HOW OLD IS "OLD"? THE EFFECTS OF AGING ON LEARNING AND WORKING

HEARING

BEFORE THE

SPECIAL COMMITTEE ON AGING

UNITED STATES SENATE

NINETY-SIXTH CONGRESS

SECOND SESSION

WASHINGTON, D.C.

APRIL 30, 1980

Printed for the use of the Special Committee on Aging

U.S. GOVERNMENT PRINTING OFFICE

65-878 O WASHINGTON : 1980

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

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HOW OLD IS "OLD"? THE EFFECTS OF AGING ON LEARNING AND WORKING

WEDNESDAY, APRIL 30, 1980

U.S. SENATE,
SPECIAL COMMITTEE ON AGING,
Washington, D.C.

The committee met, pursuant to notice, at 9:45 a.m., in room 5110, Dirksen Senate Office Building, Hon. John Glenn, presiding.

Present: Senators Glenn and Domenici.

Also present: John A. Edie, chief counsel; David A. Rust, minority staff director; Deborah K. Kilmer, legislative liaison; Neal Cutler, professional staff member; Eileen M. Winkelman, minority professional staff member; Diane Lifsey, legislative assistant to Senator Glenn; Theresa M. Forster, assistant chief clerk; and Joan D. Nielubowski, clerical assistant.

OPENING STATEMENT BY SENATOR JOHN GLENN, PRESIDING

Senator GLENN. I apologize to everyone in the room, and to the witnesses in particular, for this delay in starting, but there were two votes back to back, one of which is still on at the moment, and we may have more later on. So I apologize, we are a little bit delayed, but that could not be avoided this morning.

Today we will be discussing a matter that is very close to all of us and that is when do we really grow old? Can we all expect a significant change in our physical and mental capabilities as we age? Are these changes influenced more by the aging process or by the presence or lack of outside stimulation?

The Senate Committee on Aging has begun a series of hearings on "Work After 65: Options for the 80's." During these hearings and at prior hearings on retirement issues, the committee has been confronted with the question of one's abilities upon aging. Some of the questions have been addressed by research which analyzes the effects of aging on intelligence and physiological capacities. But many of the questions are still unanswered, and many myths and stereotypes remain. It is important to have sound data at hand as we consider work options and retirement policies for the near and distant future.

With passage of the 1978 amendments to the Age Discrimination in Employment Act (ADEA) the mandatory retirement age was raised from 65 to 70 for the private sector and State and local employees, and was eliminated entirely for Federal employees. The effects of this change are being measured; but as we move closer and closer toward a flexible retirement policy, we should have more thorough knowledge about ourselves and about our abilities.

What do we know? We know that we are living longer. The life expectancy at birth is now 73.2 years, and people reaching the age of 65 can expect to live another 16.3 years. Biomedical advances and a decrease in the death rate among older people, especially from cancer and cardiovascular diseases, will increase life expectancy in the later years even further.

We know that our society's aging population is continually increasing. Today, 11 percent, or 24 million Americans, are 65 and over. In 2030, when the postwar baby boom reaches 65, 20 percent, or 55 million Americans, will be 65 and over. That is more than double.

There has been some research conducted on the effects of biological aging. Today, several of our witnesses will discuss the results of the few longitudinal studies which are ongoing in this country. The measurement techniques used to analyze the numerous variables associated with learning and working abilities will be described. We will also look at techniques of assessment being used by other countries—countries being forced to utilize older workers, since they have become a necessity to the strength of the work force.

With our unemployment statistics as high as they are today, it is hard to imagine the time when our society will depend more on older workers. But we will. As the birth rate declines and the aging segment of our population increases, our work force will depend more and more on older workers for reinforcement.

For this reason alone, it is important to know more about the capabilities of older workers and how their skills can best be utilized, and to know how the job force can be altered to match the skills of older workers. More importantly, it is essential to have better knowledge of older persons' capabilities so that they will be encouraged to participate and contribute in a meaningful way.

Options for work after 65 are increasing in our country. I am hopeful that today's hearing will bring about a better understanding of ways to provide better options for the future.

We certainly have a distinguished group of witnesses this morning. Dr. Robert Butler is Director of the National Institute on Aging; Dr. Reubin Andres, director, Baltimore Longitudinal Study, and Clinical Director, National Institute on Aging; Dr. Carl Eisdorfer, chairman, Department of Psychiatry and Behavioral Sciences, School of Medicine at the University of Washington at Seattle; Dr. Leon F. Koyl, senior treatment medical officer, veterans affairs, Toronto District, Canada; Dr. K. Warner Schaie, director, Gerontology Research Institute, University of Southern California; and Dr. Stephen Sternheimer, research fellow, Russian Research Center, Harvard University and assistant professor of Political Science at Boston University.

Gentlemen, we welcome all of you this morning. We look forward to your testimony.

Dr. Butler, would you lead off, please, with either your full statement or a summarized version and in either instance the entire statement will be included in the record.

STATEMENT OF ROBERT N. BUTLER, M.D., BETHESDA, MD., DIRECTOR, NATIONAL INSTITUTE ON AGING

Dr. BUTLER. Thank you, Mr. Chairman.

"How old is old?" is a deceptively simple question, but really a very complex and important one, with many cultural, health, economic, and personal implications, not the least of which is the subject being emphasized today, the question of work after 65.

Much will be expected, and already is expected, of the relatively new fields of gerontology and geriatrics. Both are very important fields in trying to answer questions related to successful aging, functional performance with age, and the quality of life, in addition to questions about the mechanisms of senescence. Today we are focusing on questions related to functions over time. Researchers have long sought the development of precise measures of age, which are more meaningful than chronological age alone. We know that chronological age is distinct from biological age, psychological age, intellectual age, and social age. Broadly speaking, the aging of different functions and capabilities occurs at different rates. For example, one may retain high intellectual capacities in the presence of physical deterioration.

Certainly decline is not inevitable with advancing age. From a psychosocial perspective, there are many elements of knowledge, judgment, and creativity that in fact flourish with age. Nonetheless, there are a number of underlying physical alterations which occur with age resulting in an increasing vulnerability to disease. The ultimate goal of research on aging is to find ways to maintain, restore, or augment various functions which decline over time so that we can delay the onset of disease and reduce its duration and severity. Research supported and conducted by the National Institute on Aging (NIA) has the humanitarian and real world goal of reducing dependency and maximizing successful patterns of aging, quality of life, and longevity.

There are increasing demands for information regarding human performance and function as they relate to age. One example is the recently enacted law mandating the National Institutes of Health (NIH) to conduct a study on the relationship between age and the ability of individuals to pilot commercial airliners. Another policy issue which relates to age and human performance is the practice of not recommending individuals over age 60 for appointment to Federal judgeships. In the years ahead, decisionmakers in Government, business, industry, and academia will be looking to science and medicine for assistance in the formulation of work and retirement policies.

With the end of mandatory retirement in the public sector, and the establishment of an age-70 retirement age throughout most of the private sector, there will be a higher incidence of disagreements, it seems to me, between employers and workers as to when and why retirement should occur. Further, the possibility of an increased age of eligibility for benefits under social security raises questions about the relationship between age and human performance factors. It is important, therefore, that we become able to identify functions related to job performance and develop techniques for assessing these job-related factors. While it is not always possible to make performance appraisals and predictions on an individual basis, it is frequently possible on a group basis. For example, present knowledge allows us to predict a sharp increase in cardiovascular disease in the 55-and-older population. However,

since there is not always a relationship between group and individual characteristics and risk factors, one objective of research on aging is the development of precise assessment techniques which will enable the prediction of performance on an individual basis.

One important means of distinguishing among chronological, biological, psychological, intellectual, and social age is the longitudinal study method. Longitudinal studies provide the opportunity to examine the same individuals over an extended period of time. So-called cross-sectional studies, on the other hand, compare different age groups at the same points in time. The most efficient approach is to combine the two methodologies, comparing subjects of different ages participating in a longitudinal study at regular intervals. This cross-sectional comparison allows researchers to gain insights into human aging processes during the course of longitudinal studies, thereby speeding up the fruits of scientific research. This is the approach used by the NIA's Baltimore Longitudinal Study on Aging, now in its 22d year. Presently, over 800 healthy persons between the ages of 20 and 100 are periodically tested for biomedical and sociobehavioral changes with age.

A recent statistical analysis of Baltimore study data collected on 1,086 men throughout the lifecourse suggests that people who look older than their age may indeed be biologically older than others of the same chronological age and have an increased likelihood of dying sooner. Twenty-four factors were studied, including certain lung functions, basal metabolic rate, visual and hearing acuity, and scores on a simple test of quickness and accuracy. The biological age of an individual was established in relation to each factor. Scores were then consolidated into profiles so that each man could be rated as more like older or younger men. While the study's findings do not differ from commonly held assumptions, it has now been demonstrated scientifically that biological age is in fact associated with lifestyle, health, and possibly genetic endowment.

This recent finding of the Baltimore Longitudinal Study on Aging is of particular significance, I believe, because it at last represents significant progress toward differentiating biological age from chronological age. The NIA is also supporting three research grants which, among other things, should help delineate the relationships between intellectual function and chronological age. The NIA is now supporting the collection of followup data on the survivors of the original Berkeley and Oakland Child Development Studies.

The NIA is also supporting the creation of a data bank on the 55-year-old Terman longitudinal study of gifted children begun at Stanford University in the 1920's. The Terman data will be analyzed from a lifecourse perspective in order to better understand specific outcomes in the later years, including intellectual performance and work persistence. I am hopeful that this analysis of one of the rarest research resources of social science will contribute greatly to an understanding of the relationship between chronological age and intellectual age.

As our resources permit, the NIA will be supporting a range of longitudinal studies of various types in order to provide more data necessary to better answer the question, "How old is old?" In the meantime we hope to inventory and continue to analyze existing

data so that decisionmakers can make judgments on the best available data.

This concludes my statement. I would certainly be more than pleased to answer any questions, Mr. Chairman.

Senator GLENN. Thank you very much.

Dr. Andres, do you have a statement to make?

Dr. ANDRES. Yes, sir, I do. Thank you, Mr. Chairman.

STATEMENT OF REUBIN ANDRES, M.D., BALTIMORE, MD., DIRECTOR, BALTIMORE LONGITUDINAL STUDY, AND CLINICAL DIRECTOR, NATIONAL INSTITUTE ON AGING; ACCOMPANIED BY DR. DAVID ARENBERG, CHIEF, SECTION OF LEARNING AND PROBLEM SOLVING, LABORATORY OF BEHAVIORAL SCIENCE

Dr. ANDRES. In one sense I think it is appropriate that I follow Dr. Butler. First of all, he is my chief. Second, the information that we have been gathering in the Baltimore longitudinal study has covered a large range of variables but none that might be considered specifically aimed at a profession or a task itself in order to determine whether a person is competent or incompetent to perform a specific job. What we have been doing instead in our 22-year-old study is to get the information which might be considered the basic groundwork concerning the changes that occur with advancing age.

Dr. Butler mentioned a few of the characteristics of our study. I might just emphasize one or two points and that is that we felt it important to study individuals across the entire adult span of life so that we do have 20-year-old subjects as well as 90-year-old subjects enrolled in the study and it is the essence of the longitudinal study that the subjects come back for retesting periodically, that they agree to be in the study for their entire lifetimes. Next week we are having the first subject come in for the 20th visit to us.

What we have found, to try to summarize some of the principles of what has come out of the study, are some truisms. One, there is no adult plateau period during which no aging decrements occur. Even 30-year-olds cannot perform as well as 20-year-olds in many of the tests that are done.

A second truism is that variability in function in system after system is remarkably large, so that there are some elderly people who perform quite as well as average middle-aged adults on specific tests, and conversely some middle-aged adults who in certain specific ways resemble an average elderly person.

The third truism is that age differences may not be evident on certain tests of physiological functions unless a stress is imposed upon that system so that under resting conditions all may appear to be well in the older person but the impact of a stress—and that stress might be a natural one such as an illness or a stress that can be induced under laboratory conditions—those stresses will cause in the older person larger and longer lasting dislocations of the body's homeostatic mechanisms than occur in younger people.

The fourth truism is that exceptions occur to all of the previous truisms that I mentioned and that it is as important to understand the exceptions as it is to know the rule.

I will take just a moment or two to give a few examples of some of those principles that I outlined.

As far as the principle that there are no age decrements unless a stress is imposed, one can pick a system almost at random and come up with an example but let me give you one or two. If you simply measure the level in the blood of chemical substances or hormones, what you generally find is that you do not demonstrate an age difference. Thus, blood glucose levels do not vary with age under resting or basal conditions. However, if you induce a glucose load and see how well the body can dispose of the glucose, you find that the blood sugar curve in the older people resembles that of diabetics. Or in the cardiovascular system the pulse rate is very similar under resting conditions in young and old people. However, under conditions of exercise the older person will initially show a larger increase in pulse rate in mild exercise but cannot achieve with severe exercise the pulse rates that a younger person can achieve. Under conditions of exercise the plasma pituitary growth hormone level show no age differences under resting conditions but when exercised older people do not release this pituitary hormone in relation to exercise as younger people do.

Senator GLENN. While you are on that particular point, is that true of people who have exercised all their lives? Do you find that true with people who regularly exercise all their lives as opposed to those who have been more sedentary and then try to exercise?

Dr. ANDRES. Most of our participants are rather sedentary managerial-executive-academic types who tend not to exercise vigorously, so that we have not had a large population of exercisers. I think we are going to have to go out and find jogging groups and test them specifically for this. In fact, we have plans to do that but I cannot answer your question at the moment.

Senator GLENN. Yes, Dr. Koyl.

Dr. KOYL. I do a lot of comprehensive medicals on executives, vice presidents, and presidents of corporations and we do find that those who are habitual exercisers do much better on all the testing, including the stress tests and chemical tests. We have 7 years followup to date on several hundred of this type of person.

Senator GLENN. Thank you.

Go ahead. I am sorry for interrupting.

Dr. ANDRES. Another hormone produced by the brain—hypothalamus—and the posterior pituitary gland is the so-called antidiuretic hormone. When one stresses this system with a concentrated salt solution the body releases this hormone in order to conserve the water in the body because the body fluids are becoming concentrated. What we find is that older people are actually more successful than younger and that this may be a compensatory mechanism for the decline in function of the kidneys in the older person. Thus the decline in one organ system is compensated by, in a sense, the success of another organ system.

I might also mention to you a test that we did of how older people handle alcohol. It also illustrates an interesting point. When a longitudinal study is being conducted with large numbers of scientists in different scientific areas in the same building at work one can, with one test, get a great deal done. In this particular test

we were initially interested in whether older people could metabolize alcohol as well as young people can.

First of all, we were surprised to find that older people given a standard dose of alcohol, and this was the equivalent of three martinis intravenously in a 1-hour period——

Senator GLENN. You doctors have different standards than I do. [Laughter.]

Dr. ANDRES. We were surprised to find that that amount of alcohol only put one just at the level of legal intoxication in the State of Maryland. [Laughter.] It was horrifying to us in view of the deterioration in the performance tests that we observed.

In any case, we fully expected that the older people would have higher blood levels and that the levels would stay up longer, but as a matter of fact there was no difference with age in the ability to get rid of alcohol—the blood level fell just as fast. So this is another exception to the rule that there is a decrement in everything that one measures in older people. But I should add that at the same blood alcohol levels the deterioration in performance on certain performance tests was much greater in older people than in younger people.

I should mention, too, that there are many complexities in the aging studies that we do when one compares them to the rest of the world literature. An example of that might be that in our men we do not find a decrease in the circulating testosterone, the male sex hormone, while the literature that we have reviewed shows that most other studies have shown this level to increase. Now clearly there must be an explanation for this difference. We are not certain of the explanation but we think it has to do with the kinds of subjects selected for testing.

If one selects deteriorated or ill or institutionalized older people and compares them to healthy young adults, one is pretty well guaranteed of getting results which are going to be spectacularly different—one can publish and become famous. However, if you select the subjects with care, older people who are, in terms of health, comparable to the younger population, you may not find age differences and that may be true in the testosterone area.

Well, I would like to make a few other generalizations which will come up later on. I am sure others here could make these points but since I am speaking early on in the hearings let me make them.

One is that no test will be able to separate a population of individuals—regardless of their age—into two distinct categories of people; that is, a competent group and an incompetent group. One will have to deal with borderline or gray zones regardless of the tests.

Thus, any cut-points to separate subjects into competent and incompetent performers are either nonexistent or if cut-points are to exist they will have to be arbitrarily chosen. Obviously the specific purpose for which attempts are made to categorize individuals—for example, should a pilot continue to fly, should a scientist continue his research—will have an important impact on where the cut-point should be made.

In our own studies the focus has been on understanding the multiple changes that take place within individuals as they move

through the lifespan and another important goal is to dissect out, when we are smart enough to do so, when it is possible to do so, the mechanisms which underlie the age changes. It is easy to show a difference between young and old people. It is more difficult to understand the mechanism underlying those age changes.

In addition, we are interested in finding out which of the age changes are merely interesting; that is, it is sort of a guarantee that one will find the difference between young and old people. The question is not one of simply being of interest because old people are different from young people but the important thing is what level of function at a given age or what rate of change, the rate at which one is getting older, will predict specific harmful events in the future. Those harmful events, for example, might be simply dying, the development of disabilities, the development of specific illnesses, or, one might add, the ability to continue to work effectively.

In order to predict, to know the value of specific tests in a predictive sense, one would have to test individuals and follow them in time to find out what happens to those individuals. What I am doing essentially is to define a longitudinal followup study.

Well, I have given you several examples to illustrate some of the principles I have dealt with. The Baltimore study has been characterized over its history by the continuous introduction of new tests and explorations into new areas as scientific questions are posed and as the techniques for answering those questions are developed. Therefore, we have recently started new studies in the area of stress and coping in the evaluation of the immune functions with increasing age; thus we have a new longitudinal study which may well require 20 years to get the full answer to the importance of those changes in those areas with age. We have then a series of overlapping longitudinal studies with no foreseeable end point as long as scientists are able to pose questions and devise techniques to get the answers.

Well, that concludes my testimony. Dr. David Arenberg, who is sitting in back of me, is head of the section of learning and problem solving in the laboratory of behavioral science. I notice that the subtitle of the hearing deals with age changes and learning, so if questions come up in that specific area, I would like to turn to him as a resource.

Senator GLENN. Glad to have him with us this morning, too. I know Dr. Butler has to go but do you have to leave by 11?

Dr. BUTLER. At 11 or 11:30.

Senator GLENN. Let's go ahead with the statements and we will get the questions to you before you have to leave.

Dr. Eisdorfer.

STATEMENT OF CARL EISDORFER, PH. D, M.D., SEATTLE, WASH., CHAIRMAN, DEPARTMENT OF PSYCHIATRY AND BEHAVIORAL SCIENCES, SCHOOL OF MEDICINE, UNIVERSITY OF WASHINGTON AT SEATTLE

Dr. EISDORFER. Please let me express my appreciation for your conducting these hearings. Humans appear to have a tendency to be as efficient as possible in certain ways and as a consequence we create for ourselves quite serious problems. Our propensity to label

that cardiovascular status is a better predictor than age of pilot performance, that pilots with untreated high blood pressure don't function as well as those who have their hypertension under control was shown in the work originally performed by Dr. Spieth, now a member of the NIA staff.

Third, we are now beginning to understand the risk factors which will in fact affect cardiovascular status as well as nearness to death.

The point is that it is conceivable that by modifying hypertension we could then reduce the impairment in cognition resulting from the hypertension. I think there is some initial work that has suggested this is certainly possible. Additionally, experience in the task would lead to better performance in old as well as young. The notion that you cannot teach an old dog new tricks is not true of dogs, certainly not true of humans. There is in fact no body of data which indicates that the older worker at work is no less effective at most tasks while in others they may show some deficit but indeed these deficits may be compensable up to a point.

Learning has been shown to be impaired in older persons but it has also been shown that impaired learning may be as much related to peripheral events as they are to any basic age-related central nervous system deficit; that is to say, it is not entirely clear that the poorer apparent learning is related to an inability of the brain to handle the information as much as it is to performance factors in other areas. Apropos of one of the points that was made earlier, it is very clear that older people don't have deficits in all areas. For example, during a word-learning situation they put out twice as much free fatty acid, a component of the blood related to stress, as did younger men sitting in the same situation.

Peripheral levels of nonadrenalin and adrenalin do indeed appear to be higher in older men than in younger men. This will affect functional capacity but is not unmodifiable and may have certain advantages. I am saying this because in deciphering the basis for the difficulty, we see a good example of a disaggregation of the problem.

That is to say, instead of accepting that cognition changes or that learning changes with age automatically if we look at the factors that are involved in the performance deficit we may see that in fact some of these factors are modifiable. Certainly performance is modifiable by cognitive retraining, it may also be modifiable by medications. I don't want to get heavily into intellectual capacity because Dr. Schaie, who has significant expertise in this problem, I suspect will address it. However, our own work at Duke for about 15 or 16 years and the work more recently at the University of Washington have both emphasized that individual variation, which is the bane of scientists, has its flip side occasionally.

It is difficult for us to come up with conclusions because one of the few truisms about aging is that the older you get, the larger the variance in the population. That means we have a problem arriving at significance because dealing with statistics means incorporating the variation in the data. On the other side it means that while a lot of older persons are showing a lot of deficit, there are also a lot of others that are showing relatively little if any, deficit. That wide span is a very important concept.

So in closing, let me state that since there is much variation in human aging and since nearness to death is unknown, we should force ourselves to think differently about how old is old. We are not really sure about the relationship between age and the level of skill that is required for performance at a given function. How old is old for what particular function is, I think, a very exciting question to address.

Thank you

Senator GLENN. Thank you.

Dr. Schaie, how long is your statement? I want to make sure we have time to question Dr. Butler.

Dr. SCHAIE. About 10 minutes or so.

Senator GLENN. Let's go ahead with some questions right now and then we will continue. I want to make these discussion questions so they are not all addressed just to Dr. Butler. I will ask the rest of you to respond to them, too.

Dr. Butler, last week in testimony before this committee, Dr. Schaie pointed out that the control of infectious diseases will cause young persons to reach old age in better shape than today's elderly. What are some of the other medical advances being made which you feel will contribute to longer living as well as better living?

Dr. BUTLER. Well, first I think it is very important to clarify the distinction between lifespan and life expectancy. The inherent or natural lifespan has never really been extended. What has happened is that life expectancy has been improved so that more and more people are now surviving into old age. This achievement has been largely a consequence of great reductions in maternal, childhood, and infant mortality.

Also, particularly in the last decade, we have seen major reductions in deaths from heart disease and stroke, ranging from 23- to 33-percent reductions, in fact, as reported by the National Heart, Lung, and Blood Institute. So these are among the important factors contributing to increased life expectancy.

Gerontology, as I indicated earlier, is not only concerned with understanding the mechanisms and manifestations of aging, as pointed out by Dr. Andres, but is also concerned with the antecedents of longevity. We do, therefore, have an increasing interest in the role of physical fitness, exercise, physiology, nutrition, lifestyle, a life of substance and purpose, all of which bear upon the preservation of intellectual and social health.

Senator GLENN. On these longitudinal studies and the studies that you all are interested in and pursuing, do you see any way of speeding this up? We are all reaching senior status at the same rate. I don't want to wait until somebody's lifetime to have occurred before I get the benefits. That may be the only way we can do it. Aren't there massive studies that we could correlate?

I am thinking that they took 1,000 naval aviators back 20 years ago and started a study at Pensacola. They run them back through a check every year, I think they have 800 in the program today. I am sure different businesses, insurance companies, or other groups are doing studies. If we could just correlate them, there must be some areas of commonality that would give us a base with which to work. Are efforts being put forward in that direction?

Dr. BUTLER. I think that each of the individuals on my right and left should amplify my answer. The NIA is now supporting the collection of followup data on what began as child development studies, namely the Berkeley and Oakland child development studies, in order to study the surviving members of those samples 50 to 60 years later. Similarly, now that the Framingham study is devoted primarily to identifying risk factors associated with cardiovascular disease, we can try to "piggyback" or take advantage of this already existing study.

However, I think a very important point must be made. We have very rarely studied such factors as health, vigor, and creativity. Most studies have tended to be medical studies. They focus on problems of disease and pathology, which are indeed very important. But support for studying the entire lifecourse, human health, over time, has not been as available to us in the past.

I think another cautionary point has to be made here. We cannot really speed up types of longitudinal studies. This methodology, by its very nature, is a lengthy one.

Senator GLENN. I know that is impossible, it defies the term itself, I guess. What I am saying is aren't there already longitudinal studies that we can have somebody correlating—to put together—to get this information with the information that is already out there? Do you have anybody in NIA doing such a correlation?

Dr. BUTLER. Yes; we are already doing that with some of the child development studies because they present the opportunity to capitalize upon already existing data.

Senator GLENN. Have we made an inventory with insurance companies or naval aviator programs? Those are all in your study? You are following those?

Dr. BUTLER. Yes. We have developed an inventory that catalogs most longitudinal studies conducted in the United States since 1843, when the first one was initiated. But, again, a cautionary note. While I do agree with you that we must exploit all available data, I should point out that these studies were constructed with different concepts and methods. For example, cholesterol may be measured one way in one study and a different way in another.

Senator GLENN. I prefaced my remark by saying so we could pick out a commonality through the whole thing. I don't know what that commonality might be. You mentioned blood pressures. That is a fairly common measurement, I would think, in all of them. Maybe that backs up what you say and we suddenly wind up with 40 years experience instead of what we have with current studies.

Would any of the rest of you care to comment? Are any of the rest of you doing a correlation of various studies with the idea of broadening this base out rather than just waiting for people to live out their lives now?

Dr. SCHAIE. Yes; I am just in the process of developing a monograph on longitudinal studies concerned with psychological changes which will include reports of work done by a number of people here participating.

Another thing I would like to call attention to is that one way of shortening the time required to obtain results is to conduct simultaneous, short-term longitudinal studies. In fact, this is what is being done now in Baltimore. It is also one of the principles in my

own studies of intellectual development. Rather than taking single individuals and trying to follow them through their entire life, which would exceed the life of the investigator as well, you do look at people at different starting ages simultaneously so that you can then at least get some estimates by piecing together these short segments.

Senator GLENN. Short-term longitudinal study is sort of a contradiction of terms, isn't it?

Dr. SCHAIE. Yes; but following some people from 20 to 30 and others from 30 to 40, for example, is a lot more feasible than trying to follow a single group of individuals throughout their entire life.

Senator GLENN. Dr. Butler, we make a general assessment perhaps of how people are considered to be in good shape in their senior years mentally, physically. Those are subjective. Really there is no 1, 2, 3 measurement. It is sort of a general observation of the kind of shape and the acuity of people. Is there any commonality that you have seen so far in any of these studies that people who are in good shape, as we would put it, have a common trait of blood pressure or blood hormones or do they exercise? Is it racial, diet, urban, rural? Are there any traits that seem to be common to those people in good shape or in bad shape?

Dr. BUTLER. Yes; I do think there are some general features. These include genetic endowment, socioeconomic status, and access to health care. In the United States, for example, there is the tragic fact that black men have an average life expectancy of just barely 61 years, which is significantly lower than the life expectancy of 69 years for white American.

There are, then, some broad means of assessment in order to differentiate among individuals. There are also increasingly sophisticated techniques, for example, used for measuring testosterone, referred to by Dr. Andres. But while there are many newer techniques of assessment, again I must play the cautionary role in the sense that we must very thoughtfully develop new techniques, new means, new strategies of undertaking studies of human performance, and that we should not expect to master the subject of human performance over time overnight. In my judgment it is just not going to happen that way.

Senator GLENN. Would any of the rest of you want to comment on what you see as a commonality through any of these studies? You remember the international group we had down at the Russell Building in the caucus room, and we had the Russian doctors commenting on these things and I remember it was rather humorous. We asked them about this business of the 90-year-old that eats yogurt and then introduces his 112-year-old mother on TV. We asked them about some of the dietary differences and whether they made any difference.

The areas in the Caucasus, I believe it was, where they have these communities where people regularly live to be 95 or 100 are very unusual. The only thing, as I recall, and I am pulling this back now from a couple of years ago, that they had that was very much different in that area was regularity of lives, a regular sort of a schedule. Everyone got up about the same time, they went to work about the same time, they all stopped for lunch at the same time, went to bed at the same time. It was a regular-type existence.

Dr. BUTLER. Since those hearings in November 1977, I did visit the Caucasus, and it is true that there is a mainstreaming, or a sense of participation and substantial purpose, within the lives of the community of these so-called long-living people in Caucasia. It is also the case that they are very attentive to their diet, which is largely vegetarian and consists of very little meat. Generally, they are very moderate in their habits. It is not that they never smoke or drink, but they certainly don't smoke or drink with any kind of excessiveness. They are very much involved in physical activity, again not in the way perhaps that we would think of in American life, such as jogging, but in the sense of being naturally physically active.

But, again, we must look at the genetic consideration. You might also be intrigued to know that we have had the opportunity to test the authenticity of the reputed ages of these people because there is now available to us a means by which we can measure the passage of time through a chemical process. A tooth of one of the long-living people was brought to our laboratories, and we were able, in a blind fashion, to test the age of the tooth. The age turned out to be very close to the age that was reported by the Soviet scientist who brought the tooth of a long-living person to us.

Senator GLENN. Which was——

Dr. BUTLER. Well, in this particular case it was about 96 years, really not a very old person. Nonetheless, I think the important thing is that the chemical process occurs at a rate that provides us with a first biochronological tool so that we can begin to authenticate claims of longevity around the world.

Senator GLENN. Would the rest of you want to comment on the commonality of traits?

Dr. EISDORFER. Without attempting to be funny, one can observe that to promote one's longevity—having good genes for longevity, being intelligent, being caucasian, being a woman, not smoking, getting and staying married, engaging regularly in physical exercise, and avoiding certain personality traits and occupations may be helpful. That summarizes a whole lot of events.

At the request of the NICHD—this was before we had an NIA—I organized a meeting of representatives of all of the adult longitudinal studies, including the Pensacola study and a number of others, we did file a report with the NIH. There were at that time approximately 22 adult longitudinal studies in process. I think Dr. Butler has made an important move to bring in more including what were originally child longitudinal studies, that is, those that began at birth or shortly thereafter, thus raising the total number of studies under scrutiny.

Among many of the studies there has been a genuine attempt to share information between studies. This is not without significant problems. Most of the studies are focused on and often may measure the same thing in different ways. While a good physical example in many instances, for example, is blood pressure, I think you put your finger on one of the few that is widely performed. Psychological skills, reaction times, and so forth, are typically studied differently as are some laboratory measures. The end product of what we were measuring was often different enough so that our ability to share was difficult. While most of us were and are

interested in longevity, longevity itself does not necessarily give you functional age.

The kinds of tests we used to study function varied enough across the study so it made it difficult to directly compare, let's say, the Pensacola study which started with young aviators to the FAA study to the Duke study, to the study of railroad workers and so on. I think that effort to keep the investigators working together to try at least to appreciate what we were each trying to do has continued. I think though that it is going to lead to some problems; that is to say, there is just so much we can put together with our different measures and probably the best we can do is talk about longevity and risk factors. Those data, as you know, from the Framingham study will be forthcoming.

Senator GLENN. Has anybody ever done a study of Congress? I don't say this jokingly. We have a Capitol physician, we have records on most people who participate over there, have him take care of their medical problems. We are certainly a group that has some already in and others approaching old age, in exact proportional distribution to the whole Nation as far as geographical distribution. I think that might prove interesting.

Dr. BUTLER. So often we lack really systematic scientific protocols in measurements which are made either by a physician to Congress, or by any other executive management—related activities and health assessments. Unfortunately we don't always have systematic measures.

I wanted to add one point to Dr. Eisdorfer's comment. On the subject of longitudinal studies, because we have made considerable investments in important characterization data, we have been interested in post mortem examinations. However, this has been extremely difficult for a number of reasons.

What is particularly intriguing is that the volunteers themselves feel very strongly about the desirably of such exams. Many of them have raised the question, "Since we have testing procedures, why can't we have the 'ultimate examination' of pathological and physiological correlation?" Unfortunately, this is extremely difficult to do on both legal and logistical grounds, and it just has not worked out to date.

Senator GLENN. You know, we talked before and I was perhaps the one that made the suggestion of the continual analysis of the social security records, the cause of death and so on. There is much information we could get, but we ran into a real hornet's nest, invasion of privacy, we were going to make this into the great Communist state. All we were trying to do was to relate it back to the jobs and periods of residence in certain parts of the country.

I still think that could be of considerable value. We have the information, but we really ran into a buzz saw on that one from all the people who were so afraid we were getting into the civil liberties and we were going to defile something or other. I don't know what we were being accused of. Did we make any progress?

Dr. BUTLER. Yes; we have developed close ties with the Department of Labor, which has a longitudinal study related to employment, the Social Security Administration, and the National Center for Health Statistics, which has a Health and Nutrition Examination Survey which we are now helping to fund through an inter-

agency agreement. The latter effort will enable us to follow for the first time the nutritional status of people moving into institutions and beyond age 75.

There are also, through the Health Care Financing Administration samples of medicaid and medicare beneficiaries so that we can begin to trace the types of physician and hospital contacts of beneficiaries and study end-points. We are, then, making efforts to capitalize on available data. It is not all ideal, of course, but I think, as you have said, we must make every possible effort to utilize this kind of information.

Senator GLENN. From what you know is it possible to have a technique of assessment developed which could, with some reasonable accuracy, test the abilities of an older person? Is it possible to have a technique that could be administered by one's own physician in the office at the time of his annual checkup? Is it far more complex than that?

Obviously, I am trying to broaden this out here so we not only find a baseline of measurement for statistical study but at the same time, if you happen to have a deficit in a certain area, you begin to know it at a fairly early age and can take preventive measures. It seems to me some of these assessment techniques could be administered in your own physician's office and assessed and that is where it would really prove of some value. Do you see that as a possibility at this stage?

Dr. BUTLER. I do not think that the periodic multiphasic examinations that physicians have been using have been altogether successful in disease prevention and health promotion. You can pick up certain conditions, but I think we have more sophisticated assessments of disease and disability.

We certainly need more assessments of functional status, such as the type developed at the Baltimore Gerontology Research Center with respect to the physiological profile.

Senator GLENN. Is this something the physician himself could give in the office just as part of the examination?

Dr. BUTLER. Not at this stage.

I would like to add something else because it amplifies a point made by Dr. Eisdorfer. I think the environment in which the assessment occurs is absolutely essential. For instance, technology surrounds the pilot when he or she is flying, and factory conditions surround the factory worker. It may be that the physician's office is not really the right place for assessment. Some critical variables may directly relate to the environment in which the individual is functioning.

Senator GLENN. That would be true even for an assessment of the person?

Dr. BUTLER. Yes.

Senator GLENN. Not just because of the equipment and all, you have to put him in his own true environment, is that the case?

Dr. BUTLER. Yes; as Dr. Eisdorfer and Dr. Andres pointed out, one doesn't conduct an assessment in a vacuum. One must assess in the environment of stress since that might alter one's responses. It is important to know the job requirements or the specific challenges which the individual is given in his or her work environment.

Senator GLENN. How about the rest of you? Do any of the rest of you want to comment? Do you think it can be administered more simply than anything we do now?

Dr. KOYL. I think that the basic medical assessment is really an assurance assessment that the individual is fit to do something and what he is supposed to do won't damage him. As you follow that man through his career, time is your best indicator rather than one general medical. That is, it is repeated general medicals done to the same standard. The other factor is that in occupational medicine you have to particularize your examination so that it fits the problem.

In other words, you don't do a ritualistic examination of several common factors. If one is working with a mining community, you check their lungs. If you are working with a pilot, you check his vision and his intelligence and stability. It has to be particularized for the individual. Most of the techniques that rule out disease as such are available to the practitioner if he knows enough to look for them.

The techniques of trying to figure out the biologic lifespan of a person as has been demonstrated at the table, as yet are in the early stages of development. That is, once we can make a diagnosis, we are on safe ground but it is harder while we are still dealing with physiological concepts.

Senator GLENN. In some ways I am very critical of the medical profession, with all due respect to you gentlemen. I guess since time immemorial we have concentrated only on things when they go wrong, then we try to glue things back together. I think perhaps it has only been in very recent years, and perhaps some of the NASA emphasis triggered off some interest in it, that emphasis has been placed on how to keep well people well rather than waiting until something goes wrong.

I was trying to pin this down to the local physician's office on what we can see that can be detected fairly early. I think it is that type thing we want to get into and identify just as early as we possibly can, those areas of commonality that might provide some clue to what is going to go on. I would hope your studies are directed along that line as well as just a pure statistical base as to what happened after the wreck to x number of people. That is a big order, and I know you are all cognizant of that. That is what we are really aiming toward, it seems to me.

Dr. EISDORFER. The risk factor approach, which is our way of saying what you just said, has now become a powerful force in medicine. While we had to have longitudinal studies, from my point of view, longitudinal studies are the most difficult ones to get and keep funded. You are under constant scrutiny, pressures to change it to conform to the latest technology, but once you do that, you no longer have a longitudinal study. If it goes on too long, then you are 20 years out of date because all the technology is changing. How do you get the old laboratory studies done in the same way to get a reliable measure? How do you keep in touch with your population? How can you keep the investigative team together?

Senator GLENN. Dr. Butler, I know you have to go shortly. I will ask you one question and ask Senator Domenici if he has any questions.

Dr. Butler, if we, in Congress, were to mandate a study on abilities after 60, say, how practical do you think it would be to include resources from outside of NIH? I am thinking of some of these other studies, such as NASA, the Department of Education, and the Human Resources Lab at Wright-Patterson. Do you think additional resources are necessary and how much would we need to encourage other labs and Government agencies to help you out?

Dr. BUTLER. As a matter of fact, I think this is already happening. The NIH has been mandated, with the NIA serving as the lead institute, to undertake a study related to continuing the mandatory retirement age of 60 for commercial airline pilots. We will analyze all available data, including that of the various agencies you mentioned. Already, in the inventory of longitudinal studies that I mentioned, we have identified some 43 studies. We have begun to draw upon data sets that have been assembled elsewhere.

I also believe that the private sector should be involved in contributing to an understanding of human change over time. Having been so cautionary in my remarks, I would like to say a couple of positive things so I don't leave suggesting that I am in some way——

Senator GLENN. Before you do that, I was thinking in particular about NASA and the Human Resources Lab at Wright-Patterson. It seems to me that their ultra, ultra sensitive accelerometers, used in the early detection of Parkinson's, would be of very great value. I was thinking of some of that equipment being incorporated in your labs. Are you doing some of that now?

Dr. BUTLER. I agree that this would be of great value. As matter of fact, N. C. Marquette, a famous neurologist, discovered centrifugal forces in relation to the space program. I think it would be quite unwise of us to think that NIH has exclusive information, on these subjects. We must extend our horizons.

I just wanted to say something positive, about longitudinal studies. I tried to emphasis in my remarks that we have devoted more resources to studies of disease than to health. And, while it is important to study disease, we must understand more about functional performance. I was pleased that Dr. Eisdorfer pointed out difficulties relating to researchers, the people studied, and funding. But I want you to know that longitudinal studies really do pay off. The Framingham study has certainly paid off. The NIH studies on human aging, conducted in the 1950's, which I was party to, led to the discovery that cerebral function does not necessarily change with age. The Baltimore longitudinal study has led to knowledge about the way in which the body handles challenge doses of glucose in the diabetes relationship.

Senator GLENN. I know Dr. Butler has to go very shortly. Senator Domenici, what we had done on this, we had three statements and Dr. Butler was going to leave at 11 so we had a sort of a roundtable discussion. I want you to get your time in here and then we will go to the other three statements of the other three doctors here.

STATEMENT BY SENATOR PETE V. DOMENICI

Senator DOMENICI. Mr. Chairman, I have an opening statement I would like included in the record. Also, Senator Charles H. Percy,

Particularly if they have limitations that interfere with their work capability. Those who can still contribute to society and wish to continue to do so can do that also.

Senator DOMENICI. Thank you very much, Mr. Chairman.

Senator GLENN. Thank you, Senator Domenici. Your statement, along with Senator Percy's, will be inserted in the record at this time.

[The statements of Senators Domenici and Percy follow:]

PREPARED STATEMENT OF SENATOR PETE V. DOMENICI

Mr. Chairman, I am pleased to have this opportunity to make a few brief remarks during today's hearing of the Senate Special Committee on Aging on the subject of "How Old is 'Old'? The Effects of Aging on Learning and Working."

I would like to commend you, Senator Glenn, for your leadership in posing the question "How Old is 'Old'"? I agree with your assessment that, before we continue with our series of hearings on "Work After 65: Options for the 80's," we ought to be examining in greater detail the true learning and working capacities of the older worker. We have all heard a lot of myths about the older worker—particularly during congressional debate on the issue of mandatory retirement—and I believe that we ought to begin now to clear up these misstatements and get to the facts on this issue. We need a good, reliable data base if we, as policymakers, are to succeed in the task of affording to older workers those employment options which best suit their capabilities.

I look forward to hearing today's panel of experts analyze the relative strengths and weaknesses of older workers in the areas of learning and working. We need to hear from you not only where we are with respect to the status of research on this subject, but also we need your guidance with respect to where we should be going to expand our understanding. Once we have a more complete and factual picture of the learning and working abilities of the older worker, we will be better prepared to formulate policies which will make the best use of the valuable employment resource which our older workers constitute.

STATEMENT OF SENATOR CHARLES H. PERCY

Mr. Chairman, I am pleased that the Senate Special Committee on Aging has begun to hold a series of hearings to explore how opportunities for extended employment can be encouraged for older workers. The first of these hearings, in which I participated, was held last week on "Work After 65: Options for the 80's." Certainly, a necessary step toward achieving this goal is an assessment of the current data on the learning and working capabilities of older workers. Today's hearing on "How Old is 'Old'? The effects of Aging on Learning and Working" will help us to consider and develop future retirement and work options for older persons.

Although Congress in 1978 raised the mandatory retirement age from 65 to 70 thereby extending the available working life for some individuals, there is still a strong tendency among workers to retire earlier. During our hearing last week, it was mentioned that some retirement systems encourage workers to retire early. Further, once an individual reaches the magical age of 65 or 70 the value of the worker is judged, by some people, in a different and in some cases not in such a fair manner. At what age does one suddenly find that he or she is "old" and what are the repercussions of society placing this label on individuals?

As I wrote in 1974 in my book, "Growing Old in the Country of the Young," our culture thrives on youth. Further, I outlined in my book a number of myths which abound about the elderly and have in the past been accepted as truths:

Most of the aged are disabled.
Most of the elderly suffer from serious mental deterioration and senility.
Older people cannot cope with change.
All older people are alike.
Old age is a disease.
Physical limitations imply an inability to function.

I believe that it is our responsibility to do everything we can to dispel these misconceptions with the latest facts and assessments we have available on these issues. To that end, I am pleased that the committee is continuing to do its part in bringing the latest research and findings on the issues to the public's attention. I commend Senator Glenn for chairing this hearing.

Senator GLENN. Dr. Butler, we will continue and you can leave when you wish. We appreciate your being here this morning.

Dr. BUTLER. Thank you.

Senator GLENN. Our next witness is Dr. Schaie. We welcome any statement you have.

STATEMENT OF K. WARNER SCHAIE, PH. D., LOS ANGELES, CALIF., DIRECTOR, GERONTOLOGY RESEARCH INSTITUTE, ETHEL PERCY ANDRUS GERONTOLOGY CENTER, UNIVERSITY OF SOUTHERN CALIFORNIA

Dr. SCHAIE. Thank you, Senator Glenn.

I feel very privileged to be asked again to testify before this committee. My distinguished colleagues on this panel have already discussed a number of relevant issues with respect to physiological aspects of assessing capabilities and advanced age. I will therefore focus my remarks on what I conclude to be the state of the art with respect to psychological capability as traditionally measured by test of intelligence.

I will make three points: First, that the process of aging is different for successive generations; second, that rates of aging differ for different abilities; and third, that our technology for assessing intellectual ability in older adults is less than satisfactory.

I do this in the light of my experience in assessing several thousand adults over the age range from the twenties to the eighties and in particular from longitudinal studies monitoring change in some persons for as long as 21 years. I will then briefly comment on some of the pitfalls in using the concept of functional age which has certainly already had some attention in today's discussion.

Let me first talk about the problem of adult age changes, whether they involve true decline or obsolescence. As has been mentioned, much of the older research literature on intellectual change in adulthood has been based on cross-sectional studies, comparing groups of different ages at one point in time and which, therefore, have exaggerated the impact of generational differences, such as differences in schooling, in nutrition, and other behaviors. Recent longitudinal studies, however, permit better-founded conclusions.

First of all, it is safe to state that intellectual decrement occurring in anyone before the late fifties should be considered to be due to individual pathology and not to normal age changes. From the early 1960's to the mid-1970's there is normative decline on some but not all abilities, with substantial individual differences. Beyond 80, decrement is the rule for most persons.

For abilities involving speed of response, some decline may be noted in many persons beginning in the fifties and this finding is also true for abilities which are sensitive to modest impairment of sensory capacities, such as sight and hearing. More important, even, is the fact that adverse individual lifestyles or cardiovascular disease may accelerate otherwise moderate and relatively trivial behavioral changes with age.

Normative events occurring with age, however, must be clearly distinguished from the fact that most persons now in their fifties and older, because of the rapid pace of sociocultural change, are suffering, to some extent, from obsolescence effects. That is, older

persons at times compare poorly with their younger peers, even though, as is true for most, they function intellectually as well as they ever have. It will be one of the major objectives of assessment programs for older workers to distinguish as clearly as possible between individual pathological decline and personal disadvantages due to sociocultural or vocational obsolescence. The former requires medical and psychological intervention, but probably also retirement for cause. The latter demands obsolescence-reducing retraining through remedial education.

The facts about differential decline. As is true in the physiological realm, not all psychological abilities change at the same rate or show similar patterns of generational differences. Cross-sectional studies, for example, have identified what is called by some the classical aging pattern. This pattern involves the maintenance of performance on verbal abilities, those dependent upon the acquisition of information and skills transmitted by our culture, until quite late in life. By contrast, nonverbal abilities, those involved in abstract thinking and speed of response, are thought to be dependent on physiological characteristics, and are therefore expected to drop early.

These arguments are complicated, however, by generational differences for these abilities. Consider that persons who went through the educational system prior to World War II are likely to have had training which gave emphasis to memorization of facts, while younger generations were exposed to education emphasizing the recognition of relationships. Most traditional ability measures, moreover, have been developed to predict success in the educational process in a very general manner. When we wish to assess workers' capability, however, we are dealing with the problem of relating generalized abilities to specific work situations.

What does all this mean? It seems unlikely that a single index or test of intellectual capability is going to be very useful for our purposes. Instead, what is badly needed is to determine how carefully specified patterns of abilities relate to specific job competencies.

PSYCHOLOGICAL ASSESSMENT OF OLDER PEOPLE

Most of what we know today about psychological changes from young adulthood into old age has come about by administering test intruments which were developed for the prediction of academic or vocational success in adolescents or young adults. There are many reasons to believe that these instruments may not be the most appropriate, nor that they focus on those aspects of adult behavior which arise out of the accrual of life experience. We may, therefore, expect the same kind of challenges to ability and performance appraisal of older workers, as a basis for employer decisions, as have been encountered in the application of such techniques with minority groups.

What may be needed then is the development of a new technology for the assessment of older workers which is more relevant to the issue of remaining capability in specific employment settings and which allows a better identification of those areas in which older workers are likely to excel as well as those in which they may be at a disadvantage when compared with the young. Some of

old, then this person's functional age is less than his chronological age, and he or she should be treated like persons having the chronological age equivalent to the older person's functional age.

Unfortunately, there are a number of flaws with this thinking, and we should be careful before we jump too enthusiastically to endorse what otherwise makes good intuitive sense. Some of the major flaws are as follows:

First, as has already been discussed, physiological and psychological variables which might enter the functional equation shift across generations. We must ask then, on what generation, and at which ages the functional equations are to be anchored, and how often they are to be changed?

Second, most work on functional age has selected variables, of necessity, which show substantial age decrement. If this selection is based on cross-sectional studies, then its validity is suspect. If it is based on longitudinal studies, then there is the danger that some of the wrong variables may be given undue weight, at least in behavioral measurement. That is, a person's performance on certain variables which show very little change with age, and thus are not likely to show up in functional equations, may be far more critical than performance on variables which are reliably related to chronological age. Thus our functional age may give us the wrong estimate of what we are looking for.

To conclude, there is no question that assessment of older workers will become increasingly important if we are to protect the integrity and fairness of releasing persons from the work force for cause rather than chronological age. As these hearings suggest, a beginning has been made to develop the needed principles and technology, but much remains to be done.

We must be careful to avoid some of the mistakes made by the educational community in their early overenthusiasm on the role of objective ability and performance appraisal. Nevertheless, when all is said and done, just as I prefer educational decisions about my children to be made on the basis of objective evidence rather than teacher caprice, so would I prefer an evaluation of whether I can still hold my job or not to rely upon more objective procedures than my supervisor's personal biases.

I would hope then that these hearings will lead to the further encouragement of research and demonstration efforts designed to provide a scientifically sound, just, and practical system of capability assessment which will protect the rights and needs of the older

worker but will also help maintain the effectiveness and productivity of our economic system.

Thank you, Mr. Chairman.

Senator GLENN. Thank you very much, Dr. Schaie.

Dr. Koyl, do you have a statement?

STATEMENT OF LEON F. KOYL, M.D., WILLOWDALE, ONTARIO, CANADA, SENIOR TREATMENT MEDICAL OFFICER, VETERANS AFFAIRS, TORONTO DISTRICT, CANADA, AND MEDICAL CONSULTANT, DE HAVILLAND AIRCRAFT, LTD., TORONTO, CANADA

Dr. KOYL. I have no prepared statement because the Pony Express broke down and I didn't get any notice of this meeting except by telephone. I will submit a statement for the record on my return home.[1]

I thought the best way would be to outline what we went after in preparing the functional profiles that we use at de Havilland now and then leave it open for questions.

What happened was that in the late 1950's the Canadian Government decided to take the age limits off retirement for the civil service and General Burns, who was the Deputy Minister of Veterans Affairs, asked whether our team, which was already doing work on measuring parameters of aging, could attempt to develop criteria for assessing fitness of older people.

Five years later we had been able to study about 350 public servants aged 50 to 70 in all jobs from top management down to cleaner-sweeper. We were fortunate that we were able to do it at Sunnybrook Hospital in Toronto where we had the full facilities of the hospital which of course, includes all the service and hospital trades but we also had a prosthetic services factory. This factory used the same trades as the aircraft industry as well as woodworking trades so that we had some industry within the complex as well.

What it amounted to is that during World War II the Canadian Armed Forces had a functional profile which was used for grading competence but it was a very simple one in that it had five fits—fit for battle, fit for support, fit for base, home, and out, and that is not a very close occupational assessment in civil life.

Second, it was oversimplified in that there were only five degrees of fitness. So what we had to do was start with the idea that we would like to have a functional profile and go back and build it. We found out what the requirements were of the 100-plus jobs that were available to us to study and then assess all the individuals who were doing those jobs. Next we had to find out what was the minimum acceptable level of competence under each of the functions we were studying and then separate these levels far enough so that there would be no overlap. We found that we needed seven levels of competence before we could be assured that we were not confusing things.

This allowed us also to go through sickness, injury, through the rehabilitation process, and back to the job or to a change of job. We then took these items over to de Havilland and we have done 25,000 or more medical examinations since then and have followed

[1] See next page.

people since 1960 at least through their careers to date. In addition, we did a 5-year study at Portland, Maine, to prove that the same system would work with a central examining group handling multiple industries whereas in our organization we have a closed setup with all the medical staff within the company.

The essence of the functional system is that it is what is left that counts, not what the person has lost, and therefore we must use the minimum acceptable level of competence under each function as our baseline and work up from that, if it was required, for any special purpose. A simple example would be if a pilot has to have topnotch vision, then his visual acuity (E) is the top level in the profile. If a pilot's vision drops below E–1 he cannot be a pilot for that one reason. So one has to be at or above the level that is required by your job in order to do it. This means that nobody gets discriminated against as they get injured or sick or age.

So it is nondiscriminatory and it allows us to employ people fully to the end of their work career. We have the right to discharge for cause. We must maintain that right as we take age limits off retirement because there are people who are unfit at 50 to do the job and there are people who are still fit at 80. At present we have one union which goes to 68 so we have got 25 years' experience of age 68 compulsory retirements with 1 year's extension beyond that. So at the hourly paid employee level we have experience up to 69 and at management we give annual extensions as required beyond 65. We have not changed our law on that yet, Senator Glenn, but we believe we should. Age discrimination in employment is illegal up to age 65 under our human rights legislation. We have three superior court decisions extending it indefinitely to date.

Senator GLENN. Thank you very much, Dr. Koyl.

[Subsequent to the hearing, Dr. Koyl submitted the following statement:]

STATEMENT OF DR. LEON F. KOYL

THE GULHEMP METHOD

GULHEMP is not a fixed method of examining an employee, nor is it a fixed method of assessing the minimum requirements of the job. Basically it is a method of translating the complex language of experts in various fields, such as medicine and job analysts, into a simple arithmetical functional profile of fitness to work, or of job requirements, whichever is the problem. No one who uses it has to be an expert in the sciences used to construct it. It can be understood and used by top management, line supervision, unions, employees, and digital computers with ease and accuracy.

If GULHEMP is being used to do preemployment examinations, the information required is almost exactly the same as the requirements of the actuaries of a life insurance company. It permits the issuance of a policy which statistically and predictably will provide a calculable profit and reserve for the company. In the job market, one requires information which will predictably and statistically supply an employee who is fit for the job and will not be injured by the job. During the controlled research part of the work on employing the older worker, which was also a learning period for the research staff, the statistical probability of error was 2 percent per annum. In practice at de Havilland Aircraft, only four errors in 15,000 examinations could be identified during the period 1960–75.

On the job side, job analyses are required. These list the job requirements accurately and medically catalog the diseases or disabilities which are compatible with doing the job. The job analysis and its medical component must show not only the quantity and frequency of given lifts, climbs, and carries, but the amount and quality of residual physical ability required to do all parts of the job. It must, therefore, specify the degree of each important disability which is tolerable. It does

these things only to calculate the level of residual fitness the employee has, or the job requires. It is what is left that counts, not what is lost.

For preemployment examinations, we have no hesitation in asking the examining physician to use the medical history and examination forms of any of the large competent life insurance companies, e.g. Aetna, Metropolitan, Manufacturers', etc. If used conscientiously, these forms invariably produce the quality and quantity of data which is required for a functional profile of fitness of the potential employee. This is then matched to the minimum acceptable profile of the job(s) for which the prospective employee is applying, to give medical clearance. Sometimes the resultant profile may produce a recommendation from the medical department "not to hire." Personnel and line management can and do override the medical opinion, for example, if the person has a skill that is irreplaceable and if ways around the low profile can be found by plant or job redesign.

Diagnoses are kept within the medical department. Only the profile leaves the department. We do not use any exotic tests at this stage and specifically do not recommend any psychological testing except in very rare circumstances. If we find a disability that is remediable, such as a hernia, the applicant is told to get this repaired and reapply. Personnel is told this by giving the applicant an "R" for remedial grading opposite the relevant part of the profile. Personnel then know that the applicant should be invited to reapply when his remedial disability is corrected.

If the prospective employee suffers from a fixed disability, such as an old amputation, the effect of this is already in the data used by the medical department. For example, we have employed a tool and diemaker with bilateral midforearm amps because he can and does design and make the various special protheses required to do each job in his trade.

If the prospective employee is found to have, for example, diabetes mellitus not previously diagnosed, we recommend that he have this controlled and then reapply. Again we give him an "R" grading. This is a bit more "iffy," in that his diabetes has to be fairly stable before we can employ him in a job where there is moving machinery. Most of the time there is only a slight delay in employment if the job is an office job. A brittle diabetic can be employed in the manufacturing area in jobs where there is no moving machinery. We are fortunate in Ontario to be protected by a second injury fund of the Workmen's Compensation Board. We notify the board that we are employing someone with a diagnosed preexisting disease or handicap. Any new disability of lost time related to the preexisting diagnosis is then charged against the second injury fund and not to the company. This allows us wide latitude in employing handicapped individuals.

The prospective employee is interviewed by a personnel department interviewer for about 2 hours. He then is interviewed by his prospective supervisor and usually tested for basic skills on the jobsite. This phase takes more than 1 hour. He then spends over 1 hour in the medical department, half with a nurse, and half with a physician. By combining the observations of four experienced interviewers, we have a better idea of what the applicant is like than anything, except time or extensive individual psychological testing, can give. Cost is more than $250 per person. If we then check the level of education and if possible talk with teachers and previous employers, we get a further good look at the mental (M) and personality (P) status.

Under (P) at lower levels of employment, one is looking for "group value"—ability to get along with supervision and attendance record. At higher levels much more complex variables are studies. At this time we can confidently hire, knowing that the line employee is going to have 2 weeks' close observation in a school to refine entry job basic skills, which community colleges do not teach well. For hourly paid employees there is a further 30 working days, during which the employee is on probation. About the only type of psychiatric problem which can slip past this screen is a very well-trained and treated paranoid or paranoiac. More importantly, numerically, will be those with the potential for breakdown who simply have not been stressed enough to the date of application.

As you know, from studies of the intensity of modern battle and brainwashing techniques, everyone will eventually break down if enough stress of the appropriate kind is employed. The work stress of industry or other civilian work, such as farming, is not enough to produce problems in the majority of employees. Neither of the two psychiatric diagnoses mentioned above is an insurmountable problem in industry. Not only can we retain a person with a treated psychosis or psychoneurosis, but in some jobs we can actually hire stabilized patients, knowing they may have an increased liability to such problems under given stresses. Numerically this is a small problem. All psychoneurotic, psychotic, and organic mental problems developing during the total worklife of the employees total less than 5 percent of all illnesses and disabilities.

When hiring at management levels the medical department, if it is in doubt, may recommend that certain parts of a spectrum of psychological tests be given prior to committing the company. Usually the applicant's prospective superior, who is interviewing about the skills required for the job, queries something in his responses which make both he and our department wonder enough to want to be sure.

As we follow our employees through their worklives, they will become ill or be injured and return to work after the incident is over. At this time we may be detailed in our investigation of their residual physical (including mental and emotional) fitness. In 1974, when the 2d edition of "Employing the Older Worker" was published, the safest "noninvasive" way of obtaining optimum data about mental and emotional status was often by using psychological tests as a supplement to a state of the art medical and neurological history and examination. In the past 6 years, there have been tremendous advances in the noninvasive diagnostic and therapeutic skills of neurology. At present one tends to rely on this specialty much more than on psychology. Social work has almost matured. Therefore, most problems are referred to the neurosciences division of a hospital. Only as a backup do we use psychology, when the occasional individual patient cannot yet be diagnosed. Sometimes social workers can solve a social problem (a sociosis) more effectively than any other discipline.

Thirty years of observation by peers and management is almost always better than any battery of screening tests to show that a person is not producing as well as the person used to. Line management, however, should not attempt social, psychological, psychiatric, or physical diagnoses unless the problem is obviously administrative. An example would be issuing demerit slips and sending an employee home because the employee is obviously and repeatedly inebriated and is unsafe to be at work or incompetent at work. Demerit slips can also be issued for persistent absenteeism and demonstrably slovenly work. These are administrative actions, not a health department responsibility. Three demerits result in severance from the company.

Almost all other problems should be turned over to the medical department for diagnosis and treatment. The required part of the vast number of specialized areas of knowledge in the health and helping sciences can be mustered to diagnose the problem and treat remediable problems. When the employee's skills no longer fit the job but the ability to learn is not impaired, retraining should occur to repair job obsolescence, or produce new skills as new techniques come into use.

If a disabled employee cannot be improved to the minimum requirements of the job, reposting attempts should occur within the area where the unionized employee has bumping rights. At management levels the employee might be able to do a part of his job, e.g. be a project engineer or a consultant instead of vice president, engineering. This often takes the pressure off a harried person and allows use of accumulated knowledge and skills.

Occasionally a disability retirement is required. This is fairly unusual, except at top management and in skill areas where a few employees have to handle equipment around the clock. In these areas there is no room for more than one minimum level of fitness required by the job. Usually in jobs that are hourly rated, bumping down will do the necessary remediation. Often simply moving a skilled laborer from the production line to the subassembly shop in the same trade is all that is required.

A few examples: A bench and structural assembler has intermittent claudication—he gets cramps in his leg or legs on walking or climbing a specific distance. This is due to hardening and narrowing of the leg arteries. If he can climb 20 feet, he can continue to work at his job on final assembly. When the jobs available on final assembly are on planes, which require longer climbs, we can solve this problem by transferring to the shop in his own trade.

If a clerk develops severe angina on climbing three flights of stairs to the engineering lofts, we can transfer him to a job in product support on the street floor and if necessary give him special parking privileges. 3,000 cars can make our parking lots a long walk in winter for a person with heart disease.

An engineer who is an inventor should be promoted and another promoted in behind him to be an inventor. A study of the Hay system goals and requirements indicated some doubt as to the inventor being an effective management man. The other engineer was studied at the same time, merely to avoid any feeling of bias in the first man's mind. A very careful medical history, including psychological history was taken. A complete neurological and medical exam was done. Both persons were referred for an extensive 2-day psychological workup. The inventor couldn't manage anything, including himself, so on the medical department's advice he was promoted to be an assistant to a vice president, where he continues to invent. The proposed replacement inventor had just sufficient intelligence to graduate in engineering. He

[redacted] between employees and management for medical ethical reasons. He has to explain medical diagnoses in lay terms and have technical job terms explained to him. Some supervisors tend to try for too high a level of fitness for their jobs. We point out the negative effects of boredom with superman doing routine jobs. Often simply asking the foreman whether he or she could do the job with the discussed level of fitness settles the problem. Supervisors all realize they are getting older and more senior and want to protect their age peers. The personnel manager and the medical consultant help to avoid the opposite tendency, which the union in some companies might tend to favor, of placing the minimum level of competence too low so that production norms and productivity would suffer. The purpose of setting minimum levels of fitness required by the job is not to produce make-work jobs but to put the best person in the job or find the best job for the person, considering all relevant factors.

Senator GLENN. Dr. Sternheimer of the Russian Research Center at Harvard and also an assistant professor at Boston University.

Dr. Sternheimer, we welcome any testimony you may have.

STATEMENT OF STEPHEN STERNHEIMER, PH. D., CAMBRIDGE, MASS., RESEARCH FELLOW, HARVARD UNIVERSITY, AND ASSISTANT PROFESSOR OF POLITICAL SCIENCE, BOSTON UNIVERSITY

Dr. STERNHEIMER. Thank you, Mr. Chairman. I welcome the opportunity to appear as part of this distinguished panel and I will try to highlight my remarks and insert my full statement into the record.

Senator GLENN. The entire statement will be included in the record.[1]

Dr. STERNHEIMER. In contrast to my colleagues, my own perspective is cross-national rather than national. I would like to speak to you today on some of the ways in which the Communist States, most notably the Soviet Union, have been dealing with issues of functional aging, with particular reference to attempts to bring older persons back into the work force.

As you are probably aware, there has been astonishingly little information or analysis of Soviet efforts in this area. The information that I bring to you today represents some of the preliminary findings from a large-scale research project, "Retirement and Aging in Cross-Cultural Perspective: The Communist Experience," currently underway at Harvard University.

To be brief, the first issue to which I will address myself concerns conclusions that we can draw from the Soviet experience vis-a-vis ways to measure functional aging in the United States and to devise policy around these measures. This might seem to put the proverbial cart before the horse. But in this case, it is more interesting to look at what has actually been hauled rather than starting with the means of locomotion.

The Soviet experience teaches that a distinction must be made between efforts to measure functional aging on an individual basis and those designed along more collective lines. We, in the United States, as my colleagues have pointed out, ultimately strive to develop measures of health and capacity according to individualized instruments, whereas the Russians are much more concerned with developing a net assessment of the functional capacity of entire groups or categories among an aging population.

Second, the Soviet experience shows us that, from a policy perspective, one must distinguish between measurements geared to means for influencing the motivations of persons as they grow older and policies designed to alter the work environment in line with changing capacities—job redesign, and so forth.

Third, the shortcomings that the Soviets have experienced in their efforts to translate measurements of capacity among older persons into effective labor policy underline the importance of administrative decentralization. Otherwise, policies designed around measures for functional aging will never leave the drawing board. This applies in particular to their efforts to bring the tests they have devised on stream for use in the factory and other work environments.

Finally, with respect to a summary of the Soviet experience, I would like to underline the fact that the development of a reliable

[1] See page 33.

measure, as the Soviets have found out, still does not eliminate the problem of ageism. Ageism, as the Soviets are discovering from their own survey research, is a problem of international rather than national proportions. Active measures to combat age stereotypes among factory managers as well as local administrators are needed before measures to deal with functional aging can be made into effective policy.

I would like to add here that the Soviet experience also indicates that the successful implementation of measures for functional aging must be accompanied by concrete forms of financial incentive for the industrial management. Only then will we witness new kinds of employment behavior toward older persons.

In order to put these conclusions regarding Soviet efforts in some context, some demographic data may help. So long as the Soviet Union was a developing country and had not experienced industrialization or urbanization, it avoided the phenomenon of the graying of nations about which Dr. Butler and others have written. Indeed from the first modern Russian census at the end of the 19th century—1897—until the very end of World War II, the proportion of older persons in the U.S.S.R.—in this case, persons over 60 years of age—remained almost constant at about 6.9 percent of the citizenry. Following the war years the situation changed dramatically. We find the proportion of elderly in the Soviet population rising to about 9.5 percent in 1960 and to well over 13 percent according to the last census.

Long before demographic aging became apparent as a social and economic issue, the Soviet authorities made a commitment to the idea that only under socialism could the welfare of older persons be fully and successfully guaranteed. They tried to implement this commitment by introducing a retirement pension plan in the 1920's.

Since 1936, the old age pension scheme has covered workers in most branches of industry, with the notable exception of agriculture—until 1967.

As the demographic aging of the Soviet population became more pronounced, especially in the late 1950's, and early 1960's the authorities found themselves with a very real and dramatic problem in terms of work-force participation rates among older persons. Once a pension system was introduced—and, in particular, once it was liberalized following the death of Stalin in 1953—a dramatic decline in work-force participation among older persons ensued. From roughly 60 percent of the pensioner population still working in 1955, the proportion dropped to a little over 9 percent in 1960. It only gradually inched its way back upward, to 25 percent of the population, by 1975. I might add here that, despite their best efforts the Soviet authorities have not been able to motivate more than 25 percent of all old-age pensioners to forgo retirement in the years since 1975.

I provide these remarks simply as a brief background to establish why the Soviets are concerned with the issue of functional aging. Now let me add, if I may, a few observations about the procedures that the Soviets currently employ. As already indicated, the Soviets approach the issue of functional aging in terms of collective rather than individual measures. The issue for them is first physiological

capacity; second, motivation; and third, the positions which are occupied by older individuals as part of the larger work force; that is, mental worker, manual worker, skilled worker, unskilled worker, and so on.

Senator GLENN. Let me ask something there. Do they break these down as to the capacities required for that particular job? It sounds to me they are just making a functional analysis. If a person is on a desk job as opposed to somebody out in a situation where he has to run the tractor, these would be the different assessments. It would not be the kind of generalized assessments of general problems of aging as we interpret in this country.

Dr. STERNHEIMER. That is largely correct. I might add one other thing along those lines. Soviet research at present proceeds along disparate and somewhat unrelated lines. The Russians have done a great deal of important work in the area of longevity with respect to long-livers. At the same time, another group of researchers has been concerned with issues of functional capacity among an aging work force. Unfortunately, the research which looks at aging in general and the research which looks at functional capacity with reference to work-force participation in particular remain two separate research areas that have not really come together. The reasons, I suspect, are political as well as institutional, since each problem is handled by a different branch of the Soviet research establishment. I don't know if that fully answers your question, Mr. Chairman. But perhaps it gives some indication of how Soviet research divides between the two types of assessment.

With respect to functional measurement, much of Soviet research in this area uses self-evaluation of health status and then compares these self-evaluations to outside medical evaluations. Again, for our own purposes it might be instructive to note that because of the very severe labor force deficit that the Soviet Union now faces, the thrust of research into the functional capacity of older Soviet citizens tends to shade over very quickly into the following kinds of issues or questions: Whether or not individuals feel they are capable of working; whether or not they can be more effectively motivated to forgo retirement; whether or not an adequate tool for outside medical assessment can be devised to be used to answer such questions. But the least amount of effort seems to have been devoted to the last of these problems. It certainly has not received the kind of emphasis that one might wish.

Soviet researchers have done relatively little with respect to establishing concrete norms for older persons for different kinds of jobs. Again, I think this results from their emphasis on self-evaluation. So the kinds of things that we read about in the literature tend to emphasize the alteration of the work environment, flexible shift works, reduced working days, a reduced working week, more breaks, vacation time, and so forth without actually having established norms for older individuals based on medical evaluations that compare them with others in the same age brackets.

This is not to say that the Soviets have been doing some longitudinal research. There does seem to be a longitudinal project underway at the Institute of Gerontology at the Academy of Medical Sciences in Kiev, and this study has produced findings similar to those that my colleagues on the panel have already noted. Among

other things, the Kiev study shows that while aging brings about reduced attention span, a lessened ability to perform complex motor operations, and diminished recall ability, it does not do so in a linear fashion. And one of the things that the study emphasized, that within an older population the decline in these factors is not uniform across different forms of activity, parallels the conclusion that my colleagues have indicated can be drawn from American research.

The Soviet study also suggests that evidence for decline in functional capacity is most marked in the 5 years before retirement, which means for Soviet males ages 55 to 59, for females ages 50 to 55.

The study goes on to conclude that this may be reversed during the next 5-year period; that is, ages 60 to 64, for males, ages 55 to 59 for females, with only a further marginal reduction during the entire span ages 60 through 69. Thus, one of the policy relevant findings that the Soviets have come up with is that in the age brackets 60 through 69 years, older workers do not experience a continued diminution of capacity. In fact, decline in most cases comes immediately after retirement for men, and after a hiatus of some 5 years for women.

I would like to return now to some of the more general conclusions that we can draw from the Soviet experience. The absence of adequate and widespread economic incentives to Soviet industrial managers has been cited by the Soviet authorities themselves as a major barrier to bringing what laboratory tests have validated and what legislative measures strive to achieve onstream in terms of actual practice in the realm of employment and labor policy. This would suggest, from our perspective, that the use of some form of tax credits or direct subsidies to those who hire the elderly is a necessary ingredient in terms of substituting functional for chronological definitions in policy for the aging.

Soviet research and Soviet practice, demonstrates as well that any assessment of the cognitive, physiological, and other effective changes that occur with normal aging must take account of what older persons themselves want, or believe they want, in terms of employment opportunities. Perhaps one major difference between our approach to functional aging and the Soviet approach to functional aging is that U.S. research is more concerned with a measurement of what older people can do. The Russians, by contrast, have been traditionally concerned with what older people want to do—and, consequently, how to engineer situations so as to induce them to work instead of retiring.

Third, and finally, I would like to underline my earlier remark that ageism is a problem in the Soviet Union as it is for the United States. The Soviets, too, have found that ageism represents a set of biases and stereotypes that are not limited to the young people alone. Older people in the Soviet Union, as in the United States, have to be encouraged to seek and/or push for new roles and opportunities within the work force even as executives in social and economic institutions need to be made more aware of their capabilities.

I would like to conclude with a quote from Edward Rossett, a Polish sociologist who wrote some 8 years ago that: "Old age must

not be the equivalent of having the blade of a guillotine hanging over one's head." To which I would add, nor need old age take on such a menacing form if a proper assessment of the functional capacity of older people and their contribution to society and the economy can be developed. I believe the Soviets have made some moves in these directions. I also believe that they, like us, need to do much more in this particular area.

Thank you, Mr. Chairman.

Senator GLENN. Thank you very much, Doctor. Your statement will be entered into the record at this point.

[The prepared statement of Dr. Sternheimer follows:]

PREPARED STATEMENT OF STEPHEN STERNHEIMER

Mr. Chairman and members of the committee, I welcome the opportunity to appear as part of this distinguished panel, and to speak with you about the manner in which the Communist States, most notably the Soviet Union, have been dealing with the issue of older persons in the labor force. As you are undoubtedly aware, to date there has been astonishingly little information or analysis of Soviet efforts in this area that has been accessible to American policymakers or gerontologists. The information I bring to you today represents only a few of the preliminary findings from a large-scale research entitled "Retirement and Aging in Cross-Cultural Perspective: The Communist Experience." The project is currently underway at Harvard University, to be funded with the assistance of the Rockefeller Foundation, the National Institute on Aging, and other institutions. Although the project deals with China and Eastern Europe as well as the U.S.S.R., for today I will confine my remarks to Soviet progress and procedures for assessing functional aging.

The first issue to which I want to address myself is the following: What conclusions can we draw from the Soviet experience vis-a-vis functional aging? While this might seem to put the cart before the horse, it is more interesting to look at what is being hauled in this case than at the means of locomotion. The most basic lesson that Soviet efforts teach is that there are both advantages and disadvantages to approaching the problem of functional aging (or, more colloquially, "How old is old?") in terms of collective rather than individual measures. As I will elaborate shortly, we, in the United States, strive to measure health and capability according to individualized instruments, whereas the Russians aim more at a net assessment of the work capacity of entire groups or categories.

Second, there are tradeoffs involved among policies aimed chiefly at stimulating increased work force involvement (a motivational question) and policies geared more to things like job redesign and an altered work environment (adjusting opportunities to capacities). Third, the nature of the shortcomings the Soviets have experienced underline the importance of administrative decentralization in such areas as information gathering, job placement, and the actual measurement of the suitability of individuals for various kinds of work.

Finally, we know from examining Soviet assessments of their own problems that ageism represents a problem of international proportions. Active measures to combant negative age stereotypes among factory managers as well as local administrators are needed before programs can be successfully brought "on stream." Further the exhortation and reeducation must be accompanied by some concrete form of financial incentive in order to bring about new kinds of behavior toward older persons.

To put these conclusions in some context, it is useful to briefly describe some of the issues regarding aging that the Soviet Government has confronted, past as well as present. For a long time the U.S.S.R. resembled a developing country that had not yet experienced the takeoff of industrialization and urbanization. The combination of a high-birth rate, low-life expectancy (only about 31-34 years at the time of the 1917 Revolution), wars, and famines meant that the Soviet Union largely avoided the problem of the graying of nations. Indeed, from the time of the first Russian census in 1897 until the very eve of World War II, the proportion of persons over 60 in the U.S.S.R. remained almost constant at 6.9 percent of the citizenry. But with increased stability, economic maturity, and more attention to the consumer, came demographic aging. From 6.9 percent in 1940, the proportion of elderly rose to 9.4 percent in 1960, and to well over 13 percent according to last year's census.

Long before these population shifts were in evidence, the regime staked a major part of the appeal of its Communist ideology on the premise that only under socialism could the welfare of older persons—the opportunity to finish out one's life

in golden years of retirement—be fully realized. In 1928, the Soviet Government introduced an old-age pension system. By 1935, this system covered workers in most branches of industry—with the notable exception of collective farmers. Pension provisions were steadily expanded and benefits liberalized, most notably in the decade and a half after Stalin's death in 1953.

On the surface, such moves appeared to be a deliberate and well-conceived attempt to vanish the specter of aging as expressed in the folk wisdom of the Russian peasant: *"Starost' ne radost'"* (there is no joy in growing old). In fact, however, the extension of old-age benefits to the elderly (defined as women over 55 and men over 60, a cutoff point which, in light of our current knowledge about the process of aging, seems remarkably low) was geared to removing older workers from the labor force. This occurred at a time of large-scale unemployment in the U.S.S.R. and a need for younger cadres who were both better educated and free from the political taint of growing up under the ancient regime of Tsarist Russia. Soon, however, increasing strains on the nation's labor reserves led to a de facto freezing of pensions at a low level in order to encourage those reaching retirement age to remain in the work force.

The liberalization of old-age pension schemes after Stalin's death brought an immediate—and disastrous—dropoff in the work-force participation rates among Soviet older persons. From roughly 60 percent in 1955, the proportion of pensioners still working in the U.S.S.R. dropped to a little over 9 percent in 1960. From that time to present, the regime has concentrated its efforts on finding ways to preserve the system of old-age benefits which it cannot abandon for both political and ideological reasons. At the same time, it is an explicit policy goal to prevent the actual retirement of those who have reached, or are approaching, retirement age.

Despite the best efforts of the authorities, however, the rate of work force participation by the elderly in the U.S.S.R. climbed from only 9 percent in 1960 to 25 percent in 1975, where it has remained until the present. Such meager improvements have been viewed by the Kremlin with alarm, for a number of reasons. First and foremost is the growing labor shortage which the U.S.S.R. faces, as amply documented by CIA figures and the work of Dr. Murray Feshbach of the U.S. Department of Commerce's Foreign Demographic Analysis Division. Second, the graying of the Soviet population (i.e., rising numbers of individuals over 60 years of age) has been accompanyied by an even more dramatic rise in the number of actual old-age pensioners. By 1980, these account for roughly one in every six Soviet citizens, or some 40 million individuals.

Third, recent years have witnessed the growing feminization of the U.S.S.R.'s elderly population. Older women now outnumber older men by a factor of about 2:1. The significance of this figure lies in the fact that for reasons that have yet to be fully explained, Soviet women are much more prone to leave the work force immediately upon reaching pension age than are Soviet men. Whereas half of all men in the age group 60 to 65 are still working, the figure for women stands at only 40 percent. The disparity in participation rates widens as individuals of both sexes enter the second and third 5-year periods that follow legal retirement age.

Finally, working pensioners have come to constitute a not insignificant proportion of the overall Soviet labor force. They accounted for some 5.5 percent of the total by the mid-1970's, about 4 percent in the industrial sector and almost 9 percent in services. To these considerations must be added others such as the sheer size of the pension burden for the Soviet economy, and increasingly adverse age dependency ratios. New demands for housing by the elderly figure as well, as only about one-quarter of all pensioners today live within an extended family. Finally, growing labor shortages in both basic industry and the tertiary sector make the working elderly a resource that the Soviet State needs to cultivate.

In order to cope with these problems, the Soviet regime has placed increased emphasis on the development of a definition of functional aging as opposed to chronological aging. Presumably, the fruit of these labors will enable it to combine an established old-age pension system with appropriate and effective measures and incentives for the elderly to continue working. In what follows, I would like to call your attention to some details of Soviet efforts in this area. The ultimate object is for us in the United States to draw certain lessons from Soviet successes and failures. These, I believe, can be relevant for those concerned with U.S. policy for the aging.

First, let me say that in terms of procedures for assessing the work capacity of older persons, the Soviets approach the issue in terms of a collective rather than individual assessment of motivation, physiological capacity, and adaptability (as I already noted). The major instruments used are survey research geared to self-evaluation of health status and to motivations for working or retiring. When combined with objective assessments of health status on the basis of medical records, in

terms of numbers of visits to the doctor and the nature of the complaint, Soviet researchers have found that health status as an impediment is frequently psychological rather than physiological. No psychological tests for individuals that I know of have been developed, at least for other than research purposes.

Likewise, the use of controlled experiments to establish precisely what kinds of work are suitable for individuals with different capacities deal only with the most general categories of jobs—mental, manual, skilled, unskilled, etc. Typical of Soviet efforts are the large-scale surveys carried out by the Central Economic Research Instititue for the Study of the Labor Capacity of Invalids and the Elderly. These have been focused chiefly on attitudes and motives of working pensioners and nonworking pensioners as the basis for policies that will successfully stimulate potential retirees to stay on the job or in the work force. Capacity in this context usually derives from the following kind of inquiry, as exemplified by a 1974 survey by the Moscow City Department of Labor Resources employing over 100,000 questionnaires: Do you want to work? What kind of work do you desire? What hours? Full—or part-time? What is most important to you in deciding to keep on working or to retire—material gains, social rewards, or some mixture of the two?

In terms of the methods used to assess the physical and mental ability of older persons to work, relatively little seems to have been done to establish concrete norms, aside from paper-and-pencil tests that establish a preference for more flexible shift work, a reduced working day or workweek, more breaks, and vacation time—again, among older workers as a group. In collective terms, Soviet researchers also employ studies of older individuals actually functioning in the workplace, through the examination of medical records, attendance reports, etc. These establish that the incidence of illness, tardiness, and absenteeism among older workers is lower than among their younger counterparts. It is worth noting that in 1974 alone, the U.S.S.R. lost 27 million man-hours or the equivalent of 1 year's worth of worktime for 112,000 workers. Self-evaluations of stress levels for working pensioners have also been utilized. Predictably, the results show that older workers gravitate toward jobs that carry with them relatively lower amounts of stress and effort.

Some longitudinal research is under way at the Institute of Gerontology, Academy of Medical Sciences, U.S.S.R., in Kiev (circa 1975–76). These studies demonstrate that while chronological aging, viewed broadly, does bring about reduced attention span, retentivity, ability to perform complex motor operations, and recall ability, it does not do so in a linear fashion. In particular, the decline is not uniform across different forms of activity. It is most marked in the 5 years before retirement for males and females. It may actually be reversed between the ages of 60 and 64, and only a further, marginal reduction is evident during the entire sixth decade of the life cycle of both sexes.

The research reported also suggests that levels of education act as an intervening variable in the equation. Psychophysiological deterioration is arrested more frequently among those who are better educated. Such a finding, however, is dubious, and is probably due to masked variables such as diet, lifestyle, kinds of work involved, etc. Soviet gerontological studies from the Institute of Gerontology further emphasize that in cases where impairment of intellectual facilities with chronological aging has been recorded, there is also evidence to suggest that many symptoms can then be reversed by retraining. In short, underfed, unwatered plants wither prematurely, a finding that should not surprise any of us.

Why are Soviet researchers and policymakers so concerned with establishing the functional capacity of the elderly in the U.S.S.R.? The major reason lies in the fact that, as a series of studies in the early 1970's by a research arm of the Ministry of Social Welfare shows, fully 83 percent of all pensioners in the U.S.S.R. may be capable of continual productive activity of some sort, even as only 25 percent opt for such a course of action. A further breakdown revealed that of this four-fifths, 35 percent could still work in their existing jobs with no alterations; 50 percent could continue working with insignificant changes in jobs; and the remaining 15 percent would require new jobs, radical changes in work conditions, and the like.

Conversely, Soviet specialists stress that work for the elderly represents an individual as well as a social benefit. The evidence cited for this point of view is that among working pensioners, signs of physiological aging during the first decade after reaching retirement age are two times less by comparison to a similar group of nonworking pensioners in the same age brackets. Finally, Soviet research shows that in addition to a capacity for work and individual benefits, older persons in the U.S.S.R. want to work: A 1971 study of 14 regions in the largest republic of the U.S.S.R. (the Russian Republic) revealed that among a representative sample of 82,000, fully one-third of those of pension age expressed a willingness to work. The majority of these (70 percent) expressed a preference for either a reduced workday or shorter workweek.

In order better to assess the functional capacity of older persons in a work-related manner, the Soviet system utilizes—or, more accurately, hopes to utilize—a variety of structures and institutions. First, there are commissions for the employment of pensioners, local, quasi-governmental bodies that are still in an early stage of development. As of 1976, they were reported to be operating on a widespread basis in only 1 of the 100-odd provinces of the Russian Republic (with a push from the local party organization). As described in the literature, their function is chiefly one of coordination and gathering information through the use of surveys, the collection of economic statistics from local enterprises, and so forth. Their major objectives are: (a) to bring to employers more data about the size of the labor reserve existing among old-age pensioners, and (b) to provide for pensioners more and better information about the kinds and locations of the job opportunities that do exist.

From a second perspective, the Soviet system utilizes a wide variety of financial incentives geared chiefly to stimulating increased levels of work force involvement by older persons. These have been introduced through some half-dozen liberalizing measures in Soviet pension legislation between 1964 and 1979. The latest of these, from October 1979, provides for additional monthly increments of 10 rubles for each year of continued work by an older person after he or she has passed retirement age. The total supplement, however, cannot exceed 40 rubles a month, and the pension-plus-supplement cannot exceed 150 rubles per month. In a situation where the average pension, to the best of our knowledge, still stands at only 80 rubles a month, such potential increments represent a not insignificant motivation to stay on the job. Drawing rights for the supplement, however, are postponed until after pensioners have ceased working, and thus, actuarially, the incentive may be less attractive than at first glance. Such provisions must be viewed in a context where the minimum pension is still only 42 rubles a month even as the official poverty line in the Soviet Union stands at 50 rubles per month per person.

Two other devices for assessing and/or stimulating work capacity exist in the U.S.S.R., though perhaps largely on paper at the present time. The first of these is the expert commission for medical labor assessment. To date, the commissions seem to have concerned themselves mostly with occupational safety issues, though they are touted by Soviet gerontologists as appropriate settings for functional assessments of the work capacities of older persons. The second such device, a cabinet of geriatric medicine, has been proposed as a division within every local polyclinic. These would be important for the institutionalization of a functional definition of aging, largely because they would combine treatment by specialists with assessments of patients' work capacity on the basis of medical examinations, evaluation of levels of stress, and so forth. At present, those of pension age comprise 30 percent of all outpatients in polyclinics, even though they make up but 16 percent of the overall population.

In conclusion, I would like to briefly review the kinds of obstacles to redefining older persons as functionally capable labor-force participants that appear in the Soviet context. These provide a useful backdrop for an assessment of what the Soviet experience can teach us in the United States. I should note here that these obstacles are ones that Soviet specialists themselves have commented upon in both scholarly publications and journals such as "Social Security," put out by the U.S.S.R. Ministry of Social Welfare.

The first group of barriers include the following: An absence of retraining programs for the elderly worker, inadequate job placement mechanisms, insufficient information from enterprises regarding occupations and positions for which older workers would be suitable, the absence of a testing instrument to match older workers to job requirements on an individual basis, and the absence of concrete norms for older workers to be used for job redesign. The second kind of barrier involves inadequate information. This runs the gamut from a lack of knowledge on the part of pensioners regarding the benefits they enjoy if they continue to work, fully one-half in one survey had no idea that they could draw their pensions and still work to insufficient and frequently contradictory data on just which categories of pensioners want to work and why. From the latter perspective, it remains difficult, if not impossible, to create an appropriate mix of stimuli through uniform, national policy measures. Some studies report working pensioners as motivated by material incentives, while others stress either a mix of material and social incentives, relations with other workers, the work environment, the work itself, or motivation from social incentives alone.

The third kind of obstacle lies in the workplace environment itself. This includes the attitudes of factory managers which, according to a 1973-74 survey in Moscow, are still governed by predominantly negative stereotypes of older workers. These are coupled to a lack of sufficient financial incentives to management either to hire more older workers or to establish special work teams, brigades, or shops where the

pace of work, timing of breaks, and modes of assembly utilized are specially designed to meet the needs of older employees. To this list of problems must be added as well the delays encountered in introducing work at home or part-time jobs for pensioners. By the mid-1970's, of the 2 million-odd working pensioners in the Russian Republic, only 9,000 were engaged in part-time work (about two-tenths of 1 percent). Both sheltered workshops and cottage-industry kinds of arrangements are still hindered by the fact that they are confined to low-paying, largely "feminized" industries and do not receive priority in the allocation of materials and transport. This occurs despite the fact that Soviet research shows that it is 50 percent cheaper for certain factories to produce through a cottage industry system rather than creating positions in the factory itself. As of 1979, there were only 90,500 employed in cottage industry in the RSFSR.

What can we learn from the Soviet experience? It is appropriate here to expand briefly on some of the lessons that I mentioned at the beginning of my testimony. First, for society to provide a variety of work roles for older persons, it is important that economic incentives of some magnitude—in the form of tax credits or direct government subsidies—be made available to employers. These should be based on both the direct and indirect costs to society of working versus nonworking pensioners. They should reward not only the hiring of older workers but also the integration of the older worker into the regular work force to the extent that functional measurements of capacity render possible.

From a second perspective, any assessment of the cognitive, physiological, or social changes that occur with what we can now call normal aging should be accompanied by some concerted effort to assess what older persons themselves want in terms of employment. To put the matter another way, U.S. Government policy in this area should take into account both the satisfaction of the demands of the elderly themselves and the capacities which various tests and measuring instruments have demonstrated do, in fact, exist. Otherwise, we might well find ourselves in a situation where there are many jobs subsidized by the government but far fewer applicants than our initial calculations suggested. It would be fallacious to simply project what we already know about workers in general onto older workers or pensioners as a group with special needs and demands. The problems that the Soviet Union has already encountered in devising an appropriate incentive mix might be especially instructive here.

Finally, it is important to recognize just how important the dissemination of information is to any kind of program that might attempt to translate functional definitions of aging into workable government legislation. Ageism represents a set of biases and stereotypes that is not limited to the young alone. Middle-aged and older persons need to be encouraged to seek and/or push for new roles and opportunities even as executives in our economic and political institutions need to be made aware of the fact that older persons in the United States constitute a productive asset rather than a liability to be warehoused as cheaply as possible. The Soviet Government has certainly not found any panacea for all of these problems. We can, however, learn from their mistakes at a reduced cost to ourselves, while taking advantage of those kinds of policies that are consistent with the very different ideals and political dynamic in our own system. "Old age must not hang over one's head like the blade of a guillotine," the Polish sociologist, Edward Rossett, has written. To which I would add, "Nor need aging be viewed as such a menace, for society or the individual, if a proper assessment of the contribution of older persons to both society and the economy can be developed." This, I believe, is the task that still lies before us.

Senator GLENN. Dr. Andres, how much of your other work have you done in the international field in seeing what is being done in other countries? Are you correlating your studies with others other than Canada?

Dr. ANDRES. I don't know of any physiological longitudinal studies carried out in the Kiev Institute of Gerontology, so we have not carried out any correlations with them. I intend to get over to Dr. Sternheimer and see what his sources are. I would love to get my hands on some of their data.

Senator GLENN. Good. Glad to get you two together here.

Any other comments on that?

Dr. EISDORFER. I have been aware of the work back about 5 years, to the time 6 years now, to the time of the International

Gerontological Society meetings which happened to be in Kiev. There is some difficulty in that the Russians publish conclusions but after, the data are unreported so that it is difficult to do a direct comparison of our data with theirs. I have been impressed with that when we examine some of their conclusions we come up with very similar kinds of conclusions.

Senator GLENN. How about the Scandinavian countries? They have some of these variable work options for the elderly. They must have a lot of studies or they would not have gone to those options.

Dr. EISDORFER. As a matter of fact, as recently as Monday we were in touch with two of the very significant contributors, Marion Frankenhouser and Leonard Levy, who happened to be here this week for a meeting at the Institute of Medicine, the National Academy of Science. They have been concerned with broad issues, such as automation and changes in work patterns. For example, some of the recent studies they have been doing have been on the night shifts and they reported that the cessation of night shifts led to a short-term longitudinal study. It turns out that the workers who stopped night work appeared to be healthier a couple of years later. This, of course, raises a number of issues, one of which relates to chronobiology, and biologic clocks and its impact on efficiency.

They have also done a lot of work on physiology and boredom. Boredom, they find, is a stresser very much like the kind that we usually attribute to excitement. On the other hand, while they have been doing some very excellent work on medical evaluation of the kind that Dr. Butler alluded to, I don't know of anything that they are doing—this is my ignorance—on fitting the worker to the job through an age span, perhaps somebody else does.

Senator GLENN. I am interested in what we are doing internationally. It seems to me there is a great body of information out there. I am sorry Dr. Butler left, that is sort of in his province.

Are any of you aware of studies that are being done by Dr. Butler in this international area? I think of the Scandinavian and Soviet experiences. The Japanese now, I believe, and correct me if I am wrong, have retirement starting at 55.

Dr. KOYL. That is right.

Senator GLENN. Is that mandatory? I think it is semioptional but then by age 60 I think it is pretty much mandatory.

Dr. KOYL. They are trying to get the legislation changed to make it mandatory at 60 but they have not got it through yet.

Senator GLENN. It is mandatory at 55 at the present time, isn't that right?

Dr. KOYL. Yes; I was talking to one of their researchers just a couple weeks ago and they still have not got amendments to the legislation through yet.

Senator GLENN. I am sure there are some studies in Japan of what problems and what stresses come with early retirement. I hope somebody is correlating these studies. Are we aware of any of the longitudinal studies in other nations?

Dr. SCHAIE. I think so. In fact Dr. Butler has been quite active in the pursuit of this matter and has brought together a number of

directors of foreign national institutes of aging to exchange information.

I have just returned from a sabbatical stay in Germany where I have had the opportunity to interact with a number of people who have conducted longitudinal studies there. I also had the opportunity to interact with a number of members of the German Parliament who have an interest in issues related to a recent attempt to obtain new job placements for younger workers by lowering retirement age. However, under the impact of information from studies conducted in Germany, particularly the so-called Bonn longitudinal study conducted by Professors Thomae and Lehr, the legislative climate has changed and the tendency now is to emulate our own attempts to raise retirement age rather than lower it.

Senator GLENN. Is anyone here in the audience who is with Dr. Butler? Did any staff members stay?

Dr. Andres, you are with him.

Dr. ANDRES. Yes.

Senator GLENN. I wonder if you would ask Dr. Butler if we could have some information on what you are doing in the international area, in particular, any programs he sees or what he thinks we should be doing in that area. I know he is interested in the international area because we had all those people in that participated with the committee a couple years ago. We would be interested in any followup information he could put in the committee record.[1]

Dr. ANDRES. There are definite plans afoot for continued meetings. I don't know what frequency. I would think at a minimum at annual meetings of the directors of aging programs in a number of countries but I will get that information for you.

Dr. KOYL. Two interesting ones that I know of. One is the Manitoba Air Force pilots' heart study which is the equivalent of your Naval pilot study, it has been going since World War II. That is a good longitudinal study.

Another interesting one a longitudinal study of what is called Alzheimer's Disease. This disease is the most common form of dementia in later years. Dr. Blessed in Nottingham, I think, has followed through to autopsy several hundred so that he can assess the disease while the sufferers are still alive as well as gradually gaining competence in understanding the disease itself.

Senator GLENN. Has he come up with anything like chemical deficiencies, hormone studies or anything that shows any progress in that area?

Dr. KOYL. When I first started in gerontology 30 years ago, the terror was that that we might be seeing the tip of the iceberg—of the end of the human brain lifespan. It looks as though it is going to turn out to be a disease which a few years down the line will be preventable. A lot of the competent basic science research in this area is being done at McMaster University, Hamilton, Ontario, and the University of Western Ontario, London, Ontario.

Dr. EISDORFER. Perhaps the most important thing, they have come up with is that senility is not hardening of the arteries or a normal process of aging. They have suggested that the majority of people who become senile are, in fact, suffering from a disease which involves the accelerated death of neurons. They have related

[1] See appendix, page 49.

specific autopsy findings that we did not quite understand to the degree of deficit, that is, neurofibrillary tangles and senile plaques, an amyloid deposit in the brain.

They have demonstrated that while it is true there are many people in later life who have these brain lesions without symptoms when the density goes beyond a certain point it is associated with significant cognitive change. This is an area in which we have a lot of interest in international collaboration. There are also some chemical deficits that we found. Whether that will pan out, we don't know. Research in Great Britain, Canada, the United States, and Israel among other countries is underway.

Senator GLENN. Dr. Koyl, not everyone has access to all the sophisticated equipment you have there at de Havilland. Do you think that is adaptable to most employers and employees or is it something that would require a great deal of effort?

Dr. KOYL. No; it is quite unsophisticated as far as equipment is concerned. It is basically an insurance examination. I have no hesitation if the company wants a man from Germany or Italy or England in asking his family practitioner to examine him using our forms. We can accurately profile the applicant's fitness in a few minutes. Then I can give personnel branch the go-ahead to bring the person to Canada.

Senator GLENN. Dr. Schaie, some of your research has shown with age some abilities improve instead of degrade. Would you amplify on that and be more specific and describe some of the actual conditions and maybe the benefits thereof?

Dr. SCHAIE. OK. One subject that has not perhaps been given as much attention as it should, are the environmental criteria for moving into old age in as best shape as we can. We have classified people in terms of their lifestyle characteristics, in terms of intellectual stimulation, in terms of activity patterns, how many interesting friends they have and how many opportunities for interaction they have had. Those people who were, if you will, environmentally advantaged, had high social status and resources to engage in many interesting activities until fairly late in life actually showed some modest gain in information skills and related areas.

On the other hand, the group in which we found the largest cognitive deficit was a group of widowed homemakers; that is, women who had never had a career and whose environmental stimulation had become reduced due to the death of their spouse, and whose economic resources had declined.

These were women who spent most of their time sitting in front of the tube. This was a group in which we found the largest amount of decline.

We have also found that, contrary to expectations, there are some abilities, particularly those related to skills which we actively use such as skill in using numerical concepts, or as the competence a person has to communicate, actually seem to rise. These abilities reach a peak not, as we thought previously in the twenties, but more likely in the late forties and early fifties. A person's ability to function, a person's ability to benefit from formal or informal education in the sixties remains at about the level that it would have been in the twenties. These findings have practical implica-

tions for the manner in which we should deploy our educational resources. The point was made that "old dogs can learn new tricks." What we need to assure now is that old dogs have better opportunities to learn new tricks.

Senator GLENN. It seems to me stress breaks down. One, it can be a stress but also it is a stimulation. There can be other stress that is a very degrading thing, it is boredom, or whatever. I was involved in some pursuits which were very stressful but extremely stimulating. Your biggest concern was that every fiber and every nerve in your body was onstream and working to the fullest extent. Now that was very stimulating even though it was also extremely stressful. That is sort of constructive stress, if you will.

But then you have a welfare mother who is worried because she can't get a job, the kids are not going to eat, the rent is due and she does not have the money. That is stress and that is boredom and that is degrading. The elderly face the same thing. They get to the point where they feel they are beyond their normal working years.

People in this country don't want to retire particularly. I don't say it is a degrading stress but it is a familiar damper-type stress, a stressful situation. I don't know how you break this all down or what effect this has on the type occupation people can have in their elderly years, but it seems to me that is a factor and as to whether it is, we all have stress.

It is stressful for me to be here today, it is stressful for you to be here at the table. It is stressful for people who meet people in the back of the room. So we all have stress.

It seems to me that as you grow older and get into your senior citizen years you run into more situations of stress that are on the negative side rather than the stimulative side. Maybe we need to tip that balance. I had really not quite thought of that before but it seems to me maybe that is it, we are letting too many of the stimulative factors go over on the negative side rather than on the positive side.

I don't know whether I am making myself clear or not. Does anybody want to comment on my long, disjointed statement?

Dr. EISDORFER. Stress is related to coping. That is to say, when you have a lot of environmental challenge, but an opportunity to deal with it. The challenge tends to become more facilitating. If you are trained to do something with this input and have developed a coping strategy, you are able to work through the stress and use the enhanced bodily state and the brain changes effectively if you can channel your activity.

I think you very appropriately pointed out that one of the things that is a problem in later life, is that you get the challenge as if you are in the same situation but you have no dials to twist, in short, no buttons to press, no options for coping. Then that would be degrading because you have all of this input but you don't have the wherewithal to respond effectively. Clearly part of the problem with aging is we take the levers away.

More and more we are beginning to learn that some of the ways to help people is specifically to teach them to cope with environmental phenomena. Again I think a lot of us are saying the same thing, that we are so busy looking at deficits we don't really look at

the opportunities to develop positive coping strategies and fit the person to the position.

Dr. KOYL. Certainly there is good evidence from the occupational area where they already have had no age limits on retirement, even in the United States and Canada, that the quality of the occupation matters a lot. Boredom is a very stressing thing. Walter Ruether used to say that anybody who would stand in a pit under an automobile and screw the same four screws to the same chassis 1 day longer than he had to, should have his head read. The percent of workers at General Motors who want to stay on beyond 65 is 7 percent whereas at Woodward & Lothrop it is about 50 percent because there are pleasant jobs. Kaiser Industries runs around 15 to 20 percent. There are a lot of pleasant jobs in both plant and offices. We have a situation in Toronto where we are running a craft industry. The percentage of highly skilled people who are job-oriented, for whom their job is their society and their lifestyle, is very high.

Senator GLENN. Dr. Sternheimer, in reflecting a little on what you were saying, does the Soviet Union look at it pretty much just from the job standpoint—there is certain work to be done and we have to get the people to do the job—rather than concern for the individual and his or her standard of living? Is that correct or am I overstating?

Dr. STERNHEIMER. I would say perhaps you are overstating the case somewhat. I think, curiously enough, the Soviets have paid a great deal of attention to motivational factors. One of the things that they have come up with is that in many cases material incentives, which Soviet policymakers have relied on extensively and tried to manipulate because they are most easily manipulable, are far from the only "input" in the decision of an older person to retire or keep on working. The quality of worklife, the work place environment, relations with fellow employees, et cetera, all play an important role.

Senator GLENN. You stress that there are a whole range of definite situations for which working pensioners are not well suited. That indicated that maybe they are concerned with getting the work done rather than a consideration for the individual and that person in his particular old age.

Dr. STERNHEIMER. One of the problems, of course, in saying anything accurate about the Soviet Union is separating the rhetoric from the reality. At a rhetorical level, Soviet scientists, gerontologists, and sociologists do insist that they are concerned with the individual in terms of the thrust of policy. Perhaps we might take a lesson from this. But the U.S.S.R. labor deficit problems at this point are so severe, as Dr. Murray Feshbach of the Foreign Demographic Analysis Division, U.S. Department of Commerce has pointed out, that the Soviet Union is going to have to provide all of its future increases in economic productivity from increases in labor productivity on the part of individual workers rather than from increments to the labor force per se. There simply are no more bodies available to increase the size of the working population. Recruitment of more workers from the older Soviet population, given the current rate of success—1915-80—seems problematic at best.

What I am indicating by this statement is that the problem looks as follows: There are a whole range of occupations in which the Soviet economy experiences a deficit of workers. Yet, at the same time these are precisely the occupations which older persons tend to shun in favor of retirement, economic need not withstanding. They are dirty jobs, stressful jobs, low-paying jobs, jobs for which older people are not well suited or which they are inclined to reject.

Senator GLENN. What stimulates one person does not stimulate another. That intrigues me considerably. You are professionals in the field. We have all known older people who were vibrant, alert, 20 years younger than their calendar years, then some change happens and/or they change jobs or a family situation changes and all of a sudden they age 20 years overnight. It is like somebody pulled the plug. It seems to happen more with the elderly with a changed situation than perhaps with younger people. I don't know what happens there or how we analyze it.

It seems to me it would help if we can keep that stimulation where people are part of the community, part of the family—we no longer have that relationship with the family. My own family—I am here in Washington, based in Ohio, go back there, my son is a doctor in California, my daughter is in Vail, Colo., married to a doctor out there—is spread out the whole breadth of the Nation.

Whereas, in colonial days, the elderly were still in their own environment and there was that stimulation of family, church, and community that maybe is lacking now in our modern society. I don't know how we cope with that. I guess we make up with social security laws and hearings like this and a few other things but I don't know how we keep this stimulation going. We have all seen people that sort of came apart overnight sometimes without real major reasons. Somehow you have to keep that vitality of interest going.

Dr. KOYL. If one remembers, that about a third of the males are dead by the age 65.

Senator GLENN. That is discouraging.

Dr. KOYL. Yes; of survivors, less than 10 percent have to drop out of the work force in any but very heavy industry like the steel industry. Among those who do stay in, there are very few who have to be reallocated to a new job. Usually it is the employee himself who comes and asks to be reallocated. In veterans' affairs we have done several studies of institutionalized older people and with attempts to keep people deinstitutionalized. We do find the family ties are better than we thought. They may not live in the same place but they are surrounded by their families. Except in one generation where there was a large number of new immigrant transients who came to Canada and didn't have relatives and never did settle down long enough to get any. Most of the other oldsters have close family ties.

Senator GLENN. Gentlemen, it is almost noon. I would ask other staff members representing other Senators, do you have any questions that you want to propose here?

Ms. MADDOX. I am Donna Maddox with Senator Percy's office. As you know, the Senator has a hearing impairment, developed during World War II. He is interested in what your research has revealed

about older persons with hearing impairments. Is a hearing impairment for an older person due to the aging process or is it due to disease?

Dr. EISDORFER. I have done some work, and I know some of the others have done some work on it. The data appear to indicate, particularly among males, age-related changes in high tones; that is to say, you get from low tones, low cycles, 20 to 50 the human threshold and it goes up to 10,000 to 20,000 cycles per second, very high tones. The hearing loss is primarily among the higher tones so older men with progressively aggregated figures seem to lose higher tone hearing loss. That is one finding that seems to occur.

A second finding that occurs is more clinical, which is the absolute threshold for hearing goes up but there remains an accurate level of hearing in the higher volumes so that if you whisper the older person can't hear you but when you shout they hear you shouting and so you get into the social situation where people are saying, "Why are you shouting at me?" But if you try to talk to them in a low voice they don't hear, the raising of the absolute threshold.

The question has always been whether that is age per se, neuronal loss, changing of the skull bone or related to accumulated industrial noise. We do have a lot of evidence that industrial noise leads to changes in hearing patterns. I don't want to get involved in the theory of hearing.

Senator GLENN. Of course this was from the airplane noise.

Dr. EISDORFER. If there is noise across the spectrum, it does affect hearing very clearly and the hearing is progressive from high to lower tones. Now I have heard reports—I have not seen them—that women are beginning to show up with the same kind of deficit and that the deficit exists more in industrialized than in nonindustrialized societies so what we may have is a relationship between age and environmental noise.

Dr. KOYL. Following people through their occupational life we do find occupational noises fairly easy to distinguish in its early stages because it is monophasic. At de Havilland we produce our damage at 6,000 cycles per second. At McDonnell-Douglas Aircraft, Toronto they produce it at 4,000, amd the Steel Co. of Canada produces damage at 3,000 cycles per second. But what has happened with me, for instance, I had a gunfire dip at 6,000 cycles per second from getting too close under a 105-millimeter gun too often when I was a medical officer working up forward. It has disappeared now so you cannot see it under my aging loss—presbyacusis. This happens to our employees in factories. The presbyacusis covers it up. Also, if you don't hear a loud sound well, you will get closer to it and you will get a spread of the loss.

Senator GLENN. That is interesting. My dad had a permanent hearing loss as a result of some of the gun things. He was on an ammunition train in World War I and he wore an earphone all his life after that.

When I was in the regular Marine Corps, in fighter days, you would go in for your annual hearing check with the chart where you get the CPS on different ranges and so on. Some of the doctors could actually tell what type airplane you were flying at the time because you sat there and droned along at their particular frequen-

cy. They could see where your ear had defended itself by becoming less sensitive in that area. It would recover, as I recall, when you stopped flying that kind of airplane and went to another or stopped flying for 6 months. It all leveled out on your next check, so you do recover.

It is interesting that you do have a degradation of a CPS tolerance, high and low, as you get older as a very natural function. Is that correct? I guess there are advantages to everything. I can buy a cheaper hi-fi set now. [Laughter.] The good news and bad news, I guess.

I have no further questions.

I would like to ask only one other thing. Dr. Arenberg, you are an expert in the area of learning capabilities of the elderly and I think we would be remiss if we didn't have a statement in that particular area. We tend to put old folks in the category of making baskets or knitting, when there are many people in their senior years who are very stimulated by what is going on and desire to learn and obtain new skills. Dr. Sternheimer has found people are interested in Iran, what is going on there. I have run into that myself.

A couple of weeks ago, I went to talk to a senior citizens' home, in Columbus, Ohio, where an aunt of mine lives. It was their annual founders' day. In discussing beforehand what I was going to talk with them about, I learned that they didn't want to talk about old folks or social security, but about what is going on in Iran. I spent about 45 minutes talking to them on those subjects and you could have heard a pin drop. They were vitally interested. They don't want to be treated as though they are no longer capable.

I think this area of learning and taking on new challenges in senior years might be one of those stimulative factors that we were talking about here a little while ago. Could you comment on that please?

Dr. ARENBERG. Yes; many of the laboratory studies we have done are not that stimulating, they tend to be rather rote-type learning studies. This is one of the things about the obsolescence of longitudinal studies; you will not find those kinds of studies being done cross sectionally any more. We have been studying verbal learning in the Baltimore longitudinal study since 1960. We have found that the substantial age differences that we found cross sectionally based on first-time measures are not found nearly so dramatically in the longitudinal results; that is, the changes are much smaller than the age differences.

Senator GLENN. Changes in what now, just an ability to learn new things?

Dr. ARENBERG. These tasks.

Senator GLENN. Mechanical tasks?

Dr. ARENBERG. No, verbal learning tasks for example, learning to pair up a word with a particular stimulus—in our case a pair of consonants, something like learning vocabulary in a foreign language. You learn what word corresponds from this language to that same word in the other language. Performance on that kind of learning task diminishes much less when you actually study it longitudinally, changes within the individual, than would have been predicted just from the cross sectional results alone.

We also included a pace variable, that is, how fast the material is presented and how fast the subject had to respond before we went on to the next item. The task requires sequential responding. You see much larger age differences at the fast pace when the person is forced to respond quickly.

Senator GLENN. Does this mean just a neurological function? Does it just take longer for older people to run the same processes?

Dr. ARENBERG. We don't really know the answer to that. There is some evidence that the rate of information processing declines with age. That is mostly based on cross sectional data.

Senator GLENN. Where is the sort of threshold of decline? Is there a break where you say there is a major decline for most people?

Dr. ARENBERG. I am talking about mean changes. We always have that large variability that was mentioned several times here today. Where you see the substantial mean age changes in most of the things I have studied—learning, memory, problem solving, reasoning—we see substantial changes only for the men who were 70 initially. Below that we see much smaller age changes.

Senator GLENN. Much changes between men and women?

Dr. ARENBERG. We have not studied women long enough to know about age changes.

Senator GLENN. ERA is going to get to the old ladies as well as the young ladies. I am sure we want to do some studies on that.

Does anyone else have comments?

Dr. ANDRES. I may be the only person in the room who has just done a test on himself to see whether he should resign immediately or continue to work.

Senator GLENN. This is going to be interesting.

Dr. ANDRES. I believe I just passed the test. What brought this exercise to my attention were Senator Glenn's searching questions about international collaboration and our knowledge about other studies. I have been in contact with Rose Stamler at Northwestern University who, with Jeremiah Stamler, has just collated 15 separate studies. This was the test, to see if I could recall what all those studies were. The studies are indeed international. Scotland, workers at the Olivetti factory in Italy, civil servants in Paris and Great Britain, two studies in Denmark at Glostrup, a study in Japan, one in Ireland, one in Western Australia, one among pharmaceutical workers in Switzerland, rural communities in Finland and also policemen in Helsinki, the Chicago Peoples Gas Co., the Western Electric Co. study in Chicago, and the Chicago heart study. That should be 15.

Well, in any case those 15 studies were not designed to be relevant to the hearings today. They are looking at very limited numbers of variables with very limited outcome measures. The outcomes in those studies have to do with mortality as related to one's glucose tolerance earlier in life. We have, among other measures, assessed glucose metabolism in our study and we will be comparing our results with the characteristics of people really across the world. But when it comes to our more sophisticated studies of various aging functions there just is not that much comparable work going on elsewhere. This leads me just to make a final point

refer the patient to the medical department to find out whether it is remedial slippage or not. If it is remedial, we treat it and get him back to work. If it is not remedial, we place him in another position, not fire him.

Senator GLENN. Thank you. We appreciate your being here.

The hearing stands in recess.

[Whereupon, at 12:15 p.m., the hearing adjourned.]

APPENDIX

COMPILATION OF NATIONAL AND INTERNATIONAL LONGITUDINAL STUDIES

DEPARTMENT OF HEALTH AND HUMAN SERVICES,
PUBLIC HEALTH SERVICE,
NATIONAL INSTITUTES OF HEALTH,
Bethesda, Md., June 6, 1980.

Hon. JOHN GLENN,
U.S. Senate,
Washington, D.C.

DEAR SENATOR GLENN: In response to your request for a statement concerning the collaborative efforts between the National Institute on Aging (NIA) and international directors with programs in the field of aging for insertion into the record of the recent hearings on "How Old is Old," I am pleased to submit the following information:

Leaders of research and service programs in aging around the world, as identified and cosponsored under the auspices of the World Health Organization (WHO), organized themselves initially to provide for cooperative exchanges in areas such as rapid communication of ideas and dissemination of research results; research coordination and collaboration; increased exchange of scientists; development of cooperative training programs; and exchange of valuable biological materials such as cell lines, tissues, fluids, and organs. More recently, this group has addressed the broader range of issues related to the WHO global program on the care of the aged and the 1982 United Nations World Assembly on the Elderly.

The first meeting was held in November 1976 in Copenhagen. The following November, the NIA hosted the second meeting in Bethesda, Md., during which you will recall that testimony on the graying of nations was provided before the Senate Special Committee on Aging.

Two subsequent meetings were held—1978 in Tokyo and 1979 in Copenhagen. The latter meeting was called to develop the scope and agenda for a 50-member policy/technical committee to work on the WHO global program and the U.N. World Assembly. This committee is scheduled to meet December 8-11, 1980, in Mexico City, as a WHO preparatory conference. The NIA hopes to share financial support for this conference, which is expected to result in a report and recommendations concerning information needs for social policy, life enhancement of the elderly, research, education, and technical cooperation among developing countries. As an advisor to WHO, I have been very much involved in organizing this committee. My own contribution to the conference will be a paper entitled "From Cell to Society."

In 1981, this Institute plans to recovene the international directors during the November 30-December 4, 1981, White House Conference on Aging (WHCOA) to enable them to attend the conference as observers, following which they will meet among themselves to share observations about the WHCOA. They will also consider suitable linkages to and refine their roles in planning and contributing to those health-related research matters which will be addressed by the WHO global program and the U.N. World Assembly. We have suggested to the Social Security Administration and the Administration on Aging that they, too, may wish to make similar arrangements for international guests in the areas of service and income maintenance.

The meetings of the directors have been held in collaboration with the WHO. With the exception of the 1979 Copenhagen meeting, where travel was paid by WHO, most of the transportation costs have been borne by the respective member governments. The Tokyo meeting was coupled with that of the International Congress of Gerontology. For the 1977 meeting hosted by the NIA, we covered a portion of the travel expenses and plan to do so for the 1981 WHCOA as well.

On another matter related to the U.N. World Assembly on the Elderly, the State Department has proposed that this Institute's Ad Hoc Interagency Committee on Research on Aging, which represents 29 U.S. Federal agencies with programs in aging, be designated as the U.S. Federal planning group with coordinative functions and responsibilities for the U.N. World Assembly.

I am extremely pleased that you have expressed an interest in our international collaborative efforts, and I look forward to the opportunity of communicating with you as we progress and as new developments occur.

Sincerely yours,

ROBERT N. BUTLER, M.D.,
Director.

Enclosures.

MEMBERS OF THE NIA AD HOC INTERAGENCY COMMITTEE ON RESEARCH ON AGING

Administration on Aging.
Administration for Public Services.
Assistant Secretary for Planning and Evaluation.
Bureau of the Census.
Department of Commerce.
Federal Council on the Aging.
Food and Drug Administration.
Health Care Financing Administration.
Health Services Administration.
Housing and Urban Development.
National Center for Health Services Research.
National Center for Health Statistics.
National Institute of Alcohol Abuse and Alcoholism.
National Institute of Drug Abuse.
National Institute of Education.
National Institute of Mental Health.
Office of Health Information and Health Promotion.
Public Health Service.
Social Security Administration.
Veterans' Administration, Central Office.

FEDERAL ORGANIZATIONS INVITED TO PARTICIPATE IN THE NIA AD HOC INTERAGENCY COMMITTEE ON RESEARCH ON AGING

ACTION.
Health Resources Administration.
National Aeronautics and Space Administration.
National Institute for Occupational Safety and Health.
National Institute of Handicapped Research.
Office of Program Planning and Evaluation, NIH.
Office of International Health.
U.S. Department of Agriculture.
National Center for Health Care Technology.

DIRECTORS OF NATIONAL INSTITUTES WITH PROGRAMS IN THE FIELD OF AGING

Prof. Anna Aslan, Director, National Institute of Gerontology and Geriatrics, Casuta Postala 1004, Bucharest 8, Romania.
Prof. F. Bourliere, Head, INSERM Gerontology Research Unit 118, 29, Rue Wilhem, 75016 Paris, France.
Prof. D. F. Chebotarev, Director, Institute of Gerontology of the U.S.S.R. Academy of Medical Sciences, Uyshgorodskaya 67, Kiev 114, U.S.S.R.
Mr. H. Friis, Executive Director, Danish National Institute on Social Research, Borgergade 28, 1300 Copenhagen K, Denmark.
Dr. G. Harlem, Medical Director, Institute of Medical Rehabilitation, P. B. 61, Refstad, Oslo 5, Norway.
Dr. Hana Hermanova, Scientific Secretary, Third Medical Clinic, U Nemocnice One, Prague 2, Czechoslovakia.
Prof. C. F. Hollander, M.D., Ph. D., Director, Institute for Experimental Gerontology TNO, REP—Institutes of the Organization for Health Research TNO, 151 Lange Kleiweg-Rijswijk (ZH), The Netherlands.
Dr. Israel Katz, D.S.W., Director, Brookdale Institute of Gerontology and Adult Human Development, Givat-Ram, Jerusalem, Israel.

Dr. Kunio Oota, Director, Tokyo Metropolitan Institute of Gerontology, 35-2 Sakae-cho, Itabashiku, Tokyo-173, Japan.
Prof. A. Swanborg, Head, Clinic II, Vasa Hospital, 411 33 Gothenborg, Sweden.
Dr. Gustav Vig, Director, Norwegian Institute of Gerontology, Oscarsgt. 36, Oslo 2, Norway.
Dr. James Williamson, Department of Geriatric Medicine, City Hospital, Greenbank Drive, Edinburgh EH 1055B, Scotland, United Kingdom.

DEPARTMENT OF HEALTH AND HUMAN SERVICES,
PUBLIC HEALTH SERVICE,
NATIONAL INSTITUTES OF HEALTH,
Bethesda, Md., May 20, 1980.

Hon. JOHN GLENN,
U.S. Senate,
Washington, D.C.

DEAR SENATOR GLENN: Thank you for your letter of May 6 concerning the need for a comprehensive compilation of longitudinal studies. I very much appreciated the opportunity to testify at the Senate Aging Committee's recent hearing on "How Old is 'Old'? The Effects of Aging on Learning and Working."

I have been interested for quite some time in the National Institute on Aging (NIA) supporting a thorough inventory of longitudinal studies conducted in the United States. I estimate that such a compilation and analysis will require funds on the order of $500,000. When resources permit, I am hopeful that the NIA will be able to support such an effort.

During 1978, we compiled a preliminary catalog of longitudinal studies conducted in the United States with an examination of their appropriateness for aging research. While this inventory is an interim effort, it does provide a good overview of the rich diversity of these studies. We will be sending you a copy of this inventory within the next several weeks.

You express an interest in a compilation of longitudinal studies conducted outside of the United States. Several years ago, Dr. Alvar Svanborg, Head of Clinic II at Vasa Hospital in Gothenborg, Sweden, and also a participant in the Senate Aging Committee's November 1977 "The Graying of Nations" roundtable discussion, was commissioned by the World Health Organization to survey a number of European epidemiological studies. I am enclosing a preliminary copy of this survey for your information. If you wish, I will contact Dr. Svanborg for a more recent version.

I think this information will help you and the committee in your assessment of this important subject.

Sincerely yours,

ROBERT N. BUTLER, M.D.,
Director.

Enclosure.

LONGITUDINAL STUDY CATALOG (Selective)

Study	Institution	Year begun	Years in progress	Sample	Emphasis	Goals
I. AGING STUDIES						
Baltimore longitudinal study	Gerontology Research Center, National Institute on Aging, National Institutes of Health.	1958	22	Over 2,000 healthy men and women.	Multidisciplinary: biomedical, social, and behavioral.	To compare medical, physiological, biological, psychological, social, and other characteristics of participants of various ages; to relate longevity to individual characteristics and to identify patterns of change.
Brown University study	Brown University	1961	19	1,210 couples	Social	To study effects of health decline and illness on social roles, role capacities, and life satisfaction for the postadult period.
Duke University studies (I and II) [1]	Duke University	1955	25	270 men and women	Multidisciplinary: biomedical, social, and behavioral.	To investigate processes of aging among a panel of persons over 60 years of age, from time of initial observation to death.
Human aging study	National Institute of Mental Health, Alcohol, Drug Abuse, and Mental Health Administration.	1955	25	47 healthy men	Medical and psychological	To delineate aging changes from disease changes; to develop a description of the natural course of aging through the concluding portion of the life cycle; to develop a comparative analysis of survival versus mortality.
Intellectual functioning in later life study.	Age Center of New England, Inc.	1966	13	200 Men and women	Psychological	To improve the reliability and validity of IQ findings related to aging; to compare cross sectional versus longitudinal approaches to the study of aging and IQ; to study interrelationship between health changes, aging, and IQ; to study effects of IQ changes on survivorship and time of death.
Langley-Porter study	Langley-Porter Neurological Institute, San Francisco.	1958	22	534 psychiatric patients (600 control subjects).	Mental illness	To determine the medical, psychological, and sociological reasons for a large number of older persons being in public mental hospitals; to increase the understanding of normal and abnormal aging processes; to trace the history of mental disorders in the older age group.
Pennsylvania State University study	Pennsylvania State University	1955	25	205 men and women	Social and medical	To study behavioral processes of aging, the consistency of personality and adjustment in old age, and the problem of survivorship.

Quality of life study	American Institute for Research in the Behavioral Sciences, Palo Alto, California.	1974–75 1975 1975	5–6 5 5	500 men, 500 women 500 men, 500 women 500 men, 500 women	Educational do do	To study the impact of education on the quality of life in a sample of 30-year-olds; to identify ways of improving the quality of life for older groups (50-year-olds and 70-year-olds).
Veterans' Administration normative study.	Veterans' Administration Outpatient Clinic, Boston, Massachusetts.	1958	22	2,000 male veterans	Medical	To study and describe changes that occur over time; to make validated predictions and correlations among the large number of variables studied; to delineate true age changes.
II. OTHER ADULT STUDIES						
Aerospace medical fitness program study.	Brooks Air Force Base, Texas	1965	15	12,000 U.S. Air Force flyers	Health	To delineate the effects of biological aging; to define more clearly the natural history of the development of disease states and disorders in initially healthy populations; to identify significant problem health areas of particular importance to the aerospace mission.
Adaptation to life study	Harvard Medical School	1937	43	Academically successful male undergraduates.	Social and psychological	To make a systematic and intensive medical and psychological inquiry into the types of people who are well and adapt well to life.
Air traffic controller health program study.	Federal Aviation Administration.	1965	15	12,500 air traffic controllers	Health	To enhance air safety through the detection and correction of physical deficiencies among air traffic control specialists in the United States; to maintain health and productivity among air traffic control employees.
Atomic Bomb Casualty Commission study.	Joint—U.S. National Academy of Sciences and Japanese National Institute of Health.	1945	35	100,000 persons in area of atomic blast.	Health	To study the effects of exposure to ionizing radiation on mortality and acceleration of aging, on physiologic changes, on chromosomal material (as measured by induction of chromosomal aberration) and on subsequent growth and development of those exposed in utero or in infancy or childhood; and to study the effects on the incidence of disease, including cancer.

LONGITUDINAL STUDY CATALOG (Selective)—Continued

Study	Institution	Year begun	Years in progress	Sample	Emphasis	Goals
Federal Aviation Administration Georgetown study.	Federal Aviation Administration and Georgetown University.	1960	20	Airline pilots	Health as it relates to the ability to pilot aircraft.	
Framingham heart study	National Heart, Lung and Blood Institute, National institutes of Health and Boston University.	1950	30	Entire town of 5,200 residents.	Risk factors for heart disease	To explore the evolution of cardiovascular disease in relation to various living habits and personal attributes suspected of promoting atherosclerosis in a general population.
Hopkins precursors study	Johns Hopkins University	1948	32	1,337 medical students	Health and psychological	To identify factors preceding the early onset of hypertension and coronary heart disease; to find new ways to predict suicide and other premature disease and death in order to develop better methods of prevention.
Kaiser-Permanente study	Health Services Research Center, Kaiser Foundation Hospital, Portland, Oregon.	1964	16	5,000 subscribers	Health	To relate data obtained during the early life stages to patterns of subsequent aging; to examine medical care utilization and health status.
Lovelace physiologic and psychologic aging in pilots study.	Lovelace Foundation for Medical Research and Education, Albuquerque, New Mexico.	1960	20	500 male pilots (100 from each of 5 decades: 30th, 40th, 50th, 60th, and 70th).	Health as it relates to the ability to pilot aircraft.	To measure changes in physiological function in professional aviators; to compile data to determine physiological age; to compare the rate of aging in different organ systems.
Nebraska early marriage study	University of Nebraska Department of Human Development and Family.	1954	26	3,456 high school girls	Social adjustment	To study differences between girls who marry early versus later; to study factors involved in early marriage; to compare the success and dynamics of early versus later marriages.
Tecumseh community health study	University of Michigan	1959–60	20–21	Entire town of 4,000 residents.	Heart disease	To study a natural community—its biological, physical, and social environments; to determine underlying defects and precursor states to detect early evidence of disorder in order to seek preventive measures.

Thousand aviators study	U.S. Navy & Harvard Fatigue Laboratory.	1940	40	1,056 male student aviators	Health	Originally, to identify ideal naval aviator candidates from physical, mental, and psychological performance aspects. Presently, to study alcohol patterns and their relationships with psychological and social functions; to continue an ongoing analysis of physiological and anthropometric data.
Transition to parenthood	National Institute of Mental Health, Alcohol, Drug Abuse, and Mental Health Administration.	1959	21	100 males and females (50 couples).	Psychosocial	To investigate the initial stages of family formation and the effects of the role change to parenthood; to acquire more adequate concepts of preventive psychiatry and thereby better means of identifying the populations at risk in the community.
III. SPECIAL STUDIES OF YOUNG ADULTS						
Bennington studies of persistence and change in attitudes and values in students.	Bennington College, Vermont	1935	45	525 female students	Personal values	To follow the changes in students' attitudes toward various public issues during a period of rapid change in the United States (1935–42)
Study of academic prediction and growth.	Joint—Educational Testing Service and Princeton University.	1961	19	34,000 male and female students from various schools in the United States.	Educational	To study the educational growth of pupils at different times and under different conditions of schooling.
IV. CHILD DEVELOPMENT STUDIES						
Berkeley growth study[1]	University of California at Berkeley.	1928	52	61 infants	Development	To test and measure the mental, motor, and physical development and the health of full-term healthy infants.
Berkeley guidance study[1]	University of California at Berkeley.	1928	52	248 infants	Development	To delineate physical, mental, and personality growth and development in normal groups, and to ascertain variations among and within individuals at different developmental periods over a long timespan to clarify the relationship of these findings to biological and environmental factors; to study critical combinations of factors and to assess the predictive usefulness of appraisal tools for characteristics such as personality and mental ability.

LONGITUDINAL STUDY CATALOG (Selective)—Continued

Study	Institution	Year begun	Years in progress	Sample	Emphasis	Goals
Oakland growth study[1]	University of California at Berkeley.	1932	48	200 children (100 male and female).	Development	To examine physical, physiological, and personal social development during adolescence; to conduct assessments of social relationships within familial, employment and community settings.
Denver study of human development	University of Colorado Medical School, Denver.	1923	57	180 male and female children.	Development	To study changes in structure during growth, development, and adaptation; to study changing physiological functioning through life and personality development.
Fels study of human development	Fels Research Institute, Yello Spring, Ohio.	1929	51	300 male and female newborn infants.	Development	To study the physical and psychological growth of children and the relation of behavior during the first 12 months to functioning during the subsequent 3 years; to investigate lytical conceptual preferences and achievement motivation in schoolchildren and then parental and personality correlates.
Gesell child development studies	Gesell Institute, Yale University.	1930's	40+	100 children	Behavioral	To determine how human behavior changes with age.
Menninger infancy coping and mental health studies.	Menninger Foundation, Topeka, Kansas.	1948	32	128 infants	Psychological development	To study the dynamics of personality development from infancy to prepubescence, with a focus on the processes contributing to continuity and change and the development of individual styles of adapation.
Merrill Palmer longitudinal research program.	The Merrill Palmer Institute, Detroit.	1923	57	Over 1,000 male and female children.	Development	To accumulate individual developmental and family-environmental data; to provide a laboratory for students to observe and study children directly.

Minnesota child to adult study	Institute of Child Development, University of Minnesota.	1925	55	4,500 male and female nursery schoolchildren.	Development	To study the problems of predicting adult adjustment from data acquired in early childhood.
New York University study of behavioral development.	School of Medicine, New York University.	1956	24	126 infants (63 males, 63 females).	Psychological development	To study individual differences in primary reactivity in infancy and childhood, and to evaluate the precise relation of initial reaction patterning to psychological growth.
Stanford-Terman study of the gifted child.[1]	Department of Psychology, Stanford University.	1921	59	1,528 gifted children (857 males, and 671 females).	Development	To study physical, mental, and personality characteristics of intellectually superior children.

[1] Supported in part by grants from the National Institute on Aging, National Institutes of Health.