Edited transcript of tape recording of "73 Testing Conference" at IDA

General Paul Gorman [corrected by PFG 10/19/91]

One of the chances for which we can thank our lucky stars was that VII Corps and the 3rd Armored Division were not called upon to perform the missions assigned them for DESERT STORM back in 1970 and 1971. I think any soldier here would agree with me that there was no bloody chance that they could have pulled those missions off with the forces that then existed. General Funk, in his remarks at the outset of this conference, alluded it to the fact that the performance of the force in DESERT STORM was a function of the five major weapon systems that were fielded between 1971 and 1991, plus a major difference in the way the Army trained its forces for such contingencies.

If any of you wish to take yourself on a documented tour of Army training concepts back in 1970 and 1971, I refer you to Field Manual 105-5, which in the then-current version carryed forward the ideas, introduced into the Army by George Marshall and Leslie McNair in the era of World War II, that the way to train higher commanders and staffs for their responsibilities was to conduct large field exercises, or maneuvers of the Louisiana variety, ideas perpetuated with the STRICOM and Readiness Command exercises in the United States, perpetuated by the large exercises of the Autumn Forge series in Europe for years afterward right into the 1970s.

Also in that early 1970s field manual, Annex B, you will see described a live-fire field exercise for the rifle platoon, virtually identical to the live-fire field exercise for the rifle platoon that was published by Army Ground Forces in 1943. Such training was predicated on three assumptions.

Assumption no. 1: realism in training involves live firing.

Assumption no. 2: live firing entails surprize targets, so there were silhouette pop-up targets.

Assumption no. 3: conservation of ammunition should be taught along with accuracy. So the scoring system that was devised rewarded hitting targets and saving ammunition, bringing ammunition back, teaching soldiers not to shoot unless a target is in sight.

My friends, the simple explanation for the observations of S.L.A. Marshall, and countless other observers, myself included, on the fact that American riflemen rarely shoot in combat can be traced back to the way they were trained. They didn't shoot because they didn't see anything to shoot at. They'd been taught that ammunition conservation was what was important, not suppression of the

enemy. In fact, the notion of suppression never figured in the training exercises that the Army used in those days.

What happened in the 1970's was that the US Army adopted in its tactical training the simple notion of engagement simulation, in which the unit in training is pitted not against cardboard targets but against a thinking enemy — an enemy that could shoot back. The Army equipped both with mechanisms that introduced into exercises in close combat, suppression and some of the other major factors that bear on proficiency in combat, like teamwork in fire and movement, proper use of tactical cover and concealment, and the like. That's the real beginning of the so-called "revolution in training" that prepared the Army for DESERT STORM —I think Dr. Anne Chapman used the term, in her TRADOC Historical Study, *The Army's Training Revolution 1973-1990* .

Further, Gen Bill DePuy of TRADOC was informed by simulations about training standards to set for the force. Some of you here may be old enough to recall TRAINCON 76 in the United States Army Europe. Bob Sunnell sitting back there, I know will recall this one. DePuy went to his combat modelers, and asked them to analyze how many targets the average company team defending in Central Europe would have to contend with in the opening battle of the next war. The answer, incidentally, was 60 armored vehicles. That gave, with the closure rates that were assumed for the Soviets, twelve minutes to serve those 60 targets, and by the way, the opening range was 1200 meters. DePuy then took that data, went over to Europe, trained a tank company up to that standard, and ran a demonstration in which the tank company in fact serviced 60 targets in 12 minutes. He turned to CINCUSAREUR, and said your tank gunnery standards are not up to that kind of shooting. You are going to have to raise your tank gunnery standards, you are going to have to teach your units how to fight as teams. Not as single tanks, as on Table VIII, but by platoons and companies. Fire distribution is of crucial importance in such teamwork. This incidentally, at TRAINCON 76, was supported by testimony from the people who had undergone the training for the TRAINCON shoot. Note the similarity to what General Funk heard in the after action review from the 3rd Armored Division. I would infer that the ability of Paul Funk's lead battalion —cresting, and seeing to its front an Iraqi tank battalion in column— to eliminate a battalion's worth of targets with two volleys, goes back to the autumn of 1976, and that shift in tank gunnery standards, and other techniques for close combat in the armor force.

That shift came out of a simulation, a model, a mathematical model of combat, a construct, if you will, a way of thinking about close combat. You all have been exposed here, through *Easting 73*, to a new method of thinking about, of portraying, close combat. In my view, it is an enormously valuable forward step, precisely because it is fully apparent when you look at it why things happen, unlike the esoterica of Lanchestrian models, and in the intricacies of the computer interfaces that one has to deal with to get at combat ground truth through that mechanism. There's a sort of a face validity at work here.

Paul Funk also made mention of the National Training Center, which was sort of a broad, large scale application of engagement simulation to training battalions and brigades.

There are then, I submit, three forms of this art of engagement simulation now available as tools for the armed forces of the future. It strikes me that one of the imperatives that ought to come out of this conference is to ensure that we can take advantage of all three forms, so that one form of engagement simulation can be used to improve our understanding of the others. Again, to go back to the 70s, our early experimentation with tactical engagement simulation of the subsistent variety, that is, the actual performance of units in the field, equipped with weapons effects simulators —initially, very crude stuff, eventually laser engagement simulators— demonstrated pretty conclusively that we could raise the effectiveness of American infantry and armor units in close combat by a factor of two. A factor of two! General DePuy, Commander of TRADOC, was making speeches at the time saying even that wasn't good enough, because we had to expect odds of 1 to 4, which meant we'd better be four times better than any adversary. But he was pretty clear in his own mind that the Army on the right track toward such proficiency.

Now let me have my chart. What I am trying to argue with this visual is the proposition that there are three forms of tactical engagement simulation, each. of which has been demonstrated as an effective training technique in the US Army —and indeed, I believe, in all of the services. The Army learned how to do this, as General Welch knows well, by watching the Air Force at Red Flag, for he was one of the prime movers in setting that exercise up for General Bob Dixon. The Army watched the Navy out at TOP GUN, that's subsistent tactical engagement simulation —force on force, pitting the aviator against a wily, skillful foe and teaching him experientially how to cope with the problem of modern air-to-air combat.

I believe that what you have seen here in *73 Easting*, is a glimpse of what is possible with the third corner of the triangle, virtual tactical engagement simulation. I would argue moreover that you are looking at the onset of technology that could make a major difference in the other two forms. Let me make myself clear. Vic Reis spoke to us about the prospect of small, light satellites bringing about a paradigm shift in the way we think about satellites. My proposition would be simply, OK, DARPA, let's have a demonstration set of stellites over Larry Welch's southwestern United States' theater of war. Let's put up a satellite array and use that satellite array exactly the way we used satellites in the DESERT STORM. And I'm quoting here, Vic Reis' testimony to the Congress from DARPA's TACNAT program, "timely intelligence data on the locations and status of units were overlayed on an electronic 2-D map of the theater. From our FULCRUM project, friendly force and environmental data were added on the same map."

We happen to have, in the force today, intelligence mechanisms that can solve most of the field-exercise instrumentation problems that have heretofore depended upon relatively large computers, radio towers, triangulation, and other apparatus. We could improve the instrumentation of our exercises by an order of magnitude with the application of this ODIN-TACNAT-FULCRUM technology like that you have seen demonstrated. Moreover, training occurs in the after-action review, when one has an opportunity to figure out what it was that happened. Being able to do that after action review vividly, completely, in the sense that you were able to roam around through this land battle at 73 Easting, would be an enormous advantage for learning.

My recommendation is that not only should DARPA put up the satellites to make it possible to use ODIN, but also deploy ODIN out there and put it in support of that model theater of war. This would then pull forth from ongoing training exercises, reliable data on how forces actually behave in the field, data we need to improve our models of war. Most of our difficulties with constructive tactical engagement simulation is exactly that they represent mathematical constructs that sometimes were guessed at, or assumed by those who put the construct together, not closely related to behavioral data. By verifying or supplementing the parameters of these models, we can insure that the models are a better replication of how forces actually behave, which would make them more useful for training, or for any of the applications to acquisition or test or operations that will be discussed, I am confident, by my colleagues.

In short, this is a vision, I submit, of where we ought to be moving this art. You've been shown some new and powerful tools. All we need is the will to get on with it. Thank you

BG Gerry Galloway

First slide. I was given the mission of talking about education and being the wrap up, I wouldn't say the clean up hitter, after the distinguished gentleman that has preceded me, I'd just like to talk a little bit about reliving history and preparing to make history and how it might fit into the business of what we do at the military academy.

In eduction we are in the business of understanding relationships. I think it's important to recognize there are certain human relationships and physical relationships, some of which can be easily defined, some of which are not so easily defined. We spend a great deal of time trying to define the fundamentals and the principals and the theorums, something on which to base our future decisions. There are a lot of tools that help us get to this and in the study of the history of the military art, certainly we have found many of these tools, and they're called books. The tools haven't changed very much over the years. In many of the other disciplines, we are similarly not moving forward at a very fast pace. It's time to change. At West Point, it's important to know, that like other institutions of higher learning, we have an importance level.

Next slide. We'll get to the fundamentals, and that is college football. Somebody said I should have something about beating Navy or something like that here but I don't. This happens to be actually a play out of the Army football playbook. And why do I put it up there? Well because that is as equivalent to war in many respects as you can have young people actually engaging in some form of combat. Now this is a play, and what do coaches do? Coaches draw this on a board, they teach the people to go out and rehearse it and in days of old, they would critique by going to another board and showing them what went wrong. Long ago coaches gave that up. What do they do? We have, initially film, and then video cameras, except for NCAA restrictions, it prohibits from you doing it during a game, in practices you are examining the scouting team, the OP 4 against your team. You're critiquing every play, you're learning the fundamentals, you're dissecting, you're trying to understand the basics. They do it quickly, and as a result, they are able to make changes rapidly, and the people understand what went wrong, what theories were violated, what fundamentals were violated, and understand more of how they can improve. Well, we need to be moving the same way in higher education.

Next slide. This is a map of the battle of Antietam. I was thrilled to hear that Colonel Dupuy was working on this very same battle. This is the way we teach the battle of Antietam. Instead of using a paper map and a sandbox as they did in 1877 at West Point, we have gravitated to viewgraphs and we now discuss it in those terms. Now, I am not putting this down, because in reality, we are moving ahead, as I'll show you in the next slide. But fundamentally, in most places where we teach about warfare, we teach about it using the paper map. And just as in many places in Desert Storm, the fundamental was still the map and the grease pencil, we still find a great deal of utility to this. But you all recognize much more can be shown with some form of automation.

Next slide. This is a little bit of an extract from JANUS that many of you know. We're using this in our operations research center and some of our systems engineering courses tied in with history. This allows us to have a dynamic battlefield to show change over time and to allow us to deal in "what ifs". In the upper corner, there is some sort of a square and that happens to be the innovation of some cadets and officers for a floating screen that would stop artillery in the air, break it up before it came down. You can laugh about that, but the one great part about being 17 or 19 is you're not hindered by the constraints that many of us older folks have of what can and can't be done in the future. And so, this gives us the opportunity to do "what if". But what's wrong with it? We've learned in the Army, at least I have in my 34 years, that try as we may, we cannot get people to see that terrain rise up. The third dimension is just not there. 2-D is good, a very skilled leader will be able to interpret that map and see what's going on. But for many young people, that's just not there. So we do need the third dimension.

Next slide. Wouldn't it be great if we were teaching military history to have on a two floor set up, four classrooms or six classrooms all connected with the ability to have the magic carpet there and when you talk about the battle of Antietam, work slowly through that battle, and watch as people move across. Instead of having these little red and blues move together and suddenly come together, and have the students trying to visualize the spatial relationships the vertical dimensions, the troops of the enemy disappear behind a hill and then suddenly rise up 300 yards in front of you. You might have caught that on a topo map, but probably not. But when you get the realities of what we've seen here in the last days, what people have seen in SIMNET, you can recognize there is another dimension to that learning experience. And you can do just as football

coaches are today, reliving history and reliving it to understand more of the fundamentals, the theories and principals involved. So we think that in moving to automation we can move into better education. Now, certainly you learn more about people, more about equipment. The people dimension is an important one. All of the models that show you what it is to fire from one tank to another and show you this tank is killed, don't put the stress on the individual. I was never more amazed and never more impressed, than when I was out at the SIMNET facility at Fort Knox and watched young soldiers get out of those SIMNET simulators, the training devices, the boxes, totally sweat through because they had been so involved in that battle, and the emotions were go great, they learned the stress. Now it cannot simulate battle, there is no question about that. But when you are working in a small unit and you are working with your peers, and you are working for success, something like this that we've seen over the last few days, and it exists in the SIMNET technology, can bring that human dimension to bear in a way no other simulation can. Well, it's good for education, we see a great need for it. We see that we can work not only in our own environment but to export that and share. What if ROTC detachments around the country were linked to West Point where we had our military history setup and we could export a particular battle, interactively work with them. What if we did it with the Air Force Academy, or the Naval Academy and worked with them. We could begin jointness early in a young persons career. That's learning about the past. What about working for the future? General Thurman and General Gorman have both mentioned our success in training. Our young people expect this. They live with Nintendo, they live with modern technology, and to give them simulations that offer less than what we have here is not giving them the potential to be all they can be. Our young soldiers, who are shown how an armored vehicle attack might look on the ground and maybe having someone else demonstrate it, will not learn as much from their first time in using the equipment by just getting in and running down the field until they have had the opportunity to simulate it before hand. Take this same thing with our junior leaders, our NCOs and our junior officers. The opportunity to make the mistakes on the simulator before they have people working for them, embarrassing them by their mistakes, they're going to make mistakes anyway, we all know that, but trying to minimize those, giving them greater confidence, these simulators offer that. The opportunities to practice for the future, with systems such as the battle command training program supplemented in the

triangular relationship that General Gorman put up there, supplemented by the opportunities to have people in the field on something like the National Training Center and to have a SIMNET or a simulation as we've just seen, put before you gives the commander again the sweat. I have seen a corp staff arguing in front of their commander over what was done in the simulation. It was to them, very, very real. And imagine if they'd just been through something like we saw yesterday and have seen today. So what am I saying, I think there's a great role for this technology in education. We see, as General Thurman noted, the power of technology. We're not sure of how we can exploit it, we know it needs to be exploited. It may not be tomorrow, it may not be the next day, but I will tell you, we at the military academy are planning to have this technology in our classrooms in the future. We'd invite you and any way you have to participate with us in what we think is going to be a great experiment in improving education and perhaps readiness technology into the training and education world. Thank you.

DOUGHERTY: I'd like to open the floor to questions.

Q: You said this technology might be useful for education. Do you think recreating battles in history with this technology is possible for historical battles, battles of the past, for which detailed information like the 73 Easting data is not available?

A: (GALLOWAY) Well, I think that Colonel Dupuy would make the case that you can go back and look at someplace like, certainly our civil war battles and have a fairly high degree of confidence of where people were at a given point in time. They have fairly good records, and in the years following the war, in many cases, they went in and gathered extensive data on time/space relationships. Now, what about World War II, what about the Napoleonic campaigns...I think you would begin to gain insights rather than deep understanding. But maybe those insights are important. And the terrain does not change except at Waterloo, where we built a beautiful mound so we could look at the terrain we destroyed. Those sorts of things happen when you have tourists and other human intervention in the landscape. But, yes I think it is very useful in history for the insights its gained, the more accurate you can be then the more you'll know about that particular battle. But if you're dealing with principles and fundamentals, I think it's really the essence of the battle that you want to recreate, rather than the specifics.

GORMAN: I vote we listen to Trevor Dupuy on that point Gerry (Galloway). Do you want to walk up to the microphone, good sir?

DUPUY: I wasn't expecting to be called upon, I appreciate the opportunity, but there is no question that there is a great deal known in great detail about a number of battles in history that is approximately correct. Particularly, battles in WWII where we fought against the Germans, where the Germans kept good records, we had good records, and the possibility of recreating some of those battles is beyond a doubt available to us. To utilize this technology, which is one of the most exciting things that has come along, as far as I'm concerned, in years, would give an opportunity for training and education in a way that would make the training so valuable, so professionally inspiring to young officers, that I think we've got to move to make the maximum use of it as soon as we can. I can't speak too strongly in endorsing this particular relationship between technology and history. I think this whole meeting, and if Colonel Thorpe is the man responsible for it, he has got to be given great credit, is a historic meeting. And so I congratulate everybody who is responsible for it. Thank you very much.

GORMAN: That's from one of the premier military historians of the United States, and indeed, of the world. That was a pretty strong endorsement. I would add to Gerry's point that one of the advantages of simulation for these historical educational purposes is exactly that the simulation is not bound by the works of man on the contemporary terrain, and you can look at the terrain as it appeared to the commander at the time. I would much rather visit Waterloo in simulation than in its present state.

Q: A question for General Thurman: the issue we try to tackle, I guess is to get a balance when it comes to the training utility of simulation and I guess what we're really trying to shoot for, is we want to get vaguely right and not precisely wrong. And yet in the development process of this both from the engineering standpoint and also the training standpoint, there is this tendency to have what I would call an engineer's mentality that picks at it and says, uuh, it's not right, it's not quite there yet, we've gotta add another dial to this, we have to have another task to do that so we keep spending a lot of time and effort and yet don't get the efficacy of the tool out into the field. How do we do that, how do we institutionalize that from a training perspective and move on so we can continue to be creative in the R&D cycles?

A: (THURMAN) Well in two cases, one which I would call the battalion commander's tool, which we use now at Leavenworth is simply issuing a

relatively modest order to have it done in about 90 days. So that took out a lot of the engineering corruption that was in it. But the notion behind that whole thing was taking stock of the fact that the average battalion commander was only going to get a chance to put the full repertoire of his battalion and its components on the field, two or three or four times in a two year period of time. You say then, if he was a chess player, would he only practice three, four, six or eight times if he were going in an international chess match. The answer is clearly he would not, he would be doing hundreds of chess games a year. So you tell that to the guys at Livermore, who did the work for us on JANUS, to update it, so that the battalion commander, is now in a pre-command course, can in fact go through about 10 replications of a battalion at the National Training Center or other terrain. It's not precise, but it is good enough to cause the battalion commander's issuance of the order, understanding what happened, go back and try it again, because it didn't play out quite as he envisioned, because the thinking man's enemy was involved on the machine system. So I would say to you, I think the system we've seen in the last couple of days the computer image generator, you could get very, very, very, very precise in the CIG (and we're going to get more precise in the CIG) but even in the early elements of work with respect to the original SIMNET-like technology that was up in Knoxville, was good enough for a battalion commander to get the spatial relationships associated with working against an OP 4 and getting all his elements of combat power brought to bear. I don't believe that is overly worrisome about people who were dedicated to getting the machinery in the field. I think that's more evolutionary than an impediment to getting it quickly on the street.

GORMAN: I'd like to take you back to a point that Paul Funk made in his opening remarks...I mentioned the Louisiana maneuvers as a way of training senior commanders. We now do that training today with constructive tactical engagement simulation, with models of combat. We know those models are not a wholly accurate replication of battle. I mean, I think every one of us who has ever played with one of those models can identify areas in the model that we simply just don't believe. On the other hand, they do clearly stress a commander, and they stress his staff, and they teach battle staff integration. We've demonstrated that in a variety of ways. We also know that those teaching experiences bring about improvements in the performance of the battle commander and staff as measured by any of a variety of traditional or behavioral measures of effectiveness. So even a fairly inefficient or ineffective

view, that totally missed the point. You need the boxes that have the fidelity they need but only the fidelity they need. So at the outset, the proper definition is important in preventing over engineering.

GORMAN: I took a very senior Air Force officer, who will remain unnamed, down to Fort Knox, and he flew one of the A10 simulators. I then heard shouting and yahooing back in the box where he was doing his thing. Finally, he came out, covered with sweat. I asked, "How did it go?" and he said "Just went great. I got to take on some T-72s and I won 2-1/2 to 1." I said, "How do you win 2-1/2 to 1 in SIMNET?". He replied, "I killed two with my gun system and I flew through one".

TAPE 8, SIDE A "What If" Exercises (continued)

THURMAN: Let me give you a blinding flash to the obvious which is that, you see most battalion commanders have not been battalion commanders before they became battalion commanders. That is a maxim, OK? It's sort of like the story that half the people are in the upper half and half the people are in the lower half, and we find out that the top 50 percent are in the upper half. The point I want to make in the battalion commander game is up to that time he becomes a battalion commander he's been the S3 or the executive officer or a company commander but he hasn't had the full panacea of systems to bring to bear on the battlefield that he does as a battalion commander and then pay the consequence for it. Therefore, it doesn't require or didn't require absolute fidelity with everything in order to give him these century skills about time and spatial maneuver with his own stuff against the time and spatial maneuver of the OP4 on that. The power of the machinery that we have coming up is that in the combat developments world, we're down there screwing around with the PK to the point of distraction but you see the problem is the troops aren't getting that kind of PK out of the thing in the field. And the real PK for a particular system, may be what is actually being seen on the battlefield and landscape at Fort Irwin, California. Now to the degree that you can spin that back into your modelling system, is to the extent that you then are representing. You may have bought the weapon system for performance up here, but it's actually performing here and you can disect why it isn't getting the full value out of it and you get a whole lot different effects system coming out of these kinds of systems that

we have, and are currently sort of separated systems of combat developers from the training side.

Q: Doc, I think I would like to address this question to you as head of the panel. I'm Al Stevens from BBN and the first thing I want to say is I very much agree with everything I've heard the panel say today. I cannot endorse the kind of statements I've heard any more strongly than that. I want to express a certain amount of frustration, however, I've heard those statements now for about three years. General Thurman, I've sat in your office at Hampton Roads newly three years ago and General Gorman I've heard you talk and make these strong endorsements of this kind of technology over the last 36 months at least. At some level, for me, the technology has achieved a level of face validity and yet I see the US government having a very difficult time figuring out how to go forward with it. While on the one hand you can go and look at an army aviation master plan and see how the steps are laid out from getting from one helicopter to another. It's very hard to find any one or any place where you can look at the DoD, the Army, the Navy, the Air Force vision for the application of simulation technology. I happen to do a little bit of traveling, I go to Germany occasionally, I go to Japan occasionally. The German government has at this point, announced to industry, the BWB, the German procurement agency, has announced that all simulators shall be networkable. They are requiring that. So all of German industry is working hard at figuring out how to make simulators networkable. The simulator you mentioned in defense news, my gut doesn't tell me it wasn't networkable, I'm sure it wasn't networkable. It was not a requirement, we are not seeing that. In Japan, you see the Japanese ground self defense forces, Japanese defense industry, and the phone company all working together to establish a standard, laid on top of their fiber optic system that's going in now to allow the interconnection of simulators. If their that forward in their thinking, they have a five year plan laid out for the use of distributed simulation technology to develop a combined arms and weapons development capability over the next five years. I, as a member of industry, don't see where that kind of leadership is coming from in the U.S. Government. I think DARPA, in the person of Jack Thorpe and others has provided a strong initial set of leadership to get this all moving. What I'm trying to figure out is, where is it coming from after this, what role do you see DARPA playing, what role do other members of the panel see the services playing, and where do we, from the

industry side, look to for the leadership in bringing this kind of simulation technology to fruition in this country?

Comment from audience: "Make it competitive."

A: (GORMAN) In the acts of the Apostles there are a number of plaintive passages, like those that were just delivered; 36 AD is just a little bit early to look for the conversion of the world.

A: (THURMAN) General Welch has agreed to take on your project. He told me he had 500 professional man-years to turn to it.

WELCH: That comment is punishment for the fact that the Air Force drug their feet on this all the time I was Chief of Staff. Let me tell you why, because I think they were important insights. In the first place, for anything like this to move forward, it has to reach critical mass of supporters. And I think that has occurred much more rapidly than is usually the case. You just don't appreciate American flexibility, and etc , etc., versus Japanese planning. But there are a number of things that have happened in the past two or three years that I think ought to give you some hope. In the first place, the director of DARPA frequently gives speeches, that says he has three priorities. Simulation, simulation and simulation. There's a lot of things that go with that. Secondly, the very name SIMNET has been a bit of a problem. Because SIMNET in the minds of many people is that training thing down at Fort Knox. Which is very, very valuable, but that's not what we're talking about. What we're talking about advanced distributed simulation of which SIMNET was an early example. The 73 Easting effort is a natural mechanism by which there will be a lot more attention given to this. The DMSO. It doesn't matter why the DMSO office came about, it may be in some respects, a child of congress, but now it exists. There is a lot more pressures, from a lot more OSD offices who make decisions on these systems that will demand a greater use of these kinds of simulation techniques in order to support decisions on everything from training systems to weapon systems. So while I don't deny that there is a reason for lots of frustrations about the pace, and the lack of standards and the lack of interface definitions, etc. The fact is, within the US Department of Defense, that doesn't happen by decree. And you could lay out a Japanese five year defense plan till hell freezes over and that doesn't make things happen in the US Defense Department. What makes things happen in the US Defense Department is when you have a critical mass of opinion that this is important and ought to be done. It takes time to build that. But I think you will see that building rapidly now.

Q: (GORMAN) Is the Deputy J3 in the audience? Or did he leave?

THURMAN: To take a quote from history somebody said that the body politic obeys Newton's second law very well. A small force exerted over a long period of time will bring everything up to speed. And you can hurt yourself severely if you try to do it with an impulse. So time is perhaps one of the most important factors in bringing the commonality of the interface standards and the community to a common set of understandings.

STEVENS: Yes, I certainly believe that but, perhaps, I'm young enough to remain impatient about the process and some of the frustration comes out. It needs to happen.

GORMAN: You are the stuff of which martyrs are made.

STEVENS: I know better than to engage in a verbal battle with the two of you (Gorman and Thurman). I do want to express my interest, industry's willingness to help it happen. And when I speak to a lot of folk in the government, I feel the same thing. I do believe this conference is an example of kicking that kind of process off and moving along. I do, firmly believe, that the US government maintains a critical leadership position in this technology, and I believe that we can maintain that leadership if we move along quickly in a planned, careful way. And would very much like to see that happen.

GORMAN: One of the constructive responses that I think we could make would be to urge on General Funk, the Deputy J3 (who is now seated in the back of the room) recourse to mechanism of the Joint Requirements System. My colleague to my right, Gneral Thurman, used to sit on the JROC panel. The Goldwater Nichols legislation put the JCS into the material requirement business and it strikes me that this is a *prima facie* case for the Chiefs to articulate a requirement for moving joint training into the 21st century.

The remarks of our panel would communicate to you: A: This is urgent business. B. It is joint business. And C. It bears directly on the kind of strategic environment that we face in the future. We need to build the forces that can be trained to cope with a wide range of contingencies, as opposed to the canonical threat to Central Europe. And there is no prospect that we are going to be able to do that except through recourse to simulation.

Dr. Stevens, you're absolutely right: unless and until there is an articulated requirement for a common standard that permits the communications among various forms of simulation, from service to service, from weapon system to weapon system, from one type of warfare to another, we are not going to be able to make much progress with joint training. And Title 10 U.S. Code lays on the Joint Chiefs of Staff legislative responsibility for the joint training of the armed forces of the United States.

Q: One of the great strengths of this kind of system is its realistic representation, or apparently realistic representation, of what the warriors might be seeing. Paradoxically I wonder if the clarity of this representation in its seductive nature may not be one of its greatest dangers. Underlying any sort of system like this are mathematical models and algorithms and what's concerning me and I would like to address this to the panel, I'm wondering if you feel there is sufficient dialogue between the technical developers of these models to understand their limitations and the degree to which they can be applied and the decision makers who have to use the results.

A: (THURMAN) I believe as General Welch eloquently expressed, you have to define what it is you want the simulators to be able to do for you at the get go. I was impressed when I went out for the first time, since I'm not an aviator I'm not rated, I flew a 767, I flew it from the Seattle, Boeing field down to LA and landed it, and after it landed I drove it off onto the dirt and imprisoned it in the soft dirt there. And I asked a guy do you really believe in this simulation and he said "yeah, we're pretty comfortable with the simulation," he says, "the first time a guy drives a Boeing 767 for real, you'll have a passenger in the back end, paying passengers." I think the simulation world is quite good enough to give you whatever you need to have out of it. And people can in fact, learn what it is that goes on in tank engagements. And that is to say that, I know in the previous work I think Jack would attest to it we put engineers in the tanks and they got a chance to experiment with the tanks to figure out what tanks are doing and were therefore able to replicate them with reasonable accuracy. So I would suggest to you that, I believe, there is a good enough interface between the worker bees and the services and the worker bees and industry to be able to get a reasonably valuable simulator out of it. Butch.

A: (FUNK) I can respond to that a little bit too. I think you almost have to ask yourself where were you before the simulator, where were we before we bought a thing called combat firetrainer. We were going down table 8 just as an

example and trying the exercise once maybe twice a year if we were lucky with the simulator which by the way doesn't have 100 percent fidelity for the gunner and commander, in terms of what you see, in other words even though you can make it dark and you can blow a little smoke and haze out there, the tank looks a little funny compared with what you see in the sight in the real situation but the fidelity is high enough and the kid is smart enough, he isn't being fooled by that. That this is not the real world. I look back to when I was a tank company commander a year or two ago and then think about now when my son is a tank company commander does in the training of his people and there's no comparison. It's the training system we talked about yesterday, but it's also the devices we had. Usually the training devices went in the corner, they were lost and thrown away. You couldn't really use them because they weren't really close enough in fidelity. Now they are. Now you can talk about the distributed system doing things at the joint level with all kinds of staff officers who cause those things to happen anyhow they don't see the battlefield anyway, not really. So you can recreate it electronically. As long as everybody understands that the result in combat may be different as long as performance is based upon a set of standards to get us better at what we know we have to do, then I think the unknown is less fierce. I think that's the way I would answer that question, we're a long ways beyond what we were twenty years ago.

Q: I would like to ask a question based on one of Admiral Allen's comments earlier. What we see here is a recreation of a battle that was basically a visual battle. One which was limited by the environment but essentially the combatants engaged each other due to a visual type of scenario. Are there any plans to extend this to beyond visual range to the EW, IR sonar type of engagements?

A: (DOUGHERTY) One of the things that DARPA is planning for its simulation program in the next year is to develop more thoroughly the electronic combat environment. That's an extraordinarily difficult technical feat. Because one has to look at both the receiver characteristics, the transmitter characteristics, primary noise sources, background noise sources, jamming, broadband, narrowband, specific pulse characteristics, interpulse modulation, the timing, the criticality, the redundancy, the encoding, the capabilities of the individual systems that are playing in the battle. In addition to that, you'd like to be able to play the real radar characteristics of the targets, and as we

increase the LO content of both airborne and surface systems the desirability of having that becomes essential to have the correct characteristics to model the behaviors that you see in terms of top level outcome of the battle. Yet the desire is to keep those parameters that represent the LO characteristics hidden. Not just radar, but acoustic properties and visual as well, IR. It's a very, very difficult technical challenge to be able to integrate the RF world into the simulation world in such a way that you have the correct system level behaviors. That's one of the things we're undertaking. Second, in the acoustic arena, we have two proposals to build underwater models that give us the capability to simulate large ocean areas so that we can correctly handle both the surface and subsurface elements of submarine stealth and ASW. And our surface warfare is a piece of that. How one plays that game in context of the other systems is TBD. There are enough challenges just figuring out how to remodel the sea, how to remodel the acoustic environment, how do you handle both the active and passive elements. Again, these are questions that we need to have technical answers to before we begin to integrate them into the larger network environment of the joint operations simulation that we want to move toward. We do have both of those elements in our program for the next couple of years.

A: (GORMAN) These are issues that I would point out that can best be addressed at the theater level: EW planning, etc. for a Theater of War. And, therefore, I would hold that General Welch offered the key to approaching the problem: the U.S. ought to have a model theater of war, to which we could bring the mechanisms that Doc Dougherty just described for use with joint forces in training, test, experimentation, or whatever. And we ought to recognize that opportunities to evaluate force responses to various electronic environments may be crucial on future battlefields. Not everybody's going to be as inept as the Iraqis in that respect. Finally, the way not to prepare for the electronic future is to do it the way we did in DESERT STORM: deploy a system like the JSTARs for use in combat without its ever having been employed in joint training prior to its deployment.

A: (WELCH) I would also suggest that electronic combat is an area where we are in absolutely in no danger of duplicating understanding. But IDA has a small initial task, just to describe the C3 CM effort in Desert Storm. That unlike at lot of other areas, we're almost without BS filters on electronic combat. So that there are multiple levels of simulation that would be extremely useful in

that area. Theater wide application, more detailed simulation of the effectiveness of any specific system within a larger net. If you ask for a tank that has an unrefuel range of 400 miles that can cruise at 70 miles an hour and carries 80 rounds on board, then there's a lot of people that immediately wave the BS flag cause they know that that's not going to happen. Or a supersonic airplane, that has a supersonic of 2000 miles, you get the BS flag. In electronic combat world, you can ask for almost anything, and some contractor will say, yeah we can do that and we embark on trying to do it because we lack the understanding of what's possible that we have in others areas from years and years of experience. So that's another reason why it's a particularly furtile area to do simulation at whatever level. Whether it be the system operation level, or the system of systems operation level.

A: (THURMAN) Moreoever, I would suggest that the environment tells us, we'll never be able to turn that stuff on in peacetime, in general. So the only way you're going to get anything out of it, is you're going to have to simulate it in peace in order to figure out how to operate it in war.

DOUGHERTY: Thank you very much for coming this afternoon, I'd like to thank the panel for their participation. I'd like to turn it over to Jack Thorpe for a wrap up.