the European countries need several thousand such airplanes to really impact the outcome of a war in which the Warsaw Pact would make an all out attempt in Central Europe.

Of course, the first question that might occur to you is what is wrong with doing the job with our latest aircraft, say A-10's and F-16's. I think there are a few things wrong with trying to do the job or trying to buy several thousand of those airplanes. The first is you cannot buy several thousand of them because they are simply too expensive. Even the A-10, which at one time we had hoped would not be very expensive, is up to $5 million fly-away, probably $7 million programmed cost. The F-16 is substantially worse than that in cost. It is just not the kind of airplane you are going to buy several thousand of. Second, both aircraft are too big. For instance, the A-10 is about 900 square feet of plane view area. It has been oriented to a reasonable-sized fighter. The World War II Messerschmitt 109 had about 250 square feet of presented area. That was a good-sized fighter--small, relatively small in World War II. So here we are with almost four times that size with the A-10. That is a very significant factor. I will be coming back to that factor again.

Even the F-16, which we thought was a small aircraft a few years ago, is not a small aircraft. It is twice the size of a Messerschmitt. It has about 500 square feet of presented area. It is a large airplane. Of course, I do not need to dwell on what is wrong with airplanes that are very large, but obviously in the tactical environment that we are talking about, it is very, very valuable not to be seen or not to be seen until the last moment.

The A-10 has one other disadvantage, of course, that is associated with its size. It is pretty sluggish. It does not have the kind of performance to get really good evasive maneuvers and, of course, it is a little sluggish in

acceleration and climb-out for evading air defenses. The F-16 cannot be faulted on acceleration. On the other hand, it simply has not got the left-hand envelope performance that you need for a real anti-armor aircraft. Basically, its maneuvering capabilities down around 300 knots or below are just not what is required by the nature of the target. We will get into that a little more. Finally, its greatest deficiency at present: it simply has no weapon that is very effective against tanks or any of the targets associated with tanks. That of course, is the great strength of the A-10--it has a superb weapon very suited to the job and I think that is the thing we can be proudest of in the A-10 program.

Now, let us assume that we could build an airplane of which we could afford several thousand and which was really suited to the job of attacking armor. What would we do with it? I think you can see very clearly from the talk yesterday that there are a number of very exciting roles that airplanes have not played before that are possible.

First of all, this airplane would be very valuable in the weakly held areas, the areas outside the main efforts, outside the shoulders of a well-organized blitz campaign. Very important, and something that no one describes as well as Colonel Rudel, is the matter of visual recce. The single most important kind of recce that air forces can do is simple eyeball reconnaisance by pilots who are in direct contact with tactical commanders. That is a kind of reconnaisance that we have not had for years and probably never had on an organized basis. Rudel describes it very clearly in his book. That might be an interesting thing to ask him about. His contribution in that area may very well have been more valuable than the 500 tanks he killed.

Closely related to the question of patrolling and sweeping areas that are thinly held on the ground is the question of using this kind of airplane, a blitz fighter, to back up and coordinate with armored recce units. There is a possibility of real integration of the role and the tactics of a blitz fighter and armored recce units. Of course, armored recce units are absolutely critical to any kind of mobile warfare.

A very obvious use of this airplane is simply to reinforce the anti-tank capability of the main effort. Keep in mind, however, that in doing that, we are really talking about very carefully timed operations. We are talking

about fast-moving warfare, countering breakthroughs and so on. Just having air planes scouring the general area of enemy armored columns simply is not good enough. You have to talk about things that are carefully and closely timed and integrated with the ground tactics and the ground efforts.

Then, of course, the airplane, if it was able to do all the previous things, would be a great close-support airplane. I do not need to belabor that point. I think there are two main points that I would like to make out of this and that I think you would like to think about addressing with Colonel Rudel.

The first is that we are not talking about just attacking tanks. We are not even talking about attacking groups of tanks. We are talking about attacking, disrupting, slowing down armored units and that is very different. That means we are talking about tanks, trucks, accompanied by antiaircraft, APC's, and even, depending on the battle situation, we are also talking about attacking dug-in troups.

Secondly, just from the very sketchy description I have given and probably much more from what you heard yesterday, you can see that there is very little role for independent air operations. In this concept of Blitzkrieg or counter-blitz, independent air operations would have very much less effect than air operations that are closely tied into the ground.

Given that we wanted to proceed with a blitz fighter, what are the effectiveness characteristics that we should really home in on? Well, the first, and very critical, of course, is finding armor units. If we look at what a new blitz fighter can do compared to the A-10 and previous aircraft, the improvement potential available to us now is modest. The reason for that, of course, is that there is only one sensor that can reliably find tanks and that is the eyeball. The best we can do is provide a platform that provides the proper speed and the proper visibility to help that eyeball. We have just been through another go-around of the eternal quest after a night sensor or a bad-weather sensor for tanks. We have just been through the infrared business with the Maverick again and that is only, I would say, about the tenth repetition of the great infrared hope that started late in World War II and was already heavily exploited or explored in Korea, and, of course, without fail, that great hope has proven a disaster every time. Of course, our latest experiments in Europe show that again. So the one area of effectiveness in which you cannot expect great

improvements from the new airplane is, in fact, the area of finding tanks. However, it will critically affect the design of the airplane, as I will get into in a minute.

On the question of destroying and disrupting armored units, I think we can look towards a fair improvement. We have already made a great leap, a tremendous leap, probably the most important single weapons advance in air since World War II, with the 30-millimeter gun. However, I think there is some room left for improvement in several areas, both in the airframe and the gun area.

Thirdly, very important, is the question of response and being able to respond very, very rapidly and fast enough in a tactical situation and to respond with large quantities of airplanes, the several thousand that I am talking about. There we can certainly make major improvements over anything we have.

Finally, in the area of surviving the kind of defenses we will see over the 90 Pact divisions I was talking about, there also I think we have a potential for making very, very large improvements.

Let us address the question of finding armor. As I have said, the only sensor we can rely on to find armor is the eyeball. Radar, of course, is completely out of the question. We discussed IR. And, of course, the radio helps a lot. After all, there are people on the ground who are being overrun by tanks and so on. If you are in a position to use their information and, of course, taking peacetime preparation and training, a little hardware, if you are in a position to use the information of the people on the ground, it certainly adds greatly to the capability from the air.

The second thing that is important is, of course, the performance that is associated with using the eyeball properly and this is another area that I think you need to explore with Rudel. He is very clear on this subject. The first factor you have to deal with is that you are not going to see tanks very far away. You do not see them very far away on the ground, you do not see them very far away from the air. Tanks have a vested interest in not being seen and they do whatever they can towards that end. You cannot count on seeing tanks at much more than a thousand yards and probably (a lot of times) less.

We know what the weather in Europe is like. Although we have been so inundated with weather statistics that we have this impression that 90 percent of the time a randomly chosen man standing in Europe is standing in a fog, that is not exactly true. There are low ceilings a very large percentage of the time

in Europe. Interestingly enough the visibility under those ceilings is quite good most of the time, and we are talking about being able to operate well below a thousand feet, then all of a sudden the visibility situation in Europe is not bad at all. If we can operate at 500 feet and below, we should have visibility in Europe something over three-quarters of the time.

What does operating below a 500-foot ceiling and trying to respond to a target you see at less than a thousand yards add up to? It all adds up to a fact that is going to be the first way to make an airplane ineffective. When you are searching for tanks, you need performance capability down to 150 knots, and I do not mean 150 knots with the airplane on the edge of a stall. I mean an airplane capable of very hefty maneuvers at 150 knots. I am not saying that that is where you will stay, and I think an extended speed range is very important, but I think the first thing you have to be careful of in working on this airplane is to protect the left hand envelope performance which in some of these early developmental studies has been sliding pretty badly.

Of course, if you are going to use the eyeball, obviously you want to be able to see out of the airplane in as much of a full sphere as possible and that implies an airplane with a very, very narrow fuselage to the point of discomfort for the pilot. This is necessary in order to get over-the-side visibility, which is really the critical thing and one in which our airplanes up to now, perhaps barring the F-16, have been relatively poor.

The next point, if you have found tanks and you are not flying too fast to attack them from the position in which you find them, the next point is how are you going to go about "killing" them? I put killing in quotes for the very simple reason that you do not have to melt the tank or return it to the scrap heap. Stopping the tank is very adequate for our purposes. We have done a lot of testing in the last ten years. We have explored, I think, pretty thoroughly the range of options the current technologies have to offer. During the 1960's we looked very carefully at cluster weapons. We developed the Rockeye, which is a cluster weapon that is almost as expensive as a missile, and it proved to have very little effectiveness. Not only did it prove to have low effectiveness, it was also relatively easily countermandable with stand-off screens. As you remember, Rockeye was a little cluster weapon that tried to spread shaped charges over a sizable area. I think our experience in that testing and the calculations we

did convinced us that Rockeye was not going to bail out the basic inaccurancies of dive bombing. We checked all kinds of missiles. We checked several kinds of electrooptical missiles. We have now just gone through a big go-round of IR missiles and laser guided missiles. Basically, our tests in Europe of the Maverick show clearly that you cannot pull the lock on a tank and that you are far too vulnerable in trying to launch a TV missile just because it takes so long to line up and track and lock on. We cannot afford weapons that take 10 to 15 to 20 seconds to get rid of.

So that returns us to the only weapon that showed much promise against tanks in World War II, which was a large-caliber gun. I mentioned we have made tremendous progress with that. The results are very, very impressive. We are now at the point, I will not get into the exact numbers, but we are now at the point where we have a gun that reliably, at over a thousand yards, will give us the total destruction of the tank almost half the time and will give us mobility kill of the tank over three-quarters of the time. That is far and away better than the record of any missile that we have tried so far. In fact, as you know, with the missiles we have tried so far we cannot even get lock-on a quarter of the time, much less kill, and there are many a slip between the lock-on and the kill.

I do not want to belabor the gun point any more than that. It is critical to the design of this airplane, of course. As you may recall, I mentioned that I think there are opportunities for improvement. I think the first and clearest opportunity for improvement is the need to get out more shots in the very opening of the burst. This goes back to an old controversy of some ten years ago about the relative effect of shots early and late in the burst and we can discuss it later if anybody is interested. I am convinced that shots early in the burst, the first quarter of a second, are an order of magnitude more effective than shots fired upon the second. Therefore, we can reflect that kind of knowledge in the design of the gun by getting guns that get up to rate very quickly.

The second area in which we certainly can make improvements is in the question of aircraft handling as it affects gun accuracy. I want to be very clear on what we mean by gun accuracy. We do not mean gun accuracy on marked ranges. We are talking about gun accuracy in a tactical environment. That means in a constantly jinking approach with relatively high g's, certainly more

than two or three g's, and a bare minimum of tracking time, say on the order of one and a half, perhaps at most two seconds of tracking time. Whatever accuracy you can get under those difficult approach conditions, that in my opinion is the real accuracy of the airplane. In that kind of accuracy it is obvious that we can make great improvements over the A-10, largely because of the size of the A-10 and secondly because they did not really try for that in the A-10.

A third area in which we can make an improvement, once we come clear on what weapons work, what weapons do not, and what we are designing this airplane for, if we recognize the fact that this airplane is, strictly speaking, a gun-carrying airplane, then I think it becomes clear that we need a selectable feed. That is, we cannot go out loaded up with nothing but armor-piercing ammunition on a mission where we may encounter things other than tanks. Armor-piercing ammunition will not do much for us if we run into dug-in troops. It will not really address soft targets, like trucks and so on as effectively as he will. I think we need at least the ability to select two kinds of ammo, possibly three. That will be, in essence, the equivalent of an increase in payload.

Further, I think we need not be rigid on sticking with exactly the gun we have. As good as it is, I think we should be quite open towards the possibility of either increasing its caliber, or increasing the velocity of the round, or of changing the configuration of the round, if we see real effectiveness improvements. Since we are already doing live firing against tanks, I think we are in a good position to do that. We are in a good position to get away from the model building approach to tank vulnerability and lethality. We have to look at our live firing results, carry out some new line firings to see whether added penetration or added behind armor spall or any one of the characteristics that we could change in our round would really give us a lot more kill. If it does not, then fine, let us proceed with the round we have.

Anyhow, I think you see that there is quite a bit of potential there for improvement. My guess would be we are talking about lethality improvements perhaps on the order of fifty percent or more per pass, at least at the longer ranges.

The next question in killing armor is how do you get into the position to shoot. The first thing I would like to say is that a subject that we have ignored in the past is the rate at which we kill tanks. Some of you may be aware

that there has been a recent little exercise for the A-10 to see how fast a pair of A-10's could kill ten tanks laid out on the desert. A lot of people when they first hear about that exercise thaink it is some kind of stunt. If you stop and think about it, it is far from being a stunt. It is addressing, in fact, the heart of the tactical problem that you face once you have found a tank unit. After all, when you have attacked your first tank, they are not all going to sit there like they do on the range. They are going to take counter measures, they are going to disperse, they are going to head for the woods. They will do everything they can to destroy the effectiveness of your attack. In turn, the faster you can reattack and the faster you can wipe out the entire unit, the less time they have to take countermeasures, the more effective you will be, the less likely they are to get into a position in the woods or a barn or something that makes them invisible. This is again the kind of thing that people who have been there can tell you about, and I think Rudel is interesting on this subject. His book mentions it and I think it is something to keep in mind.

Now, what does it take to reattack fast? To reattack fast, it takes a very high level of maneuvering components at moderate speed. In particular, the thing we are interested in, and I think this is in large part an outcome of some of John's work on fast transients in air-to-air fighters, is what we call the button hook turn, which is of real interest and a really critical capability.

By button hook turn we mean a turn at high g and high deceleration. That is, if for one reason or another, you are in a fast cruise speed and you run across a tank, you want to convert as quickly as possible into an attack. That is the first step in getting a high rate of kill. The ability to decelerate very hard while turning into position is extremely useful because, of course, it leads to a turn at rapidly decreasing radius which is exactly what you want instead of having to fly out a couple of miles, reposit and reattack. If you have a real button hook turn capability, you will be able to greatly reduce the separation between you and the tank as you come in for the first attack. And, of course, I think all of you who are involved in aircraft recognize that means low aspect ratio wings.

The time we are talking about is something that can be worked out. There are some programs running in the country that will do optimum reattack profiles and we need to exercise those programs more heavily than we have in the

past. We used them once or twice in the A-10 program and now it is time to get serious about them. I think using those programs we will see that we should be able to get substantially below thirty-five seconds reattack time. I think that will be an important element in trading off the final controlling characteristics of this airplane.

There are two lessons here that I would like to leave you with. One, as I think you now realize from our A-10 experience, including bombs and missiles in payloads of the close support airplane inevitably makes the airplane big and sluggish.

The second point is for the kind of performance we are talking about, the kind of reattack capabilities and the kind of capabilities that I will be talking about later that are necessary for survival, I think we are going to be talking about quite high thrust weights, higher than people have generally talked about in close support aircraft. I think the range we should be looking at is .7 and maybe a 1.0 kilometer. At the same time, we are not interested in just maximum turn capabilities similar to that of the A-10. We would like something better and, in particular, we would like it to be able to decelerate at a very high rate while turning.

Assuming we have found tanks, assuming we have the performance and are in a position to kill them, and have the weapons to kill them effectively, the next question is how to put up enough airplanes to make a difference. In thinking about how many airplanes make a difference, I think there are basically two kinds of missions that we want to keep in mind that in essence define effective force size for us. Obviously, there are vastly more missions than this that the airplane can carry out. But just in looking at what affects force size, we are looking at covering weak sectors, some kind of all-day patrol situation, or it could be covering one of our own ground units against surprise attack as basically done in Patton's advance on France. If we are talking about that kind of situation, the force size that counts is the number of airplanes in the air all day long, and it is very simple to calculate what affects that. The thing that affects that is loiter time. The more loiter time you have the more airplanes you will have on station under the fixed force size. The sortie rate is directly proportional to the effective force in the air and cost is inversely proportional.

The other kind of mission we have is not one where we are trying to maintain a presence over some period of time but where we are trying to meet the need for an attack at a fixed time or over a fixed period of hours or days. In that case, the force that counts is our surge sortie rate or our surge number of sorties delivered to the target times the number of kills that those sorties can deliver. So very clearly what counts there is the surge sortie rate itself, the probability of kill on each burst, and the number of bursts you have on board.

Both these kinds of effective force size have to be addressed and I think you will see very clearly how they relate to the kind of airplane we are talking about. For the kind of simplicity that we have envisioned, obviously the sortie rate will be high, perhaps even higher than with the A-10, although the A-10 is certainly not to be faulted on that score. On cost we hope to make a big improvement over the A-10--that situation is not really satisfactory. In loiter time, of course, the A-10 is not to be faulted. The key thing for us is to see how to get very adequate loiter time without making the airplane big.

Given that we have enough airplanes to make a difference, they still have to be there. They have to be where they are needed and they have to be there on time. As we know from our Vietnam experience, that is easier said than done. In general, our response times in Vietnam, even in close-support and emergency conditions, were pretty poor. They normally averaged on the order of 45 minutes, which is practically an order of magnitude too large for emergency situations on the ground. I think there is some agreement among people with experience in this area, people who have performed real close support and ground tacticians, that something on the order of a five-minute response is what is really needed if you are talking about airplanes reinforcing a unit that is suddenly surprised and about to be overrun. The only way you can achieve a five-minute response--there simply is no way other--is to respond by being on station in the air and not too far away, and the only way to get that capability is to have plenty of loiter time. Keep in mind that the kind of loiter times we are talking about here, two hours or more, are not the loiter that is in the basic mission of the airplane, these are additional capabilities with wing-mounted external fuel.

The other critical thing, of course, since we have been talking about new ways of using air and integrating it with blitz or counterblitz operations,

is that we have to be able to move this force and shift it far more rapidly than we are used to shifting air forces. This you might call the strategic mobility or the basic mobility of a blitz fighter force. To really use this airplane and to apply it at the points where it is needed and within the response time of the ground tactics, you need to be able to shift a wing-size base overnight and a squadron-size base a good deal faster than that. That means very light support and stuff that basically can be operated from trucks--the kind of efforts that went into the bare base package perhaps squared.

At the same time, given that we are in generally the right part of the front because of our strategic mobility, or, if you wish, theater mobility, we also need to be able to respond very rapidly from a strip alert, and I guess if it is something like ten minutes, it is desirable. We obviously cannot put all the airplanes up on loiter all the time because it is far too expensive. But we do need to have a very substantial reserve force that can respond to the needs of some reconnaisance outfit that gets cut off or some main unit that is starting to get overrun or whatever. With that reserve force we would be on strip alert and we need roughly ten minutes to respond. That means we really cannot afford to be based much more than forty miles away. That, in turn, means we are going to have to live with a very different kind of base than we have been used to before. Perhaps many of you know we have already made progress in that area with the exercises at Bicycle Lake with the A-10. But we need to go a little further than that.

Now, in this concept of airplane we are talking about an airplane that can be based on a road or on a grass field or on light strips suitable to Cessna- and Piper-type like planes. That, as you will see in a moment, leads to some painful choices on landing gear.

The last question, and one about which there has been a great deal of conceptual discussion, most of which has served to cloud the issue rather than to clarify it, is the question of survival. Naturally, whenever we raise the question of airplanes whose principal weapon is a gun, the technology lobby immediately counters "They'll never survive" and then we get out the usual statistics of the number of SA-6's and the SA-8's and the SA-9's in a Soviet division and all that. I think, in fact, the standard views on the air defense threat over a Soviet division are misinformed to say the least.

If you put yourself in the position of a division commander who has just been told to make twenty miles during daylight, you will begin to see what the problem is. It is simply not possible to move fast with a modern mechanized armored division and carry along the quantities of air defense that our intelligence people say would be associated with divisions. In fact, if you get down into the details and the bean counts, you will see the threats that are quoted are not air defense that is associated with divisions, that it is all army-level air defense. There are no SA-6's that are organic to the divisions. Now, of course, SA-6's could be assigned forward to divisions as could SA-2's for that matter. But with a little more care about the question of the organizational level at which air defenses are located, it is very important to assess this. There is a good reason why SA-6's and other large radar missiles are not assigned to divisions and that is they are basically not supportable by divisions during most operations. Because of the long setup times involved with all radar missiles, even if they are mounted on track chassis, and because of their very large support requirements in terms of people, parts, and logistics, they are really a burden to a division commander and, in fact, will never be seen with a Soviet division that is on the move.

The actual weapons that you will see with a Soviet division that is moving fast towards a breakthrough or after a breakthrough will be surprisingly similar to World War II weapons. That is, you will see all the kinds of guns that can be towed by jeep-size vehicles and trucks or that can be mounted on trucks and you will see the types of missiles that people can carry and set up in a couple of minutes or less, and that means RED EYE type missiles, basically SA-7 or its variance. And that is it. That is all you will see in a tactically engaged, moving Soviet division.

Now, it is very important to contrast that with what you would see in a static situation. If you have a division dug in in a static position, as for instance the Egyptian division on the Suez Canal, then, of course, the nature of the defenses changes totally. Then you have time for the half-day emplacement time or so that most radar missiles take. Then you have time to bring up all the extra ammunition, the very bulky missile ammunition. You have time to bring up the technicians and get everything calibrated and so on. Then, of course, you will encounter very fierce defenses. The gun defenses too will be far fiercer

because they will have better logistics and much higher densities too and that is exactly what the Israelis ran into. Remember the Israelis did not run into any kind of mobile air defense. The high attrition rates that we have all been so worried about that the Israelis encountered were all against static defenses. There is probably a general principle there. I will not go much further, but, in general, it is probably not possible for aircraft to do much in the face of static defenses. It never has been in the past, it probably will not be in the future.

But we are talking here about a very different aircraft in a very different situation. That is important to keep in mind. Given that long preamble, what can we do to really increase the survivability of this airplane over what we have had in the past? First and most important, and this again is a subject on which Rudel is very clear and very helpful, absolutely minimum non-maneuvering time in the presence of guns is critical. The difference in the hit probabilities of guns against straight level airplanes versus maneuvering airplanes is probably on the order of two orders of magnitude. The only reason that we keep on ignoring this kind of thing and the importance of it is, of course, that we have no decent anti-aircraft guns and no anti-aircraft gunners. As a result we do not know some of the simple basics.

The last time Rudel was in this country, I think he really amazed us in telling us when we asked him what his tracking time was with guns. He said it was one and a half seconds, and, of course, most of us are used to thinking about four, five, six, seven seconds tracking time associated with dive bombing. I think our first reaction was that he was exaggerating. But after a lot of questioning on that point and on the tracking times and what average pilots were getting and so on, I came to the conclusion that he was telling the truth and that he, in fact, could execute a hard maneuvering approach basically alternating from one wing, from standing on one wing tip to the other during his approach to a tank, at say thirty to fifty feet altitude, snap out, wings level for one and a half seconds, fire and go off into his maneuvering climb out. We need an airplane that is designed to do that and the only way to get that is to insist on major improvements to the aircraft in terms of pitch and roll acceleration. In fact, we have been discussing some interesting measures that will be a little better than just plain pitch and roll acceleration.

Probably just about as important as the question of aircraft design for constant maneuver is the question of invisibility. There is just no exaggerating the importance of that and there are only three ways to get the kind of invisibility that is critical which is invisibility to ground guns, particularly ground guns and little tactical missiles which are infrared missiles. The only ways to get that is to have a small airplane, to use camouflage that makes it invisible against the sky background, not just the ground background, and to have an engine that an SA-7 or a Sidewinder missile cannot lock on to. Those are achievable. But we are in fact talking about design. There is an engine available off the shelf that has a very cool exhaust and that will essentially eliminate the infrared missile problem. We are just about there on a real step increase in survivability.

Then there are some other points that I think were already quite well addressed in some of the original A-10 conceptual work, such as reducing vulnerability in structures, measures taken with respect to fuel and so on. I will not belabor those.

There is another important point that I think we have not addressed enough, again due to lack of recent tactical experience, and that is the question of tactics and suppressive fire against anti-aircraft defenses. Once we have a gun fighter that is lethal against tanks, it is going to be extraordinarily lethal against anti-aircraft systems, particularly against anti-aircraft vehicles which are thin skinned, never heavier armored than APC, and just full of ammunition. They should be a far more vulnerable target than a tank and by the use of mutual support tactics, it should, in fact, be possible to make life very dangerous for antiaircraft gunners. That is a very important element in the survivability equation.

The last and probably the least important of all the survivability provisions, as I think about it, are the survivability provisions with respect to radar. I know in the past we have made a lot of noise about radar cross section reduction and so on. My guess is that we have taken into account scintillation effects and the fact that we almost never see airplanes head on but always from some more or less beamed aspect, not always, most of the time there is some beamed aspect, my guess is that radar cross-section reduction is not worth the

sacrifice that it requires. In any case, it is hard to foresee any radar weapon in division level environment that is likely to be effective against this aircraft.

There are two points on this that I would like to express and that are really important to keep in mind. First of all, that we badly misconstrued and misestimated what the air threat really is like over a Soviet division. And the second point, which follows from the first one, is that, in fact, it is possible to achieve very satisfactory survival in the environment that you are going to see over a Soviet division.

Let me give you a little diagram just to show why we place so much stress on size. This is, of course, by no means the complete size question--we really should be showing front views and side views. I think you can see even just from this plan view size comparison how big the differences in size are among these airplanes. Using the F-5 as our standard, the A-10 is two and a half times the size of the F-5. On the other hand, in the past, the British have built an airplane that is almost half the size of the F-5 and a very fine jet fighter that is called the Gnat. One of the early blitz fighter design studies came up with an airplane that was very similar in size to it, again about half the size of the F-5.

Keep in mind now that the F-5 itself is a large airplane by World War II standards. By the standards of the last time that we did really intensive anti-armor work, the F-5 probably is not a satisfactory size. That is why I stress the importance in these design exercises that we are going through which are aiming for airplanes that are significantly smaller than the F-5.

Now, just wrapping up on these individual effectiveness dimensions that we have been talking about and turning them into an airplane, here is my best guess at what is feasible, based in part in looking at a few design studies and in part on some scratch calculations of my own. I make no claims that these are hard and fast numbers, but I think that they are feasible. I think we can build an airplane in the range of five to seven thousand pounds while preserving the maneuverability that we are talking about, the low-speed performance that we are talking about, we can make that airplane two-thirds the size of the F-5. It would be nice to go further but there would be some difficulty. Of course, it would sacrifice low-speed performance. It is easy to make it half the size of the F-5. In cost, if we stick with roughly the level of technology of say

the A-37 air frame, it should be easy to make it less than 1.5 to 2 million dollars. Of course, on the other hand, that is a big "if". We have had lots of experience in trying to build airplanes simpler than the prevailing fashion and somehow things always get a little out of hand on the cost of them and they rarely turn out as simple as we hoped. In fact, if we were to redo an A-37 today, it would cost a little under $800,000, including all the inflations from the last time we built it. That gives you a feel for how much margin there is in these cost estimates. An A-37, I might add, is slightly larger than the airplane we are talking about.

As for lethality, as I mentioned before, I think we can probably increase our kills per pass by perhaps fifty percent or maybe a little better.

In terms of performance we are looking for a very wide speed range and one that will be challenging to achieve. We are looking for good maneuvering performance over the range of 150 knots up to a maximum speed of say 450 knots. We are looking for substantially more acceleration in climb than the A-10, at least 75 percent better, and with some luck maybe better than that.

In transient performance, whether you measure it in acceleration, roll acceleration near the stall, or in terms of perhaps a more realistic measure, the time to execute transient maneuvers, I think my estimate of 200 percent is very conservative. I would be very disappointed if we did not get 400 percent improvement over the A-10, just because the size of this airplane and its moments of inertia are so much smaller than the A-10.

Finally, we would like to be able to operate from grass fields or asphalt roads substantially shorter than 4,000 feet, and I mean operate from, I do not mean take-off roll calculations for 4,000 feet. I mean all the safety factors included that we would include in actual operation, and including landing with a loaded airplane to execute this strip alert, ground loiter type mission we are talking about.

I think that some of the features of the kind of design, at least that I have been looking at, are a high thrust-to-weight, if we get just a midpoint weight of 6,000 pounds, we will have a thrust-to-weight of .85 which is certainly a great improvement over the A-10. We should have a wingload that will be very much lower than the roughly fifty or so that people have been looking at. I am looking at a wingload of 30 pounds per square foot on a tailless delta configuration,

that is a thick-wing tailless delta. As I mentioned, we are looking at a very cold engine, the ATF-3 engine, a commercially developed and commercially available engine. If we are going to be serious about a grass-field capability, and I know as painful as it is to pilots who have grown up with tricycle landing gear, tricycle landing gear just is not adequate for landing in a grass field. There are years and years of pre-World War II experience, there are years of crop-duster experience that show that if you are going to land on a grass field, a bicycle landing gear, two wheels, is the only way to go.

A very important capability for the surge sortie rate we are talking about is hot refueling and rearming. The airplane has to be designed to be safe, to be refueled and rearmed, with the engine running.

And, finally, it would be very nice, particularly in the configuration that I was looking at, I think it is feasible with a tailless delta, that there be no external fuel at all. The amount of fuel with the kind of mission we are talking about, which after all are pretty short range missions, is small and there is lots of extra fuel volume. As long as we treat that fuel volume just the way we treat external tanks and do not count it in the structural requirements of the airplane, we will be able to meet these very small airplanes and maybe do away with the inconvenience of external tanks.

Okay, so much for the technical features of that airplane. Let us talk just a brief moment about the program. This is a subject that deserves a lot of discussion and I will just essentially open the discussion.

As we have seen in the past, when we have tried to build relatively simple airplanes, the most critical thing towards any kind of performance for the size and the cost is design discipline and that is something that we all know is very hard to achieve in the atmosphere of the Pentagon and the aircraft development bureaucracy.

I think we have two programs now based on competitive fly-off. Both show, I think, very significant advantages to having had that competition. The benefits were not all that we could have gotten, but both programs went substantially better than our standard prototype and procurement-type programs. I think that needs to be repeated, maybe even improved. And certainly, if we are going to do a fly-off with an anti-tank aircraft, it has to be made on an actual live shooting of those tanks. There should be no ducking that issue.

Very important, and a place where we really got hurt badly on our last competitive development, is the fact that we developed two sets of prototypes, had a fine fly-off, both prototypes were excellent airplanes, both prototypes were combat capable as they grew, they both had guns and IR missiles, and despite that we went into a one billion dollar engineering development program which ruined the airplane. I will not say ruined it completely because the F-16 is still a very good airplane, but they came close to doubling the cost and added about a third more weight and really destroyed a lot of the components that we were hoping for in the airplane. One way or another, this kind of program has to avoid that full-scale engineering development after a competition.

Finally, and this is in a sense the point of today's session, wherever we come out on the design of this airplane and whatever disagreements we have on what is really needed, the critical thing is that we base the design and our discussion on things that are associated with hard combat experience, and not on the promises of the R&D cartel and those endless conversations about how great it is going to be tomorrow. And, of course, that is why we have Colonel Rudel here today, exactly for that reason.

I think it will be helpful if we follow roughly the outlines that we have been talking about here, of the critical aspects of finding and killing tanks. If we follow that kind of outline in talking with Rudel, I think you will be astounded at how much insight you will get into what today's blitz fighter can do. When you sit down and think seriously about what we are setting out to do in building a new anti-armor airplane, I think you will realize just how much insight a man with Colonel Rudel's experience really has into the problem that faces us today. After all, tanks hardly look different from the air today than they did in 1944. There certainly have been no improvements in tank tactics since 1944. I think we are all sadly aware of that, and so we can expect that they will maneuver in the same way, that they will try to hide from whatever threats they have in the same way.

Secondly, we had a long discussion on effective defenses. At least in my view, the defenses today look very little different from the way they did in World War II, with one exception: They will be less dense and less lethal than they were in World War II because all armies of the world have used up so many resources in buying missiles that the gun density will be

substantially lower. The missiles will not be on the battlefield and the gun densities will be lower. And, of course, the gun effectiveness has changed very little. Gun ballistics, which is really the heart of gun effectiveness, has hardly changed at all although it could have. Radar fire controls for guns do not fight in this kind of arena because they do not work against a maneuvering target, they only work against straight and level targets.

What about tactics? I would be very, very surprised if anywhere in the world there were any advances in anti-tank aircraft tactics since 1944. Much more likely is the fact that we have forgotten some of the best tactics we knew then.

What about weapons? This is the one area which has really changed substantially since Colonel Rudel, surprisingly enough. The gun we have today is very different from the gun he used. He had to make do with two 37-millimeter cannon that fired one shot per burst for each cannon, which demanded a level of accuracy completely different from what we need today with our high rate 30-millimeter cannons. So in that sense, we have made progress and we have eased our problem.

And finally, what about the ground battle itself, which is perhaps the most critical determinant of all? Well, it seems clear to me that we have not made much progress in blitzkrieg, in counterblitz operations, or, in general, in mobile armored warfare. And again, just like in the anti-air tactics, we have probably retrogressed to some extent.

Summing all those, I think you will see why I feel that it is so important for us to really probe in depth with a man with Colonel Rudel's experience. I will not belabor his background for you other than to say that beyond the shadow of a doubt, he is the single man in the world who knows most about killing tanks from the air. He personally has destroyed two divisions worth of tanks, several battleships, perhaps a hundred locomotives, and God knows how many trucks and other targets. Probably no other pilot in World War II had as much effect on the outcome of battles as Colonel Rudel, and I do not think there is a better man in the world that we could talk to on this subject. Thank you.

Moderator: Colonel Rudel is not here yet. Let us entertain questions.

Mr. Sprey: Let me say first of all, I have really gone very quickly over some areas which need a lot of discussion. I think for today the most important thing is to have a very thoroughgoing discussion with Colonel Rudel. If there is time afterwards, I will be very happy to stay and we can kick around any of the issues that I have raised here. But for the time remaining let us have some questions.

Question: I was a little bit concerned about the Quad 23 operating in an offensive roll. Do you see that as a threat?

Mr. Sprey: About the same threat as four single 23's. Do you think it is better than four single 23's?

Questioner: Not particularly.

Mr. Sprey: Yes. And there is a lot more maintenance problem because of the tracked chassis. I am not advocating that the Russians get rid of the Quad 23. I do not think it qualitatively changes anything. We have had that thing presented to us as some frightful threat. We know first of all that the ballistics are nothing to write home about. The mount itself is not a particularly good mount and has some problems with recoil. The radar fire control is irrelevant with an evasive target. So why is that such a frightful weapon? We know it is not going to be there in tremendous density. Certainly not in World War II type gun density. I see no reason to be overwhelmed or awed by the threat of a Quad 23.

Question: (Inaudible question about the SA-8.)

Mr. Sprey: You mean Roland-type missiles? We will have to see whether those can really move with the division that has got to cover some territory. I have some doubts. However, I do not think it is a worrisome system because it could be substantially worse against maneuvering targets. It is a beam rider and beam riders have pretty poor kinetics on maneuvering targets. I see no reason to worry about it, you know. It is of course, quite lethal with straight level targets, but we are designing this airplane to not be straight and level ever except when firing.

Moderator: Excuse me. Let me interrupt here because Colonel Rudel has arrived.