One Analyst's Experience with Chemical Munitions Testing

Eugene P. Visco, FS

This article is extracted from a MORS Oral History Project interview of **Eugene P. Visco**, FS. This interview was conduct by **Bob Sheldon**, MORS Past President, and **Jack Marriott**, MORS Heritage Committee Chair, on 30 October 2000 at Carlisle, Pennsylvania. This extract represents only a minor portion of the total interview and was extracted because of its relevance to one of the hot topics being discussed in MORS and DoD today – Weapons of Mass Destruction (WMD).

MR. VISCO: In April of '44, I turned 17 and enlisted in the Navy. After the war, I went to the University of Miami in Coral Gables, Florida. I graduated in 1950 with a major in mathematics and a minor in physics.

How I Got Started in Chemical Munitions Testing

MR. VISCO: The big event of the summer of 1950 was what? The Korean War had just broken out. I was in the Reserves but I'd finished up a Reserve tour. I got a nice old-fashioned telegram which said would you like a job working for the Army, and offering me a GS-5 to work at Dugway Proving Ground in Utah. I didn't have a clue of what Dugway Proving Ground, Utah, was, but the GS-5 salary was around $3200 a year, which was considerably more than I was making teaching. I did find out that it was a chemical facility. But that still didn't mean anything to me.

I got to Salt Lake City on the train and then discovered that there was no train that went to Tooele, Utah, only freight trains; no passenger trains. I was trying to find out how I got from Salt Lake City then to Dugway, and MPs were patrolling the train station. There was a war on and MPs were out everywhere. I went up to a couple of the MPs and I said I need to know how to get to Dugway Proving Ground, and they said we can't tell you, we're not allowed. They finally said to take the 'stage' to Tooele, a stage being a bus. And at the stage station, the bus station, there'll be a telephone, a ground line out to Dugway, call them and they'll come and pick you up. Which I did.

A fellow came in about an hour after I called, picked me up in an Army pickup truck and started driving. We drove out from Tooele, up a mountain, and were starting down on the other side of the mountain, and he said, "You see there, at the horizon?" I said yes. He said, "That's where the post is going to be." I said, "Where's the post now?" and he said, "It's 10 miles on the other side." And so we arrive at this post, which had been a World War II post, and closed after the war, and, quite literally, the buildings were tar paper-framed buildings. The labs, the living quarters, the messing quarters—everything was still tar paper shacks.

Eventually they put white shingles on all the buildings, but it was pretty primitive. I shared a room with another guy. We had two cots, no closets. You banged nails in the wall to hang things up. Your trunk went under the bed. And there was a community bathing facility. They did build an administrative post ten miles east, which gave somewhat better quarters, and somewhat better living facilities. But the first year or so was pretty primitive.

I got into the chemical/biological testing business, and radiological, because we were still doing some radiological stuff, and I started out as a field hand, a munitions handler. My job, with a couple of other guys — a team of us —was to handle the experimental munition, take it out into the field and prepare it for detonation. We did mostly static testing because you needed to know where the source was when you were doing your field experiment.

Moving Up to Experimental Design

MR. VISCO: So I did that for about a year or so, and then I got a chance to move into the experimental design part of the business, which was the writing up of the test plans, and working out the analytic approach to the experiment or the test, and also writing the report, and collecting the data. So I was able to apply a little bit of statistics and learn a little bit about statistics and experimental design. I did that for six years.

MR. SHELDON: Which chemical munitions were you testing at the time?

MR. VISCO: At that time, the whole range of things. The agent was mostly the early nerve agent called GB. I guess the name for that is Sarin, the G was for German, because it was a organic phosphorus compound that had been developed by the Germans, late '30s, and became a military agent that was never used in combat, to the best of our knowledge.

The US Army was interested in it to put in howitzer shells, 105s, 155s. The Air Force was interested in it for bombs, cluster bombs, small bombs to scatter over the terrain.

I think we experimented with an 8-inch howitzer round, if I remember correctly. Mostly 105s, 155s, and mortars. 4.2 inch mortar. Historically, the 4.2 inch mortar, which was in development following World War I, was originally a chemical weapon. It was called the chemical mortar, was designed to disseminate chemicals, and then it turned out to be a very effective infantry weapon, so it was taken over. But it used to be chemical troops that fired the 4.2 in the old days before World War II.

And also rockets, 4.5 inch rockets. The Army developed a multi — this is well before the present multiple rocket launcher. This is back in the '50s. We had banks — something like 48 — either 24 or 48 4.5 inch rockets on one of these things. We actually built a bunch of those. It became standard for a while.

MR. SHELDON: When you ran the tests, what were you testing for?

MR. VISCO: You're trying to find out what kind of toxic fields you'd get, how far would the stuff go under certain meteorological conditions. So you'd have some way of calculating what we used to call munitions expenditure tables. You'd build them up from individual trials to multi shoots, so you'd know, if you're going to fire a battalion, fire for effect kind of mission, where you might be laying down literally hundreds of rounds, something you really couldn't do experimentally. You'd compile the data from individual Howitzer shells, lay a shell in there and put a bunch of sampling devices around it, so when you blew off the shell, you'd collect the agent.

It was a very complicated kind of

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process because you had to collect the agent in a solvent, using a vacuum pump, and then you had to take those tubes — the solvent with the agent in them, back to the laboratory, and then in the laboratory, the chemist would calculate how much agent there was. And then you'd plot those concentrations, or we converted them into dosages, which were concentration-time products, and we would plot that on a grid. You'd draw contours, and you'd know the meteorological conditions, so you'd say, okay, under this condition of atmospheric stability, and wind speed, this is the kind of coverage you can expect from this round. And then you tried to, either mathematically, or using an analog, build up from one shell to hundreds of shells. I'll tell you how in just a minute.

We also worked with a lot of different pathogens, with tularemia. We did some anthrax experiments, but I wasn't involved in that side of it. I was staying mostly in the chemical side. In this experimental design group, we had a chemical group and a biological group.

So I didn't get too much involved in later days in the biological stuff, but I do know we did some early experiments with anthrax out in the desert.

MR. SHELDON: Did the Army give you any training on the design of experiments? You did all this experimentation, but was there any teaching going on, or was it all OJT?

MR. VISCO: Well, we were fortunate, because the guy I went to work for in the experimental design shop — I think we called it Planning and Evaluation. The guy I went to work for there was a very solid statistician, a very senior statistician, a fellow by the name of **Ed Cox** — not the famous Cox that did the Cochran and Cox book on experimental design statistics. But he was very well rounded and I learned a lot from him.

I took a few statistics and probability courses from University of Utah. Faculty would come out to Dugway and teach courses out there. My first formal stuff came from University of Utah. But working for Ed Cox and some other senior types was very good.

So, yes, it was on-the-job training but it was under good leadership. But no formal training from the Army standpoint. Even the munitions stuff, when we were handling these munitions, we were just fortunate we had a couple of old-timers who had dealt a lot with munitions.

We had one explosives guy working with us who was very knowledgeable, and he was from Utah, and had done a lot of mining and explosive work in mines, so he was very helpful from a safety standpoint. He could teach us the rudiments of what not to do with the blasting cap (squib), and make sure that nothing is connected back at the box, or to push the plunger on it—[laughter]—before everybody's out of the target area.

An Analyst Guinea Pig Gets a Dose of Chem/Bio

MR. VISCO: I got dosed a few times with GB — but low doses. They were very low. Mostly stupid kinds of things, just got exposed. Probably even got dosed with some of the biologicals because, periodically, we'd have a little epidemic on the post and we'd lose about 15 or 20 percent of the staff, who would be lying in bed because — through something — either that or maybe one of the sera. The medics that we had on the staff out there were working with sera against some of these exotic biological things.

And we would be the guinea pigs for the sera. Periodically, the sera would back up on you or the serum would give you a hard time, and you'd get a lot of cases of mononucleosis. We'd get literally epidemics of mononucleosis.

MR. MARRIOTT: Kissing disease?

MR. VISCO: Yes; that's what it was called of course; sometimes called the students' disease because it goes around college campuses a lot. And we used to get it quite a bit. Every six or eight months, there'd be a little sequence of cases, and we didn't know exactly why. But almost all of these things had the same symptoms. There's malaise. You have some temperature. You just don't want to do anything. All you want to do is lie in your bed. You don't have much of an appetite, and so it was kind of depressing.

Hands On Testing

When I was in the experimental design business, I was actually the test director on some of the trials, and the Brits had developed a huge mustard bomb. We weren't doing much with mustard in the States but the Brits still felt mustard was a good agent. It's a vesicant, it burns.

And the Brits had developed a bomb for the RAF, a 1,000 pound mustard bomb, which contains about 800, 900 pounds of mustard. A huge thing. Well, they had no place to test it, and they wanted to test it at Dugway. We didn't want to drop the bomb because we didn't know where that load would go if we dropped it.

We had a couple of buildings out at Dugway that were built during the war, called German Village. The buildings were built out of German construction material that, quite literally, had been smuggled out of Germany during the war, and we used those buildings during World War II. The roofs had German tiles on them, and we used them to test incendiary bombs, to see how they would burn with the tile.

Those buildings are still out there and they're still being used.

MR. MARRIOTT: And it's still called German Village.

MR. VISCO: Still called German Village; yes. We wanted to see whether or not we could get mustard inside the building from a burst outside. So we took this 1000-pound bomb and hung it on a telephone pole outside, far enough away so the blast wouldn't bother the building, and we blew this thing off, and there's no easy way to sample mustard, unless you're allowed to use humans, and we weren't allowed — well, I'll tell you, maybe, about an experiment where we did try to use some humans.

But what you normally do is you put a dye in the agent, purple die, usually, and then you put out a pie pan, and you go and look to see if you've got purple stuff in the pie pan, and that'll say, yes, you've got an agent there. A very crude kind of mechanism.

Well, the engineer who had designed this thing was in the States with us, and he wanted to go in the building before the crew went in to collect the pie pans. He wanted to see for himself, and because I was the test director, I had to go in with him. So we put our gas masks on and went on in to this building, and we looked around. We saw some purple dye and we saw some pie pans that didn't have purple dye in them, and he was satisfied, and we left, and let the data collectors go in and pick up the stuff.

We got in my jeep and we drove from the operational area back to the administrative area to go to the club, have a drink, have something to eat. And we went on in, into the men's room before going into the dining room, and he went over and he washed his hands first. I didn't. I went right over to the urinal and took care of my business, and he came up to me afterwards, and he said, "You don't know very much about mustard, do you?"

Well, the notion is that mustard attacks the moist parts of the body, and potentially, I could have had some on my hands and handling my privates at that moment would not have been a good idea! Fortunately, nothing much happened but—

An Analyst is the Second Volunteer in a Mustard Test

MR. VISCO: In 1952, the chief chemical officer was getting ready to retire — at that time the tech services had these chiefs, senior officers — I think they were only two stars. But the chief chemical officer was about to retire, and he went on a round-the-world trip, as chiefs often do. He came back from Germany, from Europe, mind you, 1952, with a firm notion that something had to be done to be able to put a barrier across Europe to prevent the Russian hordes. At that time, we had not much more than a constabulary force being built up.

We had in 1948, the closing of the road from West Germany to Berlin, and we had the airlift.

We had a constabulary force, but there was great concern about, is there some way we could stop the Russians. We'd been experimenting with some radioactive stuff, laying down radioactive tantalum dust. The chief chemical officer said we need to do something about laying down a barrier.

What you want is an agent that will stay around. That implies persistency, low vapor pressure, something to give you a lot of heartburn if you're trying to traverse an area that's loaded with a persistent agent. The candidate was mustard.

However, mustard freezes at a very high temperature. Mustard freezes somewhere in the 40s or 50s, depending on impurities and stuff. So it wouldn't be very good for a good part of the year in Europe, especially, certainly in the wintertime. However, there is a thing called a eutectic mixture. Are you familiar with eutectics in chemistry? Well, eutectic is a mixture of two or more substances where the physical characteristics of the mixture is different from the physical characteristics of either component.

It turns out if you mix mustard with Lewisite, which is also a vesicant (and percutaneously toxic), you lower the freezing point. I'm not sure why, but you lower it considerably (probably well below the freezing point of water), make it much more useful for a longer period of time.

So we were directed to do an experiment with this eutectic mixture. Well, the question came up, how do you do such an experiment? How can you figure out whether or not you've got the stuff around, other than this pie pan business?

And so we decided to use volunteers. We had a rule that said no enlisted could volunteer. Only officers and civilians could volunteer. The medics were very nervous about this because Nuremberg had not been that long ago.

The medics laid down the requirements. The requirements were that a small number of people could volunteer, preferably senior people. So the technical director, who was a lieutenant colonel at the time, he was the first volunteer. I was the second volunteer.

And the medics decreed that we would have to be dressed in the following manner. We would have to put on impregnated underwear, that's impregnated with charcoal to prevent — and that's the old stuff — that prevented the agent from reaching the skin.

Then you had to put the impregnated coveralls over that. Of course you had your gas mask and a hood. Then they insisted you put butyl rubber on top of that, and butyl rubber is essentially impermeable. The butyl rubber is what you use when you're exposed to a percutaneous nerve agent or a biological agent.

So you put the butyl rubber over that. We did this experiment in the wintertime, so the heat load wouldn't be a problem. But then doing the experiment, we said, well, that's the naked person. We need to have some way of representing a clothed person and we need some way of detecting the purple dye.

Well, there's a thing called a cooling suit that goes over the butyl rubber. It's cotton, and you hose it down in the summer, and that keeps you a little bit cooler inside the butyl rubber with the evaporation.

So we put the white cooling suits on to allow us to pick up the purple dye. Then we said, well, that's still a naked man. You had to put a uniform on top of it. We had old Army khaki uniforms. Of course they had to be big by this time, because we're huge. I don't know where they got those uniforms. So I had khaki trousers and then the old khaki blouse, with the lapels and everything, and of course a gas mask.

By the time we got all through this planning, we're losing winter. We're now into the spring. We were losing the real low temperatures. So we made up some land mines, 2-gallon cans, with mixes of mustard and Lewisite in them, laid them out in the desert, blew them off with primer cord.

When we were sure that all had blown, we charged into the brush, and I crawled. We had a 50-meter field. I crawled across the 50 meters. My boss, the technical director, would look around. He had eyeglasses outside of his gas mask, because he had very poor eyesight (and we didn't have gas mask glasses). And he'd look around until he spotted some purple dye, and then he'd throw himself on the piece of sagebrush that had the purple dye, in the hopes that he could pick up some agent. Anyway, we got all through with this whole experiment. I couldn't stand up when I got through to the end. I was just exhausted. A couple a guys came over, they picked me up, and took me over to the bus, and we began taking all this clothing off. And we had one little blotch of purple dye on my cooling suit, down on my knee. And they took a picture of me, and that went into the report we wrote up of this thing. Unbelievable!

Anyway, it was the kind of experiment that didn't work out well.

An Analog

MR. SHELDON: A while ago, you talked about an analog?

MR. VISCO: This was part of the chemical stuff. Remember, I told you we did our experiments in the field with single weapons, either a Howitzer shell or a little bomb out of a cluster bomb, and the problem is how do you combine a bunch of these to get a field of — a toxic cloud. We were doing some mathematical things to build these things up, but we were also struggling with some other — what I refer to as analog methods.

Each time we ran an experiment with a single munition, we were able to create

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and then make a considered determination as to how MORS might best assist.

In a related vein, I am fully supportive of the on-going efforts to establish, on a trial basis, local MORS chapters at selected sites. Having personally served in a variety of OR positions, I am well aware of the tremendous amount of quality OR work conducted by analysts situated well "outside the beltway." We as a Society need to capitalize on these efforts and ensure that they receive increased support and exposure. I believe that local chapters will not only provide a more frequent opportunity for OR analysts to share their experiences and needs in a familiar environment but will also provide increased opportunities for local decision makers to articulate their needs and to better understand the role that OR may play in their attainment. I believe that local chapters are healthy for the overall MORS membership, will serve to energize the Society's membership, and will offer valuable, fresh perspectives to the Society as a whole from "outside the beltway."

Let me also offer a comment or two on the broad subject of MORS Heritage and what it contributes in the way of service to our members. A stated goal of the Society is "to preserve the heritage of military operations research." The achievement of this goal is manifested in a number of ways: the republication of selected military OR classics; the significant efforts of individuals such as **Lee Dick** to compile a history of *PHALANX*, and of **Gene Visco**, FS, and Past President **Bob Sheldon** to compile selected oral histories; the election of MORSians as Fellows of the Society; and the recent and ongoing participation of senior MORSians at Heritage Special Sessions of our annual symposium. All of these activities are commendable and must continue to receive the Society's enthusiastic support. In my opinion MORS must make every effort to retain not only our links to the past but make every effort to ensure that our past, as represented by our Fellows and more senior members, remain fully engaged in MORS and very much a part of our future.

As you have hopefully concluded, my focus as MORS President-Elect will be on service to our members, those who serve as OR practitioners *and* those who use OR products. MORS is fortunate in that it consists of growing numbers of multi-talented individuals. Our Society needs to focus on ensuring that each and every member is encouraged to fully engage in MORS and provided with the opportunity to attain and contribute their relevant skills and experience in addressing the critical and complex challenges of the 21st century. As our former colleague, Sir Robert Watson-Watt, might phrase it, MORS should continue to provide individuals with "good scientific training" and a forum in which to address key problems and issues, confronting the military decision makers of today.

Biography

Ted Smyth *possesses an extensive background in military operations research and systems analysis. A retired Marine Corps Colonel with nearly thirty years of active service he has commanded Marine Corps units at the company/battery, battalion, and regimental level. During his Marine Corps career his primary occupational specialty was artillery/fire support with sub-specialties as a military operations analyst and historian. As an operations analyst he filled a number of varied assignments to include service as: an operations analyst at Headquarters, Fleet Marine Force Atlantic, Norfolk, VA; an Assistant Professor of Operations Research at the US Naval Academy, Annapolis, MD; the Senior Naval Operations Analyst, Combined Forces Command, Seoul, ROK; and the Director, Marine Corps Studies and Analysis Division, Quantico, VA. He possesses considerable teaching experience in the use of quantitative methods and has served on the faculties of: University of Virginia, US Naval Academy, The George Washington University, University of Maryland, Webster University, and The Johns Hopkins University. He is a 1966 graduate of the US Naval Academy and holds advanced degrees in Operations Research and in History from the US Naval Postgraduate School and Old Dominion University respectively. Since retirement from active Marine Corps service, he has served as a member of the Senior Professional Staff of the Johns Hopkins University Applied Physics Laboratory. He has served on the MORS Board of Directors since 1995 and on the Executive Council consecutively as Secretary and as Vice President (Professional Affairs) since 1999.* ✪

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a series of contours which would represent certain quantities, concentrations of agent, over time. So you could draw — these things were kind of ellipses, depending on whether you had a strong wind or not, but you'd make little ellipses where the highest concentration would be closest to the source, and then falling off.

We were trying to do this buildup of toxic agent cloud, a gas cloud, by working, doing experiments with single bombs, or single shells, and then trying to figure out a way to combine what might be an artillery shoot with a barrage, or a bunch of bombs, bomblets dropping from a cluster bomb.

I found out that there was a mathematician back in Washington — I was still out at Dugway — **H.H. Germond**, who had been doing some stuff with an analog computer, and it sounded like what he was doing would be useful to us. So I found that it was possible to build a model, that would be a set of contours representing the distribution of agent from a single munition, using a substance called Zipatone, which was used in mapmaking. Zipatone had a characteristic — Zipatone was made up in a dozen or fifteen different patterns — each pattern would pass a specific and measurable amount of light. That is, given a light source, so many lumens would be passed through. Each different Zipatone pattern would allow a specific amount of light through. And the variation in the amount of light from one pattern to another represented a linear function, that is, if pattern number one allowed X amount of light, pattern number two allowed 2X, and so forth.

So I was able to use the Zipatone to represent different quantities of agent released from a single munition, drawing contours, elliptical-shaped things, and showing the distribution of agent going downwind, using the Zipatone material.

Then I also had a pattern of individual munitions as they had been dropped, let's say, from an airplane, scattered over a target. I was able to have a typical pattern, measured in the field out at Dugway, measure the distance and the azimuth from some central point. (We were able to drop clusters of bomblets filled with simulant, to get distributions of impact points, as a function of opening altitude of the cluster munition and wind speed.)

So I had a plot of how the bomblets would be distributed over the field, and now I had a plot of one bomblet, agent distribution, and working with this analog computer that Professor Germond had, I was able to build up the agent cloud by using this light transmission quality or characteristic of the Zipatone pattern, by simply laying multiple copies of this individual bomblet pattern down on these locations where the bomblets would have dropped on the field, and measuring the light passed through, using a light meter, and accumulating, summing up, the quantity of agent (the overlaps from the individual bomblets) — we called it dosage — the quantity of agent (at points on an arbitrary grid overlaying the impact pattern) as the cloud would move downwind. (I then could draw contours representing selected dosages that would be achieved by all the bomblets on the target.)

So I was able to do an analog construction of the total bomblets, gas cloud field, that would have been generated by all those bomblets going off. It was a breakthrough for us because we were able to match that analog computation with the statistical, mathematical models that we were also building to do the same thing. So it was interesting.

MR. SHELDON: Did you get similar results between the statistical models and the analog model?

MR. VISCO: That's an excellent question. I just remember that we were satisfied with the results, and that's as far as I can say at the moment. We used those results to generate some munitions expenditure tables, so that we could tell the Air Force how many they would have to release to get a certain effect on a battlefield.

An Analyst Learns From Testing

I learned a lot out there. First of all, I learned a lot about munitions, certainly, about chemical and biological munitions. I began to learn a lot about military operations, at least from the standpoint of the role of the possible role of chemicals and biologicals, especially when I was working in the experimental design stuff. And the last year I was there, the commander organized a separate, small group that I headed.

The commander decided that he wanted to establish a group that would begin to look at the operational applications.

Now a lot of that was already going on back at places like Edgewood. The Chemical Corps had an operations research group working at Edgewood. The senior civilian was **George Milly**, who became very well known in the chemical business.

But we decided out at Dugway that we needed to do some of that as well. I headed up a group called Operational Testing, which was the beginning to applying the engineering tests that we were doing, by and large, engineering type tests, research and development type tests. This is well before there was any concept of operational testing as we see it now in the Defense Department. So it was very early on stuff.

My job was to begin to think about how this stuff might be applied, and what munitions expenditure tables might really look like for some of these weapon systems. So that was kind of interesting, kind of fun. By this time I had been there six years, and I was beginning to think about what the rest of my life was going to be like, and should I stay at Dugway and get to be technical director or something some day, or do something else.

I decided I really wanted to get to where I could do some graduate work and get back to the city, and I had met some people from The Johns Hopkins University Operations Research Office (ORO), which had been established in 1948 to provide an operational research capability to the Army.

Later Work on an ORO Chemical Study

MR. SHELDON: What was the purpose of that chemical study?

MR. VISCO: It was a study of the potential for toxic chemical weapons in support of Army operations. So it was tactically oriented. It turned out to be a very long study, unnecessarily long. The chief of the study couldn't control the thing. It got to be something for everybody.

I did some papers on a number of the chemicals, some technical papers. I worked with a wonderful woman analyst, **Dorothy Kneeland Clark**, now deceased. She got a doctorate in 1937 from Radcliffe, and was a historian by profession, one of the sharpest, most competent military operations analysts and war gamers you ever wanted to meet.

She was assigned to the Far East Command for a while during the war. She was in Korea during the war. When the Vietnam War started up, she was still active, and she went to Vietnam.

She did a wonderful paper on the policy issue of the use of chemicals, based on looking at the history of US policy and international policy, and then trying to bring it forward to make the argument as to whether or not the country would even countenance the use of chemical weapons.

We did all kinds of papers because so much was unknown about the subject, even though there were lots of manuals and things. The new agents that were coming along, not only the nerve agent we had worked with, but now there was a whole new class of agents called the V agents, which the British had synthesized, and the V was for very toxic, because they were more toxic than the G agents were, mostly percutaneously, through the skin, which means they'd bypass a gas mask. But we didn't know anything about them.

They were British developed, and we had a tough time getting information from the Brits, even though we had a good exchange program. So we had to guess at a number of things.

Operations Research as an Experimental Science

MR. VISCO: In those days, Operations Research was still an experimental science. We still were interested in doing experiments and learning from experiments. One of my colleagues on the study, a fellow by the name of **Bob Best**, who was also extremely bright, a competent guy, spent time in Korea, been in the Army during World War II (also was an early member of the Navy's Anti-Submarine Warfare Operations Research Group, founded by **Phil Morse**) — he was trying to get some stuff on VX, which was the agent that the Brits were developing, and we were just beginning to become aware of, but he couldn't get any specifics on it. He knew that the density of VX was probably close to that of water. Most of these agents are of that sort. So he was interested in finding out how the agent might spread when it landed on — came down in droplets or spray on uniforms. He had an old poplin raincoat from his Army days, and he laid that out on his front lawn, at his house, went up to the attic, about 30 feet off the ground, leaned out, he had an old-fash-

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ioned fountain pen with a plunger on it, and he pumped a few drops, then ran down and measured the spread of the ink drops on the poplin raincoat, and that was the first piece of VX data that we had, that went into the report.

But the point was, what he was trying to do was just get a feel for what that might look like, in a crude sort of way. But it just demonstrated the ingenuity of an operations analyst who couldn't get any data, and ran a very simple experiment to give him at least a ballpark answer.

Results of a Chemical Study - Difficult to Predict the Effects

MR. VISCO: I worked on the chemical study for a long time, much longer than I should have.

MR. SHELDON: And what was the result of that chemical study?

MR. VISCO: It was a 5-foot shelf of paper and so on, toxic chemicals, and the study went on even after I left and I have no idea what it recommended to the Army. I think what it finally recommended was — it probably left it right up in the air, the same place it'd been for years. That it is so difficult to determine, with some high degree of confidence, what the effects of chemical attacks will be, that it raises serious questions about the usefulness of the systems.

Even though we built a lot of the systems, we had them in the arsenal, and we were developing procedures for employing them, there was a strong feeling of distrust among Army commanders because it was so difficult to predict the effects.

Now it's also true that it's difficult to predict the effects of any weapon, but some weapons like penetrating wound weapons, or exploding weapons, have built up such a solid foundation of respect, that people will use them, even though you're not quite sure what the effects are going to be, in spite of all the modeling and all the analysis that goes on.

So chemicals were just more suspect than anything else, and that's one reason why nobody protested very long and loud when we made the national decision to not use chemical and biological weapons, but only to build defenses against them.

I think, technically, we reserve the right to respond to any attack with any weapon

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of choice, but since we don't produce the stuff anymore, we don't train with it anymore, it's hard to imagine us ever using chemicals, and, for that matter, even biologicals, as far as I know.

MR. SHELDON: You're studying the offensive use of chemical weapons — how readily does that translate to the defense against such things?

MR. VISCO: We did look at that as part of the study, so, yes, some of the stuff in there would make some sense, even today. We looked at the standard ways of treating chemical casualties, the nerve agent casualties, and I think we made some comments about — one of the big problems had to do with the use of atropine sulphate as an antidote to nerve gas poisoning. At that time, the standard way of packing the atropine sulphate was in what we called an ampule, which was a little bulk container of some quantity of atropine sulphate with two atmospheres of nitrogen in the capsule. What you were supposed to do was — it had an enormous needle on it — and you were supposed to drive this thing into your thigh, into a muscle, and then break the glass seal within a little rubber tubing — break the glass seal and because you had it arranged it that way (vertical), the two atmospheres of nitrogen were behind the atropine sulphate, and the two atmospheres would be enough pressure to drive it, drive the atropine sulphate into your thigh. Well, it turns out that it's very difficult to bring yourself to do that, to jam yourself with that needle.

So one of the things we suggested, and others were suggesting at the same time, was some kind of an auto inject sort of system, and the Army did go to that. They found somebody who'd build this little spring-loaded device that you would press against your thigh and it would fire the needle in and fire the stuff in. But I used to travel around with three or four of these little ampules of atropine sulphate.

One of the difficulties here is that there's a downside to using atropine, because atropine is a poison in its own right, and if you're not dosed with nerve agent and you shoot yourself with atropine sulphate, especially if you do a couple of shots—because the plan was to give two ampules or two auto inject systems to each soldier.

If you give yourself that much atropine sulphate, you're probably going to become a casualty from atropine sulphate! And you get a dry mouth, and trouble with your eyes, and a bunch of other things, and more than likely you'll be a casualty from that. So those kinds of things we tried to wrestle with.

Later Chemical Work

MR. VISCO: (After a brief sojourn in Vietnam studying armored operations) I went to work for a friend of mine. George Milly, who used to run the Chemical Corps Operations Research Group, and had formed a little company to do not only military analysis but also environmental stuff. I went to work for him in '68. And I recruited **Joanne Langston** (now a senior civilian faculty member at the Defense Systems Management College). I recruited her to come to work at GEOMET, which was the little company out in Rockville, and the first study we did for Defense Department was a chemical study.

We wrote a series of papers that were compiled into a source book, on everything that was known about chemicals and chemical weapons, in one big book. And the Army (or the Defense Department) then picked it up and continued updating that.

Now I'm retired. I'm doing some part-time work for a company called Simulation Technologies, Incorporated, and of all things, knowing my reputation, my cynical attitude toward models, I'm working on a verification and validation of a Marine Corps model, a chemical/biological model. I teach a course at George Mason on the history of operations during the war. But I'm basically lazy and I don't want to work too hard! ✪