# American Meteorological Society
# University Corporation for Atmospheric Research

## TAPE RECORDED INTERVIEW PROJECT

## Interview of James N. Pitts, Jr.

## August 1, 2007

## Interviewer: Jeffrey S. Gaffney

Gaffney: OK. So, this is an interview with Dr. James N. Pitts, Jr., Emeritus Professor of Chemistry at the University of California Riverside, and Research Chemist at the University of California, Irvine. He is also a cofounder and past Director of the University of California Statewide Air Pollution Research Center at UC Riverside. The date is August 2nd, 2007. And we are doing this interview in Dr. Pitts' office, in the Chemistry Department at the University of California, Irvine.

I am Jeff Gaffney. I'm Chair of the Department and Professor of Chemistry at the University of Arkansas Little Rock, and a member of the American Meteorological Society History Committee.

Jim, you just showed me the January 8th, 2007, news item from the Chronicles of Higher Education, in which the University of California, Irvine was ranked Number One in Atmospheric Sciences. And I also looked over my shoulder, here. And you've just received the 2007 Carl Moyer Award from the Coalition for Clean Air for "Scientific Leadership and Technical Excellence in Career-Long Research and Public Service for Clean Air."

Pitts: Yes, about two months ago. (overlapping dialogue; inaudible).

Gaffney: I also see you have recently been interviewed in the quarterly publication, 'The Spectrum" (Volume 20, Issue 1, 2007), published by the Center for Photochemical Sciences, Bowling Green University, www.bgsu.edu/departments/photochem. I gather that article is "relevant" to our interview.

Pitts: Yes, it is – and somewhat more "organized" than this "informal" interview. Also with pictures, diagrams, etc.

Gaffney: So, I guess we're – I think – and a lot of times we start these interviews, we talk about, you know, OK. Where were you born, and all these things. And I know, I think you were born in January of –

Pitts: Twenty-one.

Gaffney: – 1921.

Pitts: Yeah.

Gaffney: So, you just, not too long ago, turned 86 and going on 87. Tremendous amount of experience. I just, I guess, well, let's talk about how you got there.

Pitts: Well, you start with a....You mean, what, how we got where we are?

Gaffney: How we – how you got to where we are now. And what do you think some of the important things are now, that we're facing.

Pitts: Yeah, well to start with – well, how I got there, from now, I think, way back then, a couple things that I learned from my Dad, way back when. My Dad was in business for himself. He could repair radios – this was in the '20s and '30s – and actually invented a device for long distance, an antenna, so you – because the big deal then was, boy, if you could get DX, from L.A., you might get the first broadcasts from "east" of California. I got KSL. I think I even remember the day. And that way, you could go all the way back across the country.

So my Dad did this, and he had a small store, and Mom "kept the books" and Dad repaired radios and sold them, and I swept the sidewalk, when I was seven, eight, nine, ten. In fact, the little store was on Western Avenue in Los Angeles. And one of the interesting things about being in that store was, in fact is, on an evening in 1932, we got the evening paper – the Herald – and I read the funnies. And while reading the paper, right on Western Avenue, all of a sudden things started to shake, and it was an earthquake. It was a big one. I ran out the front door, – which is where I shouldn't have run, because everything was plate glass – looked up, and I saw the whole front – the whole front – of the Safeway store, which wasn't more than 50 yards down the street, crash into the street. For the next few days, we lived at my Grandmother's home, which was a little bungalow, and stayed there, because we had a brick place. Mother ran out the back of the store, into a brick wall – (laughter) there were brick buildings all around it. So, this was my first experience in a lot of things. And one of them was earthquakes. And I've sure taken them seriously. We were in the big earthquake, at Big Bear Lake (1992) and so forth.

So, so that's just a little input there. But what Dad taught me – and I – so, I worked around there. Did some work, and what he taught me is "fundamental." And, as you know from our two books, in there, we say the "fundamental things apply."

This picture is my lovely wife, Barbara Finlayson-Pitts, who is the brains of the family. She has trained our golden retrievers – and now a black lab – through some 31 years of married life. And she has trained me very well. Some other things I learned in the training are passed on in this 2007 interview in "Spectrum" that I wrote. But I've – it's fun to tell you about it – because we're old buddies, and you know it. You've seen her. You know her so well.

One of the things that I've learned, as sort of being the "old guy" around here, is I'm very fortunate. I have a beautiful office, and her researchers have been great to me. I think I'm a little help to them, because over the years I have had a little access to the other aspects in society. For example, what I've learned in substance is a very interesting thing about guys that say, "I'm married, and my wife wants this, and she wants to do this. And my wife is pretty positive about things."

And I, sort of being the "old grandfather," can tell them, "Well, you know, what I find very successful is, salute and say 'ma'am,' and bring her a few flowers – in addition to those on Valentine's Day." And I say, "Son, you just can't believe the advantage – the benefits – that will come from all this."

Well, actually, enough cases have occurred where guys have come back to me and said, "Oh, yeah, Doc. Well -- thanks." You know? (laughter) And I (laughter) – so I (laughter) – so, one of my philosophies is, "I salute, say 'ma'am,' and me and the dogs, we do fine."

She was the senior author on the two Atmospheric Chemistry books that we wrote. In the Introduction, one of the important thrusts is that we stress fundamentals – just like in an old song from the classic movie "Casablanca." We have Bergman and what's-his-name. You know. It was in "Casablanca." It was in the song that they sang – "the fundamental things apply, as time goes by." And that was the song. "It's still the same old story – a fight for love and glory. A case of do or die. The world will always welcome lovers, as time goes by." Bergman and the guy – the fellow. Who was he?

Gaffney: [Borg?].

Pitts: Bor –

Gaffney: "Bogie."

Pitts: – yeah, Humphrey Bogart .

Gaffney: Humphrey Bogart.

Pitts: Yeah. Bogart and Bergman. Well, that's a damn good song.

Gaffney: Oh, yeah.

Pitts: And so, that has, sort of, been our model. That's why it's in the book. Interesting enough, we had to get the, we had to get the permission from the publisher. I think this is rather ironic. We did get permission. And it was written in – let's see – oh, way back, way back when, in 1931. Actually, the author was, I think, a German, Herman Hupfeld, believe it or not. We – in our book – if you open it up, it's there. It says, "permission from." We thought that was kind of an interesting, ironic twist of fate. But it was useful. So, that's our belief: "The fundamental things apply."

And that worked for me in the Chemistry Departments. I could teach undergraduates. You teach them fun – well, you teach your own kids, too. But that's another issue. That's tough. That's another whole world that I do not want to go into here. (laughter)

Barb's Dad had a paddle –and she's remembered it all her life.

As a boy, I was told what to do, and I surely – I was punished for one thing I did wrong one time, and I sure learned fast. Very simple.

I think that if you do that, stress fundamentals, in the house, then you tend to do so in chemistry courses. The basics! Fundamental things! And if you get those across, from freshman chemistry on up, you "get through" to the students. Then, you get into your research and into the research areas. I think it's one of the important ways that we looked at it – that Barb and I looked at it. But we've looked at it, and I've looked at it from the start. The impact of the inputs from my Dad and from my family, and then, from Blacet (at UCLA), whom I started to work with, at 40 cents an hour, as I mentioned, and as an undergraduate reader in 1940 – which, incidentally, beat what I was – same price I was getting for carrying groceries in Westwood, at 40 cents an hour. And that's how I made my money.

Gaffney: This was at UCLA, right?

Pitts: Yeah, at UCLA. Yeah. When I went there, (inaudible) my Dad had a store, in Westwood. I must have been about nineteen. He could fix anything. He would build anything or fix anything. So, you see, for example, he knew some of the movie stars. Because, during the war, when things broke down, it

was hard to get repairmen. So, Dad was, you know, a real "handyman".... "Ask for Jim."

Gaffney: Can you help me – (laughter) the thing is leaking!!

I went to UCLA in the winter quarter of 1939, from Manual Arts High School. It was an excellent High School – I was president of the Scholarship Society for Southern California. Not that it meant a heck of a lot. But it was kind of fun, you know. Actually, Jimmy Doolittle went to our High School some years earlier – Manual Arts – which was right next to the Coliseum.

But, to go back to the beginning. So, yeah, that's at 40 cents an hour. So, I had to make some money while taking classes.

In 1940, we moved Dad's store to a location just south of Westwood Village. I had a little 1932 Model B Ford coupe – which I wish I still had now (that would be worth money) – that had a rumble seat. And that was a fun part about that. When I went to UCLA, I had the car with a rumble seat!! Thus I was very popular with my buddies, like George Pimental, you know, (laughter) and others who were undergraduate students in the Chemistry Department. They got the rumble seat when we drove down to the beach, or the Palladium. I had to drive with my date. But it was fun!!!

But, the point being that I had to make some money. And so, my original jobs, well, they worked – I went to UCLA on a scholarship. Not big, but a scholarship. And I went there, and found out you made 40 cents an hour if you would carry groceries at Ralph's grocery store in Westwood Village. You carried groceries, because in those days they did not have carts that had wheels. Today, to anyone who reads this or listens to this, it may sound amazing. But one did not have those wheelie carts. So, the – we – I can still see this. So, you know, I would stand next to the checkout line there and package and carry out the groceries to their cars. And it was "very interesting." Still, it paid 40 cents an hour.

And as I think I mentioned, such experiences provide a very interesting insight into people. You rarely – you didn't get tipped very often, in those days, carrying it out. I learned early on that the tips – a nickel or dime (which was a lot of money, at 40 cents an hour), usually were given me by "little, old ladies," that didn't have much. They would drive up in an old Ford or an old Chevy – they did not, they didn't have much! But they would give you a nickel or two, or a dime. Boy, you know, that was money.

In contrast, most of the wealthy customers, who drove to Ralph's in their limousines, gave you <u>nothing</u>, no tip!!

So, I learned something about life and people. But then, to be an undergraduate reader for Francis Blacet and a Research Assistant for Jimmy McCullough (my Instructor in my the first semester of undergrad chemistry) was great.

So, I later worked with Dr. McCullough and then Francis Blacet, who impacted my whole life – my – well, not only my professional but also my personal life, too – indeed he was a Godfather to one of my Daughters. As we shall see later, Francis Blacet was one of the heroes of World War II. His Chemical Warfare work – leading the group that I was in, 28 of us, something like that – got a Personal Commendation – commendation from Harry Truman. Actually, he started our group, and he ran it. (More later.)

But, any rate, the interesting part, then, was just that I started grading papers for him as pop quizzes, in my sophomore year. And, at 40 cents an hour, that was good stuff, "boy."

Then, Jimmy McCullough – I worked in his lab, too – and stayed on as sort of a "cleanup" assistant for Blacet, both at 40 cents an hour from the NYA, I think it was the National Youth Administration. You'll have to check that. It might have been the NYA. But there was something that had some sort of funds so you could get some welcome money. So, it was really fun.

Then, Jimmy McCullough came through with a new machine. And that was more fun. This instrument was called a visible ultraviolet spectrophotometer. And that beauty was about, oh, about so long. This long. And it had little slots, so you could put the cells in. I think there were four. One was for the, for your solvent – the background – and the other three were for the reactions you were looking at. You would turn a dial, and you tuned in wavelengths, and, by golly, you got spectra. And, quite seriously, that really, really excited me. That was really fun stuff.

Blacet and McCullough – they were really neat guys. Really very fine men – young men, at that time. They were young men. But again, there was no nonsense. You did the job. They taught – they taught us things. They were like academic fathers. And they taught you things. And you watched how they handled themselves. And once in a while, you would be around when there was some conference in the department, or something (inaudible), they were in a special room. But, so, occasionally, you saw enough of what went on – and the "underground" knew what was going on like that. That you found, again, that the idea – and I thought, the idea was fundamental.

And you know, Jeff, you've been in athletics all your life. You were when we were together. And, you know, you were an athlete, and prior to High School, you've been in all kinds of situations. And you know – and this may sound corny, and I don't care if it sounds corny, because I'm right (laughter). You

know in life, you can be corny but right. (laughter) Well, the fundamental things apply. You clipped, or you've got blocking and tackling, baby. In every sport there's a form you learn. The fundamentals. And if you can do the fundamentals, in sports and life, and fundamentals are, you know, proper, they apply as time goes by.

So, that carried me through, in my interactions with my parents, through my public schools, through the university, then through the war. You watch this, and the whole thing. And that, actually, then, I think was, it was basic. And you ask why was this a success, why were we successful in a number of these areas. One was, we – I always believed in getting the fundamentals. Go back and get the fundamentals. If I didn't know myself, I got somebody who really knew them. I mean, I don't know quantum mechanics. I'm not – I – not (inaudible). I'm not a high-speed theoretician. But, we would get somebody who knew it. And you knew they knew it. And then, you would get these people – young men, young women.

That's coming to another point. And then, we got young women – women into this. A number. You know, Barbara Zielinska, Janet Arey – they're all brilliant people. Barb, that whole group, came in and worked with us. And you found that, you found that you applied that in, and as you applied the fundamental, (inaudible) applied problems. So, first thing you applied – if you don't mind my jumping ahead, but –

Gaffney: No, I don't mind.

Pitts: – these tell the story. And as, I try to give some examples. I'll come back to the war, but some examples of where they apply. In, oh, I think it was '50. 1950s, you get the smog now. So, we're going to move over to smog. Then, we'll go back and forth, illustrating some of what the fundamentals were, that, it's kind of an interesting story, well, in terms of, then, where did all the smog begin? Well, we knew all about the London smog, you know, in the 20th Century. And Maimonides in the 12th Century said this, "It is that dust," and so forth. But, when I grew up in southern California, you surfed, you had a good time, you didn't have any smog. But you saw haze, over toward Pasadena. But no big deal. It was haze. Well, it was very interesting that after – and this is fundamental – after, in the '50s, '52, why the – things were really getting very, very bad with the smog – what we now know as "smog" – in Pasadena.

Now, actually, it was a couple of plant scientists who really "scored." It was Middleton and Darley and Jim Kendrick – plant scientists that actually went out and said, "Hey, wait a minute. Something is just hitting these plants, just knocking out the vineyards, and knocking out the crops when they plant this field with peas. And, oh, jeez, you know, this is – they're not doing anything." Sort of where there are homes everywhere now. But they came in and they

said, you know, this – so, they said – they actually published a paper. They said OK, we published a paper saying this is a new type of plant – new type of smog – plant "enemies." And they didn't have – identify what it was. But it was a new type of plant "enemy," and it had several characteristics. Apparently, it hit the tops of plants, and some of it – something else in there that hit other parts, e.g., the bottoms. New kind of smog.

Well, here's where the fundamentals applied. The – so, good old Hahn – Kenny Hahn – who was a Supervisor for L.A., [actually his son wound up being mayor of L.A. for a number of years.]

Gaffney: Hahn?

Pitts: Yeah. Old Kenny Hahn was good. He was a sharp cookie. And Kenny Hahn saw there was something ticking, about 1952 and '3. So, it was getting pretty bad. And so Hahn – at '52. Are we OK?

Gaffney: Mmm-hmm.

Pitts: All right? So, Hahn said....I'm rambling, but that's what, you know....

Gaffney: It's OK. (laughter)

Pitts: I'm not just, necessarily, a rambling wreck from Georgia Tech and a hell of an engineer. I'm just a rambling old guy who is sitting here, without a glass of beer. I'm talking (inaudible) cold sober. But it's exciting. You know. It's exciting, fun stuff. But anyways, the – what Hahn did – so, and this just tied together – fundamentals.

Gaffney: Mmm-hmm.

Pitts: Hahn did. And I've got some of this. And then, the law was passed, and we did something about gas and so forth. That was when I came back out of that war with my degree, at that time, in '49.

But what, well, Kenny Hahn wrote letters, and said, "You know, this is bad." He wrote to General Motors. And he wrote to – let's see, he wrote Chrysler, General Motors, and Ford. See? And actually said "no," and had a list. Boom, boom, boom, boom. And, you know, of what? Of this, cars being a source of air pollution. And he asked some specific questions about these things. It was a very, very pleasant letter. But the letter stated the Supervisors have their concerns. And, I guess – it's all – this is all – in the record. So. But. So, I'm not saying "something out of line" here. But, the Ford Company, basically said no, as did General Motors. Because they're not responsible. Their (inaudible) exhaust was "clean." "Well, it's not a problem." And, amusing enough, I think Chrysler did not reply.

But that's just a memory we'll be careful of. Or something like that. But anyway, the response was, you know, "What's the problem?" So, all the time people were choking, they didn't know it, the cause.

You know, we today have a first stage alert. Say, 200 – maybe 200 parts per billion (ppb) in the "first stage." And you couldn't go out and throw your javelin or play football or something, if you were in High School, or elementary school. You couldn't prove the cause, by the way. But that just indicates it was all happening, prior to the saying "there shall be a law." So, this is the law. So, but this was smog. And it really was very serious. And so, this....Well, that's my copier over here. It's telling me that it wants something to copy. And it's not copying, so (inaudible). Quit talking. It's going to be copying, (inaudible), old boy. So, OK. That's set. So, what happened was, basically – who's the guy that did the helix – won the Nobel Prize.

Gaffney: Watson?

Pitts: Watson and Crick.

Gaffney: Crick?

Pitts: Yeah, in the early 1950s. Watson writes, he flies in from Chicago, into Pasadena. And it's a quote.

Gaffney: Mmm-hmm.

Pitts: He says, you know, well, "When we fly in, there were yellow, bile-green colors. He was – oh, that was for a big meeting, when they had big prizewinners. I think even Einstein might have been at that meeting. (inaudible). Watson described it perfectly. So, this is what it was, anyway.

So, basically, this is fundamental, the argument, and how you did the stretched rubber – the rubber band stretch. And then, he, Arie Haagen-Smit of Caltech, could actually make it reproducible enough to, well, to detect ozone...The reason Arie Haagen-Smit chose ozone is, he had used ozone when he was an organic chemist. And that's how you got terminal double bonds. If you got a terminal bond, you put some ozone in. Guess what? Formaldehyde.

Guess what? That can happen in the atmosphere. (laughter) So, there was that. So he knew that. And Arie had said, then, OK, well, well, he said, you know, let's stretch bands, and then let's see if we can take some auto exhaust and irradiate it – and then, let's take some hydrocarbons, and irradiate them in air and see what happens.

Well, there you've got the hydrocarbons and shows clearly that the rubber bands cracked. And the rate of cracking depended on its structure. Nice papers on rubber cracking, (inaudible). As a matter of fact, he developed the first hydrocarbon reactivity scale, based on stretched rubber bands. Now, that's pretty fundamental.

Gaffney: (laughter)

Pitts: (laughter) You can stretch rubber bands. That's a "stretch." And you know, it's remarkably good today. You could take those things and say, well, you know, oh wait, you've got the ozone, and then you've got your double bonds. Yeah. Heh. But any rate, so, people were looking at Arie, though, and saying, well, you know, here's a stretch. Even so, the world was saying – well, somebody was saying – I don't want to mention who – but people, some of whom you know, said yeah, "What the hell is, what does this professor at Cal Tech know? He's an organic chemist. You know, (inaudible). Well, so what's the rubber band prove?" Well, (inaudible).

So, that's when – the names will come to me shortly – the first real test – and this was a really real application of fundamental spectroscopy. Now we're getting down to basics, applied to a real smog problem. But, and I'll think of him in a moment. I've got the references. They're in our book. They did this. It's in our books. They set up a long pathway spectroscopic system. And it wasn't multi-pass, so they had to hit a source way over here. I mean, it was – I don't know – a quarter mile away, or so (inaudible). And a source, so they had a detector. Edgar Stephens was involved (Stephens, Scott, Hanst and Doerr, 1956) with that, actually. Back in the beginning it was Stevens and these other guys.

And so, they had a typical day there, in 1954. And they went to South Pasadena in the afternoon, at 4:00 o'clock. And everybody, yeah, yeah, was excited. And by golly, there was this beautiful – the most beautiful – spectrum of ozone. And that's what I call a spectroscopic kill. Baby, it's a kill. Because here is the stan- oh, here's the standard. And there's a band of so many microns at 9.2-10.0 microns.

And here's what went through that smog, and there it is, and you had something like almost four, you had 400 parts per billion, which is double the first stage alert. And it only needs 500 more, or – I mean 450, to get to be a third stage alert. Four hundred ppb. And by golly, it was ozone. And that took care of that one. Now, that's what I mean when I say "the fundamental things apply." Baby, that spectroscopy was a spectroscopic kill. And that took care of that.

Then, there was a big argument about "what's this PAN" – the severe eye irritant PAN. And there was, you should remember – you're an expert in this.

So, you tell better than I could. But I can tell you the history of it was a big battle. And by gosh, and then, and so, the Stanford Research Institute – did some very nice work there – came in to do some – and Leighton was involved in that, by the way. He was my academic grandfather and was involved in that, and one of the key players in that "game." And, actually, he coauthored the classic monograph, a copy of which is there, signed. I've got one from Albert Noyes, too, there, one of the copies, from Albert.

But Phil – they actually took infrared spectroscopy to decide which of five possible structures this could be – PAN – peroxyacetyl nitrate. And, by golly, that nailed that sucker.

Let me get the, the book – it is right behind you, here, I think. And that is the book that, "The Photochemistry of Gases" – if I have it right here. Let's see. "The Photochemistry of Gases." There we are. This is classic! [The Photochemistry of Gases, W.A. Noyes, Jr., and Philip A. Leighton, Dover Publications, New York 1941.]

That's the photochemistry book. That was the one before the war. Now, his next one, in 1961, was a book on atmospheric chemistry. Where is it now? The book, it should be here. I don't see it. It's probably lent out to someone here. But it was this book on atmospheric chemistry, by him.

Gaffney: So, Jim has just showed me a copy of "The Photochemistry of Gases," by William Albert Noyes, Jr., and Phillip Albert Leighton, that's actually signed by William Albert Noyes, Jr., and says, "To Jim Pitts, with warmest regards." So, this is a piece of history.

Pitts: Yeah.

Gaffney: (laughter)

Pitts: (laughter) Along with Jim Pitts. (laughter)

Gaffney: (laughter)

Pitts: It takes one to know one. (laughter) But that (inaudible). So, Leighton wrote the book – the "Photochemistry of Air Pollution" came out. And that was....

Gaffney: That was, was about 1961, if I –

Pitts: Yeah.

Gaffney: – recall.

Pitts: It sure was. You're on target. And that was, boy, that was beautiful. I mean, the chemistry, the whole.... It's around here somewhere. My (inaudible), there's a library at home, too. And so that book – it's laid out right there in cold turkey (sic). So, basically, that's, sort of, where it all began. And I think it's kind of fun. I'm very proud of my academic....ancestors!

Oh, oh, along that line – now, this is interesting. In 1946, Francis Blacet came back from WORLD WAR II, – after leading the "troops" and getting Commendations, came back – to UCLA as the Department Chair, and later he became Dean – and was really responsible for a lot of the great progress of UCLA. He brought in people like Donald Cram, who later wound up with the Nobel Prize – Winstein was there at the same time. Sol Winstein – he was on the faculty there. They also hired Cram, and George Hammond was there as a postdoc.

Everybody was in their labs, so, you know, you all work in a lab, and (laughter) – this is coming back after the war – '46 through 1949. That was "fun," because you were going to finally get a Ph.D. Jack Calvert and I were buddies. We had the instruments that Blacet had – and we had to put dry ice in our mass spectrometer, all that – 24 hours. And somebody had to be there. So, you got a lot of good b.s. and good input if you were around at night. I can still see a night when Cram's there, Hammond's there, and various people from other groups are there.

And actually, I was older than they were, because I first went to UCLA in 1939...I went, and I was at UCLA, and then the war came, on December 7th, 1941. And so, I was a senior. I had done all the chemistry, so I just had a few electives to go before my Bachelor's Degree.

Roosevelt was really "on the ball." As a matter of fact, prior to "Pearl Harbor," December 7, 1941, Roosevelt had set up the NDRC – National Defense Research Committee. That's the "organization" that developed the atomic bomb. And, but that was (inaudible) way back when, (inaudible). And (laughter), and "proximity fuses." You know, (inaudible) one of the greatest contributions to our wartime efforts – and success – then and indeed still today. Another example – the NDRC also instituted a major effort in tropical medicine. I mean, there was virtually nobody dealing with tropical medicine, before that time.

They....When Roosevelt did this – this is a very canny character. He was really "sharp," and he had such visions. When? The NDRC actually started June 27, 1940!! But it was kept quiet. In other words, it didn't come out to the public. The Proclamation said, "The Committee shall correlate and support scientific research on the mechanisms and devices of warfare, except those relating to problems of flight included in the field of activities of the National Advisory Committee on Aeronautics. The NDRC shall aid and

supplement the experimental research activities of the War and Navy Departments, and may conduct research for the creation and improvement of instrumentalities, methods, and materials of warfare."

There was no, "Well, we should just take an 'academic look.'" "And shall we look, old chap, at the possibility of a (inaudible) core, perhaps." That was the secret one we had then. (inaudible) released three years ago. But it can (inaudible).

You said, "weapons of war." And to that end he had Vannevar Bush, President of the Carnegie Institute, Washington, and the President of Harvard, Dr. James Bryant Conant, as the guys running the whole show.

So, he went right to the top in our academics. And then they went out, to universities, and so forth. And that was a – that's thrilling. The universities – and this comes to another major point, to the whole interview, is that, you know, it's enormously important, what they've done to "the bomb" publicly. In fact, a number of us were kind of "saved by the atom bomb," as it were. Which is a very real thing, when you're talking about what happened in WWII. In a sense, we were "saved by the bomb." But we were getting prepared to go in with conventional weapons. (inaudible)

Remember, December 7, 1941, the day that Pearl "happened." (inaudible) In the afternoon of that day, I was working on a P-Chem report – having come in late from a date dancing at the Palladium. I was at the Palladium with the gal I was "going with." They called it "going steady" in those days – a very nice gal. It was a "double date," and I came back and the next morning started working on that P-Chem report, and my Mother came in and she says, "Jimmy, they've bombed Pearl Harbor."

And boy, it was like a light switch. In your life, at one time or another, you'll have that switch, and it's like, uh oh, things are never going to be the same. It could be for a lot of reasons. And boy I sat there and – OK. Well, old FDR had this thing going in July 1940. Think about that, and I think, again, sometimes he doesn't get credit today for what – for the abilities he had. And how he really, really played the game.

And, by the way, the majority of the American public in the 30s from what I could see were not anxious to go to war. (inaudible) Do you mind my going back in time like this?

Gaffney: No.

Pitts: It's all tied together sort of. It's fundamentals, and this is how it worked – and how it ended up – we can go back later, then – but what Roosevelt did then, and this is sort of the history of it.

So in 1941 I did undergraduate research with Jimmy McCullough using the new Beckman UV-Visible Spectrometer, which I really liked (actually, I think I met him). A beautiful machine. One did it all manually. Got the spectra point by point – by hand. (inaudible) So I really liked "her" (the instrument). There it was. It was a spectrum.

So this was prior to Pearl Harbor, and this is interesting too, prior to that, and I have the dates, but they're actually – you can get them from the *Spectrum* article – I think I have the actual dates. I pulled out the article.

(inaudible)

**END OF TAPE ONE SIDE ONE**

## Interview of James N. Pitts, Jr.

## TAPE 1, SIDE 2

Gaffney: You were telling me about FDR and being ahead of the game and Lend-Lease. So I'll let you continue.

Pitts: So we had – the destroyers – and that was critical at the time because Britain had shortages in their fleet. He finagled this and tied it into something good with Churchill.

But anyhow – so, you can see this just as WORLD WAR II was going on "over there," and you look at this, and I was maybe in my junior year, and you look at this and, OK, that's going on, but it's getting tough – you know? So then what he did was a pretty direct thing. Any of you – any of you (inaudible) over any span of ages, whether you're 14 or 85, I say. And remember, you can imagine what this did to you.

All of a sudden, it was – I think it was October '40. Might have been – I don't think it was '41. I think it was 40. You have to check that again, but, guess what. He passed a bill, an effective bill for Selective Service. Selective Service!! And that came in. And we'll check the exact date and I think I have that in the *Spectrum* article, too. We'll check the exact date. But it was – prior to Pearl Harbor. That's the point. That's the point. It was significantly prior to Pearl Harbor. He got it through Congress by one vote, which is "interesting."

And boy if you don't think that hit the campus. I'd been taking – boy, I should come in here now and say, interesting enough, that all of us, in fact, I recall in 1939 when I came to UCLA you actually had to take – all of the men had to take – a couple of years of ROTC – Reserve Officer Training Corps. ROTC, they called it. And it was just one day a week. And we called it (inaudible) go out there and you'd march and drill and that sort of thing. And that was OK. I mean, but, you know, didn't take it too seriously, but you were there and it was good.

And then, of course, if you wanted to, you could do more than two years and you could actually get an officer's rank in the Reserves. And I guess I wound up a sergeant after two years – and a machine gun. I was a sergeant with a bunch of guys that drilled with a machine gun that didn't fire. But it was a gun. And that's what we were doing. And so we wound up (inaudible) – and what the hell, you do ROTC.

That's when, by the way, in the gym, that's when I'm talking about Jackie Robinson. The great Jackie Robinson who was really a neat guy because, you know, we had the gym there and the athletes had their lockers. But they'd

walk by our lockers and so forth and he would sort of wave and say "hi." And he was a hero then, but he was also a real gentleman. I mean, he was a nice guy. He was really a nice guy. And I want that to go down on the record. Certainly, when we saw him then – he was great. He was a great football player and he "had it all" – everything in track. He had track. He had football. He had basketball. And he was just as modest as you could be. He was just really a good example for today. He was just a strong guy.

But anyhow we decided – and I was with the UCLA rifle team on it, too. Not on it. I worked out with the rifle team. The only thing I had ever shot with a rifle was – I shot one rabbit when I was 12 and I didn't like it and I didn't think it was fun, so I never shot another mammal. But I did a little hunting, ducks, with my dog.

That was a lot of fun. But I liked (inaudible) and you could sort of see why you could be using a gun someday, so the rifle – this is kind of interesting. We (UCLA) had a little shooting range down in the basement of the gym. I wasn't officially on the rifle team, but I shot with them. I didn't pay. It was free. You know, (inaudible). And then guess what, one day – I can still see this day – you know, you see things from the past – we walked right out of the gym, went across the street, due west, and there are just hills there. So the coach said, OK, we've got real targets in the hills. So we get down there and that was fun, that was fun, because we were able to actually fire live ammunition. And I can remember wanting to know where my shot hit the target we were all aiming at. So I didn't shoot for the ten spot, the center. I shot for up high to see if I could center it up there, my shots, because we had several shooters at the same target. That was very fun. That was "hot"!

So this thing came up. You had Selective Service, and then all of a sudden you saw signs all over the campus. OHIO. "Over the hill in October." So you're sitting there on Pearl Harbor day and say, OK, "boom," there it came. I wasn't sure what was happening. But I did notice that it was about that time, just around that time – it might have been just before or just after that time – my P-Chem instructor went to MIT. I think it was MIT. My P-Chem reader went to Chicago. Chicago. So I'm thinking, I finished P-Chem and then all of a sudden in early 1942, Ed Brady my reader sort of just "went to Chicago."

So did Dr. Blacet – he went to Northwestern. I'll say he was like my grandfather. He had a family, two kids, wife. Gee, they're going to Northwestern. Why are they going to Northwestern? They're gone. So this is – then it was January, February 1942, and boy, all of us were very concerned – remember, the Japanese, they had released balloons that came over our coastline. They made a big mistake. They should have come right in to Pearl Harbor and the U.S., but they didn't.

That's another thing my dad told me – if you're ever in a fight, don't let them up.

So they kind of just "had us." Had they come through, had they just kept coming through Pearl, landed and then come right on in to California. What we did have then – we had an anti-aircraft gun near the corner of Olympic and Westwood. It was only one-quarter of a mile from our home. We had an anti-aircraft gun pointing somewhere.

And there were other guns. I can still remember when one night, it had just happened, so in early '42 there was a lot of our gun firing at objects in the sky. And I think once their submarine came in and hit something just below Ventura, (inaudible) one shot or something. But we were pretty well aware of it.

So anyway – anyway – so then I got this call so I was going to finish off in – I was going to finish the following semester. That's relevant because I got this call from Dr. Blacet, actually. An actual call. He said, "Well, Jim, we're set up here at Northwestern." This is in the middle of '42, and he said, "We've got a group back here. OK. And we'd like to have you join us." And I said, "Yes, Sir." That was really exciting. And I just had a hunch. I didn't know what it was – that's where I took the train ride east. So I said goodbye to Mom in something like June or July. I finished off the Spring courses at UCLA, and I still had about 10 units to go to get my B.S. degree. This is why I got my B.S. degree in something like 1945 – my bachelor's in '45, so it says Jim Pitts, Phi Beta Kappa 1945, and boy, what's this guy doing? I still lacked those 10 units for a B.S. after being down on Isla San Jose, the ongoing war, and all of this noise, it was like, no, this (inaudible) 1944. The biggest Chemical Warfare operations/tests in WWII. We'll come to that later.

But all of that – after all of that, Dr. Noyes said, "You get a degree and Dr. Burg is doing some very interesting work at USC." Burg. Who ended up being, by the way, maybe 100 years old before he died. A nice guy. He was a high jumper at the University of Chicago, had one blind eye, I think. He was just a really nice guy – a good guy. He was different but a swell fellow, very bright and thoughtful.

So I came back from Isla San Jose, Panama, in late 1944. And Dr. Noyes said, you can go back to USC because "Things are going there, too." So there was a secret group in CW at USC and, by the way, this was how secret it was. Sid Benson was there as an Assistant Professor. I didn't know he was also on a war project. He was some "young man from Harvard." What the hell – a nice guy. We played tennis at noon. I still don't know exactly what the hell he was doing. He was on the faculty, and I was on a secret project in Chemical Warfare.

So I'm up there at USC with a couple of other guys, and our job was to figure out how do you stabilize a bomb, because we had a whole bunch of bombs down stored all over the place. One of our ships that had chemical weapons on it, as I remember – the rumor is, so take this as a rumor, but it was a pretty good rumor – I would call it a high probability – that the Army (inaudible) was scared stiff because they had – I think they may have already had – one of our ships with chemical bombs on it in the Pacific. We're all set to go. But a real – some sort of a problem – but what I did know is that our bombs, which were getting transported and stored "over there," certain of them would explode while they were in storage!!

That's what our group at USC actually wound up working on – stabilizing CW gases – and that's what Burg was working on. What could you add to a CW agent in a bomb. And so I'm in that group. What do you add to, for example, a 1000# bomb containing hydrogen cyanide to stabilize it. So at any rate – and this was "really real." The bombs could explode in storage (munitions dumps), and people were pretty damn nervous because bombs are the most effective way to deliver CW munitions compared to shells – e.g., it's best if you can get a 500 or 1,000 lb. bomb.

By the way, I've got a 4.2 mortar shell. I should have showed you that. I have it at home. I rescued this mortar shell from 1944. It got a little rusted. I'll have to polish it up. I also have my GI helmet and helmet liner (inaudible). The mortar shell was one great weapon.

There is a little sideline, too. The 4.2 mortar was the mainstay of most mortar units of the combat Chemical Warfare teams. One of the most critical units of the war. Actually, all of the infantrymen wanted to get a CW unit in with them. And they had the high casualties. The reason was, the 4.2 mortar, which is only about this long, two-and-a-half feet long. About six inches wide. And you just put in gas in the shell and then screwed the cap on it, and (being like a shotgun shell) you drop it down the tube, and, boom, it hits the firing pin of the shell. The shell has to go over the hill. You can get the enemy with the 105 or 155mm guns in a straight line. But if they're over on the other side of a hill, they're not going to be hit.

Gaffney: Right.

Pitts: It is interesting that the 4.2 mortar was developed as a chemical weapon, but it was really used for actual high explosive munitions. You could drop mortar shells over a hill and into the enemies' dugout. And fire from 200 yards away, 300, 400, instead of in a straight line. Actually, the CW – Chemical Warfare units – never got the credit they really deserved.

It was also used as a "delivery system" for white phosphorous. For landings. So you landed and you needed a smokescreen of white phosphorous. They

(the 4.2 mortars) were superb for that. You just filled them with white phosphorous and went, boop, "over there." And then you got a white cloud. So the infantry troops could follow up and land. So that's just another little vision back into the war. But that was kind of an interesting aspect there, too. The Chemical Warfare. Smog. There you are. Smoke. Fog.

Gaffney: So you had, I guess – well, I know the Chemical Warfare group got together. You're all at Northwestern and –

Pitts: OK. So I'll go back in history now.

Gaffney: OK.

Pitts: I'll give you – yeah. Let me go back in history to 1942. But I want to get the history in a perspective. The perspective was, this is the war, this is –

Gaffney: Right.

Pitts: – OK, this is what – so in the Summer of 1942, I'm told to come back to Northwestern University. I don't know what's going on there. So I'm going back, and I got on a train. That was exciting, again. I had never been on a train. I had driven up to Oregon and Washington, but I had never been on a train – never been on a train in my life. So I got on the train, and you sit in the cars the whole trip.

I remember going to Union Station, and I couldn't – I couldn't say what I was doing. I just said, goodbye, Mom and Dad – so that was the thing. You don't leak it to the LA Times. You leak anything, maybe, and you're dead.

That's what I meant when I said – remember I said I had dinner at the University of Chicago with a guy from UCLA – we didn't say boo. I didn't know what he did. He didn't know what I did. And we never did – it wasn't until the bomb fell at Hiroshima. The light went on. Oh, that's what they were doing. You – when you signed that oath there, you signed it and you meant it and you didn't break it (inaudible). I'm cynical today when I see this – but that's another – that's another – that's the world today. But that was the world – my world, then.

All right. So I get on the train to go back there in 1942. It was already summertime, and I remember going through deserts and sitting up in that railroad car for 48 hours (or 52 hours) – sitting up there and waking up and everything was green. And it was green. I couldn't believe it in the summertime. It's supposed to be dry in the summertime. It's green.

So you go through all of this land to Chicago -- and you wind up at the station in Chicago. I took the Elevated and got up to Northwestern. It was there they

caught me the next day, and the Chief – the Chief – now, that's where we called Dr. Blacet the "Chief." And I can't – I'm trying to remember if we called him a Chief way back when before the war, but certainly he was the "Chief" then, the Director. Then of course that became "el jefe" when we were in Panama. All hail "el jefe." So he was the Chief. El jefe, Senor. El jefe.

So he was the Chief, and Francis Blacet said, "Well, this is what we're doing now. It's a secret. And once you get to Northwestern, we have a unit here, at the Technological Institute; it had just been built.

There were all kinds of secret things going on there that turned up later. But again, at the time, you didn't know that they were going on. For example, they developed special photo-electric cells in the Physics Department. Chemistry was doing "their thing" – it was just – only we knew what we were doing. We had some laboratories and we worked in those secret labs.

The purpose of those, the first part of that mission then was – it turns out that the problem was the safety of our troops who had landed in Guadalcanal. We had troops, then, in the South Pacific. This was in '42. And they're in the jungle. So this is now jungle warfare – and it turns out that you knew that the Japanese had used chemical weapons before, e.g., against China; they had also used them down in the islands.

This was in World War Two. In World War One, there were massive chemical attacks – and I knew there were two types of poison gases – non-persistent (e.g., HCN) and persistent (e.g., mustard) agents.

By the way, I should clarify that right now. There were two CW research groups – actually Divisions – of the National Defense Research Committee (NDRC). Albert Noyes Jr. was Director of Division 10, which was non-persistent gases. Not "persistent" gases.

The "Persistent" Group, which was, e.g., mustard gas, was Division 9. It was very active at Cal Tech, very active in 9 – and to some degree in our Division 10. We had some Cal Tech people in Division 10 also. But 9 was particularly dealing with "mustard," and that was a terrible gas in World War One. The casualties from mustard gas were unbelievable.

But our group was "non-persistent" – hydrogen cyanide (HCN), phosgene ($COCl_2$), and then the one that was, at that time, very secret. And, in fact, I haven't even talked about it until recently – some others have talked about it. It was released and published. I didn't even talk about it until 40 years later, cynogen chloride, CNCl. That was one we were going to study. So I knew about that, then. I knew that that was one of the things we had been working on. That was one of our "secret weapons."

In addition, it turns out that the gas masks we supplied our troops in 1942 had a very serious problem. Well, if the Japanese had used phosgene now (July 1942), with our masks our guys were dead, baby. And the reason was apparently nobody in the Chemical Warfare Service had ever thought about the affect of humidity. You're trying to remove phosgene in 100 percent humidity. 100 degrees F in 100 percent humidity —the gas could come right through!! So had they used it, our troops were dead ducks. Our guys were dead! You're talking about a high priority – that was our first priority. Get those masks safe!

(Pause)

Now for a bit more history. So in our NDRC group was Dave Volman who had taken a Master's Degree in the late '30s with the Chief, because UCLA did not offer a Ph.D. in Chemistry until about the time I came back in 1946. I was one of the first PhDs. So, in the '30s, they just had Master's Degrees – and Dave Volman went there and got his Master's Degree and then got his Ph.D. in photochemistry with Phil Leighton at Stanford – and then came the war. So he was a Ph.D., and then we had others with Ph.D.s and Master's – I didn't have my Bachelor's – I was actually still an undergrad, but I was treated like I had a Bachelor's Degree, i.e., the "low man on the totem pole." Jack Roof had also taken a Master's Degree with Blacet in photochemistry and then a Ph.D. elsewhere.

So that's what I'm emphasizing now. Photochemistry. Many were trained in fundamentals of photochemistry and gases, and they knew their subject. And that was kind of neat because that's what the Noyes group had trained in. The Noyes team had done beautiful in photochemistry, amazingly in 1942. So they were photochemists, which is kind of neat. And we even had a rotating sector expert in those days. They were the first scientists to employ rotating sectors to interrupt the light beams – that was Roscoe Dickinson – who, I think, was the first, or one of the first, PhDs in the late '20s or early '30s from Cal Tech in Chemistry.

Roscoe was a very nice guy. I'll come to him later, but he wound up developing the "Dickinson Meter." And it was great. It was a conductivity meter that allows you to measure gas concentrations in the ppb range quantitatively over time – thus we get time concentration profiles of the agents. And that was Roscoe Dickinson. A photochemist.

So that's got to be – that's the picture that you have right over there on the wall there. Right over here. Roscoe Dickinson is in that picture there. Here it is. Right here. And this is – that's the group in San Jose. Here we are. That's the "fearless" Blacet team. And here's Frances Blacet, and here's Bill Gwinn, who was a senior scientist – he was a – he may have become Chair of the

Department, I think, at Berkley after the war. And here's Roscoe Dickinson. And here's Dave Volman and Jack Roof. And you know a bunch of other people there. And I (inaudible). And this is just a shot of – I think this is a very nice shot of Dickinson. He's the number one man in the analytical community – so everyone was in there.

But anyhow, that was really interesting, and that phosgene humidity effect was scary – and very interesting. So the problem was apparently the CWS had never looked at it before. So they didn't know what to do. It turned out that we (the U.S.) were developing activated charcoal at the same time with Conway Pierce (Pierce Hall at UCR, whom you knew.) Conway was the head of an NDRC group that made new types of charcoal. How do you actually construct – activate a charcoal properly? What heat? What temperatures? What physical and chemical properties? The time. So he was an expert in that. And so it turned out that one of them – I can't remember the exact Company. I think (inaudible) is just a name that goes into this old man's head, but I think it's back there, but they had a certain type of activated charcoal.

So the idea was, what can we put on this thing – and we put something on called whetlerite. And we put various materials on there that would catalyze the absorption/destruction of this chemical agent. And so that was the task. How do you find out – what do you put on it.

Now let me go back a bit and indicate where I stood on this research team "totem pole" and what was going on here in wartime research. This was a very interesting challenge. Now, this is a real challenge. It's a challenge <u>today</u>! It was a challenge then! The Past is Prologue. How do you get the academic world, we academics, to work effectively, e.g., on research on classified projects during wartime, with the military and with industry. You have a three-way system. OK. Three posts to give you support (if you had a platform). Two. OK. There they are. Three. Right there like that.

Well, it seems that the military had rarely worked with academics before 1940. Industry had worked with the military and with academics, so they had some experience. So you had this very unique set of highly important projects (inaudible) where everybody was concerned about the other group – what are they doing, who's doing it, and what and with whom. Well, that's where, again, the ORSD (Office of Research and Scientific Development) and NDRC come into the "game." Blacet and Pierce were really good at that. They could talk with people <u>from industry</u> and <u>the military</u>.

So there was the actual charcoal. What you put on it was our challenge. How the hell do you make this wet activated charcoal remove $COCl_2$ in the jungle? Before I give you the final line on that, you will appreciate some background.

Let's go back in time. If you remember, things that are important – like football. In 1942, UCLA had never beaten USC in football. They had never beaten them – and there was a fierce rivalry. And Jackie Robinson was our star athlete at UCLA. I think we could have kicked a field goal and won one of those games, and Jackie played brilliantly, but we lost. And so here we are back then, and "nobody" had much heard of UCLA in research because there were no PhDs. So there at Northwestern in 1942 at the start of the war, there were guys from – Cal Tech was there, and there were more from back east and the Midwest. They were from Rochester. They were from here. They were from there at Northwestern. They were in the Big 10.

And I lived in one of the fraternity house, Alpha Chi Sigma, which I was a member of when I had been at UCLA. (inaudible) and it had been a really – it was a good group in UCLA. We just went into sports and didn't – we didn't have a house or anything, but we had intramural sports and we played a little poker and had a good time overall. To this day, Alpha Chi Sigma was and is a fine fraternity. It was a chemistry fraternity. And Phi Lambda Epsilon was the chemistry professional fraternity – also an excellent experience then and now. At Northwestern I lived in the AX$\sum$ house – and we could walk to work at our NDRC lab in Northwestern's new Technological Institute.

So anyhow, I got to Northwestern and they looked at me and what do you think – I got razzed, "What is this UCLA thing there?" Well, we had never beaten USC. So what happens is – guess what, UCLA – and I'm trying to think of the quarterback in 1942 in November – now, this was a Big Day!! I can't think of his name but I think, if my memory is still functioning, he, the UCLA quarterback, married the actress Jane Russell. Remember Russell? She was "well constructed." I'll think of his (the quarterback's) name but, by God, that first year I'm gone from UCLA in '42, we beat USC.

Now, then, I walked around the House at Northwestern and I go, "UCLA – finally we beat USC!" I'll think of the quarterback's name. He was a real UCLA hero.

So anyway, in June 1942 I get in there and I really – I did not drink much. I did very little drinking. In those days, the group that I was with at UCLA did not – I may have had a beer, but it was not into heavy stuff. You know the pre-war era, it was fun. Dating and going dancing was fun. You dance, e.g., at the Palladium. That's another thing. My dad had given me a taste or two of bourbon, so I knew enough about it and drinking hard liquor was not a big deal. It was not a big deal. You could have some – but "easy does it."

And so they – our NDRC team – I still remember the Christmas party they had then, in 1942, they had a party, so I had been back there four or five months. They had this big party at the Evanston Hotel. I think it was the Evanston Hotel, just a few blocks from the Northwestern campus. It was a big

hotel. A big hotel right there. And I can remember going to our group party and you walk in and here's this big poster on the wall and, as I said, there was this poster, this huge thing, across the wall. It turned out that this was our motto – we would consider it the motto of our group now. It was –

"AS OUR OBJECTIVES BECOME MORE UNCLEAR, LET US REDOUBLE OUR EFFORTS TO ACHIEVE THEM"!

I looked at this thing and I thought – and it seemed so "on target." You know, because you dealt with – that was the summation and that, again, the "Past is Prologue." Somehow, as I look at it today, unfortunately in some areas this motto seems applicable. "As our objectives become more unclear - - - !! So in some areas that motto's lasted through the years, and I'll pass it on to anyone who wants it.

And that was – and I got loaded on Scotch that night. They got me home, but that's where I learned a little bit about that aspect of "life" and a little of how to drink. So anyway, that was it.

Back to our research in the NDRC Lab. The charcoal – the Army charcoal used for testing had come in large bags as a mixture with fine and coarse particles that had to be separated. There were cylinders with sieves of various sizes. So you have a stack of cylinders, put on the charcoal, and you shake it with a machine, it's shaken, and then the various sizes fall in various trays.

And whose job do you think that was? I mean, Dave Volman, Jack Roof – who else could we add here. They consulted the Periodic Table, and these guys were PhDs. I'm sitting there and I'm watching this, my golly – so my job was to sieve the charcoal and save the right size. How glamorous this was!! "What did you do during the war, Daddy"? Well, I sieved charcoal and I turned black. Charcoal. While the PhDs told me to do that, they put various chemicals on the sieved particles.

But it was "fun." And it was a combination – I think it was Dave Volman, Jack Roof – those two guys figured out the right combination of chemicals to impregnate the sieved charcoal. They actually included silver. Also, they said "Let's put a little chromium in."

So it turned out we, our team, "won," and by golly, those guys were the brains. We tested – they tested this mixture (silver, chromium and copper, as I recall) and then what do you do? You make a solution and dip the sieved charcoal in. You dry it. You put the charcoal in a canister. And then you come back and test it. And then in the testing line you have one of the agents going through. And by golly, the thing that happened, as I told you in that original statement, <u>without</u> the impregnating chemicals – i.e., as in our gas

masks from the troops on Guadalcanal – the phosgene went right through ($COCl_2$). Our guys were dead. They were goners.

Well, "boom," our whetlerite treatment of chromium, copper and silver knocked all three agents – phosgene, hydrogen cyanide and arsenic – out cold! And so instead of a disaster, we have our enemy at a huge disadvantage.

Once that was completed – that ended – that was the CW defensive (protective) side of the whole operation – and, to our team, that was it. That information was turned over to the Army and industry and there we had "nailed" that project.

Then the word came in, OK, from Phil Leighton. Leighton, a photochemist, had come right out of Stanford – and wound up a Lt. Colonel at Dugway Proving Grounds – which is in the desert south and west of Salt Lake City, Utah. I can tell you there's just desert down there, and I learned a lot. So I can tell you more about that after we have a taste of hot tea. How does that sound?

Gaffney: Sounds good.

Pitts: All right. Good. Now, how are we doing?

Gaffney: I think we're pretty much –

**END OF TAPE 1 SIDE 2**

## Interview of James N. Pitts, Jr.

## TAPE 2, SIDE 1

Gaffney: – so we're going to start tape number two and continue on. Jim, basically, you're – I sense where we're going with this now. We basically got a sense of what probably some of the best known photochemists, organic chemists, thermodynamic chemists, etc., now have been working on – and getting a real national and emergency kind of scenario, OK, to apply all of that information toward a real problem at hand, which is to protect our troops from chemical warfare agents, OK. So from there, just go on.

Pitts: OK. So I want to be careful that – I don't want to be going on too long about the old days, but I think it's extremely important to recognize and to put into context what the problems were facing our Country in those days – and the role of how the academics stepped in there and in addition to the atomic bomb project, –addressed a wide range of problems, e.g., tropical medicine. For example, the NDRC, the group – they had a whole unit that researched tropical medicine. Apparently, McArthur lost perhaps one third of his troops, out of action, just to jungle diseases.

By the way, the mobilization of university academics is described in detail in the two major books I told you about that came out in 1948, e.g., they had a whole range of scientists who on an accidental basis went into the field of tropical medicine now as we know it today. You see? Then there was just "zippo." Over the years I saw how the academics came in with the military and industry and were able to get together. I am hoping this "phenomenon" is happening today. I believe it is, and my heart and thoughts go out to those in the academic world today making major contributions. I'm sure they are.

I had clearances for Chemical Warfare until the 1970s, roughly. And I went back to Edgewood and worked with them with gases, and I worked with Camp Detrick on Biological Warfare. My first research paper was on a new method for counting particles in ambient air. We got it published in the JCS in 1946. I'm low man on that paper, but I was on it.

But the point was – my point was – so what I want to say is that there is a history in CW and BW agents. You tell young people today in the fields – whether it be meteorology or – oh, is that big! That was big time! And Cal Tech was very strong and some of them at Cal Tech were in "micro-meteorology" – meteorology at, or near, the Earth's surface. That was one of the major research accomplishments. For example, does the wind go up or down a canyon day or night. Where do you drop the bombs? When do you drop them? How long do the gases last?

So micro-meteorology, including the critical effects of terrain, was a relatively new and very important research area. Obviously very important in Chemical Warfare. Because if the wind is blowing, you don't drop – well, where do you drop it at that point? You want to do it at five in the morning, in the dark, with inversions. OK. You need the temperature inversions. OK. How long do they last? So all of that is tied in to CW/BW. That was a key factor – micro-meteorology.

So in all of our "shoots," we had the meteorological data – meteorologists were doing this collecting and predicting weather conditions before and during the "shoots." Some of the experts – they were superb – came from Cal Tech and Berkley. So I want to give them full credit – it's a good time to say this. So the meteorologists and – we were all in this together, I mean, and it worked out very well. It was, again, a joint business. The (inaudible), chemists, meteorologists. That's sort of the key. So meteorology was a key player in all kinds of scenarios in WWII.

And let me just add one simple thing. We were out in Dugway, Utah, in '43. I saw the first napalm bombs being "tested" on Japanese and German buildings.

We were out there shooting these mortar shells. Firing them under different conditions. And it's just a desert out there. There was nothing out there but a desert. With goats. It had some goats staked out during CW "shoots."

Phil Leighton flew there right out of Stanford to become a Lt. Commander, and then he wound up becoming Commander of the entire operation at Dugway. He was a photochemist. There you go. He's an academic, and he became the key scientist/Commander. Actually, in 1949, he turned out to be my "academic grandfather" – my Ph.D. Advisor, Francis Blacet, took his Ph.D. with Phil.

And it was just great, so as I said, we were there in '43. And it was early '43, because when we had done the charcoal/whetlerite studies – we had gotten that secure – from then on, the rest of "my war" was on the offense in CW followed by one year, 1945-46, in BW detection in "Camp" Detrick.

We're now going to drop bombs and shells – how much (many) do you drop? That's why we lived, dropped bombs and drank with the meteorologists. I mean, key guys on the jungle island we were on were the meteorologists.

OK. We were on an island off in the Pacific about 60 or 70 miles west of Panama, Isla San Jose. We had – we got overall weather forecasts. We had weather planes. It was critical, predicting inversions, so that was where we "got it all together."

Gaffney: So did you do a test now of these –

Pitts: No. I've been – I'm coming – I want to emphasize here, just pause to say this is a story about meteorologists, about chemists and about, particularly, chemists and meteorologists – and some engineers – because we had the explosives and we had detection devices – but the meteorology was key. They told us when we "shoot." That was it. We got the bombs filled and asked them "When do we 'shoot.'" The weather!

The idea was you want to "shoot" just before dawn. You want – just like you do – if you have a camp out, if you have a campfire at night, you know, boy, in the early mornings the smoke often lays over there. Fine. You want to get maximum concentrations of the chemical or biological agents at ground level.

So yeah, that was the idea. And then what do you do under conditions in the Utah desert that could be the "model" for the North Africa campaign – then you get the terrain found in Italy, that sort of thing. Where and when do you fire your weapons?

By the way, the Germans had arsine ($AsH_3$), which was something we had to worry about, too. That's why at Northwestern we had added a little touch of silver to knock out that arsine. That was fun. So there was a tiny little bit of silver on the charcoal in all U.S. gas masks – worldwide.

Now this is old World War II history – I'm not even sure all the personal aspects are "on the record." It's probably somewhere. That's all.

Today, 2007 and beyond, the nerve agents are so tough and dangerous that I really – I'm concerned – my heart goes out to our troops that are facing – and our people who someday may be facing – nerve agents.

But that's another story I want to get to because it all ties together. Today you talk about nerve agents. Consider malathion, which you and I, the "general" public, spread across gardens, fruit trees, etc. Gee, what's the problem with malathion, you spread it – and you have to say wait a minute. I've got the – actually, I have the malathion and (inaudible) and then they developed it. (inaudible). OK. Fine. But you don't – do you know how many people wound up and how many people were injured because of malathion? You know why they were injured? Sure, malathion. Almost immediately after being sprayed it starts being converted (oxidized) to malaoxon P=S → P=O) (see *Spectrum* article and F.P. and P.)

That was not in the "early days" – later on in my life when I became involved – that's how I became involved with such chemicals – the smog, too. "Transport and Transformation of Pesticides." It's a natural extension of our research. I'm interested, concerned with what it could do.

You're talking about several things. So meteorology goes on out there in the real world, and that's where you've got the role of meteorologists in terms of protection of many aspects of our lives today. Pesticides can be very dangerous.

I've got something right here. Let me pause. I've saved this for you. This is a news clipping. "Pesticide Link." Yeah. This is pretty recent. This is as recent as a couple of days ago. OK. Autism, 30th July. July 30 of this year, 2007. This is the – and this is something given to me, that I saw in the *L.A. Times*. OK. And what does it say here? It says,

"Pesticide Link to Autism Suspected. Study suggests two farm sprays could raise chances of child having this disorder."

Very interesting. These are very small cohorts, but these are families that live next to fields that are sprayed with some of these agents. Well, that's "chemical warfare." So that would be what I want to do now – e.g., to tie in our discussion of "way back when" to where we are now.

You're spraying pesticides – and that's what one does now. In World War II, we looked at weapons in those days, exposures and toxicology – and that's where micro- and large scale meteorology comes in today – air pollution!

I want to stress that I appreciate this opportunity to reminisce – and consider it a distinct honor and privilege to be able to give some thoughts to such a distinguished organization as the American Meteorological Society. Our Professional Buddies!!

During World War II operations, we wondered which way is the wind going to go and how fast? Because when you're there in the jungle and the Air Force was bombing for us – e.g., they dropped 1,000 pound bombs, and we're there below. We're down in the jungles, and we go in there, and by golly, your meteorologists were crucial players.

So I want to say again, and I think it's so important today to see that – to see it today. There are articles on this – e.g., those by J. N. Seiker. It can be a huge problem – how and when the spray was spread. So you have to look at the whole thing. The critical phenomenon of "Transport, Transformation and Impact" on Receptor in the huge arena of the nature and application of pesticides.

So we're all in that together, then and now, and I'll bring this up earlier – and so this is again the thrust, and as we talk later on today and – yes, later on, after a cup of tea or so, coffee, which we will do, I want to again point out that this is where – when you ask about our success in working with the Air

Pollution Center – well, for one thing, we worked with meteorologists. We had them in mind as we built our smog chambers. OK. Some are static. What do we do in a fluid system? And then you try to apply what you have in a chamber as it goes out into the atmosphere and so forth and so on. So it's all tied together and it's quite a story. Well, what would you like to do? Where would you like me to go now?

Gaffney: Well, I was going to say – I know after the war, now, you –

Pitts: Let me finish –

Gaffney: – your work there and I was curious. You came back to UCLA I guess, right?

Pitts: Well, let me go back – I will make it very quick because again with meteorologists in key experiments in the war, we became a group that went to Dugway Proving Grounds and, as I mentioned earlier, we actually saw the first new type of incendiaries. They built Japanese homes and German, built them right in the Utah desert. And then they went over and dropped the newly developed napalm. The "old" conventional thermite bombs just burned a small area around where they hit – but napalm spread fire great distances. These things were awesome.

Another one of the things we learned there was you should add a little $NO_2$ to your bomb – to your chemical weapons, because you can see the gas cloud. A guy at Cal Tech (Dr. Yost) suggested that. OK. Why don't you add 2 percent $NO_2$ to the agent, and then you can see the plume. The idea is here's the dugout under these conditions. You drop your shells/bombs above the dugout early in the morning, and below it later in the day – e.g., in the afternoon. In daylight, the gas cloud generally (usually) goes up the mountain. So where would you drop your shells and so forth.

So that's where you (meteorology) come into play – and our whole CW game takes place. So (inaudible) these phenomena are discussed in the *Spectrum* article, and I think today there remain some very good questions about such "modern" meteorological/CW/air pollution concerns.

So then, back in WWII, we say, OK, this is 1943 and let's go "into the field." We went to Dugway and fired CW shells and so forth and then came back to Northwestern. Then after this, our Blacet group was the group that led the largest "field testing" of "non-persistent" agents in WWII.

So at the beginning, early in 1943, we made our own bombs and went down to Kentucky – with "pipe bombs" – and that's discussed in the *Spectrum* article.

We tested the dispersion and concentration of agents with our own homemade bombs there. Put a little tube in a large pipe. We put dynamite in the tube and

sulfur dioxide in the outer large pipe – and fired off shells down there in Kentucky to see what concentrations of gas would be generated. Nobody had ever measured (or reported) under different meteorological conditions what actually happens.

So we built our own "little bombs" and went down there and blew them up in Kentucky. We damn near killed ourselves with that first field test!

One of our NDRC engineers built the first bomb – and that was so funny, too – six sticks of dynamite in a big cylinder, and we were there and we just like – we were very innocent. We had little personally-run monitoring devices to measure $SO_2$ levels at different times in the day. The meteorology was critical. In the first we had six sticks of dynamite in this tube, at least three feet high with the outer tube about 16" in diameter high. The center tube was where we'd drop the dynamite, down the center, fired that – and then that was sort of interesting. We laid there without helmets in a little handmade "depression" as close as ~50-100 feet away – and blew it up.

And geez, these large branches of trees were falling down all around us. The first "shot" and, "Oh my God." Well, to be honest it scared the heck out of us – but we measured $SO_2$ levels. We ended up putting in one stick, which opened it up like a bomb – but the problem was we didn't get many fragments, but if that whole cylinder ever hit you, you had "had it."

But anyway, what we learned by these measurements – and Noyes points out they were the first experiments on meteorological effects – and under conditions where you had inversions early in the morning that you could exceed concentrations that could go through your gas masks. So this was then one of the impacts of meteorology.

So then we went from that – done with that study, which was very crucial – we went down to Florida, to Bushnell, Florida. Then we had a group come in, a Cal Tech group came in with our group – and then we did "stationary" CW studies (single bombs set on the ground) out in the swamps of Bushnell, Florida. And that also was very interesting. I think we had up to 250-pound – they were 250-pound bombs. "Static shoots." We had to go out in the predawn Everglades and sort of cut our way through the swamps there. This was very exciting, because you want to shoot the damn things early in the morning – so you're wandering through these swamps before dawn, through the Everglades – it was exciting, and you monitor each shot.

But again, now, the meteorology is the key. You get the early A.M. inversion conditions and boy you could get high concentration – and we shot several different agents there (as I recall).

A lot of interesting things happened, one of which was I got exposed to some hydrogen cyanide. I didn't discuss that in the *Spectrum* article. I left three things out that I had – that I haven't discussed – I didn't discuss in that. But I can tell you here. Yeah. I was coming down – once again the old mask, the tube, the face piece and then the canister was held in a little canvas bag and started shooting. And my God, something happened. I was in an area that got "nailed" – with high concentrations of hydrogen cyanide (HCN) – so I walked out. You take your canister, again, meteorology, you take your canister – I took it out and held it over my head to get an extra two feet higher – and walked upward, not ran, through those swamps in the dark to get the hell out of there – all the while I'm inhaling ambient air containing high, possibly lethal, levels of HCN.

Now, my HCN "dose" didn't seem to be serious at the time. I didn't pass out or anything. I just got out of there. I was lucky to get out. But it was exciting – and meteorology was the key.

So after those "shoots" then the higher ups said, "OK, now we've got to go to major field tests conducted under realistic combat conditions. Now we're going to bomb with our Air Force, and we're going down to actual tropical environments. OK, we all got into Army uniforms, and that's when we became a – we put on our uniforms and we became – what's the word I'm looking for – scientists. "Combat scientists."

We had regular Army uniforms, but we had a band with "TO" on it. We were official "Technical Observers." We had officer status, but you're sort of "in and out." It was a very interesting status to be "in." We had officers' ranks, but we had Technical Observer status.

So that was then what we did. OK.

We went to an island, Isle San Jose, about 80 miles off of Panama in the San Juan Islands – which, by the way, wound up recently being the island on which the TV Survivor series movie was shot on. It was an uninhabited jungle island way out there then – and still was 50-60 years later – but we survived, too.

And this island, Isla San Jose, was "our" island "out there," and we got there. The "brass" picked this island because there were no natives on it (or other humans). It was one of a beautiful group, about 50-80 miles out from Panama City. A beautiful island.

In fact, there were no natives on it. The reason was that a plantation there in ca. 1860 had been run by an Englishman who had native helpers – and the natives killed him. Apparently then – then something happened to the natives, a plague, so a curse was on the island, and everyone left for good.

So there was this beautiful uninhabited island. The Army brass and NDRC scientists had looked all over the Pacific, heck, where do we do these shoots. And they found Isla San Jose. Fine, we'll go to this island, which was, I don't know, I can't remember the dimensions, but you can look it up, and it was probably 30 or 40 miles around and probably roughly 15 miles wide with a dense native jungle. Everything is right there in a tropical island group. So that's when they decided to move out and just – nothing there and then "boom." Set up the headquarters and go from there.

Panama was the "jumping off point." Panama City was the mainland base. So we had to go down there and "whatever" – our group all got in Army uniforms and from then on, full military. It was interesting, as officers we were saluted (inaudible, yet we wore this armband with a TO – Technical Observer – on it. People said, "What the hell outfit are you in?" (inaudible) but this, what is this – but we were under secret orders and could not say anything about our status or operation. We were basically integrated into the Army. So that was very interesting. We were in the military, and right off the bat that's where we learned about "Hurry up and wait."

So we all wound up in New Orleans in early 1944. Got our uniforms on. Had four or five days of leave down there – and that's a group of pictures of our "team"(inaudible). New Orleans was a hell of a town in those days. When you're 23 – that's a great town. So there was our troop ship – the William M. Evarts – and there was the big channel where the Mississippi River goes by New Orleans(inaudible). The outlet into the ocean at one time was a gathering point for enemy submarines, but that threat had been reduced by the time we were there, but it was "still interesting" as a point of departure..

We spent several days at Gitmo, in Guantanamo Bay, on an old troop ship that was "deck loaded" with goats to be used in our CW campaign. If you think it's tough today to be in Gitmo – I look there today and I say, well, there's Gitmo. Nuff said.

So the story on that is we needed goats in our CW fields "study" because their respiratory systems are similar to a human's. So somehow in 1944 we ended up on (inaudible) an old troop ship, the William S. Evarts. We boarded in New Orleans, we picked up the goats down – I guess we picked up the goats in Puerto Rico. Yeah. If my memory serves – yeah. So then we're there, and I can see it now. Everybody is asking what we're doing – but you can't say anything to anybody about what you're doing.

So after the field tests in Florida, we wind up in uniform having a couple of great days in the city on an old troop ship in the Mississippi there, just on the east side of New Orleans. Finally, we all got on board and it was kind of neat. The Red Cross ladies were there with a small band playing for us. They gave

us goodies and we got on our ship and we were happy. We were finally "in the game." You know, OK we did it. Get on the troop ship and we're ready to go.

Four days later, we're still sitting out in the middle of the Mississippi River!!! It turned out a report had come that there were explosive munitions on that boat. After we got on, we all said "Goodbye." We said goodbye to everybody – and we were sitting out on the river– and, by the way, the room we had – we had a room the size of this little office here and there were 20 of us, which was kind of interesting. That was "officer's quarters," I might add.

And so we're in this thing – and here we are on the river – and in the distance there's New Orleans. For four days, there's New Orleans and we're there and we can't get off. So that's when we learned the old Army saying, "Hurry up and wait." Hurry up and wait.

Finally we took off, and we wound up – pick up – and we went into Gitmo first – and this is interesting, too. The first time we went in there – by the way you can't smoke at night – enemy submarines – and you can't get out – and they lighten up on you, because they were really careful and it's pretty crowded below decks. You're down there for the whole length of time.

And so we got into Gitmo – which was nothing unusual then. We stayed overnight there, then on to Puerto Rico, and that's where I had one of the best experiences in my life. We had four or five days leave there in Puerto Rico, San Juan, and I knew one of the young Puerto Rican lieutenants there, and he sort of showed me around. One night there was a big USO show, in the Normandy Hotel (I think it was), and who's there but Eleanor Roosevelt. She was going to be there. And so this was something. Let's go!

So we went there. There were a great number of people, and everybody lined up. We all lined up there – (inaudible) – there's a long line but finally I got up on the stage, and there was Eleanor Roosevelt. I saluted her and put out my hand. She took my hand and said, "What is your name?" I said Jim Pitts. "Where are you from, Jim?" I said, Southern California. She said, "Jim" – and she's just holding my hand – "I just want you to know that Franklin and I appreciate all that you and your men are doing."

Well, we would have jumped off – name a cliff for her. I mean, you can't maintain how touching that was, how beautiful she was. She was radiant. There's a difference between radiance and beauty – the definition of beauty. Boy, I tell you, we would have – she was something else. My life – in all of the experiences of my life, that was one of the best . You know why she first put her hand out to shake yours – it's so they don't get squashed. So they took your hand. Because, as you can imagine, they – I mean, she shook about 300 hands that night. What a wonderful lady. That's a heroine.

So then we get the goats on board, and they wound up the anchor – I think it was the second time (I don't remember, but it could be the third time) – but anyhow, the last time we went into Gitmo, we were just ready to enter the harbor. The first two times we had a little pilot boat to lead the way. The pilot boat took us right through the "gate." This time (inaudible) we were out there heading in and our Skipper said, "We're going right in. We're not going to wait for a pilot." There is something out here. Something? An enemy submarine? There is something out here. We're not waiting for a pilot for the ship. I'm taking this sucker in at full speed!

No pilot for the ship, but boy we went in there full speed. Getting into that docking area looked so good!!!

Let's stop this chat for tea.

[break in audio]

Gaffney: OK. So I think we're back here. We've got a cup of tea and Jim's got – I think we just went into Guantanamo Bay. What then?

Pitts: Right.

We left the next day and "cruised" down to Panama and went through the Canal – goats and all. After several days in Panama City, we wound up on the island out there, Isla San Jose – and that's where we carried out the "shoots" with the Air Force bombing and with Dr. Blacet leading our group.

Photochemists can do something!! Bill Gwinn from UC Berkeley was the Second in Command of the group, Roscoe Dickinson was there from Cal Tech – he was also a photochemist – he had published in the late '20s and '30s. The group of us was from a variety of universities – there were about 28 or so of us in all. And we can look that up. It's in the *Spectrum* article (our "group picture").

But the main feature there was the fact that with the 6th Air Force, based in Panama, doing the bombing – we were able to actually greatly advance our wartime understanding of Offensive Chemical Warfare. As Albert Noyes points out in his article – these were the largest CW bombing trials of the war – and our NDRC group here in the jungle, we led the whole thing. It was kind of "interesting."

For details, see earlier reference in this interview, "Science in World War II Office of Scientific Research and CHEMISTRY Development (OSRD): A History of the Chemical Components of the National Defense Research

Committee 1940-1946, Edited by W. A. Noyes, Jr., an Atlantic Monthly Press Book, Little Brown and Company, Boston, 1948."

We had the troops in there, GIs, and we were with them digging dugouts, cutting the trails to our bunkers – the whole bit. We learned a lot about the military – e.g., our "troops" – and it was a very interesting affair. It's discussed pretty much in the *Spectrum* article because – I don't want to take too much time now, but it involved, again, some of the principles of – the principles or things that you learn about leading troops – for example, "How not to pull rank." And that's what I wrote in the *Spectrum* article. You don't pull your rank.

The secret for a young officer, e.g., us, is, "Take good care of your sergeants and you're set…they'll take care of you." And that works in Universities today. That – you take care of your staff personnel and you're set. We saw this and we learned it.

For example, on one particular occasion, our enlisted troops weren't sure, "Were we really Army officers?" Why should they obey us?

Well, I think you will appreciate this example. We had sandbags – we had to sandbag areas around our instruments – and us – and then we go hide out so the Air Force can drop the bomb, and we hope they miss us, and then "we go back in." So there are a lot of sandbags to carry uphill through the dense jungles – and at one point – and I don't know how it happened, because I was not in command – I was "low man on the totem pole" – but something happened. The GI troops said they weren't going to follow our orders and carry the sand bags. "No, we're not going to carry them to the 'fox holes.'"

And I looked up, then Dr. Blacet, "El Jefe" said, "OK, let's go guys. So we just picked them up, threw them over our shoulders, walked up this damn hill to the dugout – and you know what. The enlisted men saw this – then they picked up more sandbags, followed us!! They never complained again. We never reported the affair and we never had a problem again! They, the troops, appreciated us, and we them. They respected us. We took care of them and "no problem."

And that's the lesson this taught me for my academic life. No matter where you're at, Don't pull your rank on your Glass Blower. Don't pull your rank on your Electronic Technician. Your Office Staff, Administrative Assistants, etc. Don't "pull your rank" on them.

Let me pause and expand on this point. This is what we've learned and that's what we discussed in a book , "Graduate School in the Sciences," that Jack Calvert, George Dorian and I wrote in the early '70s. Its purpose was to get a message out to these young people coming to academia who aren't really told

much in advance. They come out of High School and What is the university like? How is it run? – And not just Graduate Students but Young Faculty. What is the role of the Assistant Professor? What are the factors? One rule of ours was, and still is: "Take good care of the 'staff" women and men, and they will take good care of you! It works fine. It's a team effort!!

Back to the war. We dropped dozens of these 1,000 lb. bombs – and the results were used to develop "munitions requirements" for various combat situations. I had one experience observing other CW and jungle hazards with a buddy – and one a second experience impacting me personally that were kind of interesting.

We slept in little tents, but they had wooden floors. You had to be very careful getting dressed in the A.M. One A.M. we saw Bill Gwinn in the neighboring tent getting dressed and suddenly jumping up and down – he was pulling up his GI trousers and a scorpion lodged in them and it hit him (inaudible) on his upper thigh near his ____!!

But, what happened to me was, one day during the "shoots" I noticed my right arm bothering me. Recall that in these bombing runs we were regularly exposed to high, lethal, concentrations of gaseous phosgene ($COCl_2$), hydrogen cyanide (HCN), and cyanogen chloride (CNCl). You're out there and you're not wearing protective clothing because you're not dealing with low volatility persistent agents, e.g., mustard gas – one of the hideous killers of World War I.

My arm started swelling, so it wound up – my whole arm, fingers to shoulder, was one great big massive swelling. On the Island, we had more doctors of veterinary medicine (two) in charge of the autopsies of exposed goats than we people M.D.s for we humans (one). So we had one guy, "Doc" Coleman, one guy for us – and then we had a couple of "vets" who were taking care of all of the goats. In the "shoots," we had goats out there with masks – some with American masks, some with Japanese masks and some with no masks. So when we bombed them (and us), we made measurements with the Dickinson meter, for example, developed by the photochemist Roscoe Dickinson of Cal Tech. We could then get measurement of gas concentrations over a range of conditions, including meteorology. The whole thing – bombing runs, CW measurements, etc., all tied in – and "it worked"!!

Anyhow, from a personal perspective, this arm thing got worse and worse. So finally Doc Colman said you have to get back fast to the Army mainland hospital in Panama City – and fast. So they put me on a "crash boat," and got me out of here. The Army crash boat took me back to the mainland, and I walked into the hospital with this arm looking like this – skin fingers to shoulder filled with some kind of fluid.

It was sort of interesting. Our CW mission on San Jose was Top Secret, so I couldn't tell – I couldn't say a word what it was to anyone, staff or other patients. I had nothing to say about what had happened. I was given a cot in a room filled with 20 or 30 guys – and they've got all kinds of "bad things" very visible on various "sensitive" parts of their bodies. This was the "jungle ward." We had called it the crash (inaudible) –

**END OF TAPE 2 SIDE 1**

## Interview of James N. Pitts, Jr.

## TAPE 2, SIDE 2

Gaffney: OK. So you have now –

Pitts: I am in the Army wing of the hospital.

Gaffney: – and your arm is swollen.

Pitts: Shoulder to wrist, full of a fluid.

Gaffney: Shoulder to wrist and you can't tell them anything that you've been exposed to – CW poison gas!!

Pitts: So there we go. So anyway, I'm looking at these guys all around me, and they've got all kinds of horrible looking things on various parts of their anatomy, and I'm thinking, "What am I doing with all of these people" – and they look at me and are wondering what horrible disease did I pick up and is it "catching" (transferable), and I can't tell them. And I am a "TO, a Technical Observer," and the GIs say – "What's that?"

So I was there for a full week. What is interesting is what they did, their "healing" technique. They wound up soaking my entire arm up to my shoulder three times a day in a bathtub full of a solution of potassium permanganate in water three times a day – so, OK. While I was there – and one of the neat things – General Bullene was the commanding general in charge of the entire Operation. I'm sitting there on this little cot – you're pretty lonely and a little scared – what is this arm thing? – and all of a sudden I heard "Attention," and in walks General Bullene. And he comes up to my cot and says, "Jim, how are you doing?" I said, Sir, and my eyes open up. And he asked several questions. That was a big thing.

And then the GI guys around me are like, Who the hell is this guy. The General comes in here, and I was just some kid with an officer's uniform and a TO on the sleeve.

Anyhow – the bottom line is, after a long seven days and nights, the permanganate seemed to work, so they sent me to the jungle island and the biggest CW bombings of World War II.

After all of these years and our CW mission was declassified – and this is interesting – this is my memory – I've asked many dermatologists what happened to my arm – I've had no such problems being in the sun all of the time – and nobody could say.

Finally, only about a month ago (2007) I talked to another dermatologist and described the phenomenon, I said, by the way, is this a special thing or something. Whatever – can you tell me – and he said, "Oh yeah, that's the treatment we use for burns." So it must have been a CW chemical burn!! One of our CW agents really burned my arm. So that's what happened in Panama in 1944. But the "cure" worked after a week of soaking in permanganate.

So that's kind of interesting.

Anyhow, the major bombings at our Isla San Jose went on, and later the results were used by Professor Latimer at UC Berkeley. Actually, Latimer flew down. Latimer flew in from Berkley on a little dirt landing strip on "our island." These guys all came in there. Latimer. So now we're back in the history. Latimer came in because he was – he ran his group out of Berkley, and they did the modeling of the impacts on enemy and our troops in the jungle dropping these bombs. They actually modeled it that far in the war. So that's how – it went that far – and so again we chemists and the meteorologists in and out of uniform were all in the CW game. The bottom line was the massive CW bomb worked, and actually – our NDRC group did the job.

In August or September, Dr. Noyes said – they were very good to me – they said, Jim, we want you to go back to the States. Why don't you go back to USC and work with Professor Anton Burg. So I flew back.

By the way, all of our complexions on Isla San Jose turned, and remained, yellow. I was totally yellow. Do you know why I was yellow and why people would move away from me? Quinine. There was no quinine. The Japanese had all of the quinine, so we took a new drug, At brine, and it turns you yellow. And our theme song was, or could have been, "They Call me Mellow Yellow." I don't know if that song was out then but it was mellow and we were yellow.

And so what the hell – I go back to the States – I flew back, and our military DC-3 lost an engine, but we made it up to Costa Rica. And we wound up – my buddy and I, later to become one of the professors at UC Berkeley – went to night clubs in Mexico City and Hollywood on successive nights – and had a good time!!

So I went home to my parents in West L.A. The day I arrived, they looked at me, I said, "No, no, it's not a horrible disease. It will go away." And it went away. But that was funny. By the way, I couldn't, of course, tell them where I had been or doing?!!

So that was that and then I worked for about a month for Dr. Anton Burg. At that time he/we solved one of the urgent CW problems. A couple of guys who

were with me and also working for Professor Burg were "senior" people with Ph.D.s.

While with them, I had another big experience, so everybody listen – so, this was another one I learned, almost the hard way.

Whenever you have a Dewar filled with dry ice or liquid nitrogen, wrap it up with duct tape. Wrap up your Dewar! And I'm just catching on to this. And anybody – Tell your "troops" this. Wrap it.

So we had a big deal. Believe it or not, in a regular University building right across from the Chemistry Building on the USC campus. So I'm down in there in the lab alone one day and handling this u/quart bottle containing cooled hydrogen cyanide. So I put the bottle in a large Dewar flask – to cool it down further – because this is tricky stuff. And I'm not even sure I had my mask on (I should have). Then explosion!! Man, I dove out the door. Literally, I dove. I just dove out the door. What do you do? Who do you notify? So, well, I'll go back in with my mask on. I'll take a quick look and then I'll go and notify the Campus Police to evacuate the building and the environs. Actually who the hell do you call to report a CW attack? Hydrogen cyanide. I went back in and there the bottle was sitting in the demolished Dewar wrapped in duct tape. It was sitting there. The duct tape literally saved me.

So this experience really taught me. Again, so I'm getting back to fundamentals. "Wear your glasses and put on the duct tape." So that was interesting – that was a "close call."

Anyhow, while at USC I also went to night school and took a few courses and wound up in 1945 getting my Bachelor's Degree – after going through three years of the war in the NDRC (I would have graduated with a Bachelor's in December 1942).

Then in the summer of 1945, "they" sent me back to Northwestern on another project. This was on Biological Warfare. I was working under Frank Gucker, who was a senior professor there – along with my friend Chet O'Konski – and a Particle Counter. A photoelectric counter. This was a new forward angle scattering device – and Chet was really the leader behind the effort. So over the next decades of "smog studies," it was neat to have actually worked in a team that during World War II developed a unique particle counter that really worked.

To test our device, we went to Camp Detrick – headquarters for biological warfare research. You know what they had to do? You put on our gas masks with protective filters, then they sprayed them and then they had to manually

count the particles, the bugs, that went through the filter. Boy were they tickled with this to see our particle counting instrument

After the war, in the fall of 1946, I went back to UCLA and got my Doctorate Degree in the Chemistry Department then. I worked with Professor Blacet and (inaudible) and a lot of the great grad students and postdocs.

And I'd like to say another thing in passing – about a great Department of Chemistry. My heart is still with Northwestern and those people – I mean, I really enjoyed it. They were very good to me, a young guy, and then in 1949 I also came back to the faculty as an Assistant Professor for a few years – after I got my Doctorate. Great Department. Great school, Northwestern. And I have nothing but affection and appreciation for all they did for me – they were a great team. OK. Really good.

So anyhow, now we're coming back in time. I came back to UCLA in '46 and came back to fundamental photochemistry. Jack Calvert had just gotten out of the Navy. He was an Ensign. He had been in a few months and got back, and so we both did photochemistry and that's, then, when some really exciting chemistry was going on there. That's when we had Don Cram (future Nobel Laureate) as a young fellow there. I think he was at Rollins College, believe it or not, in Florida. Because we visited Rollins when we were down in Florida in '43. I guess we got a (inaudible). I think it's a very good college.

Anyway, that's where I learned "fundamentals of the trade" – photochemistry, the system, and again the Chief came back into my professional and personal life – "El Jefe," the Chief was back as my Research Director.

Those were great times. And Hammond was in the labs, too. He got his postdoc there. And that's when the smog started to come in to Southern California. So I got my Ph.D. degree in '49. Northwestern invited me back, and I went back with my wife, and we were there for five years, from '49-'54 at Northwestern.

And it was a great place, and I still would be there, I think, if it weren't for the winters. It was tough. I mean, the winters were really cold – I'm a California boy.

Then a real opportunity came up, and so I was there at NU as an Assistant Professor and taught in, and did research in, the Ph.D. program in photochemistry – gas phase and solution phase.

George Hammond invited me back; he was at Iowa State, invited me for a seminar, I think it was '52 or '53, and we talked about this stuff and it was fine and I really enjoyed it.

As I said, the N.U. Department was terrific. At the noon-time faculty lunches, I learned to keep my mouth shut. Yeah, I'll tell you this a little later. But anyhow, that's what I did. Then "they" in the U.C. administration contacted me. Conway Pierce had gone back from the NDRC after the war to be Dean and head of chemistry at Pomona College.

And so he called to get in touch with me, and he said, well, we got UC Riverside starting up and we'd love to have you come back. And the Chancellor – Gordon Watkins, do you remember Watkins? And so I met with Watkins at that point, and so this was the deal.

He said (this was in '54), "It's all set to go, and we'd love to have you come back and head up the Chemistry Group." I understood there was going to be a Doctorate program. After a lot of soul searching – and believe me it was a lot of soul searching – I decided OK, I'd go.

It was a really tough thing, but we headed back to the new UCR. That's where it all began.

I go in there – and this was the shock of my life – and I said to the UCR administration, "Now we'll get the Ph.D. program going." They didn't have Departments then. It was Divisions. And Pierce was head of Chemistry Division.

Now, in 1954-55 – when I arrived there, smog was really, really beginning to come in. And I hope – I think I've got this right, but I think – it's in *Spectrum* here. I think it was in '51 – well, we'll check it – but Blacet published the first paper on nitrogen dioxide, $NO_2$, as the source of ozone in the atmosphere.

I think it was '51 (maybe 1950) – yeah, I think it was. We got interested in $NO_2$ because we'd used $NO_2$ as the marker for our CW agents. We put $NO_2$ in the bombs. Anyhow, he wrote the first paper on the subject suggesting that ozone could be formed by the photodissociation of nitrogen dioxide in ambient air. They (Blacet and Hall) speculated that the photodissociation would give NO + O and $O + O_2 \rightarrow O_3$ is the source of ozone – right there. Photochemistry in urban atmospheres. There's your smog. There's your – getting into the game. And so Francis Blacet had done that.

So, anyway, we get back here to UCR, and it turns out then, after I arrived, they said, "No Ph.D. Program." No, we're going to be the Swarthmore of the West – said by the highest authority at UCR.

I've been there, I've been there. This is the UC system. You don't have California taxpayers making UCR a beautiful Liberal Arts college with no doctoral program. But I'm there. And what do you do? You're there. So I

thought about it. "That was a shock." Anyhow, I made a difficult decision, and it was there we stayed. .

The bottom line was we got undergraduate research going – and so it's true you hoped to get some very good undergraduates, which we did. We had great undergraduates, as you well know. And we got them going (e.g., Rich Schrock, who won a 2005 Nobel Prize (see my *Spectrum* interview). We also got the postdocs going. And that's where our long-term Program in photochemistry began (see below).

We also got interested then in Plant Pathology – e.g., crop damage. Two UCR plant scientists were pioneers in "The Smog Game" – John Middleton and Ellis Darley (and others). And they were the two key plant scientists who initially were asking us, including Dr. Edgar Stephens, about the formation and photochemistry of this "smog."

Middleton was very well known – remember, he wound up very high in the U.S. government in the '60s – and we lived there, so we got interested in the fundamental photochemistry of "L.A. Smog."

So let's look at this whole thing. And remember when I said earlier in this interview, in '54, that's where a team of spectroscopists did the "spectroscopic kill," proving ozone levels were incredible in , e.g., South Pasadena, so that was coming through.

So then things were really beginning to roll in terms of, Yes, this is smog! Yes, this is dirty air! Yes, you have transport! Yes, there is meteorology! Yes, you have chemical and physical transformations! Yes, this is photochemical air pollution!

So we got involved with that – and Jeff, you can tell your story – you can tell a better story than I can about what went on around there, UCR, in the '50s – you know a lot more – you know a lot more of the truth than some Professors did. But the bottom line was I had some great undergraduates. It was a tough fight to get the graduate Ph.D. program. It was a real fight. So, in the interim, I got postdocs and very bright undergraduates.

Remember, the first postdoc (inaudible) and he was a postdoc who came from "over there," in Liverpool, I think. I'll tell you a story about him and our new campus.

In circa 1957, I got a call at home, late at night, from the UCR Campus Cops – remember that? They said we have a guy who says he's "Working for you" wandering around these dorms and other places. He's looking at the stars "Because it's such a nice clear night"!!

I said, "It's okay, Sarge, he's perfectly all right. He's British you see." That satisfied the Campus Cops. OK, Doc. OK, Doc. Anyhow, that was the story – but that's how it was in the early days.

I had very good undergraduates working with me (e.g., Rich Schrock, see above), and later we got the first UCR Ph.D. graduate student, Jim Sharp as you recall. Getting the first Ph.D. program "sort of happened." Conway Pierce, our Division Head, took a sabbatical leave in 1958, and I became Acting Head of the Physical Science Division for one year. During that time, I worked with a couple of our geologists who were really brilliant in their fields. The bottom line was together we said, "What could we do if we had a Ph.D. program."

Well, the three of us sort of "developed one"!! The bottom line is we got it approved in 1960. The Divisions split up into Departments – I was the first Chair of Chemistry, and we went ahead and got UCR's first Ph.D. program going.

We had to hire new faculty, and that was kind of interesting, there, too – but we hired some really brilliant ones. Again, the UCLA and NDRC contacts were very helpful. For example, I called Don Cram and said, Who do you have who would be a good Physical Organic/Inorganic Chemist. He said, this guy is very enthusiastic and he's really good. He's a young guy and he's really sharp – and his name is Fred Hawthorne.

I had met Fred before. He had just come to UCLA as I left in 1949. And I liked him. He was sharp, and I thought he was a good guy. The bottom line was he was in industry working on rocket fuel chemistry (I'll think of where later). It was where we (the U.S.) did many rocket studies, and he was interested in coming back to "Academic life" in Southern California. So we hired him as an Associate Professor.

We also got Sunny Chan. We got Sunny Chan by calling Bill Gwinn at UC Berkeley – who is in that 1944 picture there in Panama – and that's how it happened. I called Bill and he said, "Look at Sunny Chan." So we hired Sunny, and he and Fred were great, and some other really good people.

As I mentioned, those two were very good – and they were "stolen." Fred went to UCLA – he was brilliant (inaudible), he's a brilliant guy and did a beautiful job, and Sunny Chan left to go to Cal Tech, where he has done brilliant work in his field. So they were great!

That's when as a Department "we got going," and in the process (inaudible) I got talking to Middleton and Darley in Plant Pathology.

We wound up proposing an (inaudible) Air Pollution Research Center – which we did, I guess I'm trying to think about when all of this happened, but it was in the early 60s, I think it was. We got together and got the idea of (inaudible) the Air Pollution Center.

That was not met with a lot of enthusiasm in some places (Department, Administrators, etc.), but it was met with "enough." The critical part was we had brilliant scientists involved, e.g., John Middleton and Ellis Darley, at the (inaudible) U.C. Citrus Experiment Station . . . and that was an important part of my remaining at UCR. It was called the U.C. Citrus Experiment Station then – one of the best in the world – I mean world class academicians and (inaudible) Research Scientists who became Academicians.

That was one of the factors that kept me at UCR, when I made my decision – you've got a brilliant group there! Surely we can do research "things" together. If they can do that – they're brilliant – they were and remain tops in the world – then this would be – so that's when Middleton and those guys and I got together.

As an example, we together bought our first – and that was neat, too – because we bought our first ultraviolet spectrometer, partly with those guys, and we bought our first infrared spectrometer together with their scientists – who were great.

So we shared, and it worked well. We were "sharing" expensive instruments, and it started right there, their recognition of the plant damages caused by smog. So that's how the Air Pollution Center got going – with chemists and these superb plant scientists.

That's how we got involved -- when just big things happened around that time – e.g., the pine trees in the San Bernardino Mountains started dying from the ozone, and Paul Miller went up there and showed that ozone was killing these beautiful pine trees – the ponderosas.

An interesting part is that the "ponderosas," who were (are) hundreds of years old, were dying in the smog. They didn't burn rapidly in forest fires, but the smog killed them! But, there was another species of pine up there that the smog wouldn't touch but burned like torch. I can't remember the name of that one – but you had your two types.

So that's in part how we got in that side of the smog game – and ever since we've been very close to the plant pathologists and researchers involved in the environmental side, the plant side, field, crops, etc. Working with them – and sharing what chemistry we knew – in terms of what was out there with these people who were involved with that side of the "Smog Wars."

So that got that going – and you were involved with that. And you know, you can tell the story a lot better than I can, but we had some really interesting times. Remember when in the mid '60s we had the old-style infrared spectrometer and one of the neat young guys who worked on it, Richard Schrock, came in and was an undergraduate and he was working on it. And you were there at the time, right? You knew him, didn't you?

Gaffney: I had just started as a freshman and was taking your freshman general chemistry class, which got me excited about chemistry.

Pitts: There you go. Yeah, that's right. And Rich was one of the seniors or something, right?

Gaffney: Right.

Pitts: And so we had – it was pretty, the infrared. What did you think of that machine?

Gaffney: I did most of my thesis on that machine!!

Pitts: Yes, but we did good sharing. (inaudible). So Rich, anyway, he did some work on that instrument in his studies of the vapor phase photolysis of crotonaldehyde. There were some interesting results (for more details, see *Spectrum* interview).

Interestingly, two years ago (2005), Richard was awarded a Nobel Prize! He was and remains a neat guy! He was really gracious – and we had a good time interacting with him then in the mid '60s – and last year when he and my wife, Barbara, were inducted into the American Academy of Arts and Sciences.

Now for a big question. "How do we follow the actual reactions that occur in polluted atmospheres?" OK.

You can start with sort of a flask, and you put in NOx and hydrocarbon fluids in. But how can you do real kinetics because you have serious wall affects. So that's where we got the idea that, well, I was thinking of a large chamber, but from 1960-1969, the "chamber plan" didn't go "forward" in the lab and in other respects.

Edgar Stephens did some very good work on air pollution – on the chemistry side – in a small "chamber." The plant scientists were also interested in the chemistry – but somehow "things" never seemed to come to fruition.

And so our, as you know, our thrust was always the application of fundamental photochemistry to ambient air. During this phase, 1961-1970,

the whole crew, I don't really want to go naming each one of them because if I forget somebody, then I really am – were a great bunch. They really were splendid scientists and nice people – men and women.

One of the things that did occur – it was in '61 –when I was on sabbatical. But first – and I think this is an important area, too, and I want to stress just another real key player. We already had worked – Jack Calvert and I had started working on a book on Photochemistry in the late 1950s, and I was interested in solution phase aspects of it. E.J. Bowen at University College, Oxford University, had written a book titled The Chemical Aspects of Light. It's a classic. I recommend it to anybody who wants to go back into history, go read – it's copyright 1941. And Bowen's book. And so I really liked it.

The bottom line was I received a Guggenheim Fellowship and, in '61, went to Oxford, and for about eight months worked on Jack's and my book. I had an office right there in PCL – Physical Chemistry Laboratory, Old Chap – you know, the PCL – and, through Dr. Bowen, a "Research Fellow" position in University College.

It was a very interesting and productive period – and an important aspect of my professional and personal life.

The British are great – by the way – as people, friends, professionals and "warriors" – and I want to tell one more story. It was so neat – our Colleagues. We had a British commando as an "Observer" of our major CW operations on Isla San Jose – largest of World War II. His mission was to see first hand the way we carried out our CW bombing exercises under jungle conditions. He was a tough guy. He – I've got to give you two minutes. He was a really great, tough guy with lots of combat experience and a British sense of humor.

OK, here's my story. We had people flying in, coming in from Washington all of the time – "Observers." They'd fly in to this little airstrip on the dense jungle island – and stay there for a day or two, and then go back. And the troops and our team remain sweating it out in the jungle.

By the way, one last thing I want to say about what I learned there – I learned there and for the rest of my life – and to my dying way, I will remember the guys – I will think of the guys on Guadalcanal. Those GIs who had to go into that mess, live in the jungles, and be shot to hell by the Japanese. They were living through all that – and here we were on Isla San Juan sleeping in a tent and still having major "combat lite" problems. So my heart went out to the Air Force, the Army, the Navy and the guys – the GIs in particular – in the sense that they had to fight through those jungle conditions. Just living through that and then to get shot at.

I can remember – I remember one of them – I met one of the Marines who had been there, and we talked. We talked. And I said, I really admire you and your outfit – and, How in the hell did you get through the "Canal" battle? How did you survive down there? Your casualties were incredible?

He said, "Well, Sir, I learned pretty early on to 'Keep moving' – they can't draw a bead on you"!!

So at any rate, I just want to state again, I hope this country always recognizes the Army, Navy, Air Force, the Marines, the Commandos that we had – they went out there and faced the "suicide bombers." You see this whole thing and I'll tell you your Dad was – so I salute them all!!

And the Major, you'd enjoy him. The Brit. Our research group here at UCI has a key player, Leon Phillips who is a senior professor at Christ Church in New Zealand. We went down there for conferences, and they're still "interacting scientifically." So we know the New Zealand lads – they were "in it," too. And so were the Aussies – big time. So I feel very, very strongly that – I want the U.S. to keep faith with all of our allies.

Anyway, to get back to my story about the Brit commando. I have to tell you this. So this is in '44. So we have this U.S. Officer flying in from Washington – who turns out to be insufferable. Some of these visiting military people are just – you know – this guy came in and started pulling his rank. His name was Rogers, and we called him Buck Rogers. Remember him? You've heard of Buck Rogers. So we called him "Buck" Rogers, and this guy was just – !

Our "Officers Club" was a tent, but someone was able to get us some good wines there. So at one point the Brit came in and we were all sitting around there and the Brit said, Why don't we have a little bit of a "do" with this Chap. Why don't we just do this?

And so we "did it." We got him in there with us and we got him "loaded" on wine. Then we had one of our military guys come in and shout, "The Japs are landing!! They are landing on our beach." And "Buck" Rogers, by the way, loved to drive around in "his" jeep. He would drive around our CW dugouts and instrument sites while we were all sweating in the jungle – and make profound and stupid comments.

So, we all hollered, Major, Major, lead us to it, take us to the enemy beachhead. You're the Major. Major Rogers.

So "Buck" gets in his jeep and races right into the ocean! Right out through the surf into the deep water. So we rescue him. We rescued him (and his jeep). And guess what – he was back to Washington the next day!!

But that was part of some fun things that can happen during a war. The Brits – he was great – they were great – and I can still see this guy.

But anyhow, to come back to the late '60s and '70s time, we were back there and the idea was can we get – can we do something with the available facilities on campus. So (inaudible) and I said, OK, let's put something together and go to the Chancellor – which is what we did – the man who was really responsible. UCR had recently changed Chancellors to Ivan Hinderaker, who had just been a Vice Chancellor at the new campus, UC Irvine.

The founding Chancellor of UC Irvine was Dan Aldridge. By the way, Dan Aldridge was originally a distinguished plant scientist at the UCR Citrus Experiment Station. Dan was a brilliant guy, tough and nice. He knew the whole UC system-wide game and was a great Chancellor here at UCI. He had done a marvelous job, and today at UCI in 2007 we still owe so much to him.

But we also owe a great deal to Ivan. He was big time and had a huge impact on UCR. Incidentally, Ivan flew in our Air Force in World War II. Neat guy.

At one point, around 1969, we realized we had a little old building here on campus, and it was called the Plant House (or something). It could be remodeled and be a real nice Chemistry/Instrumental Analysis laboratory.

**END OF TAPE 2 SIDE 2**

## Interview of James N. Pitts, Jr.

## TAPE 3, SIDE 1

Gaffney: – talking about the –

Pitts: Ivan Hinderaker, I think.

Gaffney: – Ivan Hinderaker, and you had gotten approval, I guess, or you are starting to look around now for a place to put that giant "hi tech" smog chamber and talking about renovating the "Plant House" as a place to put it.

Pitts: The Plant House, yeah. So we looked closely at the building. The downstairs was sort of – there were some pots and dead plants, and an upstairs that had a really old-fashioned chemistry lab where there were racks up above the wooden lab benches where you'd put your thing and just – and lead pipes – and, in fact, just the kind we had in 1954 in the new UCR chemistry labs. We had to tear them apart – they had designed the building wrong for modern chemistry. You couldn't even put a spectrophotometer in one of the "new" labs. We had – and boy, people were serious. "This is called an instrument lab"?

But anyhow, as I said earlier, we had worked through the '60s closely with certain outstanding plant scientists in the Citrus Experiment Station – including John Middleton, Ellis Darley and Cliff Taylor, and two brilliant physical chemist/spectroscopists, Ed Shuck and Edgar Stephens – and as physical chemists/spectroscopists.

Working with them, our SAPRC photochemists/spectroscopists were able to actually develop laboratory mechanistic studies coupled with real field sampling programs to identify and quantify key major (e.g., ozone NOx [oxides of nitrogen]) and minor (e.g., nitrous acid) chemical air pollutants.

We plant scientist and atmospheric/air pollution chemists could tell there would be interactions/impacts of polluted air on certain valuable field crops and prove the damage was caused by "L.A. smog." The plant scientists in the Experimental Station and at the Air Pollution Center detected the overall impact and specific types of plant phytotoxicants on the field crops, and the photo/atmospheric chemists could identify and establish its mechanism(s) of formation and ultimate fates in polluted atmospheres.

So we had the "fundamentals" going on in the '60s. Once again, that's where "The fundamental things applied" – and they were "on target."

So in 1961, I took a sabbatical leave in Oxford. It was very "useful" – I learned a great deal there that was actually relevant to atmospheric chemistry.

Some was just basic fundamental photochemistry, and it was really a great overall experience – we enjoyed it. My daughters went to school there, elementary school and that sort of thing. We lived in a little place on Campus there.

I have always had a great respect for the "Brits." Actually, in '58, when I was on a sabbatical leave from UCR, I had met a Brit who was over "postdocing" with Hildebrand at UCB on a high pressure sort of problem. His name was Brian Smith. We met in the Red Garter, a nightclub in San Francisco. I don't know how we wound up there, but there was a "Banjo Band," and it was fun. We met and I was there – and this is important. I was there in 1958. I came in '58 and spent six months with the Shell Development Laboratory to do research on irradiating ketones with gamma rays. So they had a "pile" – that's the radiation chemists, they invited me up. So I took a sabbatical there and came up there and that was important because we learned – it's a very interesting fact – that you do some of the same things with gamma rays that you do with UV light – e.g., photolysis and radiolysis of methyl butyl ketones, both undergo a Norrish Type II intramolecular decomposition into acetone and ethylene.

So, I worked and gave lectures on photochemistry at the labs there. The industry people there were terrific. I learned a great deal. They had a very good group there, and we got a joint paper out on radiation chemistry of ketones. So that's in '58. And that's where I first met this fellow at the Red Garter banjo band nightclub in San Francisco. We met again in '61 – he's at Oxford. So he's a Fellow there by this time. We played tennis together, Brian Smith, and when I came back to Riverside, he came over and did a paper with us on singlet oxygen. You met him, Jeff. You knew him. He's a really, really neat guy. Kind of a big, athletic guy. Two years ago he was knighted. Sir Brian. Knighted by the Queen of England.

He'd gone from Oxford, and it was a big deal – head of the University of Wales there – a big University, and he ran that so well. That's really neat.

So Brian – and his wife, as you know, is now Lady Regina – they're terrific. That was a very interesting time.

So, overall, it was very important to get such contacts. You needed contacts there at the PCL – the Physical Chemistry Laboratory – and Sir Cyril Hinchelwood was there. "Hinch." You (an American visiting scholar) learned about a number of things. They gave me an office in the PCL – they had an office in the building there, and <u>they were very nice to me</u>.

I remember the first day I was in my office at the PCL. I'm sitting there thinking about our book and all of a sudden, Holy Smoke, klang, klang, klang,

klang, and it was 11 o'clock I think and "Jeez, where's the fire!!" I go out and ask someone Where's the fire, where's the fire?

No, no, no, sir. It's coffee time. It's "Elevenses." Everybody stops to have coffee. So we go down to the PCL Conference Room and we have coffee – everybody is there having coffee. And that's what I want to tell you. You know, people differ from country to country, and when you go over there, things are different. But it was fun, and they were great.

We had worked with the Canadians and Brits in Chemical Warfare in World War II, and you get to know more about the whole story. An important part was the group at Porton in England. They had major input into chemical warfare operations, so we had very close ties between our allies, including the Aussies and New Zealanders.

So it also turns up they had four o'clock tea at Oxford, too. Civilized tea. Everyone in the Physical Chemistry Laboratory (PCL) had tea at 4 o'clock. "Civilized, Old Chap." The Professor, Sir Cyril Hinchelwood, was at tea. Hinch, they called him (behind his back). He was a superb scholar, fine gentleman and a good England-America "bridge." So, for the "record," they were great.

One thing I learned early on, just don't be too American. I learned, no, I mean seriously – I learned a few things besides kinetics and mechanisms. One of the first I learned is – you probably are doubtful, but for the tape, for whoever is reading it, hearing it, OK, I can talk – there at the PCL – but I also learned to shut up and listen.

I also learned how to smoke a pipe – the proper way, Old Chap. Well, you smoke a pipe. So when you're in the middle of "heated" discussions, you could say, "mmm, mmm," – that was fine. You didn't have to say Yes or No. Or you could say, Quite. "Quite." It wasn't Yes. It wasn't No.

So I learned some really useful things, which I can still use to this day. I can be quiet! And I enjoyed them because they were very, very good to we Americans socially, and they were excellent scholars. In 1965 – as a Research Fellow of Merton College – I actually tutored their undergraduate chemistry majors. While there, I took my three daughters to Winston Churchill's funeral. I wanted them to join me in honoring one of the world's greatest men – and another one of my personal heroes So, even today I still remember our ties to the Canadians and the Brits.

I also want to make another point while I'm at it right here, while you're recording. I've had great relationships with scholars around the world. One of the great things about science – and here are a couple of things – is well said

in the song from the 1942 classic movie, "Casablanca": The Fundamental Things Apply, as Time Goes By.

All right. You've got that one. A key aspect of it is the inherent strength of important fundamental scientific research – actually not just the groundwork, but fundamental philosophical approach to life – is universal.

So, to move on, here we are at UCR in the '60s. We have one of the Brits, Brian Smith, came over and worked with us. We had Norwegians, e.g., Alf Bjørseth, who was just elected to the Norwegian Academy of Sciences and "Commander of the Royal Saint Olaf Order." Alf came over with us, and he's very good. A long story about Alf – on solar energy. Today, he owns and runs the biggest manufacturer and supplier of solar energy panels in the world.

But also consider what a unifier air pollution/atmospheric chemistry was. Relatively soon after World War II, in the Chemistry Department at UCR and later SAPRC, we had brilliant Japanese and German scientists come over and work with us. Germans included Harte Fuhr, Uli Platt and Dieter Perner – and Hajime Akimoto came over there from Japan.

Jack and I were invited over to Japan to give a seminar back in '62 or '63 – no, '65. Our photochemistry book had just come out – so we went over there.

So here were our former enemies who we, only two decades ago, were fighting "to the death." They were prepared to gas us – and we them. So it was great in the '60s to see, and get involved with, them in fundamental research on a critical scientific/societal issue, air pollution/atmospheric chemistry. To bring in Germans – to bring in the Japanese – and to meet their friends and their families – so relatively soon after the war. Our science was/is a remarkable "unifier." A unifier. To see that, to have that happen in the 1960s, was, I think, one of the most important events in my scientific, academic and personal lives. To see and work with our former enemies – and they became lifetime friends – warm and real.

So I think this is – and again, it was done – it was started when interactions on fundamental research started – but it also included the applications to problems of all of our societies. We worked with them and others around the world and were able to apply some useful information to them – and them to us. It's been really remarkable – I feel very, very, fortunate, very fortunate.

OK. So, then I came back from Oxford in '65. The book Photochemistry, by Calvert and Pitts, was done, then. We finished the book, and I wrapped it up then. The two sabbaticals there at Oxford, 1961 and 1965, were very useful from the viewpoint of both Science and Society – and our personal lives. We traveled through much of Western Europe and did the whole thing, our kids – and that was very useful in establishing personal as well as professional

relationships there. And so after – so that got us through – the visitors from Japan and their families, including the distinguished Japanese scientist Hajime Akimoto – who came over in 1969 with his wife – and whose daughter was born here – which was neat.

So then it ended. We were sort of "in the center," and here's the Air Pollution Center, so you have this old building, we'll go and apply this fundamental research. Fundamentally, let's go build a big chamber. Build a big one. Not just a quartz tube. We're going to build this "sucker" and it will be a big one and we'll do it right. But we had no available space to do this.

So we went to Chancellor Hinderaker, and I said, "This is what we need. There's this old building. We'll have to tear down the basement. We'll do this and this." He thought about it, and I said this is what we need to do and how we need to do it. He said, How long will it take you to do it? Well, I had already had an answer to that because this is when you applied – I knew the electricians – you knew them. You met them. You knew them, the plumbers, the electricians, they were good guys. We're buddies, friends. Karoly Fogasy, who made the drawings and slides for you. He was a superb graphic artist.

But these were – you knew the campus troops, and boy the troops were – they were good for us and we enjoyed them. So I had gotten some ideas to talk to someone in advance, the builders, the carpenters, the plumbers, the painters. What do you guys think – you know, the shop people. There is a term, any big university has a term for people who do this. I forget what we call them, here, but "buildings and grounds" or whatever you'd call it.

So they said, well, they said "Gee, Doc, I think maybe we could do it in 40 days if we had to do it." Maybe something like that. Because time was of the essence in this thing. "Can you do it"? "Well, let me try."

So I said to the Chancellor, "Well, I think Sir that in 40 days we can change this nursery plant into a place suitable for putting in the world's first evacuable smog chamber. I believe we can do it in 40 days."

He said, "Go. I'll pay for it."

Well, we went. You were there. The rest is history. And on the 40$^{th}$ day we had a big champagne party. We had everybody from the Janitor to the Chancellor and, by God, that was a man, Chancellor Hinderaker, who took a risk and who was willing to go with us.

And there were a lot of people who were unhappy with us on that Campus. There were people – you – I don't have to go into it. You can tell. You can put your part of the story in later. But there was (inaudible). OK, fine.

But we did it and we were able to get that going and that's where we got – and then, of course, the (inaudible) Barb came in and we did our research and she got her Doctorate Degree – and then postdoced and did some brilliant work on the fundamentals. It was all there. And that was for chemistry. And then went to Cal State Fullerton on the faculty and ultimately here at UCI.

But the Center got going, and it was really kind of fun. We got the Chamber going, and then we had some really great people– and we again got people who were fundamentally sound. Arthur Winer who just postdoced with George Pimental at UC Berkeley – an "old buddy." Arthur also worked with Kyle Bayes, who was at UCLA. Arthur came in.

Alan Lloyd came in early on – he's a Welshman, as you recall. He's a neat guy. Great guy. Alan came in. He had postdoced with this Chap, oh, I'll think of it, in Britain, on high energy kinetics. And then he came over and worked here for a year. The rockets were coming in. So he was doing – his field was theory and modeling upper atmosphere chemistry. Chemical reactions in upper atmosphere systems and what happens when the missiles came back in. And Alan did beautiful work. So we had him.

So we had people like that and then Roger Atkinson. Roger came in from England; he ended up coming over. Janet Arey came out of Michigan, and people like – we got in all of those, came right in.

So the question was asked of me, "Where did you get these people"? Well, they're all trained in fundamentals. What's the problem? So they got together, including Jerry Sprung (inaudible) but the Chamber "wizard" basically, (inaudible) was Ernie Tuazon – he came from the Research Laboratories in Pittsburgh.

Gaffney: Carnegie Mellon?

Pitts: Carnegie Mellon – I think so. And he had been there, and so we talked to Ernie Tuazon, and he wasn't teaching, so we got Ernie and God bless Ernie. He was our Spectroscopist. And, boy, he was fundamental, and he – and you look at this whole team. So my response was to questions like – What did you do? Well, you sort of – How does this all work?

The answer is – the answer is you get a bunch of really first class young people – and get gals in, we had a number of excellent women scientists in and others in the program, Barb was there, she was excellent – get them in there, in the labs, and advise and encourage them. Get them in there and give them what they need – and maybe offer some thoughts and perspectives – and then work as a Team – and we did.

At one point, when Alan Lloyd came in, we recognized long ago it was very important for meteorologists to be involved with our studies. So we included relevant "info" in our Office of Technical Information, OTI – with Alan as our first Director of that office.

So we set that up, OTI, and I got clearance from the Chancellor, and that's when we said, OK, We'll provide any information we can on air pollution and smog to High Schools, junior highs – even elementary schools – universities, industry – we'll give you – we'll rebuild this and we'll get the information as it comes in from a variety of offices. We had our own office, Marion Carpelen ran that OTI – and they could come in – and we did.

So we had everything from going out to third graders – to High Schools. We would go out to various classes and show them – squeeze a lemon peel over a spot of ozone and here come particles. Well, that's smog. That's what happens, right. That's particles.

Along the way we did similar but more detailed briefings for Ronald Reagan, when he was Governor and visited SAPRC also. Jerry Brown, that's how we got the light source when he was Attorney General of the State. Jerry Brown came in – Democrats and Republicans. We had Reagan. We had Brown. We're not political!! We have our personal/scientific views and testified in Congress, the Legislature and to Congressmen. We are nonpartisan. We were nonpartisan.

And, we also kept our mouths shut. If they, e.g., politicians, wanted this off the record, you were briefed off the record. If you want it on the record, fine. It will go on the record. So a legislator could come in and feel free, or one of his aides, an assistant, the teams, their staff, key staff players from everybody – the ARB, from this, from that, senators, mayor, state – could come in and we would provide – and we could say, off the record, this is sort of what it looks like. And, on the record, if you want to do this, just say, here are the data and this is the basic science, and you make your decision.

So I think we went ahead then to the California Air Resources Board, which was a terrific organization that came in in the late '60s. That's how we – we got our Chambers going, and with the intense smog attacks, we were really rolling. That's when the catalytic converter came in on the cars. A big battle on that. And we got into that whole game of emissions and catalytic converters – and what could be done and so forth.

Then we got into the detailed composition of auto exhaust, what would be there, and used the Ames test – which employed reverse bacterial mutations. Should have gotten the Nobel Prize on that. He really should have, but he got nailed. He developed a very sensitive, short-term bioassay for chemicals that are bacterial mutagens. They did a reverse mutation. Very easy to do.

You could do it in a lab, and we actually set up our own testing "laboratory" for ambient p mutagens. First we went to the guys in biology, and then we – actually, we first sent samples up to SRI. They did the first ones. Then we went ahead and we set up our own system, and I'll think of the Head – who was the Head of the Biology Department? – I'll think of it, and Judy Winer actually worked there. She did the first statistical studies on our mutagenicity data as an undergraduate. What was his name? Belser? Bill Belser.

It takes a while for the right-hand side of my brain and my left-hand side to get together. It also kind of tells me that you store stuff here and there's a bridge and it takes a while to cross the bridge. It isn't the Bridge of San Luis Rey, but it's a bridge. Yeah. Bill Belser.

So we got in the biologists, and that's another thing. We got the biologists, and then he – we said, you know, the results came back, and we said a month of exposure, and we sent the samples out to the SRI ,and we got the numbers back and you know, for triplicate, you do it and you get 40 mutations – 120 – and 72 – and that's "good"??

Well, what's the accuracy? So we got into this, and so then we said, we have to improve things, and we got a "paper" out on that, and we got, I think, the chap who did our studies. Our studies, I'll think of it. Actually, it was Bill Harger

We set up a set of experiments to do – again, this is where you apply biology, now, microbiology and so we were able to do – what's the temperature in the oven if you put your thing here, here, and here, that then you – there are different temperatures in different parts of the oven, and that changes, you know. Then – electronic (inaudible), remember we counted them. What was the name of the electronics guy? I'll think of him, too (Mike Kinitz, I think). So we developed – we just passed the – what do you call the little "dishes" you put them in?

Gaffney: Petri dishes?

Pitts: Petri dishes. You put them (samples) on a little slide or Petri dish and then you could count them. The bottom line was we were able to work with that and – determine accuracy and precision.

Gaffney: Right.

Pitts: Define precision in the way that the microbiologists sometimes do.

So that was an important aspect of the fundamentals. Then working with them and getting involved with the various professions and the M.D.s we'll come to.

I served on various Committees. In 1972, The National Academy of Sciences had their big report on cancer, "Particulate Polycyclic Organic Matter" (1972). I Chaired that report and dealt with a whole bunch of M.D.s on that Committee. I mean, it was a collaborative report on sources, reactions, risks, impacts, etc. It was a big one. So I was Chair, and we got the Harvard people and the Berkley researchers and the several epidemiologists. I was in charge of the whole thing and felt very fortunate to work with some very brilliant people. That got me interested in carcinogenicity, obviously, of airborne particles.

The first test, and proof of carcinogenicity, by the way, was done at Harvard during WWII. Some of the M.D.s there actually took some samples from the air in their ventilation system, and they did a test and found, jeez, there are mutagens in it. And that was at Harvard.

But that's when we got involved in the field – and we made a point to stay on very good terms with – and to work with – a wide range of M.D.s and a variety of aspects of M.D.s to provide them with samples – this is the goal now, the final sort of goal, our responsibility and our fundamental research applications to it. We must be able to provide those primary emission and ambient air samples in a form that is useful to the epidemiologists, the M.D.s!! Where they can actually, for example, go out and say, OK, we can get a set of samples here, and we need their accuracy, precision.

We need to provide, for example, how do you accurately measure $NO_2$? How do you measure it in the field? How do you collect and measure particle concentrations in the field? Ambient particles in the field?

How do you measure ozone. The big discussion – do you remember the ozone wars – the actual techniques for measuring ozone in the early '60s – the sampling techniques were different in different Districts of the South Coast Air Basin. And that was resolved, and I can't remember the name – but by a chap –

Gaffney: I think that was DeMore, I think.

Pitts: Bill DeMore.

Gaffney: Yeah.

Pitts: Bill DeMore. You solved that. Because they were calling smog alerts.

Gaffney: Right.

Pitts: That was the other important problem, which meant that the smog alerts came in, which were so bad in the 60s, that they had to shut schools down – 200 parts per billion for the First Stage Alert, and you can't have sports outside after that. And that got the public – and that's when the public got involved – and that's when you got political figures involved because the public was really upset!

The political figures the good politicians – "politicians" is not a "bad name"; "legislators," call them what you will – but, by gosh, they had to go out and face the public. But the point is we're dealing with such people, e.g., elected officials, who are on the "firing line." So we dealt with them with the understanding that they're on the firing line. And that's what I think is important, whether you're a meteorologist, a chemist, an M.D. – all of us are in the game – chemists, meteorologists, cardiologists – yeah, you're dealing with all of the people who are on the firing line, the elected officials. And there are some good ones and some are not, but you provide them, Sir, Ma'am – and by the way, a lot more Ma'ams now. That's a great thing I have seen over time!! And I'll come back to that in a moment.

But our responsibility was, is, to provide them with the facts, as best we can. But we also have to tell them what the limits or error bars are – so they can't be "nailed," because, I can assure you, the regulations that were originally made were hotly contested by major elements of industry – who will remain nameless, but were very vocal and powerful.

And, boy, we got it from all sides. Well, you can't make everyone happy. OK. So you can only say, "And here are the results." And so we worked with the Air Pollution Agencies, e.g., the South Coast Air Management District.

We at the Center worked with the agencies, and that was really fun and important because they're "out on the firing line," e.g., The Bay Area Air Pollution Control District.

So we were able to establish the Statewide Air Pollution Research Center (SAPRC). They wanted to come here for advice, and we tried to be helpful – and maybe we could run some tests and work with them – all of this independent of politics. There were no politics in our place. We'd have them over for a drink, and after dinner talk about what's going on, but that's a different issue. There were no politics.

And so we were able to work with – and the meteorologists were great – because that was very important to them, because the whole idea goes back to my experiences with Chemical Warfare – back to World War II. That's what I'm saying.

By the way, I was a Consultant on "Classified Research" in Chemical Warfare at Edgewood Arsenal and Biological Warfare at Camp Detrick until about the mid-1970s.

So I'm trying to close the time circle now, not just because we need a cup of tea or lunch, but we'll come back later – and I want to "Close the Circle and the Circle comes back." Here we were in WWII, and the Universities came in through the OSRD and NDRC, they did the research, they did the work, worked with industry and the military, established these.

Now today, we're coming back to it again – and it impacts the meteorologists, the chemists, ranging from chemical and biological warfare – right back to the '40s – and here we are today seeing in principle exactly the same sort of thing. We must apply "Fundamentals" to very important, complex and dangerous areas of research – by golly, as we did in WWII days. There is another crisis today.

Among the air pollution challenges we see today, ultra-fine particles really scare me. The first thing I thought of when I heard about them a few years back – first thing – Can they go through the brain barrier? Apparently, the answer is, "They can!" Well, that just scares the living bejesus out of me. I mean, I'm scared enough. We worked with these. But, no, seriously, again, here's where we are. We have groups. Bob's group now, he said, you've got something and you can put it in yourself, but the surfaces, that's fascinating now because we've been thinking of the mass of particles, you know, the "rocks," and a concern now is the <u>number</u> for a given mass (inaudible) that's a lot now.

What's a 2.5 micron. OK. Now you're talking about <u>one-tenth of a micron</u> and less, and you're talking about those and you're thinking about the numbers and you go, for a given mass, it's a million or more times more as you get from 10 microns to nano particles. You get into millions.

But a real thing is, think about it. The <u>surfaces</u> and <u>surface areas</u>.

The surface of the particles – and that's where Barb's group, Barb, my wife, at UCI, is a Founder and the Director of the AirUCI Institute here. It is really superb, and, for example, they've been working with the Pacific Northwest National Laboratories. I should comment in passing: the great work with various laboratories over a period of time, decades.

Barb's group here is another whole current story. This is a fascinating story where she and her Team are today. I'm just lucky to be around here at 87 years next to the "guys and gals." (inaudible) She's got a couple of brilliant "retirees" who have been in the game for decades. Mike Ezell and Stan

Johnson. They were – they taught at state universities and conducted research at community colleges for over 30 years. They've done it in the classroom and in research, all the way through their distinguished careers.

What they (Barb's Team) are researching is a new exciting game with a look at the chemistry and physical "structure" of the particle surfaces – e.g., the surface of ultra-fines. You get moisture on them and what happens?

You can look into all of that. I'll refer the rest to Barb and her scientists – and the Institute. In any case the Institute is doing beautiful, really fundamental work. And they're going for fundamentals. They are studying physical and chemical surface processes, e.g., reactions on wet solids and liquid droplets – which sure have all kinds of applications and implications – when you think about where this field can and will go.

Gaffney: As a tie in, it definitely ties in with some of the issues you were talking about during World War II and the surfaces of your charcoal, for example.

Pitts: Bingo.

Gaffney: Where the material either goes through or doesn't go through. It really is important to understand those fundamentals.

Pitts: Bingo. It's a very good point. Yeah. Well, what you've done, I appreciate so much what you've done through the years of tying this all together. And I think – actually, I've told you this. What the heck was it? Oh, I know, it was the academician thing that I went back – I'm the Husband. I salute. My wife is the Academician in both Academies. I just come in. I'm the guy. And it's fun. But I met – one of the Candidates – she was a woman researcher from Mexico City, and I mentioned some of the things that were going on, and she was fascinated. And it really was interesting and important – what you've done – and the whole tying in with (inaudible) "fundamentals" – now that I think is something!!!

**END OF TAPE 3, SIDE 1**

## Interview of James N. Pitts, Jr.

## TAPE 3, SIDE 2

Gaffney: Definitely you had, I guess, an incredible number of other colleagues here at the University of California, Irvine, that have included, as you've noted, Dr. Roland, your wife, a whole slew of other people there. And I – so my original question I think was, "How did the UCI campus in Atmospheric Sciences get to be Number One?" And I think we've got some definite evidence of that, certainly a good reason why.

Another thing, you've also won a number of awards yourself, and that includes the Haagan-Smit award for work in Air Quality Research and, as I mentioned earlier, the recent award from the Senate of California, your Certificate of Recognition, for all of the work you've done in air quality improvements and things throughout the state. What awards meant the most to you?

Pitts: I'm thinking. Well, I'm not dodging an issue, but I think that the awards are sufficiently different that they're hard to compare. They're hard to compare. One – actually, the one from the Senate was actually part of an award – that was from the Clean Air Coalition, which is a group of people that have gotten together over the last few years, and they're really fighting the battle in the legislature and they're good. And that was one we won – the Mosher Award for "Scientific Leadership and Technical Excellence – and in recognition for your commitment to sustainable California." It was on the 18th of May, 2007, this year after the "little episode" we discussed.

That's very interesting because the Clean Air Coalition is indeed a coalition of groups that get involved with, actually, in voting – and going through and providing legislators and mayors and legislators, other public officials and industry with basically what they need to know – those legislators – and then supporting relevant legislation. That's really what I'm basically doing – supporting legislation and laws that would improve a particular air quality situation.

For example, at this Award Ceremony where I received mine – on the 18th – actually, there were five different awards. One was to the Mayor of Los Angeles for his work as a Mayor. Another was to the Asthma Foundation of Long Beach – yeah, Long Beach – and for what they've done for prevention and treatment of asthma for many kids – and another legislator – a state legislator – and then the fourth, the other one besides myself – and the other one was very interesting. He was a Manager and Director, and he works out of – he works out of Denmark. He manages air quality aspects of all of the big shipments of all kinds of things into Long Beach Harbor.

The awards were to these people of widely different backgrounds because of the efforts they've made, in their particular fields, to, for example, curtail associated air pollution impacts on people already with or susceptible to asthma – e.g., efforts they made for air pollution legislation that would, in fact, impact and improve the health of asthmatics – and also for building and using facilities that can treat them – and for educational programs that you could say, "look, this is what to do in various exposure situations." It's very neat.

Two of my three daughters were asthmatic. That's not necessarily an unusual record for having come from Riverside, California, which, by the way, seems to be still Number One in air pollution levels in ambient air.

As we said, The Past is Prologue, and over the years, we won some of the smog battles. But you have an ongoing problem of people just (still) pouring into Southern California!

So I would say that award was certainly important and heart warming to me.

I was the fifth and last "awardee and speaker" – and up to that time, I hadn't really figured out what I was going to say after accepting the award. It's one of those things that you're not quite sure of before arriving at the actual ceremony at the time. This was at the Biltmore Hotel, in Downtown Los Angeles. 800 people there. It's a big affair, and the Biltmore – it's a great old place with a remarkable history. You've been there. Actually, that's where they had the movie Academy Awards in the '30s and years later.

I knew the place "then," (the mid-1930s) because when I went to Manual Arts High School – which is right next to USC – if you dressed up and put a coat on – if you put a jacket on and – you could usher at the Biltmore Theater. Which is kind of fun. So my buddy and I would go in and – so we'd usher and see great shows – free!!! Plays. It was kind of a neat experience. You take the streetcar – we had streetcars – its name wasn't Desire – (remember the play?), but L.A. had streetcars, and we got up there to "Downtown" – and it was great. So the old Biltmore has fond memories.

Incidentally, my award came during a period when I had just developed a little problem. Have we mentioned that before?

Gaffney: No, I don't think we've talked about that.

Pitts: One week before the event, I was "hit" with "fibrillation of the arteries," (commonly called a-fib) – and spent the preceding Saturday through Tuesday in Hoag hospital in Newport Beach.

But, it's not a big deal, but I – and on occasion there I did some thinking about what exactly do you say when you accept and say Thank You for this Award. As I said earlier on in this interview, the award was for Scientific Achievements and Technical Leadership. What do you say?

And so at the ceremony you've got all of these other people being honored. So we got there – my wife and two of my daughters and a son-in-law came, too – and it was kind of a neat family affair for us, and here I was trying to figure out what to say – and then, Bingo.

I sat at a special table for the honorees. As I said earlier, the Mayor was there, the Legislators were there, and the guy who was next to me, a really neat guy, he's in charge of shipping all kinds of "things" from across the world into Long Beach Harbor – and how do you control the ships' emissions and in unloading and shipping the cargo. How do you control the packaging? And he's really a good guy working for a big company, and I enjoyed him.

So I looked at the "spectrum," as it were, of them and of people in the audience – as I said earlier, about 800 – and I finally figured out what I was going to say. Basically, these people – the Clean Air Coalition team, they don't make much money. They don't make a lot of money personally. But they're really dedicated individuals, and they've been damn effective – and they know who to contact in the Legislature.

So this CAC is a group of competent and effective young men and women who believe in their efforts – and come from various backgrounds and degrees – e.g., "biomedical this or that." And they're really devoted to cleaning up the air in the Southern California basin here.

And so they're really – they're really an impressive group – and a "team" who my heart goes out to. Who do they have to deal with? They interact with the general public and these people with professions, like we five awardees. So you have "we the people" – and the political, academic, industrial people they're dealing with – who they have impacted. Their (our) legislation comes in from the Governor – and they look at that as bills are passed, or as bills are in the Conference Committees – and then, if passed, the Governor has to sign them before they become law.

Well, they put their Clean Air Coalition ideas and influence into various stages along the game. Like, for example, the asthmatics in Long Beach. What can we (they) do about this or that – so they're really involved in everything from emissions to ultimate impact on the receptors. It's not so much that they're (the CAC) air chemists, but they take what's known and then apply it. So they've been effective in introducing and changing things – including the legislation passed and dealing with the Governor and dealing with the Legislature.

So you had this group of awardees – and it really struck me as I listened to them. So, I was the last speaker, and what I basically said in my "acceptance remarks" was:

"You know, we Academics, we've got it easy. We do our technical research, we get some grants, we do some science – it's really a heck of a lot of fun, science is fun. We've enjoyed it and it's a great thing. It's exciting. We professors have the fun and we have the challenges, and it's our job to take on those challenges. But the people who are really under pressure all the time are you people here today – the legislators, the M.D.s, the State agency staffs and appointees – and the Clean Air Coalition – and you the public. You are really on the firing line.

And so I guess my thought is that this Award really ought to be going to you people here. I'm really impressed with (a) What the Coalition is doing and (b), I think these Awards are given to just the right people. For example, here's this fellow who has figured out how to get containers in and out of the U.S. – and I'm sitting down here and we're talking about this – and here you've got the Mayor of one of the biggest cities in the country dealing with all kinds of problems – and then there is the Legislator who has to get reelected. You have to go before people who can be – and sometimes are – very unhappy with what you're doing.

So my feeling is, (a) first of all, you're all doing a very good job. A tough job!! And a great job, and I'm proud of all of you. And you Clean Air Coalition "team" are motivated people. You're not making a lot of money. You are really motivated and so – You deserve an Award!! We academics are just very lucky to – I feel very fortunate to be included in a group of people that receive an Award like this, because these other awardees are "on the firing line" compared to we academics. For example, I spent a lot of time on two sabbatical leaves in Britain – we academics could get into the "Club," you see. We could say, "This might be a little interesting "affair" here – yes, we might study this. Yeah, why not – we'll come up with some information." So we go to the lab – or we'll play with it or both. We have the fun. We have the fun. And if it doesn't work, with tenure we don't get fired!! You see?

But you – so, my feeling is – "But we're (academics) useful." You – society – need our information, and our responsibility is to provide it to you. Here's the bottom line. Our overall responsibility is to find out what's going on in polluted atmospheres. What and how much are the ambient levels of key pollutants? Then provide, in terms of the atmospheric chemists, information which we can provide to the epidemiologists, the endocrinologists, the heart specialists, provide to the public officials – to give you all a means of understanding, for example, (a) How you can get the data with these certain kinds of instruments; (b), these are data you can accumulate that are necessary

with these instruments, techniques and procedures – and then be darn sure that what we give you in terms of the science, the impact, the levels and the instruments can be effective, useful and accurate.

So we academics have those responsibilities – and it's frankly a challenge and a lot of fun to try to meet them. I feel very honored to be in front of a group such as this, dealing with these various aspects of our air pollution system."

The Haagan-Smit award was heart warming because I knew "Haagie" well. "Haagie" was a great guy. And he understood the ball game! He understood legislators, elected and appointed "regulators," and academics. He was a good Dutchman. Once, we discussed the fact that I was in the Netherlands and got this nice letter back that said, in addition to the science, they have good gin over there.

He had a good sense of humor and understood how to deal with both political figures and academics. It "ain't easy," but he did it. And real credit, of course, goes to Cal Tech, his research team – and the whole ball game.

So I would say those are really heart warming awards along with others received through the years. They are important to me – but the awards really go to our research teams, the men and women that I've been lucky enough to work with, and I want to make a comment on that. This is a good time to comment to you on the "women side," but I want a moment to say – I have been so fortunate to be able to deal with young as well as older people. You know, "across the spectrum" – but particularly in generating the information through the Air Pollution Center – and concurrently serving on panels for the state and for the country. They often were challenging, but really rewarding, and if you needed to get something passed, by golly you got something done.

One of them I can remember – I'll remember – was really a rewarding experience – I was appointed to the State of California Scientific Review Panel for Toxic Air Contaminants. Now, this was set up by a law passed around 1984 – AB1807, the Tanner Bill. It said the State of California will set up a Panel who will oversee the State Agencies who are dealing with Toxic Air Contaminants (Federal nomenclature is Hazardous Air Pollutants [HAPs]). And the panel shall contain – it must have a Chemist (that was me), an Oncologist, a Heart Specialist, an Epidemiologist, and also several other professions. So basically they were medical people. They came from Stanford, Berkley, UC San Francisco, the top names. Actually, Dan Aldridge was one of the – well, the first chair was Emil Marak in '84. He was the Chancellor at UC Davis – the guy who transformed UC Davis from a small school to a big-time University.

So this was – and being on this panel was really exciting. And I was on it from the very beginning, in 1984 until 1997. One reason I resigned as Chair and member was that I had to get our "damn book" completed.

I was Chair for a number of years, and that was educational – in several ways -- and fun. And let me give you one example of what we could do. We had, really, we could "oversee" the Departments responsible for Toxic Air Contaminants (TACa; Federal designation Hazardous Air Pollutants HAPs). It was – oh, what exactly was that title? It was "Office of Health Hazard Assessments." It's the State agency that evaluates, along with the California Air Resources Board, for example, various kinds of pesticides and their impacts on health and the environment – this sort of thing – pesticides and other agricultural chemicals and along with a variety of other aspects of – this whole area of hazardous airborne pollutants, including diesel exhaust. The California Air Resources Board and Office of Health Hazard Assessment evaluate those pollutants, and our Panel did the overview. Our perspective was that of a panel from all different fields.

One of the members was a chap at UC San Francisco who actually defeated a tobacco group in – yeah, Stan Glantz was his name. "Stan The Man" Glantz. He was outspoken, by golly, he fought the battle. He won against the tobacco industry.

That's the kind of people we had on the Panel. The pesticide expert was Jim Seiber. And others were just as well qualified in their fields – but they (we) weren't "advocates" in a sense.

This was just – one of the things that came up where I found I was able to act a little bit as a chemist – I sat back and watched most of these people from industry, universities and agencies who are in the toxicology field.

And, of course, evaluating pesticide risks, that was a big thing, and Jeff, you remember when they sprayed ethyl parathion (and later malathion) on the orange trees (both contain a P double bond S) on fruit trees in Riverside.

So all of the people who are listening to this – think of the "stuff" hanging on structures which contain a P double bond S. Ethyl parathion, for example, is an example. This was sometime in the '80s. So there was this big review of this organic phosphorus pesticide – this big article – saying, OK, this is our evaluation of ethyl parathion toxicity (I've got it here somewhere). Anyhow, so it says, "no real problem" – they then have to say what is the by-product, etc., etc. – it's "safe" – here's the toxicity and all that. They, the evaluating agency, did point out that about one percent or one-tenth of a percent of the organics present can be peroxones– a very small amount. And this is such a small amount, you see, it's "really not a problem in there" and it can be sprayed and used "safely" and so forth.

I went to Jim Seiber and said, "Wait just a minute. Hold on. How long is it, the parent compound, stable when it's in the atmosphere? What's the lifetime?" So everything came in – this is where as an amateur chemist, you could come in and talk to these M.D.s who are listening and say, You know, isn't that deadly – oh, yeah, that's right. It kills people. In fact, they're banned (inaudible). Well, now, if you write this whole thing, don't you think – where's your section on showing the lifetime in the atmosphere? And what are the reactions going to convert it to?

I said, maybe we ought to look at this in detail, and it turns out that very rapidly after you spray it on the tree it is converted to ethyl peroxon. So the Panel listened to this, and boy, the "heart guys" said, "Holy mackerel, that does that?" Yeah. There it is. And that formal pesticide evaluation would have gone through if we had not been able to catch it right there in the bud (so to speak).

So, that review had to be all rewritten, and I'm pleased to say that that's one of the things that was and remains what's really most interesting to me as a "contribution."

Then, consider malathion – everybody uses it in their yards and in some cases even in hairspray for kids! In fact, in some places, it's actually recommended for kids who have "things" in their hair.

Well, malathion – well, so, we kept looking at this – and mind you, this was back in the 1990s that they did this widespread spraying – I've got it! It's in our 2000 book. Malathion has a P double bond S, but the toxicity of its P=O form in the environment all depends upon if you have a strongly electron withdrawing group. If you make a P double bond O out of it, then the toxicity depends upon the electronegativity of the molecule.

So actually, if you're talking about ethyl parathion or malathion, you have a compound readily oxidized to actual nerve agents! I raised hell back in the late '80s or early '90s about this phenomenon – they were spraying residential areas near L.A. with malathion. Do you remember that? They sprayed large areas of homes near L.A. – they sprayed in Florida, and they sprayed somewhere in the Valley. They were actually spraying not only the plants and trees, but also the swimming pools. They warned people about swimming pools – "Don't go in."

Well, it turns out that then some people actually went and measured the concentration of malathion put on and of the oxidized malathion, malaoxon.

It turns out that if you put the spray on and you actually measure it, you not only have P double bond S, which is malathion, you get rapid conversion –

actually within less of a day, more than half is converted to malaoxon, which is a nerve agent. Which is deadly. Really bad. That's what kills – that's what kills the bugs (and the fish, etc.). So this thing was – this was really a very interesting example, and the sprayers and the public should still worry about malathion → malaoxon.

Well, I'm still concerned about it and concerned that malathion is still available without – I think, without sufficient warnings. And you've heard – you've heard them say, use this, it's safe. The warnings are not there, or if there, not strong enough. They ought to be there. We did get the ethyl parathion banned in California, but I think it may be still used down in Texas. Actually, I shouldn't say that. "That was then." I don't know the situation today.

I think that's a very interesting issue you can get together and discuss with meteorologists. The meteorologists could be interested and useful because it's a "transport and transportation phenomenon." This chap and his name – I've got to think of it (actually, it's Jim Seiber ) – he's on our Panel, and he's a brilliant guy. He looked at agricultural chemicals and atmospheric reactions. He did some beautiful work tracing the spreading of the pesticides, and they found the oxon form (highly toxic) up in the bodies and nests of eagles and the birds that were way up in the Sierras where the winds had transported it. So that's an interesting example – and I find it very challenging and very useful to have been on that Panel.

Actually, I'm still interested when I pick up the paper today and again see headlines like "Pesticide Linked to Autism Suspected." Small number, 28 or 29, of women – but they live next to this field that was sprayed by a couple of classes of organic compounds. It is something like, there are 29 women, but there's a very large number of those women that are affected – it's high – of the 29 women examined, let's see, where is it – ok, they found something like 10 or so, eight or 10, I should give you the right number, but a very large number of people who lived there. It says, the rate of autism among the children of 29 women who live near the fields is. OK. Found the article. Eight of them. Eight, believe it or not, eight – 28 percent of the – eight of these 29 people, eight kids had autism. Now, this is – well, anyway, so this is bad!!!

This is what you've got to look at, and this is where I think, again, the emphasis is on transport and transformation – and then dealing with this oxidation process of thiones and direct impacts of other classes of pesticide.

So this is today. "The more things change, the more they remain the same." I remember the first part. Barb remembers the middle – my wife being of Canadian origin, an American citizen for 30 years – but that's it. OK. That's one.

Here is – there's another one here that I had here that I was just – there's another one here – "Printing could be hazardous to your health"! This is recent. August 1, 2007. The laser printer sitting on your desk "could be emitting high levels of potential hazardous particles," according to a study published today. Some printers released ultra-fine particles, study authors say.

There have been a few studies, the researchers did the work – the people who were doing this, a woman, Lydia. Yeah, interesting study – physicists at the University of Technology in Australia. They found that 37 printers are not emitters, eight are medium and 17 are high emitters!!

On another final topic, Barb has what we call Community Day at UCI – she has an Institute funded by the NSF, "AirUCI" – created it and has directed it for a number of years. She did/does something really novel – she sets aside a day, Community Day, to discuss what are we studying – and why – with the general public. Very interesting interactions.

She also has an ongoing NSF-supported program with 20 high school teachers coming in to UCI chemistry labs every summer. They spend two weeks here actually with lectures and in the labs! These High School chemistry teachers are really neat. In the first "class," interestingly, only one of them who was teaching High School kids actually had a degree in chemistry. They're biologists or "environmental something" – who knows what they were/are. But they were not chemistry majors in college.

Barb's group brings them in here. Actually, this NSF-funded program has been very successful. They got the 20 High School teachers to come over to UCI in the summer for two weeks, and they got them all, all 20, put them in lectures and laboratories. The faculty said, "Here's a UV spectrometer" – and showed them how to use it – with real samples. Each one of the senior researchers in Barb's AirUCI Institute, the faculty – some are doing modeling research – they show the teachers how they do air pollution transport modeling, for example. It takes hours, and they go through this whole set of experiments, and two weeks later they go out of here with a wholly new perspective on chemistry techniques applied to real problems.

Well, it turns out that now High School teachers from all over the country are trying hard to get into this program. That's a lot of work, setting up the labs and "teaching the teachers." They're doing that at UCI.

This is getting to another point. When Barb was elected to the National Academy of Arts and Sciences, this was last year, in 2006, we went back to Harvard for the induction ceremony.

Alan Alda – MASH – was an electee in her group. And he was great. Alan Alda was terrific. Really a neat guy. He had a good sense of humor. Gave a very fine talk.

The American Academy was founded in 1784, and they have all kinds of inputs – you walk into this building at Harvard and learn, for example, Einstein and Churchill were elected years ago. In Barb's group, they also had U.S. Supreme Court Justice Roberts. So hundreds of people were there, and it's a big affair, American Academy – and it's been going on for hundreds of years – and it's kind of neat because they're not just chemists, and they're not just scientists, they're everybody, e.g., they've got Alda.

In one part of the ceremony, they had presentations and then asked if any one of the inductees had a question – Does anybody in the audience have comments about this? Nobody did. And then Barb stands up and says, Well, you've got to go back to the High Schools. Curricula are meager enough starting at the colleges and universities – but it's the High School teachers. You've got to go back and get them into chemistry as a discipline early.

By the way, and it was a very interesting – when she got up to get her "diploma," the head of this Induction Ceremony, a woman, had quietly told Barb that she "made some very interesting comments." So that "rang a lot of bells." So, shoot. Ask me more.

Gaffney: Clearly the group here, and you, have been just very prolific in terms of getting the information out, which is, of course, crucial to the points you're making. And that is the success, is really communicating that information with the people who need that information, legislators, etc.

One of the things I did here was look you up. The ISI has the "Most Cited Scientists," and they keep track of not only how many papers you write but how many citations you get, which basically means that people are reading what you're writing. They've read, and they are impressed enough with it to cite it and refer to it.

So there's a new way of doing this now with a numbering thing that they just started – they call it an H number – anything over 50 is they've cited among the chemists as being just absolutely outstanding. I looked yours up and it was over 65. And I think they have – as I understand, only about 12 chemists in all time have ever gotten as high as 100 – so I just wanted to point that out to you and congratulate you on that fact, etc.

I know you've been telling us about lots of different things you're working on. Clearly, you're still active and doing just tremendous work. I know you're working with the students here. I've watched you interact with them, and it's just incredibly exciting in my mind to just watch you interact with the

undergraduates, because having worked with you as an undergraduate and as a doctoral student, I have always enjoyed and continue to recognize that if it hadn't been for you, I wouldn't be where I am. Is there anything else you want to tell us about what you're working on currently, that we've missed here?

Pitts: Well, I'm still – there are various areas that – well, one of them – yeah, I'll tell you – one of them is these indoor "air purifiers." Actually one of the neat things was work carried out by Sergey Nizkorodov, in this corner lab here. He is one of the newer faculty members. One of the things about being the "old guy" in the department – they set me up here with a neat office, and I'm sitting here looking out, and I'm surrounded by really – some really brilliant young people. We see students, graduate students, and young and older faculty, and that's just really a thrill.

And when you mentioned all of the citations, the citations should go to the men and women, the guys and gals that I've worked with through the years. The men and women at all stages – that " H number" of "over 65" really applies to each and every one of you. You're in that "number." It's "our number."

So you look at it that way and through the years, it's been and remains "our number," whatever it is – because that's the ballgame. That's our number, and I feel so lucky to have had this honor.

But, at any rate, we have a good bunch here at UCI. Let me give you an example of interactions. It turns out manufacturers have been selling these so-called "air purifiers" across the *country*. This is despite the fact that *Consumer Report*s says there are real health problems with some of them. The interesting thing on this, and I want to see if I can phrase this properly.

Well, a few years back, you know, Barb and I – she's sensitive to ozone and formaldehyde. She's also – by the way, I've got two things I want to tell you about quick. This is important. One, remind me about formaldehyde when we get through. I have both indoor and outdoor concerns that this primary and secondary air pollutant – which is designated as both a Hazardous Air Pollutant (HAP) and Toxic Air Contaminant (TAC) – can affect a lot of people in your audience – and this involves meteorology and can affect a lot of our audience.

**END OF TAPE 3, SIDE 2**

## Interview of James N. Pitts, Jr.

## TAPE 4, SIDE 1

Gaffney: OK. Jim, you were mentioning the fact that there are some real indoor air pollution issues that you've been looking at recently that have to do with indoor air cleaners and the fact that meteorology plays an important role in that as well as the mixing of these gases and indoor photochemistry and all sorts of things, so tell us a little more about that.

Pitts: So it's indoor "meteorology" in a sense coupled with indoor air chemistry. But you are now looking at indoor surfaces – but, let's go to the air purifiers.

OK. A few years back, on the "domestic" scene, from a number of companies, the idea came:

"Well, let's get air purifiers. If your air is dirty, let's put some type of instrument – in the window or put something in the room and – if it's in the room – it will purify the dirty (polluted) indoor air. Either outside coming in or inside – inside your house. You put the purifying machine-device inside. You turn it on. And your air gets purified!!!"

So there've been a number of different units that have been sold by different manufacturers. A while back, a couple of years ago, I became interested in how well they work – in part because I've been asked, "What do you think about air purifiers?"

At that time, Barb was – well, that was on the formaldehyde side of the "indoor problem." I will come to that in a moment. She was an example of what can happen with indoor formaldehyde – and that brings us to – just to "titillate" a bit, the audience, or whoever is listening to – or reading – this interview. Remember what happened down there in New Orleans in 2006 following Hurricane Katrina. Do you remember what kind of buildings they put the "refugees" in? Temporary buildings. Mobile homes. What they used to – and still do – put your kids in as elementary schools. Still put kids in. Mobile homes, right. We'll get to that major "indoor health problem" – formaldehyde – later.

Let's go to this one, now. A possible problem in your own home. The idea is that you put these "purifiers" in your home, and it circulates and purifies – cleanses – the air. Well, it turns out you put one in your home, run it a while, and your air smells good. OK.

Well, in fact, a significant number of these "purifiers" – and this is in the *Consumer Reports* – actually produce high concentrations of ozone. They generate ozone!!

Well, do you know why ozone – from the "purifier" – in your air works? You do. But I guess most people don't. Ozone is a great "purifier," because it destroys your sense of smell!! If you get enough ozone in the air, you can walk into all kinds of dirty indoor air and it smells good. So certain manufacturers advertise and say put one in your bathroom and your air will be clean. Put them in your bedroom, etc.

Not all air purifiers generate ozone – some types of air purifiers work well and are said to be safe. I won't go into the specific companies who are making them. I suggest to anybody interested in indoor air purifiers go online, go find out – i.e., go to air purifiers as tested by the State of California Air Resources Board, and look these up.

How do you know this problem must exist? Because it's suspicious. Because Barb knew – we both knew that this phenomenon, i.e., ozone, can destroy one's sense of smell. This was years ago. You knew it when you were back in the lab.

So it turns out that I talked to (inaudible) a brilliant young Russian atmospheric chemist, Sergey Nizkorodov. He is now an American. Here, in our Department of Chemistry. He's next door!!

That's what's kind of neat about being here. You can talk to these brilliant young people – and the older ones, too, e.g., Mike Ezell and Stan Johnson. These are Chemistry Professors who have been – they've been in the game for many years as teachers and researchers and are today working with Barb. The two older – the gentlemen are – retired from their life-long careers in State Universities – my point is – and I made this before – when you "retire," you retire from your job but not your profession.

So these guys here are retired Professors of Chemistry. One was a Dean, one was a Chair. I've known them for years – they worked summers with Barb when she was on the faculty of Cal State Fullerton some 15 years ago.

Today, they are working right here, right down the hall on her AirUCI project. They're invaluable because (a) they "Know their Game," and (b) they're working with Barb's young graduate students, postdocs, etc.

So you've got her great group – at least half are women from everywhere – e.g., from Lebanon, Israel – from here, from there, she's got them all.

Anyhow, so Sergey is here and is a brilliant teacher/researcher. I've had a chance to interact with him over the last couple of years. So I suggested, why don't you find out what's produced by various home "air purifiers." By the way, he teaches Freshman Chemistry beautifully, and advanced courses, and

he's really sharp and a good guy. With a good Russian – and American – sense of humor. He sort of blends together those "humors."

So anyway, he went and got several purifiers and measured in his laboratory, indoor $O_3$ levels with various devices. He got some beautiful data – and there's just no question about his results. They're published now. The data have been published. It turns out that for some models you get very significant amounts of ozone generated. So you're getting levels that are really serious – and the sad part about it is some of these devices were exceeding the Federal and California Air Quality Standards by large amounts.

An interesting aspect is that the saddest part of all of this is their impact on sick kids. Like, if your kids have asthma. Well, they've shown now, there's a paper that I could give you – it's a couple of years old – published by a woman at Yale, I believe, in epidemiology. She looked at kids who actually have a problem, asthma, and they go to their doctor to get a refill – they have to see them for prescriptions sort of regularly – and they're sensitive down to, I don't know, like 60 or 70 ppb of ozone. Ninety ppb is the State Air Quality Standard– well, with certain "air purifiers," they're getting 200, 300 ppb.

Can you imagine – and more people are, including our own, you're looking around and your kid is sick. Well, gee, we'll put one of these "ozone generalizing" air purifiers in their rooms. It's really serious stuff.

But the bottom line is, Sergey gave a beautiful paper, and it's classic. It's all there.

If you've seen the posters on the wall outside our offices – you've probably seen them – there are the results. So there is no question with these various instruments. The instruments are beautiful, and there is the guy you are interviewing (me). Sergey has been nice enough to put a little acknowledgement at the tail-end of this poster – and you should read his paper.

Not only is ozone itself a serious health problem, they show that it reacts with other contaminants, gaseous and absorbent. They had a whole Conference on this – Indoor Air Chemistry. So you can have indoor reactions on the things you put on your rugs and the paints and the whole thing – with the ozone that is generated by the so-called "air purifier."

A bill went to the California Legislature about four or five months ago. It got to the Governor's desk to sign. Well, the Clean Air groups were for this, and they cited a host of references. Among the people who were opposing this bill were the Hotels Associations and such. It turns out that's what some of them put in hotel rooms. You have a dirty, smelly hotel room, you put in an air purifier and it smells good! So they were opposed to this bill. I'm not saying

all hotels did this, but this was very clear – their Association strongly opposed the bill. The bottom line is that we were asked for a letter – so we were able to come in and write one – and it turned out the bill did not undergo a "pocket veto." Governor Schwarzenegger signed the bill!

So, indoor air chemistry is really exciting. And now the last "item/subject," because this is enough. Talk about up to date. Here it is Friday, May 22, 2007, and you really have to think – "Oh, formaldehyde!" The last two indoor air quality problems are current!! The mobile homes FEMA used for refugees from Katrina everyone has seen in the last couple of weeks. If you have watched TV, CNN and the others have dramatically brought up and illustrated the fact that these people lived in the mobile homes that the Government put in after, what's it called – whatever it's called, they take care of – it's their job to take care of putting sound, clean new homes in the aftermath of this sort of disaster. The agency –

Gaffney: Homeland Security?

Pitts: Home – no. Not Security. It's where you actually –

Gaffney: Oh, FEMA?

Pitts: FEMA. Federal Emergency Management – yeah. And they come in and bring in all of these mobile homes – thousands of mobile homes – and it turns out here are these people, a couple of weeks ago, and they're in tears. They're red. Their faces all swollen. It turns out that formaldehyde is coming out of wall panels in these trailer homes. Loaded with formaldehyde, and these people – and they testified – and this was on CNN – and I bet you the people listening are all over the world – have listened – should be listening to this. This is important. I warn anybody who is, has been, or might be impacted – if you've got indoor paneling, you've got to be very sure that that room is properly ventilated – i.e., very well ventilated. After thousands of people, including little babies, have been exposed to high levels of indoor formaldehyde is terrible – you know that.

My wife, Barbara, was exposed back about 15 years ago. I was going up to a conference in Canada, and we had this little home at the beach. We had had some wall paneling put in recently. When I came back, she had been inside a lot writing a research proposal. Her whole face was red and broken out – it was formaldehyde. We got the new panels off, and it wound up they were the cause. We knew this from one of our previous studies at the Air Pollution Center, where we had studied air quality in an old school mobile (trailer) classroom.

By the way, that's where some of our school kids throughout the U.S. go. Elementary schools often were/are in these buildings. Now, it isn't every

panel that's the problem. It's just certain panels from certain countries at certain times. But you darn well better know.

Today California has been looking at indoor air in classrooms, and they're doing a good job, now. They're really checking this out. Earlier on at SAPRC, we carried out some studies where we put multipass (inaudible) infrared and UV spectrometers in a mobile "home" – bouncing the beam back and forth on a multipass mirror system. We measured indoor emissions from a gas stove – and we also wanted to check another thing. We wanted to check for how one could accurately measure indoor formaldehyde. Do you want to do a wet chemical method? Well, let's check it. Let's confirm it. There is a name. I'll think of the name of the wet chemical way for formaldehyde –

Gaffney: Chromotropic acid.

Pitts: Yeah, you're right. So we got it in there, and so we went ahead and checked it out. There was some small background formaldehyde in the home which was some 20 years old. Then we brought the new wall panels in. I bought some of these panels, and I took them some from our house, too.

So here are panels. Let's put them in our instrumented mobile home. Raise the room temperature, and formaldehyde levels went zoom on these panels from our home – hundreds of ppbs.

So there it is. We had it all there. And they originally came from a foreign country, and they were selling like hotcakes. These were expensive panels. These weren't the cheap ones. So there we were. We had the formaldehyde – and the impact on Barb? She's still allergic to formaldehyde! We published this(Biermann, Pitts, et al.), and it's in our Book. Anybody who has paneling in their house should be thinking about this possible problem. That inexcusable FEMA disaster in New Orleans. My heart went out to those impacted families.

By the way, that wet chemical chromotropic acid technique worked fine when properly handled!

Well all of this is late in the game when the formaldehyde problem has been known for decades.

Now here's where, again, I think our public and all of we scientists should be very sure that our "Regulators" and Legislators know that there are such things as Indoor Air Pollution (note the caps) – as well as Outdoor – and that it's our responsibility to let elected officials know the facts. It's our responsibility to interact with them – so that we "academics" have a way of saying, "By the way, check those panels." That should have been done long ago. I think indoor formaldehyde is a tragedy – and the health impacts last for

years – perhaps lifetimes. Consider Barb – she's still allergic!! So it's really a serious, serious game – that's current now. So to wind it up, it's the "little guys and gals" who are out in the mobile homes who are getting nailed – but check out expensive panels in your homes.

Speaking of the "little guy or the little gal," they "get it" again. Friday, May 26, 2000 – L.A. Times – which is quite a good paper, actually. Headlines. California Edition, here. This is the California edition. "Cancer risk rises for those near rail yards. A study says neighborhoods near several major facilities face a greater threat from diesel soot than residents elsewhere. Residents who live in the shadow of Southern California's booming rail yards, the rails, face cancer risk from soot as much as 140 percent higher, 140 percent higher, than the rest of the region, according to new studies by state air regulators."

"In addition, clouds of diesel exhaust smoke blown by the wind from the rail yards, blanket wide swaths of greater L.A., upping annual cancer slightly for millions more residents."

The risks are much higher than they ought to be, and we need to reduce them. So now "they're" looking at these things – and the hardest hit were the neighborhoods near Commerce, which is low–moderate income, but it's not the lowest end of it – moderate income near one Union Pacific and three BNS yards. Residents in the tiny working class neighborhoods by the yards are 70-100 percent more likely to contract cancer from diesel soot than people in the rest of L.A. Regulators said some homes are only a few feet from rail yard fences, and there are schools and parks which are operated.

So anyways, I think this is another of a wide variety of challenges that, <u>in conclusion</u>, face us – our "society" today!! And it's understandable, the booming society, so they are challenges that face all of us.

I can see challenges to the Governor and the Legislators. It's tough for them – there are challenges, again, as we said, being faced by this Clean Air Coalition. There are challenges to the Legislator, there are challenges to the industry involved, there are challenges to "we the people." Are we really – do we really <u>know what the challenges are</u>, e.g., in terms of "What's in our home" – in our cars as we drive crowded streets and freeways (see recent papers by Winer, et al.).

So are we willing to support, e.g., non-polluting electric cars? This "option" was once before advanced – and it was deliberately "shot down" – at least according to one movie. It was one show, one film – that's an interesting film – you ought to think about that. I just heard the other day that they're starting over again. Starting over with electric cars. What a great idea.

But, at any rate, let's not be cynical. We're not. We'll end on a positive note.

We have great groups of young people that we see coming up from around the world. That's what's inspiring to me – to see these young people coming in. Also to see some of the older researchers coming back – to see them come back interested in the fundamental sciences – and their "atmospheric" implications and impacts. This is what Barb is doing and has been doing at her Institute (AirUCI) with High School teachers. The international collaborators – women and men – and the idea of surfaces, looking at surfaces. You are really looking at some really exciting phenomena – and it's there.

The science is there. So I think that we're very positive, very fortunate, to have the facilities available and people who are listening. I have a real hope for the future that we can, in fact, by working with the universities, government, private sector, we'll be very happy to do something exciting and positive "this way or that."

We're not out to knock anybody – but "These are the facts – just the facts, ma'am," as they used to say in an old show.

Finally, as an atmospheric chemist, I want to thank all those on the meteorology side. Thanks a lot, guys and gals, for what we (I) learned in WWII (and subsequently in air pollution). I can tell you all, it was fundamental meteorology, especially micrometeorology!! that I saw right down there in the jungles, on the desert, etc. – and it was real.

Finally, I want to thank you, Jeff. I'm so proud of what you've accomplished in your career. You've mastered and then "transmitted" the science, etc., from so many aspects – air pollution to nuclear energy – and all the way to atmospheric chemistry here and in Mexico. You're "carrying on the fight" for Clean Air. It's not a fight against industry or government. It's a challenge on all fronts.

And, you know what – it's a lot of fun, too, to be involved in something that is just plain exciting, challenging and worth doing – and to be interactive!!

So I want to thank you, the American Meteorological Society, and Barbara, my wife – my inspiration, all the people and the whole ballgame, she, you and my students. I wouldn't be here without all of you. At least, as I said, "I didn't negatively impact you the good ones." I want to thank them and Barb, who has been the real driving force and senior author of both of our books. She not only handles me – and handles me well – but she also concurrently handles our current two-year-old black lab retriever Major and our 10 year old golden retriever B.R. The golden is trained. The male black lab is a little harder to train. More like me.

So thanks a million, Jeff, for putting all of this together and conducting a really fun interview. And thanks to all of you in the Society, including Diane Rabson, Archivist at the National Center for Atmospheric Research, for having a transcription made of this interview. Then finally, I want to express my deep appreciation for the splendid efforts of Jennifer Collopy in assisting me in editing and carrying out the actual word processing the final document. If you have any future follow-up questions – I'm around (hopefully).

Gaffney: I really want to thank you, Professor Pitts, for your time and your answers and I think I – I want to thank you, too, for actually having been my Thesis Advisor and having had the opportunity to get excited about chemistry and the atmospheric work, etc., as an undergraduate at the University of California, Riverside, where you taught. But I want to thank you for your time and, at this point in time, our interview is now complete.

Pitts: Great.

**END OF INTERVIEW**