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WORKSHOP ON DIFFERENTIAL SUSCEPTIBILITY OF OLDER PERSONS TO ENVIRONMENTAL HAZARDS

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DR. WEGMAN: Good morning. I am David Wegman who is chairing the Committee on the Health and Safety Needs of Older Workers and pleased to begin the second day of this workshop on differential susceptibility of older adults to environmental toxins and it has been a very interesting day yesterday and we are looking forward to a continuation of that level of interest today with discussion at the end to try to bring together our thoughts at least in a preliminary fashion.

I would like to ask people to be thinking for our final discussion about particularly those of you who had an opportunity to hear the report or read the report from 1987 that was done from the Academy on the issue of the environment and older adults and if you can contribute a sort of brief summary at the end of the relevance of those recommendations and how they could be updated to the present day so that we can take full advantage of that report in addition to the work being done by our committee which is specifically targeted to older workers, not all of older

adults.

With that brief comment I would like to introduce our first speaker, Paul Gilman from the Environmental Protection Agency who directs the Office of Research and Development.

DR. GILMAN: Good morning. It is nice to see who knows how to handle the snow. For those of you from out of town you are very lucky to have survived a town that isn't very good at handling snow and those of you who are from here certainly know that very well.

I am going to try to give you a sketch of the Office of Research and Development and of EPA, really give you a feel for the breadth of what we do.

I knew I would be talking to an audience some of whom would know very well what we do and many of whom would not and given the snow factor I don't know exactly what my proportion is although some faces and names I know a great deal.

I am going to try to give you a little bit of a flavor for how we have approached children as a special subpopulation and how our thinking currently is about how we will approach the aging to give you a flavor and that is to

say that our thinking is not complete and that is why this workshop is so valuable for us, but we have felt a need to begin to organize our thoughts and begin discussions with some of our colleagues in other research agencies.

Let me start by just saying that for the Office of Research and Development which is about a $600 million enterprise within the EPA which has the mission of both supporting the regulatory side of what the agency does and also supporting a research and development program that can deal with emerging issues and look to future issues and in many respects what we are doing here today is in that category. We rely heavily on our collaboration with other federal research partners, state and local researchers and academic researchers because of course we don't have the resource base that many of our colleagues in Federal Government have but nonetheless we try to exercise leadership in the environmental arenas and environmental health and in particular in the science and technology associated with risk assessment and risk management.

We think that science is a critical component for credible decision making in our mission area. It is not just the doing of the research which has to be relevant, has to

be current, has to be really leading edge in many instances but it is how we characterize the findings of that research and put it into a package that is available for decision makers that ultimately is where we get judged in the quality of the work we do.

I mentioned that our resources are about $600 million a year for this work. That is roughly half what we call core research. Some might call it basic research. It is not research that is immediately relevant to the applied missions of the agency. The other half is that research, so work directly applicable to the agency's mission on regulating particulate matter in air for example, food protection, pesticide and the like, solid waste disposal, water-related issues looking at programs like the total maximum daily loads initiatives and programs of the water office.

One thing I am discovering as I have been at EPA is that the time frame from that core research moving to the application is very, very different than I would have expected before going to EPA and probably a lot different than many people thinking about core basic research. We find instances where even our university-funded research is

having immediate effects on our programs.

One example is some work done by a statistician out of Colorado State that had immediate impact in our environmental monitoring and assessment program looking at more statistically and scientifically based environmental monitoring program. I recently attended an event in our region one, the New England region where the folks in that region,sort of really the ground troops in our work in enforcing environmental laws and carrying out voluntary programs wanted to meet in a one-day workshop with our university researchers who are funded through our STAR(?) grants program and they were very enthused to have that opportunity and get in it firsthand.

They, also, were very excited about trying to pass along to those researchers some of the issues and problems they face on a daily basis.

We organized our intramural research and our extramural research around the risk paradigm. We like to think that we have embraced a lot of the leadership that has been provided by the National Research Council and the Institute of Medicine. We also like to think that we are in the forefront of putting into sort of the practical side the

application side some of the tools that have been discussed and when we talk about uncertainty and variability, uncertainty in the work and variability in the populations we are struggling with that every day.

If I use this particular graphic to discuss how we have focused our work in children for example as a special subpopulation a great deal of emphasis in that box called exposure trying to better understand how children's exposures differ from other populations and certainly on the toxicodynamic side trying to better understand the biology of children and how those exposures affect or don't affect what we normally think of as the adult biology that we are much more familiar with.

Again, as organized around a risk paradigm usually as we develop our research programs we do so thinking along the categories that you see here on the left, the way we gather those, the data to sort of fill those categories of work are pictured on the right and the purpose of this slide really is to also speak to the fact again that we do much of this work in collaboration with others because the breadth and depth of it is so great.

Let me now speak to some of the specifics of our

thinking on senior citizens and the aging. Obviously we wouldn't be here if we weren't all well aware of the demographics of the situation and again as I have said for children we already know that one of the areas of focus at EPA has to be on better understanding exposures and then overlaying them over the particular disease and biology of the aging.

We, also, know that we need to better understand the environmental impacts of an aging population and I think that is probably something that is somewhat unique to the EPA perspective on an aging population.

Let me do this in a little bit more detail. Obviously we can think about senior citizens who are normal, in quotations but with diminished capacity, those who are in the process of having an emerging disease or illness and those who are currently afflicted with a disease or an illness and we believe and I think that it is not a revelation that the strategies aimed at intervention or prevention have to recognize these different circumstances because we are not going to be able to find one particular approach that would be suitable for all situations, and certainly again in order to better understand exposures for

the environmental stressors versus other stressors associated with aging is a key approach that we feel EPA is uniquely positioned to focus on.

Our focus, we think, should be on increased susceptibility and vulnerability at the life stage and how it affects health not how the particular susceptibility or exposure might affect the aging process and that is a distinction we think is appropriate for us to make. The latter is something we think we have to look to our colleagues in other federal research agencies and in biomedical research more generally to look to. We think our emphasis should be on again clarifying exposures and drawing the relationships as to how those exposures affect both the kinetic and dynamic sides of the toxicological questions.

We believe our focus should, also, be as we turn our emphasis more and more to understanding cumulative risks rather than risks on a case-by-case basis to approaching this set of issues for the aging with that overlay of understanding both cumulative and aggregate risks.

We, also, understand and appreciate and believe we need to be focused on interaction between pharmaceuticals and environmental exposures, an obvious step we believe, and

ultimately then developing and validating risk management approaches again recognizing that not one size will fit all.

On the environmental risk side clearly we understand or are beginning to understand the demographics and the related effects of that, housing, recreation, transportation, medical facilities. We do believe that we can begin to understand those patterns and to develop strategies that would allow us to protect natural resources and particularly looking at questions of retirement in place versus retirement migrations and understanding the environmental consequences of those sorts of things.

I am usually moved to make some jokes about golf courses at this point but I won't do that. I think that basically lays out our initial thinking.

Again, we are looking to parallel approaches that we have done in the children's arena but obviously reflecting the differences in biology and exposure that we can imagine are true for an aging population. We are in the process, our colleagues from the NIH this afternoon will be speaking to their own particular interests and emphasis and we are in the process of beginning to talk with them about a collaborative effort. I hope it is both intramural and

extramural aimed at really dividing up the expertise of the different agencies and applying ourselves to those areas where we have the most experience.

I don't have a great amount of time but I am more than happy to answer any questions if I can. Hal Zenick, I hope will be here from Research Triangle Park this afternoon to join the federal panel and he has been our lead person in putting together these initial thoughts, and he can give you a better sense of future research directions with a finer grain of detail.

Yes?

PARTICIPANT: I had a quick question about monitoring exposure in older adults. I know we have done some studies in New York and I know there have been other studies done of the elderly population and one of the difficulties is that the equipment we have generally is too bulky, too difficult for them to be taken around with them and one study that I remember I was chairman of a session and they did a study of older adults. Actually I think they called them elderly adults, and they started out with that defined as 65 and above and then to get enough people to be able to carry the equipment around they changed it to 50 and

above as elderly.

I found this first of all very threatening but secondly, I think what it points to is that we need some equipment that lighter and easier to use to monitor this population if we are really truly going to measure their exposures.

DR. GILMAN: Point well taken. I often when I give our little talk on our children's program I will bring some of the cotton garments that look like footed pajamas that we use to better assess exposure and especially to pesticides and the like that are used in the residential setting. It is not terribly high tech, but it is the kind of thing you need to do to get the right kind of data and that is a very good point.

When I mentioned that we like to think that we are very much involved in advancing risk assessment science we like to think we are also very much involved in promoting the advancement of risk assessment technology. So, it is a point well taken, something we need to be thinking about. Anything else?

Okay, thank you for your attention.

(Applause.)

DR. SALTHOUSE: My name is Tim Salthouse, and it is my pleasure to introduce the speakers for the next session. Robert Friedland has been delayed. So he is going to be moved to later in the program and so we are going to start with Diane Gold who is associate professor of medicine from Harvard Medical School and she is going to be talking about ambient particle pollution in the elderly.

DR. GOLD: Thank you very much for inviting me to be here. As you mentioned, I am going to be talking about cardiovascular effects of ambient particle pollution on the elderly today. Why are the elderly more susceptible to the cardiovascular effects of particles? Well, in great part it is because they already have a higher risk of underlying coronary artery disease, of autonomic dysfunction with a tendency to arrhythmias, inability to compensate when they lie down or when they are we, lie down and then stand up again and underlying diseases such as diabetes which increases the risk of coronary artery disease.

The very first effect os particles were pretty obvious as was the pollution itself. This is a picture of Donora, Pennsylvania, in 1948. You could feel and taste the particle pollution and at least to most people the health

effects which immediately came after the pollution were pretty obvious, too, and you didn't need highly sophisticated epidemiology to see that something was going on in relation to particle health effects, but nowadays we need to look at large numbers of people quite often to see subtle effects of pollution that we can neither taste nor feel.

Here are the results of studies from multiple cities in the United States and these results have been duplicated over Europe and other parts of the world showing very consistently that particle levels increase the risk of cardiovascular mortality and consistently Joel Schwartz whom you heard yesterday and many others have demonstrated that increased particle levels in the air are associated with increased admissions to hospital for cardiovascular events, not just heart attacks but arrhythmias and stroke.

Now, why should this association be found/ It made sense to many people that an increased level of either gases or particles in the air might affect the lung, might in vulnerable people lead to pulmonary symptoms, but why the heart? Well, one explanation is that in fact pollution isn't directly affecting the heart. People are dying of

pulmonary diseases but when you die the heart stops. So, the diagnoses are incorrect in terms of this association.

Another explanation is that particles lead to low oxygen in the lung in the vulnerable elderly and that leads to poor oxygen delivery to the heart and therefore you get coronary artery syndromes and these explanations are not necessarily separate from each other but they could be interconnected.

In those who have chronic obstructive pulmonary disease air pollution could lead to a change in the vasculature of the lung and right heart failure could increase.

Air pollution could also cause systemic autonomic dysfunction with increased arrhythmias. The autonomic system for those of you who aren't terribly familiar with these terms leads, involves the sympathetic nervous system with the fight or flight response and in some situations you need your heart to go faster. In some situations you need your heart to slow down and what you really need is a system that can adapt to various circumstances and air pollution may cause this adaptive system to function less than optimally.

Particles could also lead to systemic inflammation

or pulmonary inflammation that goes on to the rest of the system and then ultimately to the heart and in coronary artery disease and myocardial infarction is more and more so felt to be a syndrome which involves inflammation within the blood vessels as well as clotting and inflammation can lead to clotting.

Particles could also lead to endothelial damage and therefore narrowing of the coronary artery vessels. So, these are all the hypotheses. Our colleague John Gotalesky and others in other laboratories went to the laboratory with animal models to start to see if they could understand or make sense of this association found in these large-scale epidemiologic studies between increased particle pollution and increased risk of cardiovascular morbidity and mortality and in healthy canines exposed to concentrated Boston air in larger levels but not extraordinary larger levels than might actually be seen in humans they found no hypoxia, no lowering of oxygen concentration in these dogs but they did find electrocardiogram changes called ST segment changes which suggested inflammation around the lining of the heart and also changes in autonomic function which are associated with increased arrhythmias.

They then went on to build models of dogs with coronary artery disease and found that the time to having full-blown equivalent of what in humans would be angina was much shorter when exposed to particles.

So, we as epidemiologists and pulmonologists and cardiologists went on to see if we could see similar subtle changes of particle effects in panel studies in the elderly using an outcome which is hard for people who don't work in this area to put their fingers on which is heart rate variability.

Heart rate variability which I think of as the ability of the heart to respond to situations appropriately and also relates that a tendency to have arrhythmias including malignant arrhythmias like ventricular fibrillation where the heart will stop or atrial fibrillation where the heart can't pump adequately and people get clinically into trouble to the point of being unable to function; so heart rate variability is important and lo heart rate variability decreases with age. It is lower when people are chronically ill. Low heart rate variability in the Framingham study and other studies has been associated with risk of sudden death and also

associated with increased risk of myocardial infarction.

Our colleague, Dr. Leo, Dr. Shy and other people both in Baltimore and North Carolina led the way in starting to do panel studies and then we worked with them to design panel studies in Boston to see if heart rate variability varied with particle pollution and then to look at complementary outcomes which might suggest that this association between high particles and cardiovascular mortality was a real one.

Some of the outcomes we used all relate to the variability of the time between normal heart beats. SDNN and RMSSD are two measures of this. RMSSD relates to the part of the autonomic system which is the vagal part of the autonomic system.

If you have a lot of vagal tone your heart slows down, but the vagal, you need a certain amount of vagal tone to be able to respond appropriately. If you have too much sympathetic tone your heart ticks far too quickly and again you are not adapting appropriately.

So, we conducted quite a number of panel studies and I am going to just show you the results of a few of them. The Boston summer study of 1996 to 1997, yes, George,

there was one 51 year old, a very frail 51 year old and it is true I fall in that category and I am almost up to, well, I am a member of the AARP. So, you know we are getting there like it or not but most of these people were 65 and older, I think everyone but this one 51 year old, and in our Boston 1998 to 1999 study 27 people participated and then in Steubenville where we had been for our six-city study we had 30 people who participated and in each of these panel studies there were repeated measures be they eight or 10 or 12 or in Steubenville up to 24 repeated measures where the same person was seen multiple times at the same time of the day and the same protocol was conducted but particle level varied from week to week when we saw these people and we saw many of their cardiac outcomes varied as particle pollution varied.

Our baseline data included EKG, blood pressure, oxygen saturation data, medications, and we are looking for interactions in fact between beta blockers and many of the antihypertensive medications that the elderly are on and the effects of particles, cardiorespiratory history and then bloods for C-reactive protein and the other sort of factors that indicate chronic inflammatory process which you may

have read in the papers is starting to be a good indicator of vulnerability to myocardial events, coronary artery events.

Our protocol consisted of 5 minutes of rest with respiratory rate and blood pressure measured, 5 minutes of standing. Then we went for a little walk with folks up a tiny incline and that was enough to be quite a bit of exercise for most of our frail folks, 5 minutes of recovery and 20 cycles of paced breathing.

In each of our studies people lived in more or less the same apartment area and we were conducting the study in a room and in the neighborhood of the apartment area.

So, the pollution exposures were pretty much the same for everyone, indoor and outdoor although we did get increasingly more sophisticated about measuring personal exposures.

This just shows where we put our leads and the modified V5 lead was looking at the electrical signals across the anterior part of the heart which is the larger part of the heart and then we were also looking at the inferior electrical signals.

Here is one of our participants. She looks serious here but she wasn't always and we will show you some of our integrating social activities into our research. We were doing blood pressure, oxygen saturation monitoring with the finger and here is the Halter(?) monitor and our research assistant carried the Halter monitor for her when we went for our walks around Huntington Avenue and Mission Park which is where folks lived in this very modest apartment block and we asked folks as a sort of give back because we believe in interaction with the communities where we do research whether they wanted some instructions on health risks, and they said, "No way. We want some social activities."

So, we brought kids from one of the art schools and we had a lot of nice interaction between the children and the elderly and we tried to conduct all our studies with this model of not being serious all the time and having some good interaction and give back.

We had a varied community in Steubenville also. This is the Boston community with a fair number of people who said that they were in fair to poor health but everybody was able to get about and go for their walk. It was a choice

but almost always people chose to do this with us.

The air pollution for those of you who know about these levels was very modest with a range of 2.3 to 45 micrograms per meter cubed for the 24-hour PM mean and likewise ozone levels were very modest indeed and because particles peaked as perhaps somewhat expected at a different time from ozone we were able to some extent separate the particle from the ozone effect in our first study and what we found was that overall and during this paced breathing which was the end part of the protocol designed to bring out basal function and dysfunction there was a reduction in heart rate variability and I won't go through the units here that was associated with increased particle levels and that reduction was at a level that is considered as a characteristic of folks, a risk factor in the Framingham study.

My yellow light is telling me to speed up but I will say that in 1999 when we conducted the same protocol again with repeated measures what we found was again a repetition of our observations two summers before, an association between particles and reduced heart rate variability and we were able to measure black carbon that

summer and lo and behold local traffic particles appeared to have larger and more significant effect on reduced heart rate variability than the measure we had of secondary regional particles suggesting that local traffic might be more important.

We, also, found a very small but significant reduction in oxygen saturation, so some consistency between messages here. Oxygen saturation was down a little bit with increased particles and now as we look at our data more closely lo and behold we find that there is ST segment depression which to some extent had a level that would go on with angina but without symptoms in the same study. So, there is consistency in the measures, in the outcomes.

We are getting several outcomes with signals from particles. In Steubenville we looked at one other outcome and that was exhaled nitric oxide in addition to the heart rate variability and the oxygen saturation in the ST segments and nitric oxide exhaled is a good indicator of pulmonary inflammation and ultimately what we are looking for is to see whether we can see at the same time PM particles being associated with pulmonary inflammation, systemic inflammation and a variety of cardiac outcomes.

We are looking for consistency in multiple signals and what we found was that as particles increased that particularly with the 24-hour measure of particles that exhaled nitric oxide increased adjusting for the nitric oxide and other gases in and outside of the room.

So, what we find in summary is consistency in a number of measures that particles do appear to have an effect on cardiac function in the elderly with decreased heart rate, variability, decreased oxygen saturation, increased exhaled nitric oxide suggesting pulmonary inflammation, decreased or depressed ST segments.

Other studies like the Dockery study have shown an increase in the firing of implanted defibrillators in folks who have those defibrillators and because they have a tendency to malignant arrhythmias our Canadian colleagues, the Brooks brothers and Francis Silverman and others have found that the diameter of the brachial artery is smaller with exposure in the chamber to particles. So, there is evidence for change in vascular tone and there are a number of studies showing evidence for systemic inflammation which may be in part the reason for the changes in vascular tone or arrhythmias with increasing particles and in a cardiac

rehab study we find that blood pressure goes up with increasing particles.

So, these multiple studies are starting to suggest to us that the effects found in the very large epidemiologic studies of particles on cardiac morbidity and mortality are likely to have some basis in physiologic rationale and outcomes and of course this work wasn't just by one person but many and I am sure I haven't acknowledged as many people as contributed to this work and the understanding of the outcomes.

Thank you.

(Applause.)

DR. SALTHOUSE: The next speaker is Paul Leigh from the University of California at Davis who is going to be speaking on cost of occupational chronic obstructive pulmonary disease and asthma.

DR. LEIGH: I would like to thank you for inviting me. It is quite an honor to be here with such distinguished speakers. I would like to talk about the cost of occupational chronic obstructive pulmonary disease and asthma with the idea that COPD and asthma are also two important diseases to look at in the elderly that can be

affected by environmental hazards.

First let me make some comments about economics. There are many different economic studies, many different ways to study problems using economics and one way is for example to look at the cost of a disease to Medicare or to Medicaid and the studies that I do and this study in particular doesn't look at that. I am much more concerned with trying to compare one disease to another to try to assess the overall burden.

For example, let us suppose you have somebody that dies young at age 60. One person dies of Parkinson's disease, another person with myocardial infarction or heart attack and let us suppose with the heart attack that the person hadn't gone, hadn't sought any medical care and just basically drops dead at age 60. The person with Parkinson's disease as we know has considerable morbidity prior to age 60. Other things being equal we would tend to argue that while the person with Parkinson's disease is a greater burden, a greater burden associated with that disease for that person than the burden associated with the person who just drops dead at age 60 with a heart attack and with that in mind the economic approach tries to ask questions to

measure that burden.

Were there hospitalizations prior to the death? Was the person seeking physician visits, a number of physician visits, the drugs that were used, days lost from work, days lost from home production, that is just enjoying home life, things of that nature and if you can measure those things, and we can measure those things then we can end up with some sort of relative magnitude measure to say, "Yes, in fact, there are more dollars associated with the death, Parkinson's in this example, the death of Parkinson's disease versus the death of myocardial infarction at the same age.

So, keep that in mind as we go through this study and think about other and as I said there are many different types of economic studies.

Well, the objective here is to estimate the number of annual deaths and most importantly the direct and indirect costs of occupational COPD and asthma in the US in 1996.

All obstructive diseases, chronic obstructive disease and asthma represent the four leading causes of death in the United States. They are interesting diseases

for a number of reasons. One is they are increasing unlike circulatory disease which is dropping and cancer I guess is remaining relatively the same but COPD and asthma are increasing fairly rapidly and there is cause for concern.

In particular among women COPD has been increasing quite rapidly. A lot of people will attribute this to increasing smoking among women, but as we all know in the past 30 or 40 years women have increasingly entered the work force. So, you could also argue that some of this increase for women is due to increasing exposures at the work place.

COS(?) measure the magnitude of the burden and can be used to rank as I said before, rank public health initiatives in order of economic importance and of course the idea here is that we can rank these. Then we have some basis to say, well, you know if we have extra dollars let us go after this disease because it appears to have more burden on the American population than some other disease.

We use standard methods and we use some improvements that I will go over in a minute rather than try to invent new methods. If we continue to invent new, well, I am in favor of improved methods. However, if you have an entirely different method for each different disease then

you can't compare them. So, I use a method developed by Dorothy Rice and Thomas Hodgson and others that has long tradition in health economics.

So, we can compare these to other diseases. Now, there are two methods for considering disease rates, the incidence method and prevalence method as probably most of you are familiar with. When it comes to looking at costs we prefer the prevalence method in part because it is a little bit easier to deal with.

The incidence method says that you need to find somebody who was just diagnosed with asthma and say, "What is the future course of the asthma for the rest of their lives; how much cost will be generated for the rest of their lives?"

(A fire drill interrupted the meeting from 9:20 to 9:35 a.m.)

DR. LEIGH: Welcome back. I hope you are fired up now. I don't know what inflammatory remarks I made.

Let me see we were in the middle of this slide talking about incidence versus prevalence. We decided to go with prevalence. It is easier to deal with and that is what the literature does. One problem with incidence is that you

have to presumably you are supposed to diagnose somebody with asthma, let us say at age 20 and then estimate how long they are going to live and how much cost is going to be associated with the morbidity of asthma over the next 60 years.

So, that requires incredible assumptions about what is going to happen to that person for the next 60 years. So, we went with prevalence which is just how much disease is there now in this year, and as I say this is how the literature deals with it. Eighty to 90 percent of COPD is attributed to smoking. However, etiologies of asthma and COPD are multifactorial.

Studies have determined the percentage of COPD deaths attributed to occupational hazards. This is called a population attributable risk.

I am interested in however what is sometimes called the modifiable population attributable risk. We assume that the prevalence of obstructive lung disease would drop by the PAR, the population attributable risk, if occupational exposures were removed. So, we just think about if we could remove occupational exposures how much would the disease decrease, the prevalence of the disease.

There is no consensus in the literature regarding the correct PAR. Becklake has one of the premier researchers in this field and she has mentioned 15 percent PAR in the studies that she has reviewed. One that seemed especially strong for us was written by Korn and we used a 15 percent PAR from that. That is we are saying that basically roughly about 15 percent of COPD can be reduced if occupational hazards were eliminated entirely.

Turning towards asthma Paul Blanc and Toren published a comprehensive review. Fifteen percent also appeared to be a reasonable figure there. However, when we look at COPD in asthma the accumulation of these is zero. The incidence of this disease is influenced by age and to be working on a job for a period of years generally is required prior to getting COPD. That is not the case with asthma.

So, we assumed that people had to be 35 years of age or older to look at COPD morbidity and mortality. With asthma we selected the age of 20.

We estimated about 5 percent of asthma deaths are eliminated by looking at people with -- those are supposed to be a less than or equal to sign or no, greater than equal to sign in this. Anyway about 5 percent of asthma deaths we

are not considering because of our age restriction and over 99 percent however of COPD deaths we are including and this is the definition of COPD we are using. We are using the ICD-9 code and some of the data of the national hospital discharge survey, health care cost utilization project. We used nationwide data to estimate these costs.

The economics, the method here is called the human capital method and the human capital method looks at what is called the direct and indirect costs. With direct costs you have medical expenses, out-of-pocket expenses by the patients as well as the insurance companies paying for physician visits and hospitalization. There is also insurance administration that is paid for. These are out-of-pocket expenses that are going to the direct category. Within the indirect category we are looking at lost wages, lost fringe benefits and what is called lost home production. This is just well, taking care of children and home repairs and things of that nature.

The lost wages captured not just a hardship on the person and the family but also the cost to the economy. So, people are producing at the job, adding value to the economy at the job and one way to capture that is through lost

wages.

The direct cost we rely heavily on hospital days. These data are very reliable and have been used for a number of years. Hospital days are associated with the different diseases, the ICD-9 codes and we used these as, they act as anchors in our estimations of total costs. Hospitalizations are a good thing to use in part because they generate so much cost, about 40 percent of all national medical costs are associated with hospitalizations.

Many other studies have used just hospitalizations and estimated based upon that we came up with an improvement here. We tried for an inpatient adjustment and an outpatient adjustment reasoning that COPD and asthma don't generate the same amount of outpatient care.

Asthma generates quite a bit of outpatient care. COPD relatively speaking doesn't generate as much compared to the early death that is associated with COPD. So, we make adjustments for that in our analysis. It is one improvement we have over many prior analyses which don't look at those inpatient, outpatient differences.

National expenditures on medical care are over $1 trillion in 1996 and these include physician visits and

nursing home care, medications, medical supplies, dental services and over $1 trillion. It includes also about $61 billion for the cost of what is called program administration.

We believe this estimate is an underestimate of true program administration because governments, for example, have especially low administration costs but in part they can rely on taxes in the event of a shortfall whereas private insurers are not allowed to do that. Private insurers have a larger cushion and as a result in part that is one reason they have higher administration costs and these are accounted for in our study and many prior studies don't account for this.

We, also, excluded dental services reasoning that COPD and asthma really are not going to affect that. There are many equations actually in the study but just to make it easier to understand let us just take a look at kind of the broad picture here.

If we want to estimate for example COPD, the medical spending on COPD, we can look at the $926 billion. This excludes dental expenses and the program administration and this is the anchor I was talking about before. This is

the ratio of hospital days for COPD divided by all days, all hospital days for all diseases and injuries in the United States and this is the PAR that we assumed and there is an inpatient adjustment and outpatient adjustment that is fairly complicated but we adjust for these two things and this is just the name we gave it, medical dollars for COPD and $926 billion.

We, also, add to that equation 15 percent for insurance payments. This is administration cost for the insurance companies over and above what the administration is in hospitals. So, we have this and in the case of occupational disease you have worker's compensation indemnity payments that also had to be accounted for.

That is also the, well, I guess it wouldn't be true, well, no, it would be true for the elderly because you have Medicare payments to people. So, this would also have to be accounted for among the elderly over and above what Medicare administration costs.

The indirect mortality costs use the present value calculation, that is you try to discount things back to the present and we use standard methods there and to calculate morbidity costs we use the estimates from Rice and others

that looked at morbidity to mortality ratios and they included COPD and asthma in their calculations and we simply used their ratio to look at morbidity.

Our estimates using the 15 percent PAR we estimate about 15,000 occupational COPD deaths and about 800 occupational asthma deaths for 1996. The total is about 15,000 or 16,000. This is a busy table. It just shows you some of the calculations. We have some of the administrative costs down here and these are unique to our study, a little improvement over prior studies there.

This is some of the estimates we have for COPD, occupational COPD, occupational asthma. There is a misprint here. That should have been 1.7 and these are in billions of dollars. So, we have the direct costs for medical only, administration for medical insurance, administration for indemnity insurance. These add up to 2.8 billion.

For the indirect costs we have lost earnings for these people. We have the fringe benefits and also home production. This is estimated based upon how much time is lost in the home multiplied by a percentage of their wage, a smaller percentage of their wage than they would get doing the job.

So, these add up to the indirect costs and notice the direct costs for COPD are 56 percent and here indirect costs are 44 percent, the direct costs for asthma, but in part because of the medical care, well, the inpatient care is more and there are fewer deaths in asthma. So, there are less indirect costs that accrue.

So, again we are trying to get at this measure of burden and if a person dies young then there is a greater burden associated with that disease than if a person dies in old age, and I had better move along.

Okay, so, about 15 or 16 thousand deaths, by comparison about 20,000 people in 1996 died of leukemia. The cost of job-related obstructive lung disease is about 6.6 billion and this is one of the comparisons you can draw.

Another study looked at the costs of hepatitis C which gets a lot of attention in the press. However, that was 5.5 billion and here the cost of chronic obstructive pulmonary disease and asthma due to occupational factors is more than that. Yet I don't think that that gets nearly the attention that hepatitis C does.

Another point here is that worker's compensation systems rarely compensate COPD because a lot of this occurs

late in life and a person is retired. It is hard to go back to the worker's compensation insurer and say that you should now pay for this.

So,much of the COPD that is job related is paid for by taxpayers through Medicare. Employers are not paying the true costs of the production. They are shifting the costs to workers and taxpayers and a simple economic analysis shows that in this circumstance the price is not right. The price should be higher on worker's compensation, on employers associated with COPD. If the price is too low they will generate too much of what is called the negative externality, that is job-related COPD and asthma.

There are many limitations to our study. We looked at 1996 and naturally we would like to have more recent data and many of the exposures leading to these deaths occurred of course 20 or 30 years prior to this and many people in industry will argue that well, we cleaned up the industry and this is no longer the case. You have an over estimate there.

The death rates for COPD, however, have been increasing. So, you could make the counter argument well, no, wait a minute it is probably more now because the COPD

prevalence has been increasing and certainly the labor force is growing each year.

There is certainly controversy around the PARs. By the way in the article we looked at a range of PARs, anywhere from 5 to 20 percent and we used linear estimating techniques so that you can fairly easily extrapolate from 1 percent to 20 percent on what the PAR is, just multiply by the cost figures.

The PARs can be added up to more than 100 percent because of the synergistic effects. In our case for some people occupational dust exposure and smoking would be required to cause COPD. If either were eliminated then we could reduce the incidence of COPD.

The presence of synergistic effects would imply that more than 20 percent could be allocated to non-smoking causes and this would also apply to environmental hazards. So many people will say, "Smoking is causing about 80 percent of COPD, environmental hazards and occupational hazards must be pretty small," but if these are synergistic effects then you can argue that well, it could be more than 15 percent. It might be 20 percent for both occupational and environmental effects, perhaps more than 20 percent

because they act synergistically.

Oh, oh, I am over my limit here. Okay, let me just come back to the last point and that is that the advantage here is trying to calculate costs in a standardized way so that we can then compare diseases and get an assessment of the overall magnitude and that is the point of the economic analyses I have been doing and you can then draw inferences about where national priorities are. Are they appropriately placed or inappropriately placed and I think economics and costs should be one factor in deciding what are the major problems we are looking at versus lesser problems we are considering.

That is it. Thank you.

(Applause.)

DR. SALTHOUSE: Okay, the last speaker for this session, remember we had to switch around the order is Robert Friedland from the Center on Aging Society. He is here now, right? Yes, and I think we are now 20 minutes behind schedule because of the break. So, we will resume the next session at about 10:05 a.m.

DR. FRIEDLAND: Good morning, and I apologize for having to disrupt the schedule. I, obviously didn't allow

enough time to get here even though I applied a lot of extra time.

Thank you for inviting me. I feel a little bit susceptible since I am not an expert on environmental policy, environmental politics or the vulnerability of older persons to specific hazards and I should be.

I have long focused on the relationships between demographic change, the economy and public policy and while I have focused on health care, long-term care and income security as a broad concept the changing environment has played little if any in this role and yet surely the environment does matter.

I suspect that I am not alone in ignoring the environmental implications of these other public policy issues. In fact, when you look at environmental policy literature you tend to see the same phenomenon in reverse. The environmental policy tends to be about environmental standards, controls and incentives. Consequences tend to be measured in terms of industry costs, mortality and morbidity rates.

The previous speaker is an exception in the kind of work that we need more of. Far less focus has been on

other intermediary factors like health care expenditures or labor markets for instance.

Given that all of our public, private and personal institutions share the same air, literally public policy research should make note of the environment.

We should work towards a better understanding of the relationships between the environment and other sets of arrangements.

In the last 50 years the world population has more than doubled and over the next 50 years it should increase another 45 percent. By 2050 there could be over 9 billion people in the world, nearly 3 billion more than today.

Certainly in the developed nations and increasingly in developing nations larger and larger proportions of society are expected to reach an older age.

The scientific and technological and financial advances that define modern life have also resulted in declines in fertility rates. As a consequence we not only face the prospects of more people living longer but that a larger percentage of the population will be older. These growing populations in societies that are aging seek higher standards of living. Market-based economies are almost hard

wired to seek economic growth. Economic growth necessitates ongoing environmental pressures.

Over the next 50 years the population in the United States is expected to increase nearly 40 percent. Middle series Census Bureau estimates for 2050 suggest that 5 percent of the more than 400 million people in this country will be age 5 or younger. Seven percent will be age 85 or older. Perhaps these two age cohorts, the youngest and the oldest are among the most environmentally vulnerable but of course at every point in time the vast majority of people are growing up and growing older.

Wittingly or not each generation is a part of the ongoing struggle to balance growing societal needs and wants with the need to preserve the environment.

We know we need to protect the environment for our own sake but instinctively we want to protect the environment for our children and our grandchildren. The environmental challenge depends on understanding the risks, financial consequences and the technologies that may be able to ameliorate those risks.

Understanding the challenge would be aided by a better appreciation of how an individual interacts with the

environment over a lifetime and how the demographic changes of the population interact with the environment, what precisely are the linkages between population growth and environmental degradation? How important are these linkages to changes in the age distribution itself, migration patterns and other demographic aspects of society?

How does environmental change affect the demographics of society? The root of these questions is scientific but it is important to aggregate up from the specifics of a particular type of hazard and evaluate how these risks interact across hazards and with the rest of society.

The scientific questions should be a part of an examination of how people, the economy and environmental policy interact. Ideally public policies would always be based on a full understanding of the costs and benefits to society of the proposed policy change versus the full costs and benefits of not implementing the proposed policy change but public policy debates are virtually never about the full societal costs and benefits associated with change versus the status quo. More often they are about winners and losers narrowly defined to a moment in time and to stakeholders

with voices in the legislative process.

I applaud the Environmental Protection Agency for initiating special efforts to better understand the environmental risks of older people.

I recognize that because so little is really known well that this should be, I am sorry. I understand the environmental risks of older people that so little is really known well that those questions related to those specific hazards should be the central focus but I would encourage you to try to keep your eye on the larger picture. To get there these risks need to be better understood as a cumulative risk. Increasingly the scope of the inquiry should be pushed to go beyond mortality and morbidity rates to include implications for the broader economy as well.

Clearly the most limiting factor in this kind of thinking is the data that we have and so an important component of the discussion should be on developing and encouraging the kinds of data that are needed and more importantly and more realistically in the short run is developing better ways of linking information from one data set to another.

To the extent that we can begin to connect more of

the dots of time we will be in a stronger position to evaluate the costs and benefits from a lifetime perspective. This is a positive and appropriate way to frame public policy issues as it helps to identify the winners and losers over a generation.

What is learned through science is necessary but insufficient unless we learn how to apply the science to our social context. I would also hasten to add that we also need to be able to communicate the science to the public and to the policy makers.

Again, thank you for inviting me. I would be most pleased to try to expand on these points.

Thank you.

(Applause.)

DR.CHARNAS: I am Neil Charnas from Florida State University and it is my pleasure to introduce the next set of speakers for the session intervention and participation. Given our untoward interruption earlier this morning we are going to change our 11 o'clock planned break to being an informal break where people can come and go as they need at around that point in time but we will continue with the speakers to try to get back on schedule.

So, the first speaker for this session is Scott Wright, University of Utah, Gerontology Center and he has the longest title of anybody in our session so far.

DR.WRIGHT: Again, I would like to thank the committee for inviting me this morning to speak on this important topic.

I am going to probably present a different angle to the workshop topic given the switch in focus. I am a gerontologist primarily with a social behavioral background although I think this approach fits well into the EPA initiative and objectives and I am a firm believer in the idea of forming a team approach, an interdisciplinary approach to these issues.

One of the things I have been doing in the past 10 years is trying to build a bridge, promote the connection between gerontology and the topic that I like to focus in on is human ecology especially in my professional organizations, the Gerontological Society of America and the American Society on Aging and while it is with good intent that we focus in on Medicare and Social Security issues, entitlements and the health care policy I believe it is equally important to focus in on the other infrastructure,

that being the quality of natural resources in an aging society.

The focus that I have is in a particular geographic area of the United States known as the New West and this encompasses a lot of the states known as the Intermountain West States from Montana down to Arizona, from Colorado to Nevada. It is known as the New West primarily because what has happened is that there have been changes in the economic structures away from the extractive industries such as mining, ranging, agriculture and more toward the service industry, especially with tourism, but there have, also, been dramatic changes in the demography in this area.

For example, many of you are aware with the Census 2000 data if you compare back to 1990, there has been a dramatic shift in population out of the Northeast, in Midwest into the South and into the West and this has had dramatic impact on the economic and environmental structures in this area.

A lot of the growth that is taking place in the interior West interesting enough is in urbanized areas. In fact some of the most urbanized areas in the United States are in the New West region where for example in my home

state most of the population if Utah is along the Wasatch Front, heavily concentrated there.

One of the distinct differences between the West and other parts of the country is the percent of public land making up the proportion of the states in the New West region and what is also interesting is that this represents a very important magnet or lure for people who are relocating who have the perception that this area has cleaner air, water,, open space and I like to refer to this package of higher environmental quality, at least perceived by people who migrate as natural amenities and indeed part of the research that I do is I survey and interview older adults who relocate to this part of the country and what you would think that they are trying to find a place with economic tax breaks, for example, the cases is a lot of them are looking for what they call a higher standard of living in terms of quality of life and that they find natural amenities to be very important.

A lot of people are pointing to the issue that this will resonate with aging baby boomers. So, the projections are quite interesting. If you look ahead the percent increase of the elderly in terms of by region is

going to be quite dramatic in the Intermountain West States, primarily the Western United States.

You can see where the increases of the young-old, the old-old and what I call the super-old will take place in the New West States.

This is going to have some interesting economic consequences on specific areas which I call retirement hot spots in the New West. It turns out that a lot of pre-retirees, people who are in the retirement years are seeking out locations known as gateway communities. These communities are experiencing rapid population growth, the influx of older adults into these specific sites and typically they are located next to environmentally sensitive areas like national parks, state forests, national monuments, recreational areas and again when I interview the older adults in these different hot spots again they are pointing to the idea that they have the resources to move and relocate to these areas because they enjoy the environmental quality there.

One of the things though I think what is going to happen in the New West of course is that when you have these relatively young, healthy older adults who are moving into

the area they are going to age in place and over a period of time become more frail, perhaps with chronic illnesses and dependent on services and programs that aren't there or aren't prepared to handle this increasing population.

Well, this is my favorite area that I like to look at, Las Vegas, Nevada. In the 1990s it was the fastest growing metropolitan area in the United States and arguably, no offense to a person who is from Florida and other states, for example, Mississippi, South Carolina that are doing a lot of publicity to draw older adults to retire to their states because of the discretionary income that they have which helps with the local economy but one of the issues, this is a scan out of National Geographic of Las Vegas, one of the suburbs and one of the concerns is the issue of environmental quality in this area.

I saw a report out of one of the Las Vegas newspapers that particulate matter in large part in this particular area in Clark County, Las Vegas, is in large part due to construction just with highways, building new homes and a lot of people who move here,older adults spend their golden years thinking that of course they moved away from another area like Minnesota or the Northeast to experience

year-round recreation and when they get here they realize that well there is about a million other people following them in right behind them and what they would like to do is build a moat and keep others out. Of course, that doesn't happen..

So, issues like water availability, water quality are big issues and I remember reading an anecdote along the front range of Denver about a lot of people said that they couldn't wait to move to the Rockies you know to smell the spruce and the sage and instead all they could smell was roofing tar and asphalt due to all the changes in their neighborhoods. On top of that in this particular region the New West is also experiencing a severe drought and of course this calls for some interesting connections between the ability of the area to handle this population growth in this area and earlier someone mentioned not making any jokes about golf courses. Well, I am going to.

The area that I look at, one of the areas, St.George, Utah, is consistently ranked in the top 10 as a retirement place for older adults and it is in the middle of the desert, but yet it boasts itself as having more golf courses per capita than anywhere else in the United

States.They have about 18-hole golf courses in this desert area and they are constantly changing the landscape here to build new adult gated communities and they are just growing up like mushrooms all over the place in this area and the interesting part is at the same time there is water rationing going on all over the place and in Las Vegas and I have been following this development over the past 10 years watching the development of these golf courses and in the back near the top is the Virgin river. It is one of the few rivers that runs through the area and it is constantly being tapped into to support these large requisite golf courses that have to go along with these adult communities, not to mention the amount of pesticides, fertilizers that it takes to sustain a gold course in terms of affecting the Virgin river.

Another interesting part is that Las Vegas has its eye on the Virgin river and I can already see the political tension there, almost like an Owens Valley, Los Angeles a la Chinatown political tension building up in the area already.

Water is a valuable resource and it is a limited commodity here and one of the things that I do is I ask older adults when you move into these areas do you look at

issues such as legacy, stewardship or the long-term impact because a lot of these older adults will move in, spend their golden years, 10 or 15 years and then they will move back, and it is known as the J-curve effect back to where their relatives or family might be and do they realize the kind of long-term consequences on this area?

I am kind of switching gears here. Primarily most of my research is looking at those older adults who have the ability the resources to relocate, to find areas that have higher environmental quality and they have the resources to move about. In fact, a lot of older adults in Las Vegas, they are leap frogging. They move to Vegas and they look for other areas until they find their perfect Arcadian site, but about older adults who do not have the resources to relocate? Most of you know about the acronym NIMBY, not in my backyard. I have the acronym, FABY, find another backyard which is what a lot of older adults do. When they have enough resources they can go find another area but a lot of older adults don't have the resources. They age in place and they literally fall between the cracks when faced with environmental stressors.

So, I have kind of a switch in my focus and I

think the book by Eric Klinenburg(?) does a really good job, Social Autopsy of Disaster in Chicago, a really good job of pointing out some very important issues for this group.

The issue of social vulnerability I think is an important one to look at when we look at environmental hazards in an aging society. Klinenburg's term, social autopsy refers to the issue of looking at social ecological issues in particular during the Chicago heat wave in the summer of 1995.

Most of the heat-related deaths were concentrated and they varied almost by community in terms of where the disproportionate impact was felt by people of lower income, primarily older adults, African-American and in high-crime areas and a lot of other factors but the most important issue that Klinenburg brings up I think that is important is that he has a concern about the increasing numbers of older adults who are living alone. They have no social contacts and he sees this as a high-risk factor when we are looking at an aging society basically meaning that it is important to look at the sociodemographic factors, the socioeconomic issues when you want to understand the context of older adults in terms of environmental stressors. Thus, in this

case he looked at the issue of aging characteristics, hypothermia in context of the socioeconomic status of this group and that led me to think that it would be important to take advantage of the Census 2000 data to identify geographic areas across the United States but particularly for me in the New West to look and identify those clusters or concentrations of older adults who are at risk given the criteria of social vulnerability that Klinenburg and others have mentioned and I don't have the time this morning but I have a handout, if you wish, if you want to see me later with a complete table of the parameters I am going to be looking at in relation to this connection.

Closer to home in Salt Lake City this is an NASA fly-over thermal imaging look at the metro area and you will notice that some areas in terms of thermal energy are ranging from orange to red to white represent areas that are dramatically hotter than the cooler areas to your right which is up against the Wasatch Front and I found this to be kind of a nice parallel with Klinenburg's work. Salt Lake City definitely has a different climate than Chicago in terms of lacking humidity. Nevertheless downtown has its own micro climate along the Wasatch Front as well and one of the

things I am going to be looking at is trying to see the location and the concentrations of older adults who are socially vulnerable on the west side and that would be on the left side of the slide here indeed on the west side of town there is a higher concentration of people with lower income, a greater proportion of ethnic minority groups and interesting enough locations of senior centers, skilled nursing facilities, assisted living facilities, adult day care centers and the location of these sites is quite interesting as a place in this particular area.

So, I think it is important to combine several different aspects, sociodemographic data overlaid or grided against the location sites of point and non-point sources of environmental hazards and I think that the geographic information systems approach can be very helpful with our group here in terms of looking at how we can integrate and weave together different kinds of data levels, demographic data, environmental hazard data and use a computer took to kind of create spatial mapping products and analysis.

In Utah one of the things we don't probably think about in terms of being an environmental hazard is earthquakes or having earthquake hazards and along the

Wasatch Front which happens to be one of the, is considered one of the third most at-risk places after the San Andreas Los Angeles and then New Madrid area in Missouri is the Utah area along the Wasatch Front and to plot the fault lines in terms of where the most at-risk areas are in location to these areas where older adults are congregated, whether it is in institutional settings or in their own homes would be a good way of trying to combine these different data points.

I should, also, mention that 30 miles west, sorry 30 minutes, a 30-minute drive west of Salt Lake City are some interesting sites here in terms of potential environmental hazards.

There is a significant number of hazardous waste facilities, nuclear waste facilities just to the west of Salk Lake County and this is one of the fastest-growing areas in terms of for people to move to because people are spilling out of Salt Lake City and trying to find a place to live with economic housing and they are building different kinds of congregate housing facilities here for older adults on this area and I should also mention this is also the location of the Tuwilla(?) Army Depot where nerve gas is being incinerated in that part of the desert, west desert as

well, but it just not the location. It is how those materials are being transported to those sites with rail lines, interstate highways that basically converge right through Salt Lake City on their way into the west desert and one oft he things I want to look at is again the proximity of the concentration of older adults next to interstate highways and rail lines with these transportation issues.

GIS also has great potential to help coordinate at many different levels with service agencies ranging from the social side with the triple A's, the area agencies on aging to hospitals, fire stations, police stations and to kind of grid the spatial distance between these areas where older adults live and the services that we might need in the event of a disaster for example and in this case here I am going to be looking at the grid of the law enforcement jurisdictions matched up with locations of older adults in Salt Lake County.

Part of the research goal that I am looking at in the next couple of years here is to work with the Department of Geography. It is again, I believe, in this team approach to these issues, identifying geographic areas with greater concentration of socially vulnerable older adults using the

Census 2000 data, particularly summary file No. 3 as it applies to Salt Lake County but part of my goal is going to be to expand out of Salt Lake County along the Wasatch Front and throughout the Intermountain West as well in other metropolitan areas, Boise, Phoenix, Las Vegas, Albuquerque and Denver and so on, then to identify institutional and congregate living points in Salt Lake County, identify the environmental hazard points and zones and again I have a table to list those ranging from air quality monitoring stations through the Wasatch Front to the hazardous waste sites and then to use GIS to link the spatial data together to provide these visual mapping looks at the way in which this is woven together, basically targeting for the ability to use for mitigation strategies, how to prevent and intervene on behalf of older adults.

So, I would like to summarize this presentation in this regard. I would hope that this group and the EPA would of course consider taking into account demographic trends, projected trends as well in the United States where older adults are going to move, relocate and where there will be heavy concentrations especially with aging baby boomers. It is predicted that they will be a highly mobile group and

they will be seeking out areas with a higher degree of environmental quality as they perceive it. So, we will have to look closely at how this affects the demographic trends.

No. 2 is taking into account social ecology issues around environmental risk and finally considering using GIS as a powerful tool to integrate many different kinds of data points especially in the initiative looking at aging issues and environmental hazards.

Thank you. I tried to speed it up a little bit for time.

(Applause.)

DR.CHARNAS: Next in the intervention and participation part of our session is Denise Park who is professor of psychology from the Beckman Institute, University of Illinois at Urbana, Champaign and she is going to be talking on the topic of memory, comprehension and the ability to process information decline with age.

DR. PARK: Okay, what I would like to do is present an overview of the aging mind. First I will be presenting some summary data on cognitive aging and I would like to talk about behavioral data as well as neurobiological aspects of aging, then second sort of segue

and moving along I would like to talk about structuring information for older adults in a medical domain because I think it has fairly substantial implications for presenting environmental warnings and packaging information about environmental hazards to older adults and then finally we have some specific data on some somewhat surprising findings on memory for health-related warnings and how they interact in surprising ways with age, but since there has been so much interest in this conference which has been quite gratifying in cognitive function with age, I would like to present a series of data from my laboratory that are more or less associated with basic function and then move on to some of the applied aspects of this work.

So, cognitive psychologists and people who study cognitive aging have been very interested in understanding how across the life span our ability to process information changes. How fast can we process information? In other words, how rapidly can you perform mental operations? Tim Salthouse who is here has done a great deal of work on this topic. How much information can you maintain in your cognitive system; what is the online process and capacity, your ability to manipulate and hold information in what we

call your working memory and then cognitive aging psychologists have also been interested in knowledge and how does accrued experience and knowledge change with age and these are basically the fundamental building blocks of cognition that we believe play a tremendous role in mediating variants and explaining other kinds of higher order cognition such as decision making, memory and things of that sort.

I thought it would be useful to give you an idea of the kind of people that we study. Who participates in these experiments? Basically I am going to present you some data from a large study that was done in my lab when I was at the University of Michigan, 350 adults, all community dwelling; we didn't test college students and roughly equivalent numbers of males and females. These are well educated subjects. You can see that the mean education is round a bachelor's degree. People are not on a whole lot of medications although it does change with age and it is important to equate or show better verbal ability of older compared to younger adults so that if you do see any changes in abilities you know that people were roughly equated at what some people refer to as crystallized abilities.

This is an example of a task we might give in the lab. The task simply involves making simple yes/no decisions. This is actually from Tim Salthouse's lab. Are these items, these digits, these letter strings the same or different and you can present increasingly longer strings. It is a very sensitive measure of how many you can complete of these in say 2 minutes. It is an extraordinarily sensitive measure of the rate at which you can process information and a very powerful explanatory construct with respect to all kinds of cognition. This is how much. This is a verbal working memory span task. The experimenter says, "Six plus three." The subject would select nine, but they would also remember the three. The experimenter would say, "Two plus eight." Ten. The subject would remember the eight and then after a series of slides in this case two you would say, "Recall." SO,the subject would have to recall the three and the eight and so you are both processing information on line but also storing information and how many of these you could get correct in a row is a very sensitive measure of sort of your mental horsepower and I think that is a really simple way to put it.

This is the results of the study we did with those

350 older adults. We tested them for a total of 8 hours over three visits and here is what is compelling about this graph. I think everyone sees what is compelling on the one hand. We have multiple measures of processing ability. We have three measures of how fast people process information. We have four measures of this online working memory capacity, two in the verbal domain and two in the visual spatial domain. We have verbal recall, lists of words as well as visual spatial recall where subjects recall figures and there is basically 10 different measures here and they are all declining together. Admittedly this is cross sectional data but the reality is that longitudinal data conducted over 30, 40 and 50 years of life span look very similar.

So, on one hand you know we have this decline in mental horsepower or processing across many different tasks and modalities but at the same time admittedly this is cross sectional but at the same time we do see that world knowledge as measured by three different measures of verbal ability is constant or even increasing with age. You are not necessarily going to see this increases in world knowledge depending on the kinds of tasks you give but in

any case you can see there are very, very different functions for experience versus process and I think that is what this really reflects.

A couple of things that are striking about this graph, one is that there is nothing magical about getting old in the sense that it is not the case, whoops, oh, oh, that was bad. Okay, let me start over. So, it is not the case that when you turn 70 there is some kind of falling off or steep decline. It is a very gradual continuous process and I think this is surprising data to people. I do not believe this is sampling error or some kind of cohort effect. If you think about the brain as another organ of the body and you think about who is winning awards at the Olympics, who is winning? People in their teens and twenties and I don't think any of you would debate that starting in your twenties if not your teens you get a little tiny bit slower in your physical abilities every year and the brain is part of your body and it ages like every other part of your body. These are striking differences and they are readily measurable in the laboratory. They don't necessarily translate into these magnitudes of decrements in everyday life and that is an entirely other topic.

The other thing that I would like to address before I move on to some of these applied issues very briefly is there are things we could learn about the aging mind that we literally would not suspect from looking at these behavioral graphs and that is by using a new tool that has become available to cognitive neuroscientists and that is functional imaging, okay, and you can literally look at the neural activations and the activity of the brain that underlie cognitive behavior and I have been particularly interested in the use of functional magnetic resonance imaging that allows you to determine what parts of the brain are activated when you are performing a specific cognitive task and you can literally see with age the neural route to a behavior is the same for old adults and young adults and I think you will see that it permits us to learn some different and very interesting things about aging and I think also provides a very sensitive tool for understanding the effects of environmental impacts, okay, such as toxins.

This is an example of a brain scan being performed at the University of Michigan where I was until a few months ago. This is a couple of my graduate students moving an older adult into a brain scanner and while the individual is

in the scanner, I am very hesitant to use this mouse or the pointer but in any case, there were two kinds of task subjects got while they were in the scanner, both young and old and on the top you can see that they saw a picture for 6 seconds and then after they saw that picture they had to say yes or no was that little fragment part of the picture and then we had a long resting interval of 14 seconds to allow the neural activations to go back to baseline.

We are measuring blood flow. That is basically the mark of a hemodynamic response of the brain that allows us to determine what parts of the brain are activated. In the other condition they saw a picture for 2 seconds and then they had to hold it in their memory for 4 seconds. Do you see the picture is off for 4 seconds, then they see that probe and they have to make a decision about the probe.

So, we can literally look at how the brain is functioning when that picture is on in some conditions and when it is being maintained but is not actually there for those critical 4 seconds, okay? So, this is just to give you sort of a flavor of how we go about studying the brain.

This is probably the most interesting two slides that we found. Do you see that little activation there? That

is the left anterior hippocampus, okay? That little red dot that is a slice of the brain going in an axial manner. So, it is like from there to there and that is the part of the brain that you use to learn information and store information and it is the part of the brain that is damaged with Alzheimer's disease.

So, look at these graphs. See the red line? The hippocampus, right there is when that 4-second interval is occurring. When the picture is on the hippocampus in young adults is excited. It is showing a lot of activation. When the picture is off it is not showing a lot of activation but for older adults there is no systematic activation for either of these kinds of stimuli. This is a time course analysis of the activation in this particular part of the brain to the two different kinds of stimuli and you can see that the hippocampus doesn't show a lot of systematic activation in response to the stimuli the way it does in young adults but interestingly if you look in the frontal area of the brain at the time of the probe, the frontal area is the front of your brain and it where basic higher order cognition is occurring.

A lot of decision making occurs in this part of

the brain and working memory function, that type of thing and what is going on at the time of the probe? At the time of the probe we measured how much activation there was in the left and right inferior frontal cortex and older adults are showing more activation than young adults at the time of the probe. Okay? So, it is like the hippocampus isn't engaging during the rehearsal interval but later on when they have to make the judgment more activation is occurring in the frontal areas in old compared to young, perhaps in compensation, okay, for the decreased hippocampal activation. These are sort of overly simplistic interpretations at this moment but it gives you an idea of how sensitively we can look at different patterns of neural recruitment in response to a task and there is quite a bit of interesting data suggesting that older adults will often show compensatory, apparently compensatory activations where they will show more activations or show left-and-right-sided activations when younger adults use one side of their brain, for example, and one could expect that environmental toxins might push the curve for changing neural recruitment patterns earlier. So, perhaps maybe people exposed to toxins might start showing these bilateral recruitment patterns or

these increased activations at a younger age. So, you can see a young or a middle-aged adult acting like an old adult or someone who has never been exposed to many toxins performing more like a young adult and it seems plausible that these neural changes could occur much earlier than behavioral changes.

People actually have not yet studied middle-aged adults and these neural recruitment patterns and that is something I will be interested in doing in my lab.

I am going to run out of time here. Here is another study we did, very briefly and I am getting too interested in this brain stuff. We presented there is evidence that young adults show very specific patterns of neural activations to faces, to words, to houses, okay? So, we gave people pictures of faces, words, houses, chairs and these face scrambled pictures and all they had to do was look at them.

So, this is occurring very early in the processing stream and look what we found very briefly. Do you see how the young adults showed specific activation to faces in neural tissue right here. They showed a piece in their ventral visual cortex that was highly active to faces but

not active to these other areas. What about the older adults? Do you see how the neural response is much more distributed and that the same voxels or pieces of brain tissue that are getting active to faces are showing similar activations to houses, pseudo words and chairs. In other words they are not showing neural differentiation. These are really new data. We just got them very recently, similarly to the houses. The young adults are very selective in what brain tissue they activate. The older adults show some selectivity but not as much as the young adults. They are showing the same voxels activated to houses are also showing a lot of activation to these other stimulus categories, the same pattern for word selectivity in the young, much less selectivity in the old.

So, that is another example of how we can literally look at how selective a brain is. We think that as you get older your neural tissue dedifferentiates and this is actually a really, really good demonstration of this dedifferentiation process.

I am going to run out of time here. So, let me just briefly present a few more findings. Here is some evidence that now we have also done work on applications of

this basic information and we have shown for example that when we give old and young adults memory about medications to remember regardless of whether they have a fixed experimental presentation rate or as much time as they want to learn the information or to make comprehension judgments about it, consistently the younger adults make fewer errors than the older adults.

We have also looked at the role of pictorial information in facilitating instructions and memory in old and young adults. That is not a simple case. Sometimes pictures help. Sometimes they don't and we have a pretty good idea about the conditions under which that is true. There is evidence that older adults make similar medical decisions to younger adults but they process the information and the procedures they go through and the reasoning processes to make those decisions are very different. We, also, have some interesting information suggesting that medication adherence is better in older adults. I believe that this is due to using a cognitive system called implicit memory or procedural memory that doesn't require a lot of active processing and we have demonstrated this reliably in a number of studies.

So, basically we also have gotten interested in this procedural system. Okay, there is a memory system that is not explicit that doesn't require a lot of frontal cortex and relies on more primitive areas of the brain and we think that that system is largely intact as you get older and there is a well-known finding in the literature that information that you have heard before even if you didn't believe it at the time you heard it, later on it might seem try to you because it feels familiar, and it is relying on this more primitive memory system that recognizes the familiarity of the information and because old we hypothesize have particularly poor episodic explicit memory this more primitive cognitive system may be stronger in older adults and we considered that they might be more susceptible to the illusion of truth.

So, we decided to study this in the lab and developed a series of medical statements all of which were true but which were initially unfamiliar to subjects. These are true statements. DHEA supplements can lead to liver damage, even when taken briefly. Cold medications cause they eye's pupils to dilate. This one is a very alarming piece of data. Corn chips have twice as many calories per cup as

potato chips. So, eat those potato chips and we gave subjects a series of these statements and after each statement we told them whether the statements were true or false, okay?

So, they would see a statement and they would be told true or they would see a statement and they would be told false, and they saw them in a list, okay? And some of the statements were presented once and some were repeated three times and they would always be told true, true, true or false, false, false. The truth value of the statement was always the same.

So, then they have to judge whether or not the statements are true or false 30 minutes later and here is what we see. We see that in younger adults if they have heard the statement was false three times you know they are much more accurate in their judgment.

You can see that old adults show what we call an illusion of truth effect. If they heard a statement one time, so they don't remember it so well but it sounds familiar you know they are going to say, "Yes, I think that was true," even though they were told it was false, but if they have heard it three times they are okay. So, I will be

done in a minute.

But 3 days later what if we present them with statements and then test their memory for them 3 days later? Think about reading a tabloid on a supermarket where you know the information is false at the time you read it but 3 days later it might feel familiar; what happens to the young? Three days later you know the illusion of truth effect increases. They are more likely to say, "True," to a statement they heard once that was false, but it doesn't persist for stuff they heard three times. What about older adults? They show about the same effect as the young initially but 3 days later the statements they heard three times that were false, they were told three times a statement was false, okay, they are more likely to say that that statement is true than a statement they heard one time was false. Why? They have little explicit memory for the situation but at the same time the statement feel deeply familiar and this more primitive memory system is telling the subject therefore it must be true.

So, the point of all this is that it is not a simple case about how to package information about environmental hazards to older adults. Very briefly it is

critical that differences in information processing systems between old and young be recognized and just extrapolating from this study recall the repetition of false medical claims increases the truth value of claims 3 days later even if it is understood at the time of the claim that it is false.

So, this is my last slide. We should present warnings in the affirmative. Eating Great Lakes fish will increase the risk of mercury poisoning as opposed to it is not true that eating Great Lakes fish is good for your health. Do you see? I don't know if this statement is true. I have made it up. So, it may or may not be true. Do say that you will have breathing problems on days with smog. Do not say that it is not the case that is okay to go outside on days when the air is bad. What is the subject going to remember? It is okay to go outside on days when the air is bad. So, intuitions about how to package information for older adults may be incorrect and I think cognitive aging research can offer much guidance on this topic.

Thank you.

(Applause.)

DR. CHARNAS: Okay our next speaker is Jacqueline

Agnew, professor, Department of Environmental Health Sciences, Johns Hopkins, Bloomberg School of Public Health and her topic is exposure equity.

DR. AGNEW: And I am going to try to demonstrate my cognitive ability by showing that I learned not to touch the mouse and if I forget please don't laugh.

It is a pleasure to be here this morning. I am really happy to have this chance to interact with the committee that is steering this workshop and it is a pleasure to talk to you about my renamed topic which is issues related to environmental exposures and aging.

I would just say beware of the topic that has the word "issues" in it because that means no answers, just questions.

I live in a very interdisciplinary department of environmental health sciences in the School of Public Health and the folks there that I interact with on a daily basis deal with the issues that you see in our toxicological paradigm which is the mantra in my department. We all have it hung on our walls and in this conference you have heard a lot about the issues on the left side and the right side of the paradigm in this schematic.

What I thought I would talk about today are some of my thoughts about issues that relate to exposure and perhaps issues where exposure and susceptibility might come to an intersection.

My real area of interest is occupational health, older workers, ergonomics, occupational stress and when I talked to Jim about what my topic might be today I said, "Those don't sound like things that the EPA is interested in."

So, I did a little bit of thinking outside the box from my usual areas, but I will get around to talking to you a little bit about some things that are near and dear to my heart.

I think that two of the important questions that can be asked are in what ways do older persons differ from others in the population, other aged individuals in the population and also what is associated with differential exposure among older persons? I intentionally used the word "associated" here because I was trying not to necessarily imply cause and effect.

I think it is probably important to think about when we look at older population and we see differences in

exposures what else might we be seeing in those same populations associated with those differences in exposure?

So, to think about this I borrowed a framework that Ellen Silbergeld used recently when she and Jody Floz presented an article that looked at environmental exposures and women's health, another very important demographic consideration and what Ellen suggested is that exposure is linked to patterns of our human activity so that we could look at different compartments if you will of our activities. We can look at our community residence, our home as an area of our activity. We can think about activities such as subsistence food gathering and the work place. Others might be added.

There is of course our recreational activity, our time we spend in transportation and here in my mind what I think of as sort of a big giant exposure matrix that if we were lucky enough to be able to construct for all individuals would be a very useful thing.

This picture by Earl Dodder reminds us that where we live and where we work are not necessarily separable and although this shows a swing set in the middle of a very industrial community, obviously it might as well be a park

bench where elderly are sitting trying to spend some time out of doors.

So, looking further at the community it has been recognized that there seems to be a disproportionate exposure to certain vulnerable populations according to the communities in which they live and this has sometimes been called exposure equity and environmental justice is another term you hear and this can be a factor whether we are talking about urban environments or whether we are talking about rural environments and their exposures and the vulnerability factors we generally consider are low income, non-white populations being at risk of this, working class populations, unemployed, children of single parents and so forth including elderly.

However, most of our focus has been with regard to environmental equity issues. Most of our focus has been really on low income and non-white populations as being factors that we think about when we think about environmental justice issues and I would suggest we need to think about also our elderly populations.

Now, I am really happy to have heard Scott Wright's presentation because he really brought this home

and the point is here that elderly populations may not have the resources to be mobile in their upper years. They also may not want to move from their community if that becomes otherwise a necessity.

Can you imagine if you were older and had a disease that might accompany aging such as a disability and had made your home accessible, renovated it extensively as some people do, maybe ramps, you know, altering the interior and then you think about the energy it would take and the resources it might take to move to an entirely new home. It becomes almost burdensome to even put yourself in those shoes and think about that situation.

There was a community in South Baltimore where industrial organizations had grown up around a small residential area and the community only had one route of egress, ingress and egress by which it could be reached.

Some of the industries began to have toxic releases and one had an explosion which brought to everyone's attention the fact that this may not be such a safe community in which to live and so then the issue became to stay or to go and if we go also who should pay for it and negotiations began with the city of Baltimore to try to get

the city to buy the residences there, but this was not without resistance from some of the community residents. Some and many of these were older people, really felt this was their home. They had spent their life there. The industries came after them not before them and they really wished that they could have stayed.

What about the indoor environment in the home that one faces if perhaps they are disabled or infirm have to spend more time in the home, and we heard examples of some of the indoor air contaminants that have been looked at including phthalates which were a little newer on the front of our concern in terms of indoor air contaminants. There is also potential exposure by way of our drinking water. Dust-bound contaminants we may not always think about but we have of course there the possibility for metals such as lead from sloughing paint, perhaps allergens like cockroach allergens and dust mite allergen might reside in the dust of a home and you can see where it is possible that this situation of exposure might be different according to whether or not the home is in good shape, the age of the home, the condition of housing, and you can see a lot of links there, and I have also put up the idea of what has been coined take-home

toxins. I like to actually use the term "work, family exposures," but it is a little bit more dull, not as sexy as a title.

So, the issue here is the phenomenon of workers bringing home to their family the exposures from work. They may bring them home in say particulate form on their body and their hair and their clothes or shoes, etc., and it is interesting that most of the attention here and I have to admit when I have thought about this as well it has mostly been oriented toward children's exposures, you know what can parents bring home into the home environment from their work place that now their kids crawl around on the floor and get exposed to, but it is also a fact that other family members at home who might be elderly these days might be exposed as well.

So, this is another route by which elderly may become exposed. This particular topic interests me. I feel sort of passionate about it because I feel like it is something that we can do something about with relative ease with some education of both workers and employers and it was looked at by NIOSH in the nineties and a review was done of all the studies that were reported on this issue in the

literature and then it was reviewed by an external committee that I had the pleasure to serve on called the Worker Family Protection Task Force, and we found that the most commonly reported substances were metals, pesticides and asbestos. There are reasons that they are probably the most commonly reported, that I won't go into now but others that are also seen to be an issue in some cases that made it into the literature and remember not everything is going to are listed here and this is a problem that has been noted for 28 countries at least. This is the tip of the iceberg because this is what we are seeing reported, many different substances, the reports are increasing in recent years but we don't have very good information. There are a few epidemiologic studies of either exposure or health effect in this area and we don't really understand it fully. Mostly what we see are case reports. So, I think that bears more thought in terms of what families in general are experiencing as their exposures.

What about subsistence food activities, and here I give crabbing its own billing because I am from Maryland but fishing would also include shellfishing and we can't forget that it is not just the fauna but we also have to think

about the flora as well and growing plants, foraging for plants is another area of potential concern and in fact you know related to the environmental justice area there was one Native American community that was advised not to grow food, not to eat the food that was grown in its soil because it was contaminated by local incinerator and industrial contaminants.

Now, why do people do this? Partly because they need to under some circumstances in order to feed their family, but we have to keep in mind that there may also be cultural influences at play.

My parents were very interested in the area of mushrooms and actually participated when my father was semi-retired and going out and finding those mushrooms and eating them,hopefully always the right ones and I would go with my parents to the forays that are held by the North American Mycological Society and what I learned there was really it is a very wonderful heterogeneous mix of people who do this activity.

Some, mostly the younger members are interested in the scientific side, the toxicology of mushrooms and I have to thank Peter Spencer for yesterday bringing up the point

that it is not just synthetic toxins that we are worried about but also natural toxins as well, and what I learned was the older population in that group often brought with them from the old country as they would put it their knowledge that they would share in going out looking for mushrooms and then eating them and I also learned that when some groups immigrate to this country they don't know the indigenous mushrooms as well and so what can happen is they will go out and they will pick mushrooms that look like the ones that they had in their country and were non-toxic there but here they are toxic. They get in big trouble then and then I heard a discussion ensue where they were talking about ways that they could warn these populations don't pick these seemingly innocuous mushrooms and so their idea in terms of health communication if you will was to put signs up in the language of the population and these happened to be Cambodian immigrants and they were going to put signs up and pictures up in the emergency room. A little problem here. This is called closing the barn door after the horse is out.

Okay, to the environment that really interests me, the work place, I don't have to belabor this with the

committee but the numbers of older workers are increasing. The participation rate of the group above 55 years old is increasing and we see a difference in age structure according to occupation.

An example that Peter Bierhouse pointed out is that in the nursing population you are familiar with the nursing shortage the average age of nurses is increasing and between 1983 and 1998, a 15-year period increased well beyond for example in hospital nurses it increased 5 years on average whereas the population in the US only increased a little more than 2 years over that time and this just depicts the same thing.

You can see on the left the red curve is the 1980 age structure of the nursing population marching to the right as time goes on. The purple curve is the 2000 age structure.

What faces older workers? Increased prevalence of chronic diseases while they are still working, diseases with long latency periods that probably would have shown up when they were in retirement, that now show up when they are in their working years, long-term exposures and this points out why we have to think not just of current exposures but also

body burden from our lifetime exposures.

We know the inter-individual differences are considerable and this has an impact on age-specific policies that employers might want to impose and we know that the exposure equity issue takes place in the work place as well so that if workers lose their jobs, have to go to a part time or contingent job those are likely to be the ones with higher exposure and potentially more danger.

Older workers face the same design and exposure challenges of other workers which are often poorer. You can see this nurse is trying to life a very heavy monitor out in front of her body and you can see that this isn't the best ergonomic example either.

I think I will skip this slide because I am a little worried about that orange button. My car has a nag light like that, too, when my gas gets low and what do we see that workers have to deal with in the work place? Well, we know that employers have been shown to have negative attitudes which can impact on their relationship with their workers. They believe that workers are not as productive, that they aren't going to be working for them as long and this can lead to discrimination, not just frank

discrimination like hiring and firing but also not selecting workers to go for retraining.

It, also, means that workers don't have as much social support coming from the management side in the work place.

We really know that workers stay in their jobs; they don't migrate around between jobs as quickly as do younger workers and they are absent less.

Age discrimination is something workers we feel face and it is the most common form of discrimination these days. In fact, the EEOC is seeing more complaints, a higher rate of complaints for age discrimination claims than any other type of discrimination in the work place.

Most age discrimination, however, is indirect. It is subtle. It is hard to get your fingers, hard to wrap your arms around. It is really hard to study. It is very complex and I am going to just give you the results of one little study we have done pretty much as a substudy of a much larger effort that looked at policies in the telecommunications industry.

What we did was look at 276 organizations and these were customer service organizations and each one had

one reporter and the reporters were then reporting on their impression of their work place.

So, the unit of analysis here organization with one reporter. Okay, we found a significant association in the, I have to say that about 18 percent of these work places were classified as age hostile and the way we determined this was to ask what would be the outcome if an employee was found to violate a policy in your organization; would it be harder on them if they were older, if they were minority, if they were female; would it help their case or hurt their case and when they said that it would hurt their case we counted that as an age hostile work place and so the age hostile work environments were associated with worker morale, job satisfaction and job security. It was not associated with levels of job stress but as you can see those were very high anyway and we had indices of management support and supervisor support. Again, the age hostile work places were seen to have lower levels of both of those.

What can age discrimination mean? Well, it can mean that people have to stay in their jobs longer, can't migrate to ones where the demand is less or perhaps the exposure is less.

There is evidence that there is less social support in these types of environments and it looks as if training might be related to their opportunities in such a work place and these workers may not have as much opportunity to give input into the work place in terms of redesign or improving their work and health situation and of course if they lose their job and have to move to a part-time or contingent work that could be a problem as well.

So, the summary slide I think we should better consider this exposure activity link idea and it would be good to be able to characterize people's exposures for both the current and their lifetime experiences although I know that is a really tall order.

I think it is important to look at the distribution of environmental exposures by population age and I think we need to think about when we are controlling for age what other things might we be controlling for, and you know we so typically control for age, control for sex. If there are other associated factors that are collinear with age we should have a better handle on that. We know that for example in the occupational health studies that we do we see an association between cumulative exposure and

age. We might think the same way about environmental studies that we do and ask when we control for age what other things might be going on here and thank you very much for your attention.

(Applause.)

DR. CHARNAS: The final part of this session, James Sykes who is a fellow of the Department of Health Sciences, School of Medicine, University of Wisconsin, Madison will be talking on the topic of participation of older persons.

DR. SYKES: Consider this a segue from the research findings that you have had, we have had since yesterday and that now a social gerontologist who even though he has had a long association with the medical school probably should have been introduced as the whatever past chair of the National Council on the Aging or a member of the Federal Council on the Aging or Chair of the Wisconsin Board on Aging, simply put somebody who has over his lifetime been deeply concerned about if you will translating the research findings, the evidence that truly careful scholars have amassed in their work and translating that into some policy implications or practices throughout the aging community.

I am a social gerontologist in a medical school which means that I have spent more time criticizing the findings of my colleagues than contributing to them and I won't miss this opportunity.

I accepted the invitation wondering why but realizing that when I was discovering more and more about this new aging initiative at the EPA and I should in the spirit of full disclosure admit that my name, Sykes, is similar to the name of the person leading that initiative at EPA, my daughter, Cathy Sykes. So, I have been informed and eager to be involved in her discussion of what the EPA might be doing in this area.

My data will come from some prior experiences where the aging community the network and others have tried seriously to focus the nation's attention on serious issues or concerns, problems that needed attention and I will just cite three and that will refer to the White House Conference on Aging where I have been a part of the membership over three different White House conferences.

I will make a quick reference to the Wisconsin Coalition of Aging Groups, another coalition of groups trying seriously to affect policy outcomes within the State

of Wisconsin and thirdly I will just refer to the fact that I have just finished my 18 months I think it has been or 18 years, I can't recall as a member of the US Commission on Affordable Housing and Health Facilities that so desperately tried to put together the database to answer Fred's question of get the facts right, get them up front realizing during that entire process that the facts wouldn't make any difference because any commission that would propose serious efforts on the part of the government to allocate new resources to solve the problems that we have in the dearth of affordable housing and the terrible situation we have in health facilities across this country was not about to be heard even by the members of Congress who appointed us.

I want to return to where we started yesterday morning for just a moment to say that Governor Whitman I think has defined what is an excellent way to move now based on really the best practices but I will come back to the White House Conference and the others.

She has recognized it seems in her presentation at least that a good place to start is what do we already know, what are we already doing and to do the kind of survey of what is out there; what works and how then might we bring

these together to increase the impact of these and she wanted to do that first within the EPA but also across other government agencies and that makes eminently good sense and it also kind of undercuts those who want so quickly to suggest that any new initiative is somehow a little bit more of what we have had before.

The second had to do with then setting a research agenda. What is it that we truly need to know in order to mount a campaign, do some efforts to in fact make our environment more friendly for older people and the third point and the one I am most interested in is to say, "How can we effectively engage the elders themselves in the process of not only being sentinels if you will about their own environment but to be the mentors and the teachers and we of our age having a right to be those who are guiding younger people into understanding, appreciating their environment and certainly not being patient with those who abuse the environment whether it be the close environment or through national policy?"

Let me come back? The White House Conferences on Aging of which we have had three, some would argue four have been really national efforts to focus, to bring together the

elders of the society and those who work with them and for them to say what is it that the Congress; what does this nation need to do to change the friendliness if you will of our society for an aging population, and so that system many of you are fairly familiar with it, was essentially throughout all the states and in all the regions. Groups met and they started to say, "What are our issues? What do we care about?" and in that process some began to float to the top and so when we finally gathered in Washington we had a whole stream of information that came seriously from the grassroots, the people talking about their own lives and some of us then trying to translate that into some kind of policy action.

In the 1981, White House Conference on Aging which ties to your committee I was privileged to be the chair of the technical committee on older workers and we had about five or seven technical committees that was trying to say what is it that we know; what is the research; what is out there so that in fact we could as the second part of this or a second stream to be sure that the delegates to the White House Conference those who were setting policy and reporting to the Congress would have evidence-based findings to

present and so the White House Conference model is a good one.

The learning that I would say we took from that is that even though the reaction of the Congress and the Administration to the many, many recommendations that came out of that legitimate political process might have been rather uninspiring the fact that 2000 or in fact 80,000 older Americans and others were engaged in this process changed them forever even though they may not have moved the hand of Congress.

I referred secondly to the Coalition of Wisconsin Aging Groups of which I was a founder some now 30 years ago when we just said that if Wisconsin is going to address properly the issues of older people in our state we had to bring together the organizations that had some power or certainly had some concern and we set a little quick rule and it was called the rule of five, simply to say that when we walk out of this room, we who had gathered there as members of this coalition would agree that those are our five issues, not 10, not 28 or not 546 as the White House Conference but we would together bring all the force that we could bear on those issues and those were cross-cutting

issues but they were specific, and we did move the hand of the governor the legislature because the results of that effort were profound.

Once again the system was similar. We got those issues from the people. We trained the elders themselves, one of whom I am. We trained them to be the ones who made the case to their friends in the senior centers or wherever they lived and their churches and so that they became an energy and a political force within our community.

The beauty of that is that it is still in place and it is still effective and no governor of Wisconsin and no legislature can ignore the Coalition of Wisconsin Aging Groups because it is a coalition, because it is focused and because it is effective in its case.

Now, I would look quickly to some examples. Some came out of those efforts of what the government, what our government has done and I would just like to cite three; the RSVP program has filtered throughout the country in which retired senior volunteers have become organized in some ways and available to community organization to help in a variety of ways and what these senior volunteers bring of course is their energy and all the capacity that they have despite the

shocking charts that show us totally in decline. The truth is that the energy level of people from, well, all the way up is tremendous and that what is needed to unleash it as the RSVP program was successful in doing is just somehow getting it organized.

A second big issue has emerged and there has been a response that is appropriate. The second big issue is that we have many people who are raising children, single family parents. We have many,many more grandparents who at this point in their life all of a sudden find themselves actually raising little children. So a program like Foster Grandparents was a national effort to say that we have got to figure out some ways to organize this tremendous potential of older people to be engaged in their process and that is why the EPA initiative, aging initiative that has as its third part the engagement, the empowerment, the utilization of volunteers and the partnering that the governor made reference to with, the Coalition of Aging Groups, the Leadership Council of Aging Groups, the Gerontological Society which is another good research group to use us to help us help you help us preserve what we love most about our country and to use us as older people in

achieving that.

Throughout my 30-whatever years of being involved in -- is there something I can do to let you read that? I can read it. It is only one phrase I want to bring to you anyhow. It is the last one that says that only from the linking of what we know and can do with what we hope for and desire is how social policy emerges. I have been so impressed with these presentations and the literature over a long time that what we know is a helluva lot. We have information and the journals and you who are doing the research, we have information that even if it were an efficiency model won't be useful or won't be out there in the field effectively for a very long time. We continue to add to what we know and of course we must do that, but I am concerned that we already know so much that we an apply. So, it is not a lack of knowing. It is the can do that says, "What does it mean?" and that is why I asked the question in the last evening of the panel; what in the light of your scientific career, what are you doing to take the next step, not to add more data, not to replicate the study but to further bring the importance of what you have found and what you continue to find to the practitioners and to the elders

themselves; that is the missing bridge that is not there.

So, what we know and what we can do has to also have political will and that takes me back to the US Commission, the Seniors Commission.

I saw no political will to translate what it is we have found and what needs to be done with a will of these people, you and me to pay the taxes necessary to solve a problem that needs to be solved and I am pretty tired of hearing the people talk about creative financing meaning you bring your own money; I don't have any, but yet we must solve a systemic problem in this society or partnering which means you bring your money; I don't have any or the Congress saying, "Give me a neutral budget, show me all these things that you are going to do, but don't ask us to spend more money," and I would not be so cynical about that were it not for the fact that in these days a phrase that found its currency soon after 9/11 that kind of described without having to describe it the malaise, the problems, all of these things in these days, the need for heightened security and the fact of credible risk and as I listened to this and conducted a hearing in San Diego for the Commission I used the occasion right after that to say, "You know hundreds of

thousands of older people are living every day with credible risk, not even enough staff to turn bodies in a nursing home, not enough people to care in assisted day care programs for these people. They live every day with real risk, and it is an important risk, and that they need heightened security."

I am one of those who travels every week and I have the privilege of frequently 40 SS, security scanners, confronting me as I move onto the airplane. So, we who are traveling have all the security we need and thank you a lot more. I don't want to get in that debate. I just want to draw a distinction. At the very time that our seniors commission was able to report that there was totally inadequate human resources applied to a dramatic large current, not only current also future need we simply don't have the resources. While the same numbers of us, we, the people, with that same political will said, "Yes, we will federalize the security scanners. We will double their salaries to substantially above what the people working in nursing homes and other places caring for our elders will get and we will do it out of the resources even though there are no resources for the likes of the kinds of programs that

we are advocating.

So, with that little note I just want to conclude by saying that I am delighted that the EPA has taken on an aging initiative. I think when it expands beyond simply and please continue to do that, bringing to the attention of people who can translate that information into ways to be good sentinels in their own communities, to be alert to the problems that they need to have just like the best police force is not a big police force but neighbors who are alert to problems in the community, bring us that information and involve us as older people in carrying out that message because we will be both the beneficiaries of your efforts and we will be your partners.

(Applause.)

DR. CHARNAS: I want to thank all the speakers so far in this session. Normally we are scheduled to take a break at this point. What I am going to ask people to do is individually take little breaks if you have to and must but I would like to try to catch up a little bit on our schedule by asking that we move to the audience questions portion at this point in time.

For those who are interested and can stay please

do and others who absolutely must take their break please do that as well, but are there questions now from the audience for any of the speakers we have had so far this morning?

Please feel free to come up to microphones.

DR. BENSON: I would like to take advantage of the agenda that said, "Opportunity to ask questions or make a comment," and I would like to make a comment, if I could. I am Bill Benson.

I am here in two capacities really. One is a consultant to the Centers for Disease Control but also as the Chairman of the Board of Directors of the nation's only organization dedicated to bringing older people together with environmental work and that is the Environmental Alliance for Senior Involvement or EASI as we call it and I noted Andrew Geller yesterday from EPA mentioned the work we do,not the organization by name but he had been very excited about a presentation from our Executive Director the day before to the regional folks from EPA.

We are very proud of what EASI does but that is not really what I want to talk about but I will say just a little bit about what we do. All over this country we create what we call senior environmental corps, senior environment

corps and they are cadres of volunteers, older people that tackle environmental problems in their community whatever it might be.

I want to note one program in particular though that is not a local senior environmental corps. Jim Sykes mentioned RSVP. One of our key affiliates is the RSVP programs across the country. We try to work through local RSVP programs wherever we can, senior centers, area agencies on aging but in Pennsylvania the Commonwealth of Pennsylvania itself through the leadership quite honestly of Governor Ridge and Secretary of the Department of Environmental Protection at the Time, Secretary Sife(?) thought we ought to put some money into protecting our environment through older people and something very unique happened in the Commonwealth.

Two state agencies combined which I don't think this has ever happened before, the Department of Environmental Protection and the Department of Aging,two cabinet level agencies came together and created a dedicated funding stream to us to create a statewide water monitoring project for the State of Pennsylvania, and we do that. We now have over 2000 volunteers assigned to communities in I

think 41 of the Commonwealth's 67 counties putting in tens of thousands of hours doing water monitoring.

We are now doing acid mine drainage monitoring and a variety of other environmental works but what is interesting that we find is that we are a struggling organization financially and what we find is that foundations for example that fund aging programs look at us and say, "Gosh, you do environment. We don't do environment." We go to the environmental community and largely they say, "Gee, we don't do aging," and so what this conference represents to me, this meeting is a real effort to try to bring the two worlds together a bit more.

They are not together at all in the policy arena. They are not together in the funding arena. We started local senior environmental corps. The idea is that they become self-sustaining. They can't find the revenue to support them. Public policy makers haven't yet, with the exception of the Commonwealth of Pennsylvania, the exception of the Commonwealth of Virginia which has done what Pennsylvania has done, policy makers have not yet recognized that this extraordinary wealth of older people that exists out there that are talented with resources and things that have been

mentioned by Jim Sykes and others is sitting out there ready to be tapped to really deal with serious environmental work and so I hope that one of the outcomes of this is to begin to really more formally recognize the importance of that resource and bring them together and in closing I do have to give not only kudos to EPA for this initiative but actually EPA has been the one federal agency that has supported EASI throughout its entire more than decade lifetime. Much more funding has come from EPA to do source water monitoring and other kinds of activities and just about a month ago we signed a new memorandum of understanding with EPA to continue the work of bringing volunteers into environmental work. So, I just didn't want to miss this opportunity to talk about my organization, certainly but more importantly that we have a long way to go to even take advantage of the few things that are going on out there and this is a good step forward.

Thank you.

DR. CHARNAS: Thanks for that comment.

We have another question if you would come up to the microphone, please, one of our speakers?

DR.GOLD: Just a little reaction to that

interesting comment that you just made about your organization. The only kind of critical comment I would make is that while volunteerism is wonderful a lot of the elderly folks we work with need actually to be paid to some extent for their participation in some of the environmental monitoring because they have fewer resources than they had when they were working.

In a microcosmic way we have tried in our little repeated measures studies to not only involve the elderly but to actually pay them for recruiting and participation and so when the EPA goes to start new initiatives I would encourage you to consider the elderly as paid participants as well as its volunteers.

DR.CHARNAS: Thank you for that comment.

Are there other questions or comments, particularly questions for the speakers because we have gone through quite a few of them in as usual a very brief fashion?

MS. ADLER: I am Tina Adler. I am a reporter, a free lance reporter and I am very impressed with the presentations and the whole goal of the program but I just am wondering, I mean I know a lot of elderly people and I

understand clearly that they are more susceptible to environmental hazards as are small children but it kind of seems to me that elderly people are more susceptible to everything, I mean icy sidewalks, and I am just wondering if there is something unique about -- I still think it is important that you consider the elderly when you are making environmental regulations and all that. So, I am not saying just because they are sensitive to everything that you shouldn't also take them as a separate group when considering environmental problems but is there something unique about the environment that sort of makes them particularly susceptible to environmental problems or is there some sort of interaction between the elderly and the environment that makes that kind of a unique interaction other than just the sort of you know broad kind of concerns that elderly people have as they age having to be more concerned about really everything and it is a question that may not really have an answer but I was just wondering if anyone had any thoughts about that?

DR. CHARNAS: Actually I think that is one of the central questions that we are attempting to address at this conference. Would one of the speakers like to respond?

Diane?

DR. GOLD: Specifically in terms of the vulnerability of aging folks to outdoor and indoor air pollution as one gets older the tendency is to develop more chronic disease such as diabetes or coronary artery disease and also autonomic dysfunction and as I was showing in that that means there are specific as well as general issues about aging though people age at different rates. As you know somebody can be more aged at age 50 if they have had diabetes, for a long time than someone at age 80 but these specific diseases and physiologic problems do grow as you get older and it makes you more vulnerable to certain insults from the environment. I don't know if that answers your question a little bit in one area.

DR. SYKES: May I add another perspective? It seems that particularly in the built environment whatever we do to make our communities easier to navigate for older people also makes that community easier to navigate for younger people.

We, also, know from a lot of research that the extent to which we are sorted out because we have turned 65 or something as though we automatically have some disability

is not very welcome.

So, our strategy has to be essentially to keep engaging us even though there is a lot of evidence and all the papers that have been here have shown those very particular vulnerabilities; nonetheless most of us and that will be the 80 percent category until we reach age 80 or so meet more the criteria of a 55-year-old person than an 85-year-old person. So, treat us as normal people but create an environment which is not only healthy for older people but also for younger people and we will all win in that process.

DR. CHARNAS: Another comment?

PARTICIPANT: Just a very quick response to that question, also, from the perspective of pharmacology. We know that there are physiological differences that affect the handling of medications and broadly speaking medications are a part of environmental exposure to the elderly.

What we don't know very much about yet is the extent to which that might influence the handling of toxicants.

DR. BENSON: If you don't mind if I delay the break one more moment, the comment about employment versus volunteerism, first we absolutely agree with that. That

creates the opportunity for me to mention a program that I don't think has been mentioned here. Within the Environmental Protection Agency there is something called SEE, senior environmental employment program. It allows the hiring of older people specifically to work in the EPA through the entire country.

To my knowledge EPA is the only federal agency that has statutory authority to specifically go out and recruit and hire older people and I might add parenthetically it pays them wages that are far better than what we see in the senior employment program under the Older Americans Act which is tied to the minimum wage.

The SEE program pays as much I believe as $20 an hour to older workers to work for the EPA and it would be unfair for me to not note that very unique program that exists today.

DR.CHARNAS; Okay, thank you.

I think since we have made up a little bit of time although we are still a little behind schedule I would like to continue the session by looking at the industry perspective and we will first have James Bus from Dow Chemical Company, Toxicology and Environmental Research and

Consulting in Midland, Michigan who will talk on the general topic of impacts of chemicals on the elderly building on testing and research foundations.

DR. BUS: Good morning. I wanted to thank the National Academy of Sciences for giving me the opportunity to make this presentation from an industry perspective.

Certainly the issue of effects of chemicals on the elderly are important and as I looked at how I might address this question today I am going to take the approach that a number of the speakers have taken already today and yesterday and that is to really address the question what do we already know as a foundation of science that we can build upon as we look at the issue of the impacts of chemicals on the elderly.

With respect to Foundations let me first start off with some information that often I find when I talk to public audiences or even scientific audiences it is not fully appreciated what the real world of chemicals is and I am of course speaking to you as a representative of the chemical industry dealing specifically with industrial chemicals and of course pesticides and of course in this particular arena you often hear a number that there are many

industrial chemicals that are currently out in our environment.

In fact a common number that is often referred to is 90,000 chemicals and I thought I would share some information of where that number comes from. That number is actually the number of chemicals that are listed in the current EPA TSCA inventory of chemicals and that inventory right now as it is composed today is basically made up of 58,000 existing chemicals.

Those were chemicals that were entered into the inventory in 1979, which was initiated shortly after the passage of TSCA as a law and since that time, 1979, every 4 years there is an update of the TSCA inventory of chemicals and approximately 30,000 chemicals have been added during that time.

How does that come about? Every time a new chemical is either imported or anticipated for manufacture you have to submit a pre-manufacturing notice to the US EPA and of course that gives the agency an opportunity to consider what that chemical is, where it is going to go, what it is going to be used for and of course that is an important aspect of the overall TSCA law.

However, those 90,000 chemicals do not represent the actual total number of chemicals that are present in our commerce today, and in fact the current TSCA inventory as it examines those number of chemicals that are really used in some degree of quantity, that number probably is closer to 9000 and the reason for that is the TSCA inventory requires those numbers to be put in place if you produce more than 10,000 pounds of chemicals per year.

So, currently there are about 9000 chemicals in commerce today that are produced at greater than 10,000 pounds per year in terms of quantity.

That probably isn't the total number though. Other information from the agency says that obviously there are some chemicals produced at less than 10,000 pounds per year and that number probably could be as high as 6000. So, the total universe of industrial chemicals that potentially is out there for contact with the environment and also obviously with humans would be probably in the range of 15,000 chemicals currently but o that range of 15,000 chemicals the vas majority of them in terms of their potential impact to us and to the environment are what we would call high-production volume chemicals and then when

you look further at that TSCA inventory list you find that approximately 2200 of those chemicals could be classified as high production volume chemicals.

Now, those are substances that are defined as being produced in quantities greater than 1 million pounds per year per chemical and just to give you a reflection in terms of how that impacts the total volume of chemicals that accounts for about 90 percent to total market volume is made up of these 2200 high-production volume chemicals.

A few years ago a legitimate question was raised particularly by environmental defense, what do we know about the particular testing of those chemicals that are classified as high-production volume chemicals and frankly when you looked out into the general literature you couldn't find the information to support whether those chemicals had been adequately tested.

So, the chemical industry in partnership with environmental defense and also with the US EPA took on a program, what we called the high-production, volume-challenge program and that program was designed to communicate to the public by making public the information that is already in our files with respect to testing

information that is available on these high-production volume chemicals. Those tests are screening tests that are designed to evaluate end points such as acute toxicity, chronic toxicity, developmental and reproductive toxicology, mutagenicity and also ecotoxicity and environmental chemistry.

So, all those things are part of those battery of tests required for the high-production, volume-testing materials, and as you can see from this information we have committed as an industry to make that information fully public by the year 2004, and that is going to be and in fact on a current web site maintained by the US EPA. The advantage of that program obviously will be because that information now will be in the public domain as information that can be used by the scientific community, by the regulatory community or other interested parties concerned about the impact of chemicals on their lives and on the environment.

Now, there is, also, an additional set of information that is important when we talk about industrial chemicals. Not only do we have chemicals in commerce, but we also find and know that those chemicals are extensively

regulated and have been for a good number of years and of course, the primary law that impacts particularly industrial chemicals is in fact the Toxic Substances Control Act which was passed in 1976 and implemented really in 1977, and this particular law was really intended to regulate both existing chemicals, the battery of 58,000 chemicals that were entered into the inventory in 1979, and also new chemicals that came into commerce subsequent to that.

The law, also, importantly requires that there are reporting requirements associated with that whole range of chemicals that are out there in commerce today. So, for instance, in the chemical industry if we come across or generate in our own laboratories a toxicology test that we believe has important impact for human health outcomes we are obligated by the law of TSCA to report that information within 15 working days to the US EPA at risk of both criminal and civil penalties.

The testing requirements, also, come along with TSCA in that the US EPA if they look at the chemicals that are submitted to them as potential new molecules for commerce have the ability to in fact ask for additional tests if they feel the particular use or application of that

chemical presents threats to either health or the environment.

Now, in addition to industrial chemicals there is another battery of legislation, the Federal Insecticide, Fungicide and Rodenticide Act otherwise known as FIFRA is a law that is specifically in place to regulate pesticides and pesticides of course must be exhaustively tested before they are commercialized. So, by way of example this particular law currently demands that over 120 tests are required to register a molecule today to be a pesticide for general use and those tests basically cost about 35 to 50 million dollars to conduct and take about 5 to 7 years to complete.

It is a complete battery of tests dealing with human health and I will show some of those tests to you in just a few months but it also deals with issues of exposure and environmental fate and potential impact on the environment as well and as a consequence not only of this legislation but also because obviously of efficacy concerns we currently find in the pesticide industry that only about 1 in 20,000 potential molecules that are candidates for pesticides actually survive the registration process and the efficacy process.

There is also other federal legislation that controls the use of chemicals. For instance, there are laws dealing with pharmaceuticals and food additives and food contact chemicals and there are a number of other laws that have been passed since the 1970s, such as the Safe Drinking Water Act, the Clean Air Act and obviously we heard yesterday about the recently passed Food Quality Protection Act and essentially all of these pieces of legislation what they really fundamentally do is they set up a scenario where obviously hopefully they are going to demand and encourage the production of scientific information necessary to help us make assessments about potential human health impacts of chemicals.

What are those types of tests? Well, let me turn first of all since the topic of this meeting is in fact the elderly, what types of toxicology tests tell us something about the impacts of chemicals on human health as it is directed at the elderly and one of the primary tests that is certainly mandatory for pesticide and is commonly encountered with industrial chemicals is the conduct of rodent chronic toxicity and cancer testing. This is usually done in two species, both rats and mice. Those studies in

fact are lifetime studies and that is where the impact of chemicals on the elderly comes in. The dosing starts as a relatively young animal but it goes all the way out through the entire lifetime of the animal which is usually 2 years and at that point in time a rodent is in the last stages of its terminal time. So, in fact, those studies go out through old age and of course those studies are designed primarily to look for cancer effects but they also are intended to evaluate for chronic toxicity effects, in other words, the impact of chemicals over the range of organ systems and of course these studies are conducted under a good laboratory practice guidelines which again is another aspect of the TSCA and FIFRA legislation.

What do those studies actually look for? Obviously they look for cancer outcomes but more importantly they also look for a full range of target organ toxicities in those animals. So, there is full histological evaluation of all those tissues, of the animals at their terminal sacrifice which is at the end of their life span and we also do clinical observations of the animals on a daily basis as they are undergoing testing for these particular chemicals.

What is the outcome of these particular tests?

What are we trying to do? Obviously we are trying to characterize not only dose-response relationships which are very important and I will say something more about that in just a few moments but also we want to get an indication of an identification of what we would call the no-observed effect level or the NOEL dose because of course often for a non-carcinogen it is the NOEL dose that forms the fundamental framework for whatever risk assessment might go forward.

Now, in addition to chronic toxicity tests because some industrial chemicals don't always have chronic bioassays available does that mean we still don't have information available then with respect to the impact of chemicals on the elderly? The answer is no because in fact most industrial chemicals do in fact have what we would call subchronic studies conducted on them. Those are studies that are basically approximately 28 days to 90 days in length and in fact they are likely administered by the relevant route of administration and through studies that have been done by the British Toxicology Society and other organizations what has been found is when you look at the effects in subchronic studies and correlate them, do they identify target organs

as the animal would age, for instance, in a lifetime study and the answer is yes. The subchronic studies indeed are highly predictive of target organ effects at subchronic times identified in a younger animal as to what might potentially develop if that exposure is continued to later stages of life and again these studies are, also, intended to identify NOELs and again when you look at the comparison of subchronic studies to chronic studies you find that the NOELs really don't change very much between subchronic studies and chronic studies.

Often they change less than a factor of two to three, but in addition to these studies there are still yet other batteries of toxicology tests that are available that do have implications again for impacts of chemicals on the elderly. Acute toxicity tests are routinely done. These look at not only LD50s but they also look at things like skin sensitization, eye irritation. Those are the types of things that you obviously expected to be important across a full range of human population. We, also, do a full range of genotoxicity testing looking at the potential for chemicals to impact our genetic composition and of course if you get a positive finding in there that usually means that we need to

do further follow-up studies which often means the conduct of a full chronic bioassay because the implication would be if you have genotoxicity it may very well be a potential carcinogen and then in addition we also have available in our portfolio of tests a number of specialized tests that also can have applications for understanding health effects of the elderly.

These can include, for instance, a neurotoxicity test, immunotoxicity test and these are done by protocols interestingly enough that have been developed in concert with EPA.

So, these are worldwide guidelines that are available in terms of how we should do these particular tests. The last one that I have listed there, metabolism and pharmacokinetics is a very important one because I think in this day and age and certainly in the future yet to come our understanding of how chemicals are handled in the body is going to be extremely important as we look at the potential effects of those chemicals across the entire range of age sensitivity, whether that be young, middle aged or the elderly.

Now, toxicology tests as I just described to you

are pretty much descriptive in nature. So, the fundamental point is is there other information that also flows from the toxicology expertise area that allows us to understand more about potential impacts of chemicals on the elderly and in fact there is a huge body of information and that is what I would call mechanistic information and what is often overlooked is that the era of mechanistic toxicology fundamentally started I would say about 30 years ago and that particular investment was the result of not only research activities funded by the US EPA but also institutions like NIEHS and also by the chemical industry through activities of our organization, the Chemical Industry Institute of Toxicology now known just as CIIT.

What is flowed importantly from those particular mechanistic studies? They have clearly identified for us the full range or growing range of scientific principles and also toxicologic methods that lead to better tools and better understanding of what the potential of impacts for chemicals can indeed be on the full range of individuals whether it be young, middle aged or elderly and those mechanism studies have led us to understand better structure

activity relationships so that as we look at the broader universe of chemicals that we should be concerned about structure activity relationships which flow from mechanism studies help us make better decisions about which priorities we should put our research investments into, but perhaps most importantly what mechanism studies do for us is they confirm the essentiality of dose as it relates to toxicity outcomes and as we all know or some of you may know in toxicology and certainly in the society of toxicology we have a mantra called the dose makes the poison and in fact mechanism studies really help us understand what that phrase really means. How does the dose in fact translate into making something into a poison, but lastly what I need to say about mechanism studies and perhaps this is the most important point is mechanism studies coupled with descriptive toxicology studies really do indeed improve our confidence in our ability to extrapolate from our animal toxicology studies to potential human outcomes. They also allow us to improve the confidence in our extrapolation from high-dose studies which frequently our toxicology studies are to the range of exposures that people commonly encounter and then lastly relative to this particular meeting

mechanism studies can provide us some very important clues about the potential outcome of chemical influences on the elderly and what we are seeing now and already we will see I believe a lot more in the future is use of toxicology and mechanistic tools such as physiological or biological-based modeling techniques. Those techniques are largely supported by the mechanistic research that is currently ongoing in toxicology and then there is the new phrase that is starting to surface in the community of toxicology called systems biology and that is a terminology that is beginning to elevate because of the recent advent of what we would call the "omics" technology on the whole range of biological research activities including toxicity, genomics, proteomics, metabonomics and that information which is really designed to really enhance the ability of systems biology to be important; what is systems biology? It is essentially looking at the scenario in terms of how with the advent of these technologies now we can much more effectively examine how these chemicals can impact environment.

Now, importantly, I skipped one here, what these studies also tell us with respect to mechanism is that the

toxicology information flowing from descriptive toxicology studies which is identification of hazard does not equate to risk and in fact in 1983, the NRC recognized that and they really said that there really are two other important contexts that one has to be aware of, the exposure context and the dose-response context and as I have already alluded to when we look at toxicology studies the current risk assessment paradigm is to identify a NOEL and put uncertainly factors into the equation. Often the first uncertainty factor is the 10-fold factor for extrapolating between one species to another and the second factor is for that intrahuman variability which includes young to old disease whatever it may be and mechanism studies help us understand what those uncertainty factors could look like in the future. Why are dose-response relationships important? The Society of Toxicology Risk Assessment Task Force a few years ago issued an opinion that said that toxicology research if it is intended to be useful for risk assessment which is really what we are about should build in dose-response studies and then likewise it also said that toxicologists must consider those dose levels they employ with respect with doses of chemicals that people commonly

come into contact with. So, those are important elements when we design dose-response studies for toxicology.

Just to show you how that works and why is that important for this particular issue of the elderly, here is a scenario where we might have a single dose toxicology study done and an equivalent response starting over here and the old animal if you just looked at this information is clearly more sensitive than the young animal and one could come to the conclusion this chemical is a problem because here this dose is closer to this potential human exposure, but where does dose response come into this scenario? If you float in a dose-response curve, if in fact the dose-response curve looks that way for the young animal what does it look like for the old animal? If it looks like this clearly the conclusion would be that even down at low environmental concentration perhaps that exposure is indeed encroaching on the toxic effects, something really to be concerned about.

On the other hand, if the dose-response curve looks like this what it really says is as you get down to environmental concentrations the concentrations found in the environment that perhaps the young animal is really no different from the old animal. That is the reason why dose

response is so critical when we look at this issue of susceptibility of chemical exposures across the range of age.

Now, let me, also, say something about exposure because on this last slide I showed you something about exposure and fortunately there is in fact some significant progress being made with respect to exposure. The CDC has issued a national report card and they are actually starting to monitor for chemicals in the environment as well as from human samples and currently they are sampling about 100 individuals.

This should be a very useful activity because it points out to us what potential chemicals are in the environment and what their trends might be in terms of their appearance or disappearance and then likewise we, also, know on the industry side using pesticides by way of example the industry is funding through an academic research effort a farm family study and this is where we are really looking at how do the use of pesticides on the farm translate to actual exposure to these individuals as monitored by biomonitoring, not only dad who is often out there on the farm spraying the material but also to mom and the kids who may be in the home

but living right next door to where those pesticides are applied and fortunately from some of the data that we are already finding the principal investigator has stated that it is erroneous to assume that appreciable pesticide exposure may happen as a result of the participants' presence ont he farm.

What do we mean by that statement? By actual biomonitoring of mom and the kids who live right next door to where the pesticides are being applied we really find negligible exposure to those individuals.

So clearly as we move forward in the area of exposure we need to be concerned about as I have now modified the phrase, it is the dose, not just the presence and of course as our analytical techniques improve increasingly we will be finding the presence of chemicals in our body or in the environment. The question will be what does that mean for potential human health.

Let me just close here really quickly with a brief context with respect to the world of chemicals really is bigger, and you have heard this from other speakers as well. The natural world has to be considered as well. The NRC Council a few years ago issued a series of observations

about natural chemicals in our environment and they said something like natural components in the diet may prove to be of greater concern than synthetic. Naturally occurring and synthetic substances can cause similar, can operate by similar mechanisms and then lastly synthetic chemicals in our diet are far less numerous than the natural and have been more thoroughly studied and regulated and what do I mean by putting or what am I intended to imply by putting this information on the screen? Certainly I am not meaning to imply that this type of observation means as a chemical industry we should cut back on our efforts to be vigilant about manmade chemicals.

Certainly we need to continue those efforts but what this also tells us though is that the world of chemicals is clearly bigger and if we are going to view the world of chemical impacts on public health we have to view this as a public health question and that means the universe of chemicals is bigger.

We might also ask because it was addressed yesterday what role would the EPA possibly have in this world of natural chemicals. Indeed it could be in fact very important because natural chemicals are there because they

plants have to defend themselves against their external environment and we certainly know from a number of published studies in the literature that those particular chemicals, those natural chemicals will increase dramatically unless modern agricultural practices are used and of course EPA certainly has a role then in looking at how those practices will interact with the production of these natural toxicants.

Then lastly in summary what I have basically done is simply listed for you some of the things we have been speaking about and clearly what I am intending to say here is the chemical industry is trying to do the right thing. There is a lot of information that is currently available. We need to use it and as Governor Whitman started out this particular session we clearly can use that information to help focus our research of the future.

Thank you.

(Applause.)

DR. CHARNAS: Okay, we want to thank our last speaker. We are going to make another slight change in schedule. Tom Sinks is Associate Director for Science, National Center for Environmental Health. He is time

constrained and so we are going to let him go next and then allow Daniel Goldstein to finish up our session.

DR. SINKS: First let me apologize. I do have to catch a 2 o'clock flight. I have to be in Atlanta by four, and I am sorry that I am jumping in front of one speaker and I believe I only have 5 minutes. So, I will try to keep it that short.

I think I want to start by one, congratulating EPA and the National Academy for taking on this issue. It is a great issue. It is one we don't pay enough attention to our elderly whom many of us are quickly becoming and I am thrilled by it.

I want to direct two comments specifically to the committee, David, to you. The first is that I think it is pretty obvious that the committee is going to identify opportunities to fill countless research gaps concerning susceptibility of the elderly to environmental factors as well as the need to consider the elderly in the regulatory risk assessment process. It is not as clear to me if the committee will do two additional things which I would love to see them do.

The first is that I encourage the committee to

highlight the fact that we currently have sufficient information to prevent illness and early death for some conditions among the elderly and to recommend that we establish such interventions as soon as possible and I am going to give an example of that and the second is the challenge to the committee to challenge the Centers for Disease Control and Prevention ourselves to use the biomonitoring data that we are going to generate and to encourage the use of it to look at issues such as this and to give us guidance on where you think we should be taking that program.

This first slide is simply one that says who the National Center for Environmental Health is. It is something like the BASF commercial that says, "We don't make the cruise ships. We just make them go through the water faster," and I am just going to skip by it because I really don't have enough time.

Now, this particular slide and I apologize for the quality of it is the first experience I had in identifying the fact that the elderly are clearly at increased risk and susceptible to environmental factors.

In 1991, the Harvard Teaching Hospital had a

separate endocrine grand rounds and identified two cases of idiopathic hypercalcemia in Boston which were later identified as hyper-vitaminosis D.

Those cases it turned out were related to a home delivery dairy that had over-fortified its milk by 600 times with vitamin D and then delivered it to thousands of families around the Boston area, about 60 miles south of Lowell.

When we were asked to become involved and to identify the extent of the problem we assumed that the children would be the ones that bore the brunt of this condition. After all what families are going to in this day and age have a home delivery dairy deliver its milk to them? What we found, we found about 45 cases of people who were hospitalized and two deaths of hyper-vitaminosis D and about 35 of them were associated with the dairy and what we found was that there were very few elderly who received this milk but clearly the vast burden of illness was among the elderly. It was not among all of the children who drank copious amounts of milk and were able to pee out the vitamin D.

Now, I mentioned to you before the opportunity

that may lay before us to move into practice interventions and an earlier speaker mentioned the heat wave in Chicago. The Centers for Disease Control has been conducting epidemiologic research on natural disasters since 1976 and in 1980 we studied the heat wave, a very severe heat wave in Missouri.

We since studied the Chicago outbreak. This graph here is a graph that was published one year following it in the New England Journal of Medicine showing the epidemic curve of the deaths and I can tell you that besides heat waves that about 2000 people a year die with an underlying cause of death from hypothermia or hyperthermia each year, that the risk for death in this population is twofold, is twice as high among 65 to 75 year olds than it is 45 to 55 year olds and about six-fold higher for 85 and above and the issue here is that these are really preventable deaths. We know the cause. We know that isolation has a lot to do with it. It is a great opportunity to stimulate communities to work together and get these people out of isolation and we know how to prevent them and I would say to you that I don't believe these deaths are due to the weather as much as to the built environment and the social infrastructure that we

have in our communities, and I would challenge the committee here to look at this as an opportunity.

Whoops, I had better get moving. Okay, the National Report on Human Exposures, last year we published our infant, if you will, our first report of 27 chemicals. In January we plan to publish on 116 chemicals. We will be providing information on the national representative sample. There will be five age categories. I don't know what the cutoff is at the upper end. That will be refined as we gather more and more data over time. There will be seven percentiles that will be in the report, the 90th and 95th percentile age, gender. There will be about 40,000 data points in this report.

I think it provides a great opportunity to look at what actually is getting into the elderly as well as the rest of the population and to use that information in the future and I hope that the committee will see it as an opportunity to both suggest the utility of these data and to encourage us in using it for other purposes and my light is blinking. My flight is about to go. So, I had better hang up.

(Applause.)

DR. CHARNAS: The final presentation of the session on intervention and participation is by Daniel Goldstein who is a senior science fellow and director, medical toxicology,Monsanto Company and we are all waiting for his title and topic because it isn't listed.

DR.GOLDSTEIN: I actually kept the title of my talk, the title of this symposium. Being toward the end and wanting to do something useful along the lines of what I have been doing with the Office of Child Health Protection I want to take a look back at what we have heard over the last several days and talk a little bit about how that might translate into a regulatory infrastructure that incorporates susceptibilities for the elderly.

Now, having said that these slides were made up several days before this presentation actually occurred. I think I have come pretty close to being on the money as to the salient points of this presentation. I would like to tell you that that is because I am a genius. That in fact is not the case.

What it reflects is the fact that we haven't come very far in the last 10 years. Even looking at old information not much seems to have changed in the context of

this conference.

I will tell you I am a pediatrician. So, I am not specialized in gerontology. I will tell you that there is no industry position or industry perspective on this issue. It is new. We haven't had time to really think about it very comprehensively yet.

Geriatrics is sort of like pediatrics practiced in reverse as any pediatric pharmacologist will tell you but only sort of and there are some critical differences that we will address a little bit.

I haven't extensively reviewed the literature and pharmacology. There is a lot of information there. We need to look at it in detail to understand more about adult and aging metabolism and I will start with my children's position which is that children are not categorically more susceptible to environmental toxins than adults. They are very much more susceptible to some things. They are resistant to others and about the same for a large number of materials and I think the same ultimately probably will pertain to the elderly but that remains to be seen.

So, what about the aged? I started out as a child, going back to Bill Cosby. All children start out in

childhood. Not all of them make it to old age. There are other causes of mortality. As you get on in life the size of the population becomes more restricted. Therefore the public health impact numerically goes down.

I don't want to sound insensitive. We talked yesterday about how public health deals in the hundreds of thousands. I understand that those hundreds of thousands are made up of individual people.

I don't want to imply that I am being insensitive to those needs here but I am going to talk a little bit about the risk assessment and public health perspective that deals in broad issues.

In children and especially adults physiological age does not correlate very well with calendar age. In particular as we heard yesterday the aging process with senescence does not relate well to chronological age. Not all older adults are infirm. Many older adults have a lot of remaining life.

The onset of physiological senescence varies widely. How do we incorporate this into a risk assessment model? Do we want an age-based model or do we want a model that looks at the last say 20 years of life however long

that life may be as the time frame in which senescence occurs? How we build this model makes a big difference in how our risk assessment comes out and makes a big difference in whether we reflect the effects that are really happening to the elderly.

As was mentioned no adequate biomarker exists for senescence and I think as we move ahead with this we need to keep thinking about whether senescence per se is a valid concept for building the risk assessment.

The validity of that concept implies that all the various factors that come with senescence happen in some organized and reliably related time frame. That may in fact well be true but we don't yet know that that is the case and we have to keep an open mind.

I am not suggesting we shouldn't do the risk assessment but we may need to look at individual characteristics of senescence individually rather than collectively.

End points, classical adult end points will be my focus today. We talked a little bit about possible effects on the aging process per se and I don't believe there is enough science to be brought to bear to really discuss that

productively at this point in time. Are there unique outcomes to the aging individual? Possibly. Again, I don't have any information at least that I found that I could work off of. From what I can see most of the outcomes in the elderly can also affect younger populations. No question they happen more frequently and they may be increasingly susceptible.

Just because diseases present in the elderly does not mean we are dealing with a susceptibility issue. There ar progressive diseases for which the elderly may not be more susceptible. They just are the people who have been around long enough to get the disease.

There are diseases which involve latency, cancer where there is a time lag which occurs and so the critical exposures in fact may not be occurring in the elderly but earlier on in their life.

Long latency then makes it quite probable that risk is attributable to prior exposure and the sensitivity, the susceptibility in fact mathematically pertains to a younger age group and that has to be incorporated into the modeling appropriately.

Decreased remaining years of life means decreased

attributable risk of additional exposure and the aged may in fact be resistant to some things. Look at the mesothelioma data and you can see that as one ages there seems to be at some point a reduced susceptibility.

We heard as well about changes in gene frequencies. There is in fact a component of selection which occurs in the elderly and in fact they are certainly selected perhaps not always for resistance, perhaps for greater susceptibility in some cases but an issue that we need to consider.

The aged have already gotten most of their lifetime exposure. Changes in susceptibility as it relates to chronic or stochastic disease may in fact have very little impact on lifetime risk assessments as traditionally done when we look at the elderly population.

Small changes in susceptibility probably won't make large changes in lifetime risk assessment. However, the elderly clearly represent a population that is more susceptible to the acute effects of things like air pollution rather than latent or long-term disease.

It is to some extent the opposite, frankly of the situation that occurs in pediatrics. What is it that makes

the elderly unique? We heard a little bit about pharmacokinetics. Unfortunately, we are missing a speaker. My review of the literature indicates that absorption, GI, skin and inhalation on the average are unchanged. When I say that I am speaking in the broad average with individual chemicals I am sure that we will find age-specific differences, but I am speaking in broad generalities.

Clearly there is decreased muscle mass, increased fat volume that affects the distribution patterns. There is decreased organ perfusion.

Phase I and II metabolism, all you can say is that there is a lot of changes that occur with aging and they are highly variable as they relate to effects on particular agents but there is in fact as I mentioned earlier a great deal of data out there. It is in the pharmacologic literature. It has not to the best of my knowledge been comprehensively reviewed and assembled to try to understand the changes in metabolism, Phase I and II and changes in excretion which occur in the aging population.

Clearly we can say there is decreased renal function and that seems to be the one thing that everyone agrees on. Kidneys don't do well as you get older either

frankly in rodents or in human beings.

What else makes them unique? Life style factors, retirement, less work for many, not all, more home, relocation, decreased mobility, diminished resources to relocate, to avoid, to deal with threats that may range from heat to infection to chemicals and air pollution, changes in dietary intake. I am not a nutritionist. I don't claim to understand this very well.

Clearly there is reduction in total caloric intake as metabolic rate slows. There may also be reductions in dietary variability due to illness, due to cost, due to no teeth, due to who knows, a factor which is shared in fact with children who oftentimes will eat nothing but cheeseburgers for 3 years as many of us who are pediatricians have seen, very peculiar dietary habits and needs that may affect exposure.

Existing illness, we heard a great deal about this, lung disease, atherosclerosis, heart disease, osteoporosis, malnutrition common in the elderly, particularly the elderly who are underprivileged and under served, the existence of malignancy or its residual effects of treatment or the effects of therapy.

Pharmacologic intervention is critically important. Not only is there a wealth of data but in fact if we are looking for interactions between environmental toxins and other chemicals what are they most likely to interact with? Are they most likely to interact with some other environmental component which is present at relatively minute concentrations or are they more likely to react with a chemical agent, a drug given intentionally at a dosage which is sufficiently large to produce a physiological effect? Clearly if there are going to be interactions I can almost guarantee you there will be interactions between environmental agents and pharmacologic therapy.

Chronic changes in general organ function I will not try to reiterate. You heard about central nervous system. We didn't discuss much on endocrine. Those changes are in fact important. Certainly there are immunologic changes that we heard about. There are other organ system changes as well and I don't want to insult anyone by leaving their particular organ system off. These just happen to be the examples that I thought of.

The validity of animal modeling as it relates to aging and frankly to childhood remains to be adequately

defined. We need to understand what those models mean and that will need understanding of pharmacokinetics and pharmacodynamics of the aging animal as well as in humans and we have knowledge deficiencies in both areas.

The aging population is in fact more amenable to study than the childhood population. There are ethical constraints around pediatric research as there are in any research of course. The senescent population conveniently already happens to be in the medical system in many cases. It gives us access to a great deal of existing data.

In some cases there may be increases susceptibility but in fact we may be basing our regulatory infrastructure on data that is already specific for that population and which already incorporates that susceptibility and in particular the effects of air pollution on the elderly where we are in fact looking at the population directly of greatest concern.

I will try and wrap up. There is a few minutes left. Aging individuals are also not categorically more susceptible to environmental toxins. A one-size-fits-all solution isn't going to work any better than it did in child health. We have been struggling with how to implement

the extra 10X safety factory, when, where, how, that has become the expertise of the Office of Child Health Protection and a good reason for putting aging initiatives in fact into that office.

There are multiple phenomena associated with what we have called aging but more properly probably needs to be deemed senescence to remove that association from calendar age. We clearly will not have resources to immediately address all of the theoretical scientific issues which could be brought to bear in this area but as was pointed out in a risk assessment model not all aspects of all phenomena are necessarily critically important to know.

We need to focus our efforts. What is the task at hand? From a regulatory infrastructure standpoint we need to identify instances in which particular phenomena either as a general case like changes in renal function or on an agent-specific basis result in a differential susceptibility which is not already accounted for in the data as it is with elderly and air pollution to some extent and produces a change in susceptibility which is substantive enough to meaningfully effect the outcome of risk assessment. Risk assessment is not about the fifth significant digit. Risk

assessment is about one significant digit, two if you are lucky and getting the right order of magnitude.

So, although there is great value in understanding the science we have to aim for the big issues, not for understanding the details of the minutia, from the standpoint of regulatory priority.

Once we establish that information obviously we need to regulate accordingly. Two other comments, attributable risk resulting from ongoing exposure will probably assume diminished importance in the overall risk assessment in the aging population because of issues related to latency and because of diminished years of remaining life.

However, acute illness or acute exacerbation of illness or mortality of acute disease will assume greatly increased importance in this population. There is a critical difference between adult and childhood susceptibility issues. In childhood we have already focused on long-term effects of early exposure. So, in that respect the needs will differ substantially.

Outcome research does increase the likelihood that we will actually have human data for this population, in the

medical system the fact that we get some information. The last thing I would like to say in closing is thank you.

Thank you to the National Academy of Sciences. Thank you as well to the Office of Child Health Protection. I co-chair the science and regulatory working group of their advisory council or committee, FACA trying to do what we are doing here, trying to bring good science to the regulatory infrastructure first of child health protection and now of the aging population.

It is a growing and increasingly important population. I think this conference has been an extremely productive discussion to try to scope out the issues and begin to understand how to move the regulatory process ahead.

Thank you.

(Applause.)

DR. SILVERSTEIN: Thank you very much. My name is Michael Silverstein. I am another one of the NAS panel members on the aging worker project and I get to host the final session here which will be as you have seen from your agenda a series of very brief presentations, comments from a significantly large group of final speakers.

I intend to handle this in the same way that I once saw David Bern in the Talking Heads do a concert. I am going to ask each of the speakers to come up to the podium and give their final remarks and then sit down at the table and bit by bit we will fill up the stage for a glorious conclusion or finale to this whole conference.

The first of this group of speakers is James Grosch with National Institute of Occupational Safety and Health.

DR. GROSCH: Thank you. In the hope of making this brief I don't have any slides, but what I would like to do is just say a little bit about NIOSH and also about the topic of older workers which we heard about earlier from Jackie Agnew and a few other people have also talked about the issue of work.

For those of you who don't know that much about the National Institute for Occupational Safety and Health we are the principal federal agency responsible for studying the health and safety of workers.

We are not a regulatory agency, however. We really do research and our goal is to understand certain issues and also to translate that information so that the public and

interested parties can benefit from it.

A number of years ago NIOSH developed a national occupational research agenda called NORA and one of the priority areas that we identified was the study of special populations at risk and that is obviously a very broad category but within that category is older workers and that is something that we are very interested in looking at.

NIOSH is helping to fund the National Academy of Sciences study on older workers and it is a report I think that will have quite an impact on a lot of the research we do and probably that other people do both in this country and elsewhere.

When one talks about older workers obviously we are focusing a little bit on people whom you might consider the young-old, so people in their fifties and sixties but increasingly we know that people are beginning to work more and more after the age of 65. This is obviously for economic reasons. In some cases it also is related to demographics and in the future there may be changes in things like Social Security policy and Medicare that may also impact the number of older workers that we have beyond 65.

Just as one quick example of this about 2 months ago in Washington, DC there was a conference by a group called Experience Works and these are folks who promote older workers throughout the country and they have a conference every year to honor some of the older workers that they have identified and NIOSH was asked to come and give a brief presentation a couple of months ago and the outstanding older worker for 2002 was a gentleman who was 102 years old. He is a research chemist. He teaches at a college in Pennsylvania and is quite active. I think he has two patents in the last 10 years in some of the work that he does and many of the people at the conference who were attending it were workers, older workers in their seventies and eighties, in many cases working at least 20 hours and several of them were actually working full time and although probably not everybody in this room wants to work until they are 102 it would be nice to when we get to an older age to be able to work if we want to and to be able to have a job that we like enough that we can continue working at it.

When one talks about why the work place might be important in this issue of increased susceptibility I think there are two ways you can look at it.

One is in terms of aspects of the work place that might accelerate the aging process, so exposure to toxins, to chemicals, to pesticides and I think the work place offers a very valuable laboratory in terms of looking at specific kinds of exposures. There are certain occupations, for instance that have specific kinds of exposures, so for instance painters get exposed to solvents. Migrant farm workers may get exposed to pesticides, etc.

There are many of these things that the work place allows us to focus on in a fairly systematic way. Another aspect of the work place that we should not forget either is that it may allow us to do something proactively in terms of promoting health and it is through the work place that we may be able to reach people in terms of education programs, training programs.

Some companies for instance have things like health promotion programs where they help people with exercise and diet. Some organizations have health screening programs. So, there may be a positive aspect when it comes to work that we may be able to help people as they get older. In terms of this relationship between work and health one thing that we have known now for many, many years is

that there are some fairly dramatic occupational differences when it comes to health. So, when you look at health outcomes like heart disease, cancer, musculoskeletal problems, asthma, suicide, depression and the list would go on and on we find that not all occupations are the same. Some occupations have higher rates in terms of morbidity and mortality. Some have lower rates and even when we control for confounding variables like income and education we still find that there are differences and clearly that is an issue that needs to be explored further but it does suggest that occupational differences exist and perhaps through some changes in the work place we can reduce those differences.

As one quick example of some research that we are doing at NIOSH let me just describe very briefly and I have about 21 seconds, a study that we are doing looking at cognitive functioning and this is from some data from the health and retirement survey and this is a longitudinal survey of about 10,000 individuals many of whom are working and within that survey there is a fairly brief short-term verbal memory test that is given to individuals throughout the waves(?), and we have been comparing the memory performance of different occupational groups and in this

analysis I should say we control for things like income, education and health status, gender, ethnicity, not everything but a good number of variables and what we have found is that certain occupational groups tend to decline at a different rate from others and that in general blue collar occupations tend to decline a little bit more quickly than white collar occupations and that for instance agricultural workers seem to decline more quickly, construction workers, also. Their performance over this, it is about an 8-year period from 1992 to 2000 declined a little bit differently and it raises that particular issue of why that occurs

and again if we can discover why that is there is something we could perhaps do about it in a proactive sense and finally let me conclude that clearly one message from this conference is this is a multidisciplinary issue. The work place is one issue and one perspective but clearly there are others we have heard about and I think NIOSH as an organization is very interested in working with other organizations and groups and using multiple perspectives to look at this issue of increased susceptibility.

(Applause.)

DR. SILVERSTEIN: Thank you and we will turn now

to Samuel Wilson from NIEHS.

DR. WILSON; Well, let me start by saying that our institute at the NIH is very excited that the US EPA has taken on this topic as an initiative, the topic of the environment and age combining to impact human health and the overall public health burden thereof.

Certainly this is an area that we at NIEHS have been interested in for some time. For example, in the area of neurotoxicology, neurodevelopment, the area of respiratory disease, of course, the area of other chronic diseases such as cancer and in all of these areas we are substantially invested in the relationship between age and environmental exposures.

The age-related research portfolio that we currently have from the standpoint of what are we doing at the present time numbers about 50 projects and roughly is in the area of $10 million.

These research projects focus on the public health areas that I just mentioned a few minutes ago but then in addition there is a substantial research effort in the area of the inherited diseases that are associated with advances in aging and associated with abnormalities in stress

response. So, for example, the Werner's syndrome, Bloom's syndrome, the well-known DNA repair defects, all of these inherited diseases have allowed us to understand pathways for stress response, for DNA metabolism, for cell cycle signaling that must function properly in order to prevent premature aging.

The research portfolio in this area numbers about 75 projects and the expenditure is roughly the same as it in the specific age-related portfolio.

So, I think you can see from just this very brief set of comments that we do have a substantial interest in aging related research and are very excited about the possibility of further partnerships with the EPA to extend our very productive partnerships already in place. This particular topic area is most appropriate and offers a great deal of opportunity for expansion of research in these areas that I have already summarized.

These two research portfolios that I mentioned represent about 5 percent each of our overall research portfolio and certainly further investment, further opportunities should be productive in the future.

So, what is next? We look forward to working with

the EPA, with the committee using the report from this meeting to further define a research agenda and productive ways that we can further partner on this initiative.

Thank you very much.

(Applause.)

DR. SILVERSTEIN: Next is Andree Harris from the National Center for Chronic Disease.

DR.HARRIS: I should clarify that the Chronic Disease Center is part of the Centers for Disease Control and Prevention. I, too like other speakers would first like to thank the Academy and EPA for focusing increased attention on the important issue of older adult health. I think in particular they are to be credited for focusing on the science of this issue and CDC has also raised this as a priority lately. In fact, our new Director, Julie Gerberdeen(?) has indicated that the health of older adults will be one of her personal priorities during her tenure.

CDC in its role of monitoring the nation's health through the National Center for Health Statistics and other centers within the agency provides the evidence of this epidemiologic transition that was mentioned yesterday but what we have less information about is the underlying causes

of some of the environmentally related conditions and diseases that are occurring.

The nation is faced with a demographic imperative. Given the aging of the population and the rising cost in health care and long-term care we have no choice but to begin to try to identify better ways to prevent unnecessary disease and disability, particularly among older adults. Speakers have mentioned CDC studies and we are committed to continuing those studies and doing good science in terms of advancing prevention research and understanding the health effects of the environment, also, work place exposures.

Yesterday Larry Branch mentioned the public health perspective around aging and the environment. These issues, environmental issues lend themselves well to population-based approaches. Population-based issues also require though a large number of stakeholders in terms of moving the science forward, certainly health and aging professionals, physicians, the public at large, a wide variety including the scientists.

I think another important player here is the aging network headed by the Administration on Aging. This group with a state unit on aging in every state and over 600

area agencies on aging and over 6000 senior centers around the country reaches virtually into every community and I think that is another important partner that we have spent the last couple of years trying to build linkages with and needs to be pulled in as a key stakeholder in this effort.

Finally I think no one when you look back at the beginning of the 20th century could have anticipated the progress in health and quality of life that came about as a result of attention to environmental issues in sanitation, in housing, in water and the like and it gives me hope that at this meeting in terms of what has been presented here as well as the work we do as we move forward that we, too, can have some real dramatic impact in terms of moving environmental health issues forward for older adults but also for the population at large.

So, thank you.

(Applause.)

DR. SILVERSTEIN: Thank you and is Christopher DeRosa from ATSDR here? We are not sure. Apparently not. So,we are going to move on and go a little bit out of order and I am going to surprise Henry Anderson by asking him to come up next from the State of Wisconsin, Department of

Health but also here representing the Association of State and Territorial Health Officials.

DR. ANDERSON: Thank you. I counted the chairs and I saw I was No. 6, and there are five chairs and I am going to have to leave to catch a flight after my talk. So, I am not going to sit down.

I, like the others want to certainly congratulate EPA and the National Academy for putting this on and from the state perspective a critical factor here is leadership and the importance of raising the visibility of these issues that really could only be done when leaders step forward to raise these issues.

It is not as though the older persons or chronic diseases have not been well represented by their various organizations. They are very active as you heard at the state level and elsewhere and I see from the state perspective a critical factor here is increasing the linkages and that this is not something that has been newly identified but the critical factor now is to join these additional resources in this leadership and visibility with the existing programs and a critical factor will be in fact establishing the coalitions that one of the critical factors

we have learned in coalition building is identifying commonality, that the older person community has identified many priorities already. Those priorities will continue to exist and what we need to look for is where is there commonality between the environmental information and the science we can bring to augment their existing and strengthen their position and their need in the priorities that have been identified.

It seems that in listening over the last 2 days there have really been two critical issues that I have seen. One is the impact of the current environment on our current older population. There are some critical overlaps that I have seen. The one which seems to resonate with many of the already priorities out there is the one of interactive effects and multiple interactions,medications. There are over-the-counter medications. There are dietary supplements. There is a whole host of issues that are important to the aging community as well as the environmental exposures and the second issue I see as important to the research community is recognizing that the older population in fact is a cumulative exposure group, is a cumulative risk group. If you think of the 70 year olds they were 25 when we first

identified medications to treat tuberculosis. Think in terms of if you are 50 years old, you can remember sitting on airplanes and getting off and the stench of tobacco smoke in your clothing. We didn't have cell phones. The seventy year old didn't have television. So, there have been major mega trends that have occurred in our society that is all integrated into the experience of the cumulative risks and of course the success of the older population to survive those hazards.

So, from the research community the critical factor will be how do we tease all of that experience out.If you again think of the 1930s over one-third of the US population had no electricity. That of course was in the rural part of the country as well. So, there have been some major advances that have been made that we tend to lose sight of as time goes by .

So, from the research side it is going to be very important as we assess the older population unlike a rat that may live a long time in the laboratory eating the same food in the same cage with the same cage mates until they die, the adult population that is out there has lived through many things, we hope changes for the better.

So, the focus on the EPA regulatory-wise on addressing cumulative risk as well as aggregate exposures really are critical factors when we address the older population as well. So, I see that as a linkage that is very important.

So, with that I would like to again say, "Thank you," and we will look forward at the state level to participating in the meetings that are going to be held in the coming years and participating in helping mobilize our resources and our older community to assist in this initiative.

Thank you.

(Applause.)

DR. SILVERSTEIN: Thank you. Next is Stanley Slater with the National Institute on Aging.

DR. SLATER: Thanks very much. We at the National Institute on Aging have a responsibility and interest in supporting competitively successful scientific applications related to improving the health of older people and it is my hope that the presentations here at this meeting will stimulate some of you to submit grants to the NIA and also to other NIH institutes which study diseases in many cases

which are commonly found among older people and if there are good cases to be made for exploring environmental contributors to some of these diseases we would very much like to see applications from your.

Thank you.

(Applause.)

DR. SILVERSTEIN: Okay,now if all goes well, through the miracle of some electronic technology I don't understand we should be able to hear the voice of Harold Zenick speaking to us from some secret undisclosed location.

(Laughter.)

DR.SILVERSTEIN: So, is somebody up there going to do this? Hal, can you hear? Are you there? Hal is that you? Are you in touch with us? It feels like a seance. Watch as the podium rises.

(Laughter.)

DR. ZENICK: Hello?

DR. SILVERSTEIN: Yes, Hal, you can start.

DR. ZENICK: I am sorry, we seem to be getting a lot of static. I am with the Office of Research and Development and the Associate Director for Health through the National Health and Environmental Effects Research

Laboratory at RTP and I apologize for not being up in DC with you today. We are trying to deal with, I guess I am experiencing the effects of aging, inclement weather, frozen branches and chain saws right now and trying to dig a little bit out but thank you for setting up this hookup.

I know that Dr. Gilman had a chance, I believe to address the audience this morning. I wanted to take the opportunity very quickly to reiterate a couple of his points and as part of this panel and I sort of viewed this as you know our research program needs to, the office of research is trying to take into account both the human and ecological impacts of what I sort of view as baby boomers becoming of age and we want to I think in trying to begin to look at research in this area, we certainly want to take advantage of what I believe has been the excellent and substantive work that has been done today on understanding the biological processes that govern aging and the response processes and capacities that characterize this particular life stage.

I think it is important that we sort of distinguish sort of ontogeny from chronology in moving into this research field and recognizing that those of us that

will move into these ages are not all identical and as a result we have to appreciate something about the health status we bring into our later years as to the implications for experiencing environmental exposures.

I think the challenge for ORD is in the backdrop of the substantive work on aging that has been done is to find a niche that also allows us to collaborate with a lot of other research entities.

Dr. Gilman emphasized where we believe a major emphasis on our part will be is having a better understanding of where we baby boomers are going to end up residing, whether this will be retiring in place where we live now or migrating to other areas. I think it will be important to understand in those settings where we will spend time on the nature of activities that we will engage in in those settings and as a result what may be the concurrent exposures that we will experience, how do those exposures translate to actual doses and then developing very mechanistically grounded dose response models that are unique for this particular age group so that we can better assess what the risks are and the proper interventions.

I think it is going to be extremely important that

we develop an approach that is complementary to the efforts by others studying age-related diseases and I think one of the big challenges is trying to understand the attributable contribution of environmental exposures when considered in the complex of a bunch of other multiple stressors that impinge on us and may influence our health status as we tend to age so that we understand the degree to which we have to attempt to ameliorate those exposures on this background.

I think it is very clear that for EPA to move forward in this it is essential that we partner with our sister agencies and other organizations that this type of a holistic approach can be applied and finally I think we may have at least a little bit of lead time if you look at when we will rapidly begin to increase this particular cohort moving into our sixties and older. The projection is somewhere within the next 6 to 10 years. So, even with this modest lead time I think we do have the ability to establish the important partnerships, take advantage of what may already be under way and where that may suggest real natural interfaces and then try to get it to develop a strategic plan that focuses on what may be the important priorities to understanding environment and aging and then looking at how

we strengthen what I like to consider the three C's, that being communications, coordination and collaboration. So ORD I think is interested in moving from what has been sort of pockets of research and project driven research on aging to a far more integrated program not only that compliments agency efforts but also looks to extend to partnerships outside the agency and I will stop there.

DR. SILVERSTEIN: Thank you very much. Hal, can you hear me now?

DR. ZENICK: Yes, I can, thank you.

DR. SILVERSTEIN: Okay, so, I can say, "Thank you very much," and we will move on and just continue with the last group of speakers and then with everybody up at the front at the end we will have time for a final round of questions and discussion.

Hal, are you staying with us?

DR. ZENICK: I am going to stay with you and I think as long as the speakers take advantage of the microphone hopefully I will be able to hear you.

DR. SILVERSTEIN: Okay, very good. Thank you.

Next is Carol Schultz with the Gerontological Society of America.

DR. SCHULTZ; I don't really have anything to really add to the conversations that have already gone on at this meeting. I think pretty much things have been covered but since I am up here I, too, want to thank Governor Whitman, EPA and the National Academy for recognizing the need to do more in aging and particularly aging and environment.

Obviously given the demographics that are coming down the road we all have a stake in improving the health status of older people not only for personal and moral and social reasons but also for economic reasons which of course becomes very important these days.

One of the CDC reports in fact the report on healthy aging just to sort of put it in perspective states that if disease patterns remain the same the health care system will have to spend an additional 400 to 500 billion dollars to cover the costs of an aging population.

Now, of course, as new things are developed these figures change but it is still a big issues and you know aging, there is a lot going on in aging but it still demands a very high priority and ongoing effort. Obviously the broad range of issues that have been covered here

demonstrate that there has been a lot done but there is clearly a lot more to do and I think there is just a couple of observations and coming from GSA which is a research multidisciplinary organization this is very close to my heart.

One, just as I said there has been a lot of research but there is still more necessary and we have learned a lot but there are still many, many questions and I think that was evident from the presentations here and what was also interesting to me as I listened to the presentations over this last day and one-half was that even many of the important studies that were reported here didn't include an aging population. So, obviously those things need to be done on the other populations.

The other thing that I wanted to add is that when we are doing the research and I think that this is getting better but there is a tendency still in the, again, looking at the issues of economics to lump if you will older people into 65 and above and I think that that is really important not to do. We have to have to data that breaks that out because we all know 65 is very different than 75 and it is very different than 85 and if you really want to look at

what the implications of different interventions are you really have to have that data and this is particularly important in a lot of the federal data collections and so I know that things are getting cut these days not expanded but I think it is very important that that be included.

The other thing was the collection of research. I heard a number of people talking about lots of different things that I had never heard of and I am sure a lot of you hadn't either and so I would see another issue to come out of here was how we can better collect the data so that it becomes more accessible to other researchers from all disciplines as well as the public and the policy makers and finally the last thing that I heard sort of coming through here was how do we get this to the policy makers and I think obviously organizations like GSA and the other organizations that are going to speak and that exist obviously we are trying to do a lot of that, but we can't do it all and I was really interested I think in the organizations that Jim Sykes and Bill Benson mentioned. This is a very grassroots mentality these days and I think that while the organizations try to do things and we try to coalesce and do things together so that there is a bigger bang for the buck,

if you will, it is at the grassroots where the congressmen hear it and research is in hard times right now.

I mean they are not going to double NIH's budget again immediately in the immediate future even though we push for it but I think that the passion that I heard in a lot of these presentations would really be valuable at a local level if you all, you have the information and you have the passion to go and work with these different local coalitions to help inspire them to take the message forward and it is those local voters if you will that give the congressional people the courage to make these choices. There are obviously very hard choices and when research is going to be pitted against Social Security and education and everything else there have to be some very strong voices to give them that courage.

So, that is you know I think that obviously there are lots of opportunities to work together and I just hope we will do that and I think that is all I have to say.

Thank you very much.

(Applause.)

DR. SILVERSTEIN: Next is Jennifer Hilliard with the American Association of Homes and Services for the

Ageing.

DR. HILLIARD: Good afternoon. The American Association of Homes and Services for the Aging represents 5600 not-for-profit, mission-driven providers of long-term care services and elderly housing. Our members together serve over 1 million seniors a day at every level of care throughout the continuum including HUD senior housing, care facilities, assisted living facilities, continuing care retirement communities, skilled nursing facilities, home health providers and home and community based services such as adult day care.

All of our members share the same goal and that is to provide a healthy affordable and ethical system of long-term care services for the elderly. During the past 2 days we have heard from a number of distinguished researchers and although I have to say that much of the science is beyond the reaches of my decidedly unscientific mind there is one theme that seemed to be echoed by many of the speakers and that is the need for a better understanding of how the environment affects seniors and how seniors affect the environment.

Armed with the knowledge that can be gleaned from

research and studies of these issues AAHSA members can someday be able to provide a healthier environment for seniors, thereby enhancing the overall quality of their lives. The question therefore becomes well how do we get from here to there and that is where member organizations such as AAHSA can help.

As I thought about it during the various presentations there are a number of ways that organizations such as AAHSA can further the process initiated by this workshop and by Administrator Whitman.

First, through its institute for the future of aging services which we refer to as IFAS AAHSA conducts direct research on aging issues. Headed by Dr. Robin Stone, an internationally renowned researcher in the area of aging services IFAS is actively engaged in a number of public and privately funded research projects.

Accordingly it can conduct research, act as a clearinghouse for research conducted by others and serve as a direct link to the provider community. Second, AAHSA serves its members primarily through its advocacy division of which I am very proud to say that I am a member.

The advocacy division is responsible for policy

analysis and dissemination, government relations and grassroots advocacy through, for instance to illustrate the role that we play, through a 40-day grassroots advocacy effort earlier this year on a number of long-term care issues AAHSA generated more than 10,000 contacts with Congress from its members and in many cases it resulted in favorable action by Congress on some of these targeted issues.

Accordingly AAHSA can play an active role in creating awareness at all levels of both federal and state government, energizing support for the initiative and the efforts of its participants in the press and among our own members and providing a valuable link through our members directly to seniors whose buy in and active support are absolutely critical to the ultimate success of the initiative.

Finally, AAHSA has worked concertedly during the past years to establish and maintain a number of strategic partnerships with groups such as AARP and to foster the efforts of the industry leadership groups such as the leadership council of aging organizations and the assisted living workshop.

Such organizations and stakeholder groups can provide valuable assistance in promoting the work of the EPA's aging initiative and the research needed to move it forward.

According AAHSA intends to explore the ways in which its strategic partnerships and participation in industry leadership groups can be leveraged to promote and achieve the ultimate goals of the initiative.

As I stated before AAHSA is committed to ensuring the future of quality long-term care and housing services for the elderly. The knowledge to be -- I am sorry, I can't read what I wrote, to be gained by providers of such services through the EPA's aging initiative is critical to furthering that mission and we look forward to playing an active role with respect to the impact of the environment on aging and the impact of aging on the environment and thank you very much.

(Applause.)

DR. SILVERSTEIN: Next is Diane Lifsey with the National Council on Aging, I think. Is Diane Lifsey here? No?

Okay, well, then we will just move on to a final

round of questions and comments before I turn this back over to David Wegman for some concluding remarks.

Does anybody from the audience want to add something or ask questions of any of the panelists?

David?

DR.WEGMAN: I have a question that I think would probably be most logically addressed to NIEHS and EPA but maybe it is bigger question than that.

DR. ZENICK: I am getting just a bit of break up. I hope the speakers can use the microphone. I might be able to pick up the conversation.

DR. WEGMAN; Is this better, Hal?

DR. ZENICK: Yes, thank you, Stan, I appreciate it.

DR. WEGMAN: This is David Wegman, Hal.

DR. ZENICK: Oh, hi, Dave.

DR. WEGMAN: We have heard a lot today and yesterday about the heterogeneous nature of the aging process and the interface of aging in its somewhat natural form with disease and the growing burden of disease that occurs as we age.

We heard an extended review of toxicology's approach to how we examine the agents that we experience in

the environment and how they might potentially, the toxicologists might potentially contribute to our knowledge about the impacts of chemical substances on aging.

What we haven't heard about at all is research efforts addressing the issue of the fact that in our environments we never see any one of these agents individually. We see them only in heterogeneous complex circumstances and as I am aware of it there is little research, effective research that has explored this issue of mixed exposures in experimental situations that have realistic meaning to risk assessments that could then be realistically based on the true nature of exposures that older adults experience rather than the theoretical risks that would be associated with a single agent.

So, I wonder if anybody is aware of research in this arena or how we might move ahead in it?

DR. ZENICK: Dave?

DR. WEGMAN: Hal, you should just speak as you need to.

DR. ZENICK: Okay, that is fine. I didn't want to be impeding somebody else's comments. I think that the two dimensions that are compatible with what you just commented

on is that ORD has begun to more aggressively look at the issues of mixtures primarily as it looks at questions related to aggregate and cumulative exposures and risks. It has not been done in the older population but they have come up with models at least at this stage for pesticides that try to appreciate the fact of this multiple gemish that we might be exposed to and obviously the other side of that is understanding something about the mixed exposures as they relate to pharmaceuticals and environmental agents.

So, there are some efforts not targeted specifically to this particular age group but that have begun but they are just sort of scratching the surface but might provide somewhat of a springboard to get more aggressively to pursue these issues.

DR. WILSON: I would like to respond to that question and comment. I think you pointed out that the mixture topic area really is a real-world problem in the field of toxicology and environmental health sciences.

The reason we don't have very much information, however, is that we don't have the tools to ask precise questions about the impact of exposure to mixtures. I think the research under way on stress response so that the

molecules that can be measured as changing as a result of stress is an approach toward the mixture problem because single pathways and single molecules are seen to respond to a whole variety of environmental exposures or mixtures of compounds.

So, that idea of indicator end point type studies to look at stress response might be an answer. Of course, the genomics, proteomics area might actually provide us with a big increase in the precision of analysis but again we don't have enough experience yet with that technology to be able to know whether the mixture problem can actually be addressed with the technology.

So, do I have any other comments from Dr. Slater?

DR. SLATER: Yes. I would add that the problem is even more complex in that geriatrics is well known to be a situation characterized by comorbidity where we don't find people with single diseases and we don't find people taking one medication.

We frequently have people taking five to 10 medications with a similar number of diseases and now we add to that multiple environmental exposures to toxic agents. This is hard research. Everybody thinks it is the type of

research that needs to be done. Practically it becomes very difficult requiring very large N's and complex analytic strategies and while it is widely accepted that this does represent taking on the real world as we find it, people often shy away from doing this.

DR. SILVERSTEIN: Yes, another question? Oh, it occurs to me by the way that we did not provide an opportunity to ask any questions of James Bus or Daniel Goldstein. So, if anybody would like to ask them questions at this time it would be appropriate.

DR. BUS: I was just going to extend a further comment on mixtures and that is that particular issue has certainly been the focus of interest just over the last year of the Society of Toxicology actually working in partnership with EPA, with NIEHS, with ATSDR and the American Chemistry Council to actually start asking ourselves just the questions that Sam alluded to and what types of tools do we need to have, what types of basic data sets do we need to have; how complex do they need to be and what is it going to tell us in terms of the potential interactions that can occur particularly with respect to environmental exposures to chemicals, not so much the pharmaceutical world but

really more the environmental chemicals.

So, it is in fact an issue that is really grabbing the attention I believe now of the toxicology and risk assessment research communities and looking at the scope of the problem it is clearly one that is going to require a partnership across a variety of different research organizations because the activity will not be trivial. In fact that was one of the conclusions of the working group on environmental exposures to chemical mixtures is that we would have to develop partnerships to make progress in this complex area.

DR. SILVERSTEIN: I think one more, well, there are two more hands that went up. I think we have time for those, and, Daniel did you want to come up and go to the microphone?

DR. GOLDSTEIN: I had an additional comment. The real problem with mixtures is the multiplication problem. You have 20,000 chemicals and you want to do pairs and square that number and multiply it by the cost of doing one animal study.

The gross national product immediately comes into question. You just can't do it. What we need to move ahead

ultimately with a true experimental approach to this issue is a combination of what has already been mentioned, genomics with what I saw in our microrobotics laboratory a couple of weeks ago at Monsanto. We have 800 well plates. We have a robot that does literally 10 to the 6th plus experiments in replicate per day. You can actually do this, but in order to do that you have to take the output from the omics, from the genomics and the proteomics and you have to correlate that with outcomes in in vivo systems and that is the big missing piece is the genomics exist. The robotics exist. The theoretical throughput exists, but if we do the experiment today we have no idea what the output means and so a critical next step both from preserving the animals and from streamlining science is to take the growing number of in vitro test systems and begin to understand how they relate to in vivo results.

DR. SILVERSTEIN: Yes, you had a question?

PARTICIPANT: I have a couple of questions with reference to the previous recommendations from the panel that met and I guess issues recommendations in 1987, and how recommendations might have changed. Paul Gilman this morning emphasized that our research, this go-around will

emphasize or will concentrate on susceptibility to effects of exposure on the aged population rather than on aging itself and I am wondering if you consider this a departure from the previous recommendations when there were recommendations for example for looking for compounds that mimic aging or for looking for biomarkers of aging itself and if you do see this as a departure do you agree? Is that a good idea?

DR. SILVERSTEIN: Does anybody on the podium feel in a position to answer that?

PARTICIPANT: I will. Maybe I can take a moment just to respond. I am speaking for myself, obviously, not the whole committee that met in the late eighties.

First of all I would like to say that I think this conference has been very, very informative. Secondly, I would like to say that I think that if the recommendations of the previous committee are viewed through the lenses of the objectives of the EPA as outlined by Dr. Gilman and the objectives of the EPA initiative I think there will be identified substantial congruence.

Now, with respect to some of those specific issues regarding biomarkers of aging and so on you know that really

is a research agenda that is probably best addressed by the gerontology community, probably best supported by the National Institute on Aging as at least one source of funding. That would be my view. Stan, you might want to comment on that. I think my own view would be that we have to deal with the knowledge base that we have now and move ahead as best we can to address the very pressing issues that I think arise as a result of environmental exposures and that would be my major recommendation.

Look at those recommendations from the 1987 report, see where there are areas of congruence and focus on those issues.

DR. SILVERSTEIN: Thank you. There was one other question in the very back.

MS. ADLER: Tina Adler, again. I had a quick question which might be too clinical for you all but I am writing an article about the conference and for the Washington Post. So, it would reach a very consumer audience and I am just wondering do you have any advice from your research for elders at this point or is it premature to sort of be saying, "Look, you guys should be more careful about this specific set of chemicals or these types of

environmental pollutants," I mean are we that far along where we have that kind of specific advice?

DR. SILVERSTEIN: Would anybody be interested in providing advice to the Washington Post, for the Washington Post?

DR. HARRIS: One of the things that CDC is doing, we have worked with the American Society on Aging to try to get out information to the age beater(?) the journalists' exchange on aging regarding health issues of importance to older adults and in fact in March they had their meeting, the American Society on Aging, the National Council on the Aging had their meeting in Chicago.

They will have another session this year. One of the issues to be addressed is West Nile virus, diethylstilbestrol, you know a variety of things and I think that that has been one way to try to get information out to journalists in a very targeted way to aging journalists and then by extension to consumers.

DR. SILVERMAN: Thank you. Are there any final questions or comments?

Okay, I would like to thank the last group of panelists for getting us right back on schedule and I will

turn it over to David Wegman for concluding remarks.

DR. WEGMAN: It is difficult to think of how many different ways and appropriate ways that we should be thanking those who have attended, both because of the weather and because of the challenge of the topic.

This conference is obviously the beginning of a process that EPA is entering into. We will take advantage of it as we can in our more narrow or targeted effort to examine the health and safety needs of older workers but I think it has been an exciting start and Governor Whitman's challenge to us at the beginning indicating here commitment to this area I think is encouraging to all of us.

I want to thank all the participants for their energy, for their precision in timing which I think is rather impressive given the large number of participants and the rather unreasonable constraints on the amount of time offered anyone to speak, but I think we accomplished a great deal and it will be very interesting to see this come together as a document to guide the immediate future thinking about where we should go in examining the differential susceptibility of older persons in regard to occupational hazards or to environmental hazards.

So, again, thank you to those of you who happen to still be sitting on the stage and thank you all who are in the audience and particularly those who came just to listen because we need more people listening.

Thanks very much.

(Applause.)

(Thereupon at 1:30 p.m., the meeting was adjourned.)