

To Understand the Aging Process



The Baltimore Longitudinal Study of the National Institute on Aging

U.S. DEPARTMENT OF HEALTH
AND HUMAN SERVICES
Public Health Service
National Institutes of Health

Foreword

Recently, it has become fashionable to question the value of "basic research." This questioning comes with increasing frequency from all quarters—national policy makers, the media, and the general public. We have ended our national love affair with science which marked the Mercury-Gemini satellite years, and entered into a period of skepticism—questioning the long step-by-step research required to unlock the secrets of the cell, the mysteries of cancer, or the reasons the heart falters. Test tube research is frequently called impractical, without direction, and not tied closely enough to human health needs.


However, intriguing studies are now beginning to appear which have given us more than anecdotal evidence of the value of basic research. Writing for himself and the late Dr. Robert Dripps, Dr. Julius Comroe* reported on a study of how research is accomplished. The two scientists asked the question, "What had to be learned before heart surgeons could successfully, routinely open the thorax, stop the heart, open the heart, restart the heart, and care for the patient in order to insure full and speedy recovery from heart surgery." The two researchers examined 4,000 scientific articles and picked 529 as "key articles essential to this major clinical advance on heart

care." Upon review, the researchers determined that 41 percent of the articles were clinically or disease-oriented at the time of publication, and more than 60 percent described studies as basic as how living organisms function or how drugs act. Dr. Comroe concluded that heart surgery has hardly taken a giant leap forward, but rather has climbed slowly, drawing from as many as 25 different disciplines.

Some 160 scientists at the National Institute on Aging's Gerontology Research Center in Baltimore, Maryland, are examining the basic biological processes and social phenomena which contribute to "aging," not with the goal of discovering a magic elixir, but rather with the idea of understanding the normal process of aging. Without such research, we can hardly expect to develop the base on which we can build and produce practical results, much less extend our life span. By expanding our understanding of the normal human aging process, we will ultimately acquire the knowledge needed to enhance the quality of life in our later years.

A healthier old age means the continuing contribution of a large proportion of our population and alleviation of the great emotional and financial burdens which fall on those families who have older relatives. In addition, knowledge gained through research and applied to prevention can help reduce our incredible national health expenditure, much of which is associated with the disabilities and diseases that become increasingly frequent with advancing age.

* Julius H. Comroe, Jr., M.D. and Robert D. Dripps, M.D., *The Ten Top Clinical Advances in Cardiovascular-Pulmonary Medicine and Surgery Between 1945 & 1975, How They Came About*, Final Report, (January 31, 1977); support by Contract 1-HO-1-2327 from the National Heart, Lung & Blood Institute and grants from The Commonwealth Fund and the Burroughs Wellcome Fund.



Les Higbie, a volunteer subject in the Baltimore Longitudinal Study of Aging, authored this booklet and is pictured in the illustrations. His participation in the study has given him a special insight into research on aging that the ordinary writer might not have. His interest in the subject is probably due in no small part to having been poked and prodded in the name of science for some 20 years.

Over the past 20 years, the NIA Gerontology Research Center has developed a cadre of 650 active, community-dwelling volunteers for long-term longitudinal studies of the aging process. This research is known as the Baltimore Longitudinal Study of Aging. It is the belief of those conducting the study that only through repeated observations of the same subjects over a long period of time, can researchers begin to understand and explain what happens as people age.

Why a longitudinal study rather than a one-time investigation of people of different

ages? This is a good question. Basically, the effects of aging in humans can be studied in two ways. The one-time (cross-sectional) approach involves examining groups of individuals covering the entire age span at one point in time. The differences seen in these groups can then be said to reflect the effects of aging. One difficulty with this cross-sectional method, however, is that the differences noted could result from such factors as selective mortality or so-called secular trends—people who grew up at the turn of the century and were exposed to a life style and environment entirely different from those maturing now.

The longitudinal approach, on the other hand, provides a biological profile of each individual in a group of people covering the entire adult age spectrum. These people can be followed over a long time so that actual changes within individuals can be measured as each one ages.

For example, suppose that a group of 55-year-old men or women and a similar group of 65-year-old people were examined in 1970. Then, in 1980, the survivors of these two groups are reexamined. They are now 65 and 75 years of age, respectively.

The first question to be answered is: Do these groups show the same rate of aging in all body systems (heart, lungs, brain, kidneys, muscles, and so on) over this 10-year period? Second: Are there large individual differences in the rate of aging among individuals? If so, why? Third: Did the 65-year-old subject in 1970 resemble in all re-

spects the 65-year-olds in 1980? If not, are there environmental or biological explanations for these differences?

Answers to such questions are critical to our gaining a better understanding of aging in humans. They can be answered only by long-term prospective longitudinal studies—studies that follow subjects as they age and then analyze how they aged.

However, cross-sectional studies also have an important role to play, and the Baltimore longitudinal volunteers are valuable subjects for these one-shot research projects. The volunteers save research dollars when they participate in these projects because so much basic information about them has already been collected. Longitudinal studies are less costly than clinical research with its high overhead, and they provide a necessary normal standard against which diseases can be measured.

The longitudinal approach has the advantage too of uncovering *antecedents* (earlier events, conditions of early life) that may account for differences in intellectual, physiological, and other capacities of individuals, including such things as genetic inheritance, life experiences, work and health histories. These would include, also, the impact of such great historic changes as the rural to urban migration and this century's revolutions in transportation and communication. Uncovering such earlier life factors could provide information that would help prevent certain disabilities of aging and thus be invaluable for future generations.

The nature and character of aging, as a process and as a subjective experience, undoubtedly are influenced by social and behavioral factors which must be understood. Although the Baltimore volunteers represent a fairly select group within the U.S. population—they are highly educated, and relatively healthy—we think the essential biomedical trends in aging discovered through the NIA Baltimore Longitudinal Study of Aging are likely to be representative of our population as a whole, regardless of social, economic, or educational status of the subjects.

The recent addition of women (1978), many the wives or widows of male volunteers, gives NIA scientists the opportunity to make comparisons never before possible in this study. For example, women have an 8-9 year life span advantage over men. Now, we can study men and women with comparable socioeconomic backgrounds and lifestyles to see how life span differences may be related to such things as genetic, environmental, and physiological factors; adaptation to life stresses; or, health care patterns of men and women.

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Successful and Creative Aging, Not Just Survival

At the beginning of the twentieth century, 4 percent of all Americans (about 3 million) were 65 or over. That figure has now grown to more than 10 percent (23 million). Looking ahead 50 years, we can expect one in every five Americans to be 65 or older.

These figures emphasize the need to plan now to deal with the serious social, economic, and personal consequences of this increase in the number of older people in our population. Our challenge is to guarantee that this population does more than just survive. The fruitful middle years of life must be extended so that the aging live creatively and remain productive contributors to society.

To achieve these goals, we need more knowledge about the aging process and the diseases which beset our older citizens. We must try through research to improve economic and social conditions. We must correct widespread negative attitudes toward older people.

Aging is the one biological condition common to all. New knowledge about how and why it happens, therefore, is one of our most urgent priorities. Science must find ways to prevent, modify or even reverse some of its undesirable aspects. Without new knowledge through research, we will continue to age in much the same ways but at an ever increasing cost to society. Time and effort spent on research now will mean more efficient services for the aged in the future. The National Institute on Aging (NIA) was established in 1974

to carry out biomedical, social, and behavioral research and training in this field and to deal with the special problems and needs of the aged.

NIA Gerontology Research Center

The intramural (in-house) program of NIA is located at the Gerontology Research Center (GRC) in Baltimore. The Center occupies a four-story building on the grounds of the Baltimore City Hospitals complex. Currently over 160 scientific and support personnel carry out research into most of the biomedical, as well as behavioral factors, involved in aging.

NIA/GRC origins go back to 1940. Farsighted scientists such as Dr. Thomas W. Parran, then Surgeon General of the U.S. Public Health Service; Dr. Lewis R. Thompson, then Director of the National Institute of Health; and Dr. William H. Sebrell, Jr., then Chief of the NIH Division of Physiology, recognized that improving the nation's health required research on chronic disease and aging. At the same time, Dr. John T. King, Chief of Medicine, Baltimore City Hospitals, and other Baltimore officials, recognized the importance of studies on the medical problems of elderly people. The union of these two research groups—national and local—was catalyzed by the Josiah Macy Foundation which provided a financial grant to NIH in 1940 permitting establishment of a gerontology unit in the Division of Physiology under the leadership of Dr. Edward J. Stieglitz.

Drs. Sebrell and Stieglitz decided that the gerontology unit should begin studying aging in humans. At that time there were no resources available at the NIH campus in Bethesda, Maryland, for patient studies, so Dr. Stieglitz and Dr. King negotiated an arrangement locating the laboratory for the gerontol-

ogy unit in the Baltimore City Hospitals. NIH provided salaries for Dr. Stieglitz and one technician and the Hospitals provided laboratory space and access to chronic patients as well as to residents in the home for the elderly located on its grounds. Healthy aged people and those with medical problems could thus participate in these studies.

When the one-year Macy Foundation grant expired in 1941, NIH took over support of the unit and Dr. Nathan W. Shock, Associate Professor of Physiology at the University of California, Berkeley, came east to head the research unit.

During World War II, the unit concentrated on studying the effects of vitamins on work output and recovery from fatigue.

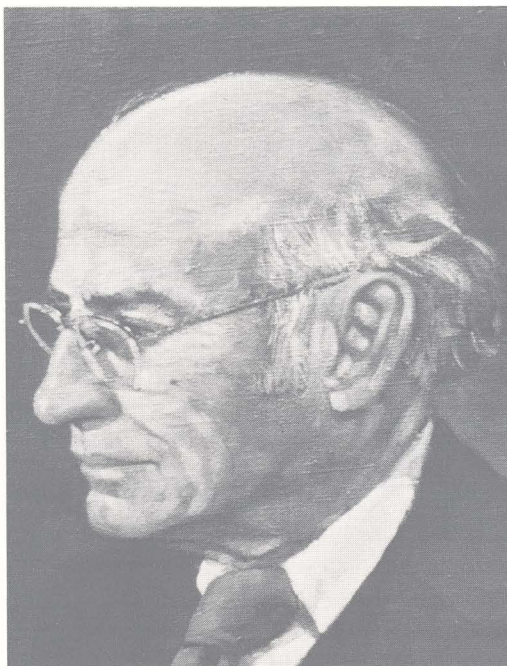
After the war, in 1946, the Section on Gerontology returned to studies of the aging process. More space was provided by Baltimore City Hospitals and, in 1948, this was expanded to include an entire 40-bed ward which was remodeled and used for patient studies and for projects involving volunteer subjects. And eventually, in 1968, gerontology had its own building.

Under the leadership of Dr. Shock, NIA/GRC developed into the largest institution in the western hemisphere devoted entirely to aging studies. Researchers study the aging process using a variety of laboratory animals, human longitudinal volunteers, and other volunteers for specialized studies. Since 1958, all of the 650 male longitudinal subjects have traveled at their own expense, every year or two, to undergo tests designed to discover

the actual changes with age that take place in human subjects.

These volunteers, ranging in age from their early twenties to mid-nineties, participate in the internationally known Baltimore Longitudinal Study of Aging. Three-fourths hold Bachelor's degrees. In addition, nearly half of them have Master's and one-fourth have Doctoral degrees. Their occupational, educational, and economic status, their generally good health and high level of social adjustment, and their motivation and interest in gerontology research and its results make them an especially homogeneous study sample. Indeed, their research value lies in their homogeneity. It is true, however, that they reflect only one sample. Others, with different backgrounds, must be studied to compare results. But NIA/GRC scientists think that the essential biomedical findings from the Baltimore study are likely to apply to other subjects having different social, economic, and educational backgrounds.

It is not easy to obtain the help of healthy individuals for medical studies. It is less easy when participation requires a long-term commitment from volunteers who must make periodic visits to the Center and spend 2-1/2 days and 2 nights in an institutional setting. Some of the testing is quite tedious. Some requires substantial mental and physical effort. Some of the questioning intrudes into areas of private concern. And, the test of intellectual function can be threatening to the ego. Nonetheless, there has always been a



Dr. Nathan W. Shock, former Scientific Director of the National Institute on Aging, is often called "the father of aging research." During his 35 years as head of the Baltimore aging unit he developed the longitudinal program into an internationally known research project, published more than 300 research articles on aging, and was the prime mover in making gerontology an independent discipline.

long waiting list of willing volunteers. Most have been recruited by volunteers already in the program who knew the demands that would be made upon them. Although the volunteers may decline certain tests, if they wish, refusals are rare.

Certainly the opportunity for a comprehensive physical examination is an inducement to participate, even though all the volunteers have their own private physicians and most are able to afford medical services. But a free physical checkup is small reward for the demands made of them. It is obvious that an interest in the Study and a desire to be part of it are major motivations. The homogeneity of the group can be attributed, in the main, to their positive views concerning the methods and objectives of science. Their generally good health is an added benefit for one of the research objectives from the outset has been the investigation of *healthy* aging.

The late Dr. William W. Peter, the first member of the volunteer group and the man who began the chain-letter-like process 20 years ago of building the original 650-man sample, put it this way: "There is a reason why people like us should volunteer. We are not receiving custodial care and we are not living institutionalized lives. Nor are we medically indigent. Indigent and institutionalized subjects, if preponderant, distort the picture. Many persons being cared for in old people's homes have been buffeted by the storms of life for so many years that they present more than the average number of abnormal findings, both physical and psychological. People

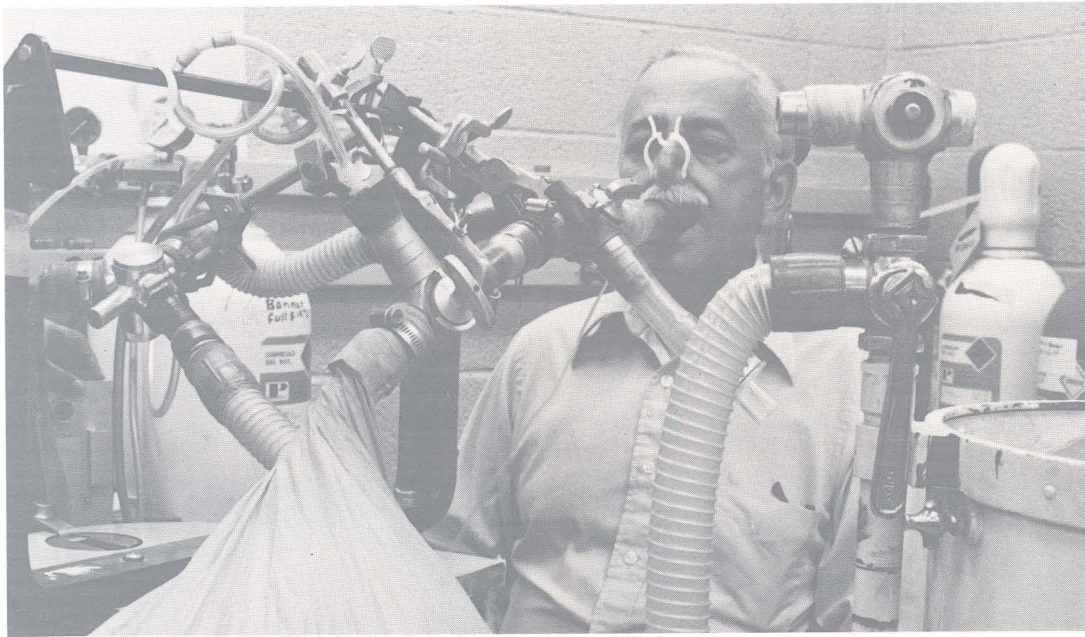
are needed from the outside—people who live normal lives in their communities."

NIA/GRC researcher Dr. Bernard T. Engel takes this statement one step further: "One of the reasons for looking at this kind of sample is that we hope to understand not only the process but also the peak achievement possible. It is not reasonable to strive for mediocrity when we can reach a very high level of attainment."

Not only are the Baltimore volunteers generous participants in the Longitudinal Study, but they also represent a pool of available research subjects whose basic characteristics are already known. They are useful as subjects for limited-scope, cross-sectional experiments in aging which might not require a long-term study to produce significant results, thus saving the expense of developing a separate sample for each cross-sectional study.

Despite additions and losses over nearly two decades, the membership of the volunteer group remains surprisingly constant and stable. With the addition of women to the program in 1978, the contributions of these volunteers to aging research will increase greatly. And with subsequent studies of other subjects from differing social, economic, and educational backgrounds—either in Baltimore or elsewhere—comparisons can be made to prove or disprove NIA/GRC scientists' expectations that the essential findings from the Baltimore study are likely to stand.

In organizing a group of female volunteers, the researchers are making an effort to



recruit as many of the wives, mothers, daughters, and sisters of present participants as possible because of the various family relationships which may be significant.

Women are recruited on an individual basis also. At present, women applicants must be at least 25-years-old and be able to furnish their own transportation to and from the NIA Center in Baltimore. They, like the men, must have a personal physician who approves their participation. Matching the men's schedule, women volunteers can expect to return to NIA/GRC for 2-1/2 day visits at two-year intervals if they are under 60, at eighteen month intervals if they are between 60 and 69, and annually if they are 70 or older.

Those of us who are "gaggers" sometimes have a problem with this test. The plastic "clothespin" on my nose is not comfortable, but it's an important test so we try. We know lung capacity changes dramatically with age. This so-called "nitrogen washout" test measures the volume of air remaining in my lungs and the amount going into the plastic bag which the researchers call a "collection spirometer." Interesting comparisons can be made between the results of this test and a thorough smoking-history questionnaire which each of us fills out. Because I quit smoking 25 years ago, I tend to be a little smug about my lung function.

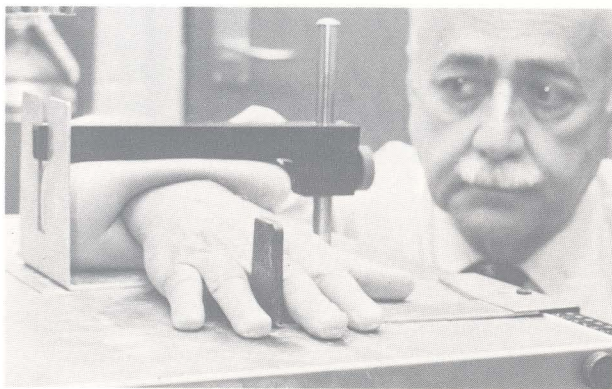
“Minimum Disability” not “More Years of

Dr. Shock, who retired as NIA Scientific Director in 1977, says the goal of gerontology research is “not to increase the number of years of old age and infirmity but rather to allow more people to reach the presently attainable life span with minimum disability.”

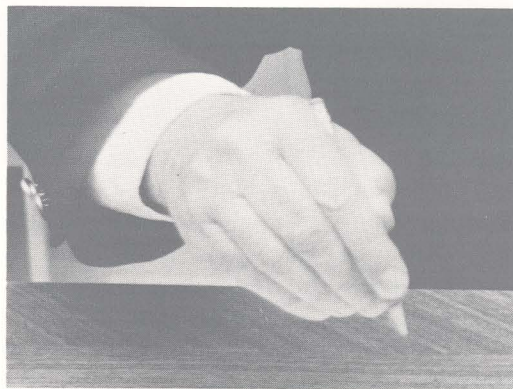
With this goal in mind, NIA/GRC scientists try to find the reasons for the changes that take place as people age. They know that the 30-year-old is not the same biologically as the 20-year-old. Nor are 40-

year-olds the same as those in their thirties. It is important, therefore, to study the aging of an individual on a long-term basis, not just as he or she progresses from old to very old when the more obvious changes take place.

The Baltimore Longitudinal Study involves a constant search to discover the reasons for physiological changes with aging, how people acquire and deal with various diseases, and how they perform intellectually. Changes are measured by taking medical histories, physical examinations, X-rays, tests



Despite my apparent skepticism, this test is painless. A narrow beam is scanning my forearm to analyze the mineral content and width of the bones. A computer analyzes the data and reads out an index of density on the dials at right. Bone loss is one of the very serious problems of old age—especially in postmenopausal women. Even in elderly men, bone loss in the spine is a serious problem. The rate of loss, as measured in this test, provides an index to understanding these problems.



My coordination ability is measured with this test of speed and accuracy. The object of the tapping test is to put pencil dots in alternate target zones as rapidly as possible while maintaining maximum accuracy. On nine different sheets the distance between the target zones varies widely as does the width of the zone itself. Speed and accuracy of movement, as measured here, reflect the condition of my central nervous system and its ability to coordinate the basic movements necessary for everyday living.

Old Age''

of hearing and vision, metabolism, nutrition, learning, memory, and problem-solving. There are also studies of the heart and circulation, exercise and neuromuscular function, kidney and lung function, and body composition. The combination of all test results in time should provide scientists with ways to prevent or ease the debilitating effects of old age. The Longitudinal Study continuously produces new information on aging—not one grand conclusion but specific areas of knowledge that, added together, provide a better picture of what happens to the human body with advancing age.

“We try harder” in this pulling and pushing test to measure changes in arm and shoulder strength. My grimace represents “effort,” not “pain.” Muscle strength, we learn, is maintained at near young adult levels through age 60. This is a good example of the value of a “longitudinal” as opposed to “cross-sectional” study. Changes in my muscle strength over a period of 20 years are more significant than simple one-time tests of individuals of various ages.



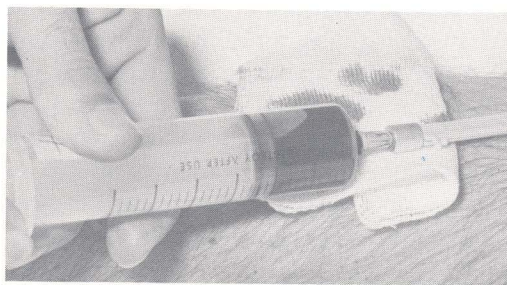
What Do We Know About Aging Now?

Longitudinal research at the NIA Gerontology Research Center in Baltimore has already produced substantial knowledge of the aging process through studies of such things as body cells, glucose tolerance, cholesterol, alcohol metabolism, heart size and performance, problem-solving, and memory.

One major practical achievement is the opportunity to develop better standards of normality. In the glucose tolerance test for diabetes, for example, after the subject drinks the glucose (sugar) solution or has it injected in his vein, the glucose level in the blood is checked by taking blood samples at intervals over a two-hour period. The level that doctors have for years assumed to be “normal” is the normal level for young, healthy adults in their twenties. But the NIA/GRC studies show that this standard is inaccurate when applied to older people. By this standard of normality, up to half the older subjects would be mis-classified as diabetics. So an adjustment must be made for age, and Center investigators have devised a way to make this adjustment.

Similarly, in tests of kidney function there has been no normal standard for persons in their middle or older years. With newer data from NIA/GRC research, it is now possible to advise doctors and the scientific community as to just what might be expected of kidney function for normal middle-aged and older people.

This ability to judge what is normal in a test enables the Gerontology Research



In the longitudinal study my ability to metabolize glucose (sugar) is measured over many years to see how it changes with age. The sugar solution is either injected in a vein, or I must drink about a pint of it. The volunteers' joke about World War II "battery acid" drinks made from instant powders get a little stale, but there's a late breakfast to look forward to, usually about 30 minutes before lunch time. During the two-hour test, blood samples are collected periodically through a vein catheter in my arm.

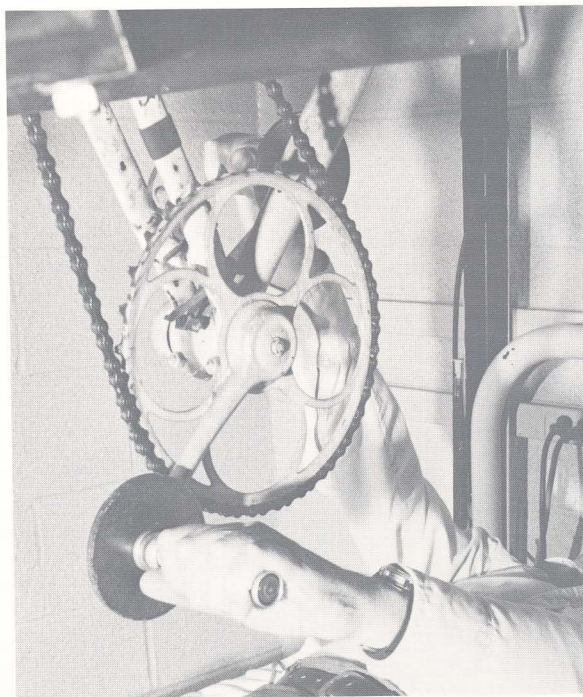
Center to help practicing physicians achieve better clinical diagnosis and to avoid over-treatment of the aged. Such knowledge is a direct, practical result of information gained from a number of years of longitudinal observations.

Aging brings a loss of cells in many of the body's tissues. As a consequence, the older person is less able to meet and combat various environmental stresses. A simple example involves two men running for a bus.

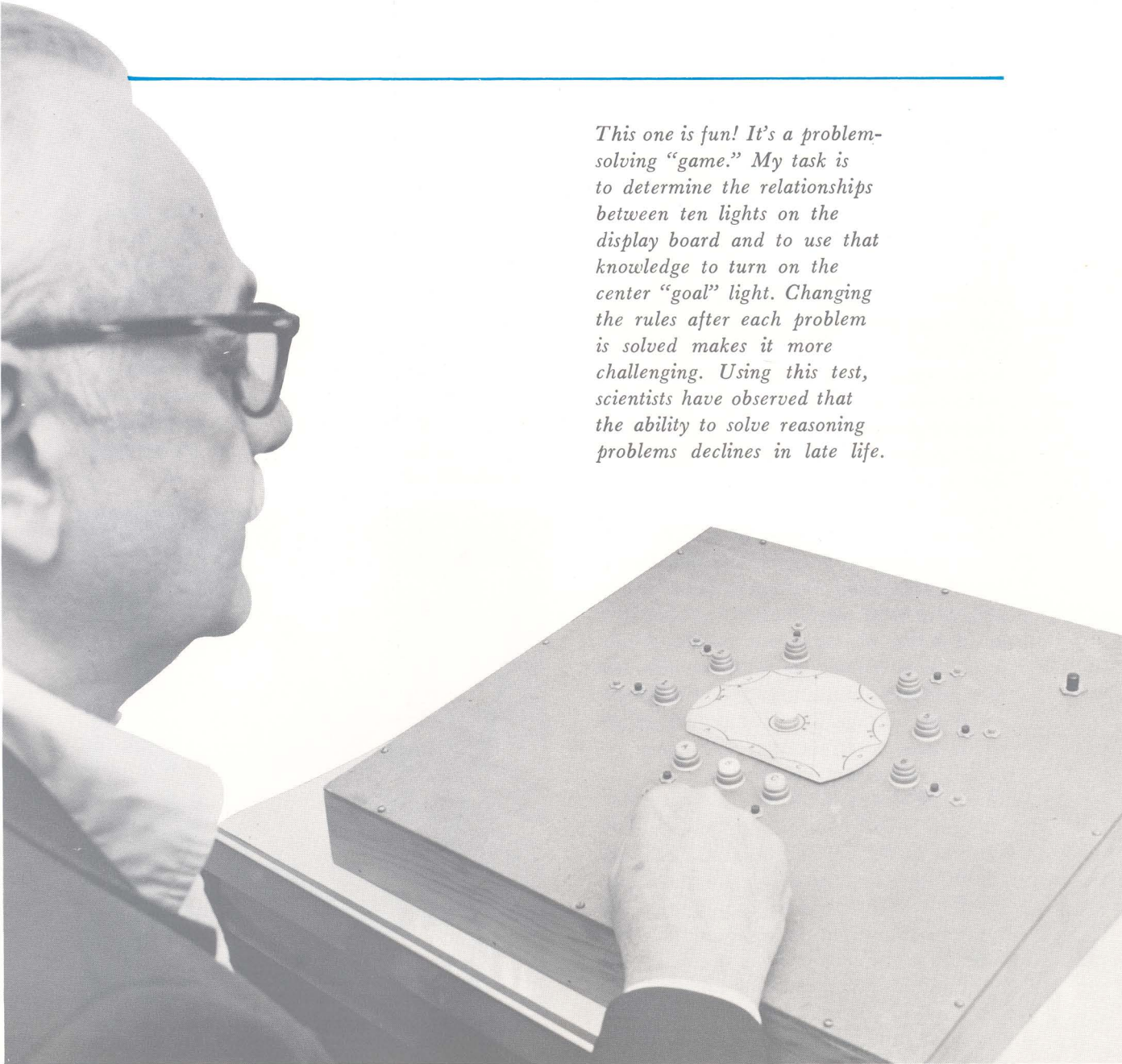
As they board and fumble for their fares, the older man is breathing harder than the youth. And it takes him longer to return to a normal breathing pattern. Nonetheless, NIA/GRC studies show that many 80-year-olds are in better condition than those much younger. Their lung function shows relatively little decline. Like the lungs, other organs and body functions exhibit a tremendous range of capabilities among individuals of a given age. NIA/GRC studies show quite clearly that chronological age is not a very good index of performance capabilities. In the future, longitudinal studies may be able to uncover antecedents that account for intellectual and physiological differences between individuals.

NIA/GRC research has also laid to rest the theory that there is an adult plateau period for most physiological functions. It is not true that the individual reaching maturity achieves a long period of stability and then, suddenly, begins to slide downhill faster and faster with age. Most changes are gradual and progressive. In the area of reasoning and logical problem-solving for example, Dr. David Arenberg and his associates have demonstrated a decline in performance by older men, but only for those subjects who were over 70 when first tested. Comparisons of performance of young and old men in the volunteer group show that the proportion who successfully solved each problem decreased with age, even in a group of highly educated men. Older persons, when confronted with problem-solving situations, tend to be less able to try new approaches, repeating instead the

This one is hard work even though I'm lying down. I'm cranking a bicycle "ergometer" to determine the effects of aging on the maximum "arm work output" I can muster. The muscle strength of arms and shoulders declines less on the simpler task of pulling or pushing a stationary object than does the overall ability to use the muscles in a coordinated movement such as turning this crank. The decline begins at about age 45. I was almost that young when I started these tests 20 years ago.



This one is fun! It's a problem-solving "game." My task is to determine the relationships between ten lights on the display board and to use that knowledge to turn on the center "goal" light. Changing the rules after each problem is solved makes it more challenging. Using this test, scientists have observed that the ability to solve reasoning problems declines in late life.



same approach. On the other hand, many older subjects, especially those first tested while in their sixties, showed no decline in performance on retesting.

In the glucose tolerance tests, NIA/GRC scientists do find a plateau. They note a loss in the ability to handle glucose as the individual moves from his twenties into his forties. And finally, in later years, a decline sets in again. There are, however, some important exceptions to this principle. The *patterns* of age decline in the various diagnostic tests for diabetes differ. In the commonly used oral glucose tolerance test the usual pattern of progressive decline occurs. But when the glucose is injected into a vein there is actually a more rapid age decline in the early adult years than in the middle years of life.

Cholesterol studies show an increasing amount in the blood up to age 55, then a decrease. Thus, high levels of cholesterol in the blood—a possible risk factor in heart disease—peak at about age 55. Cholesterol in the blood shows still another age pattern, with a gradual increase in level during the early adult years, then a plateau period, and finally a decline in older years. The role of changes in body composition (obesity, for example), dietary habits, and patterns of activity in this important variable are under investigation.

Despite the importance of alcohol from a social, behavioral, medical, and legal standpoint, there has been no investigation of the relationship aging might have on the way it is metabolized by the body, until NIA/GRC scientists studied its effects. NIA/GRC

researchers made the rather surprising discovery that alcohol is metabolized just as efficiently in the aged as in young adults. But, at the same blood levels, the older men had greater declines in intellectual functions such as memory and decision-making tasks, as well as in reaction time.

A new echocardiography technique which measures heart size and performance shows a significant increase in the diastolic (or relaxation phase) blood pressure in the aorta of older men—a 10 to 15 percent increase from age 30 to age 80. In addition, the wall of the left ventricle of the heart shows a 25 percent increase in thickness over the same period. And the speed with which the mitral valve (which controls blood flow in and out of the heart) opens and closes decreases by 5 percent, perhaps reflecting the slower filling of the stiffer, thicker heart ventricle in later years. The size of the heart cavity, the extent of shortening of contractile fibers, and the speed of that shortening do *not* change much with age.

Longitudinal subjects in Baltimore have also participated in a study of cellular aging outside the body—that is, in test tubes. Small pieces of skin were taken from the upper arms of the volunteers and were used to develop skin tissue cultures. NIA/GRC researchers find that the cells in these small pieces of skin will actually undergo growth and cell division in cultures. This opens broad areas of study since human cells from different aged donors can now be studied under carefully controlled experimental con-

ditions. NIA/GRC finds that cells from older donors undergo a smaller number of generations of cell division before losing their ability to reproduce. Age differences have also been noted in the structural and chemical characteristics of the cells in culture.

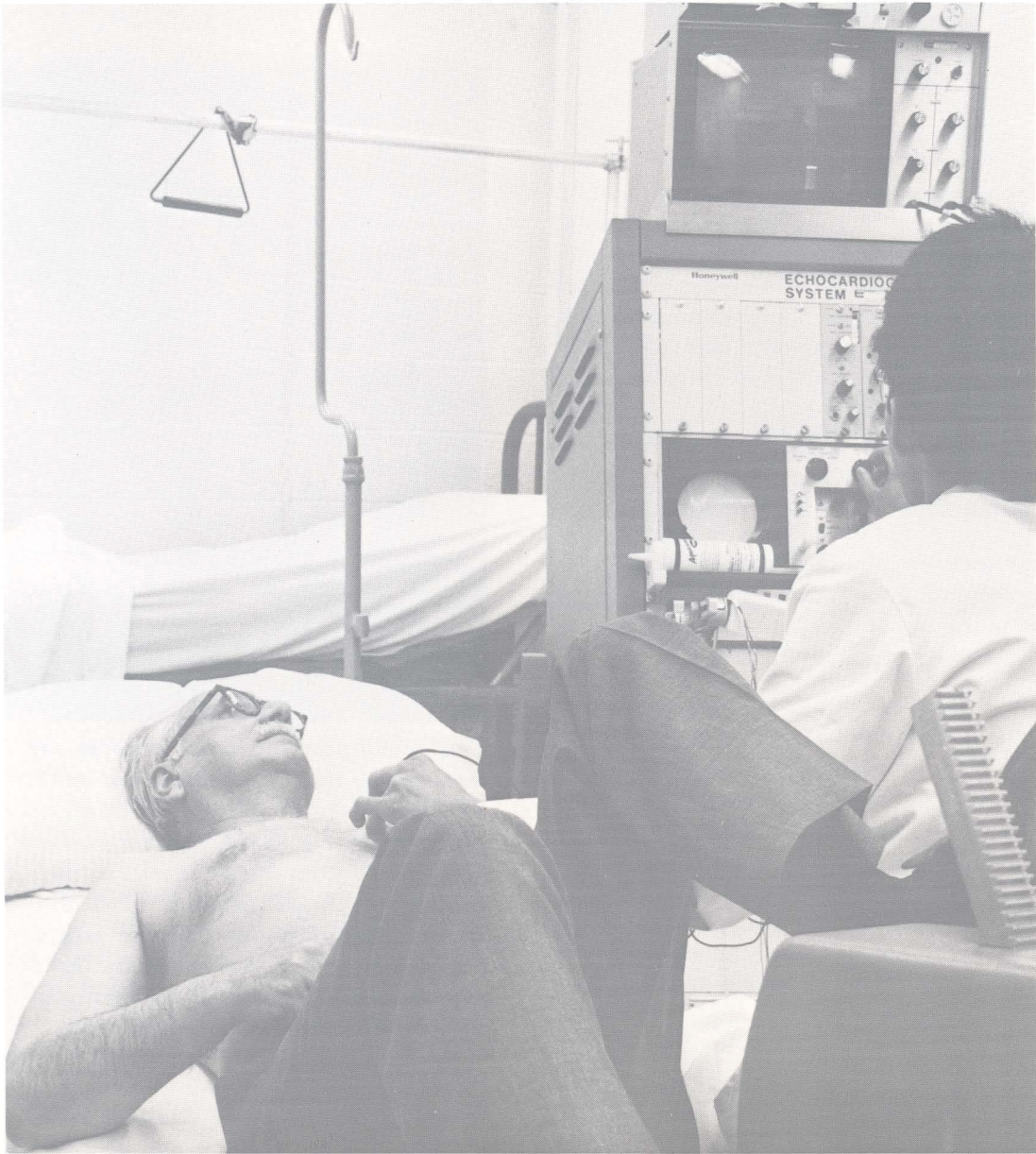
Promising results may come from NIA/GRC studies of so-called *hormone receptors* (which may be thought of as tiny receiving sets) and their role in the aging process. Medical scientists have known for a long time that hormones, circulating in the blood stream, send signs to body cells which call for certain functions, such as metabolism of fats or to help the body in adapting to stress. They have known too that these signals are received from the hormones by small protein receptors located either outside or inside the cells. The Baltimore researchers find that the receptors definitely change with age, decreasing in number in both humans and animals. They conclude that the loss of receptors may be an important factor in the aging process. Currently they are trying to learn more about the way in which the receptors are lost and to determine if certain chemicals can reverse the trend. If ways can be found to restore the numbers of receptors in old cells, the practical benefits for older people would be enormous.

Separate studies of daydreams and sexual activity conducted by NIA/GRC researchers Dr. Leonard M. Giambra and Dr. Clyde E. Martin add important new understanding of sexuality among older people.

Dr. Martin's research shows a high de-

gree of correlation with previous studies in this field which told us that frequency of sexual activity steadily declines over most years of the male life span. But Dr. Martin also finds that males tend to maintain comparatively high or low levels of sexual activity throughout their lives. Frequency in early marriage and in the 20- to 40-year age period, corresponds significantly with sexual frequency after age 40. Dr. Martin also correlated these studies with such tests as maximum breathing capacity, basal metabolic rate, cholesterol level, and oxygen consumption and concluded that physical well-being (as measured in these terms) is an important

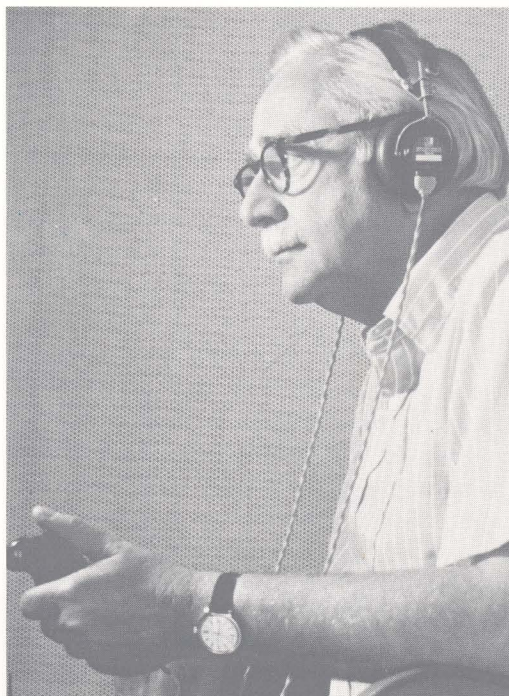
The new technique of echocardiography permits studies and measurements of my heart size and performance. The "nozzle" through which the ultra-sound waves (two million cycles per second) are sent into my chest is cold to the touch, but, as the doctors tell me, it's "noninvasive" which means that no needles or vein catheters puncture my skin. The sound waves reflect off the various parts of my heart, sending echoes to the receiver at upper right which transforms them into a line picture. These echoes show variations as small as one millimeter in the movement of my heart.



factor in determining sexual responsiveness and activity after age 65.

Dr. Giambra found that the frequency and intensity of sexual *daydreams* show a direct relationship to age, decreasing in older subjects. In a joint analysis of their separate studies, Drs. Martin and Giambra conclude that greater sexual activity or vigor and greater frequency or intensity of sexual daydreams are directly related and that these findings are consistent across the male adult life span.

To sum up, NIA/GRC studies show a large variation in *how* individuals age. In observing a group of persons in their seventies, it is obvious that some are physically vigorous, mentally alert, and happy with their position in life. Others seem to slow down at much earlier ages. It is possible now to document some of these changes.



This sound-proof chamber is about the same size as the one we have seen on TV, but there's no \$64,000 at stake. Tones of varying pitches and duration are piped into my earphones. I indicate my hearing "thresholds" (levels at which I can no longer hear the tone) by pressing a button on the device in my left hand. My "thresholds" are plotted electronically on a graph outside the chamber.

What Is Ahead?

The exact mechanisms of the aging process are still unknown. To meet expectations for an improved quality of life basic studies of the process must continue. To insure growth in this field, new ideas must be stimulated among competent researchers.

More research in the field of drugs and aging would make an immediate contribution to the prevention of disabilities and decrease use of nursing homes for the elderly. The classic text in pharmacology does not even have "age" in the index. So the absence of a comprehensive body of knowledge about drugs and aging poses a serious problem. There are no prescription guidelines for physicians, most of whom are not adequately educated in the special problems of the elderly. The overuse and misuse of drugs often results in unnecessary falls, fractures, confusion, excess hospitalization, and expensive institutional care. A complex chain is involved, for example, in the problem of drug absorption: how the drug is distributed throughout the body; its attachment to and effectiveness on the target organ; metabolism and excretion of the drug; undesirable side effects; behavioral problems such as remembering to take the drug; and the special problem of multiple drugs interfering with the effectiveness of one another in elderly persons who have more than one medical condition.

A better understanding of the relationships of nutrition to aging and disease is of great importance in the study of the aging process (gerontology) and for the treatment

of diseases of the elderly (geriatrics). NIA/GRC has made a start in this area. The researchers evaluated the effect of age on diet among the longitudinal study volunteers, and determined the amount of energy they use in relation to the number of calories in their food. These studies show a significant decrease with age in calorie intake and the Baltimore researchers relate this to a decline in basal metabolism and the amount of energy used in physical activity. More research is needed in the field of nutrition and aging.

It is no secret that women tend to live longer than men. Cardiovascular problems are less frequent for women during their prime (reproductive) years. But, after menopause, the life expectancy gap between men and women narrows. With the addition of women to the Longitudinal Study it may be possible to determine why women have an 8 to 9 year edge in life span over men. Is it genetic, hormonal, physiological, social, or psychological? Only time and longitudinal studies such as this will help provide the answers.

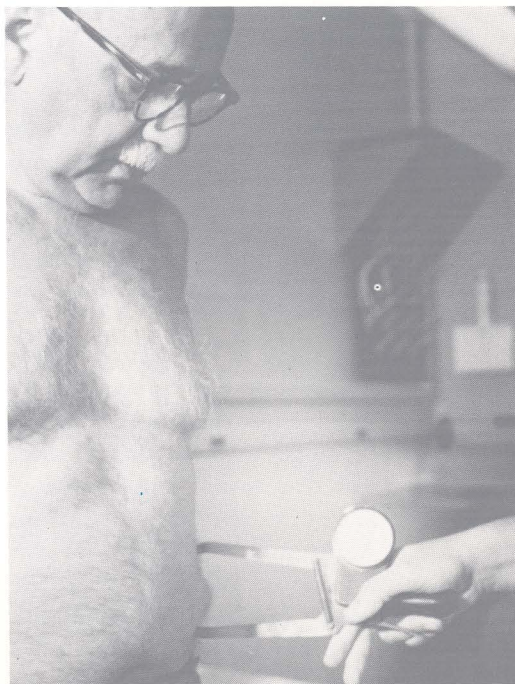
Current systems of mandatory retirement result in economic and human loss to society. The productive contribution of retirees is lost and money must be paid for their care and support. One answer to this problem would be flexible retirement systems, based on standards of health and well-being that can be measured and reproduced. Research with the Baltimore Longitudinal volunteers, among others, can provide the necessary physiological, psychological, and social data on

which to base retirement policies. With women playing an increasingly larger role in all phases of modern life, the new women's program at Baltimore can, in time, add important facts on which to base future public and private decisions. Flexible retirement systems alone might save billions of dollars paid in social security benefits and in public and private pension systems.

What else lies ahead? A slow creep upward can be expected in the average life expectancy, because of improved living conditions, improved health, better medical diag-

nosis and medical care. An interesting statistic on life expectancy is that the projected increase is greater for women than for men. For women in highly industrialized and developed nations, the increase may be five to ten years over the next half century. In 1900 women lived approximately two years longer than men. Today the gap is nine years. NIA/GRC studies now in progress may determine why these differences exist between males and females.

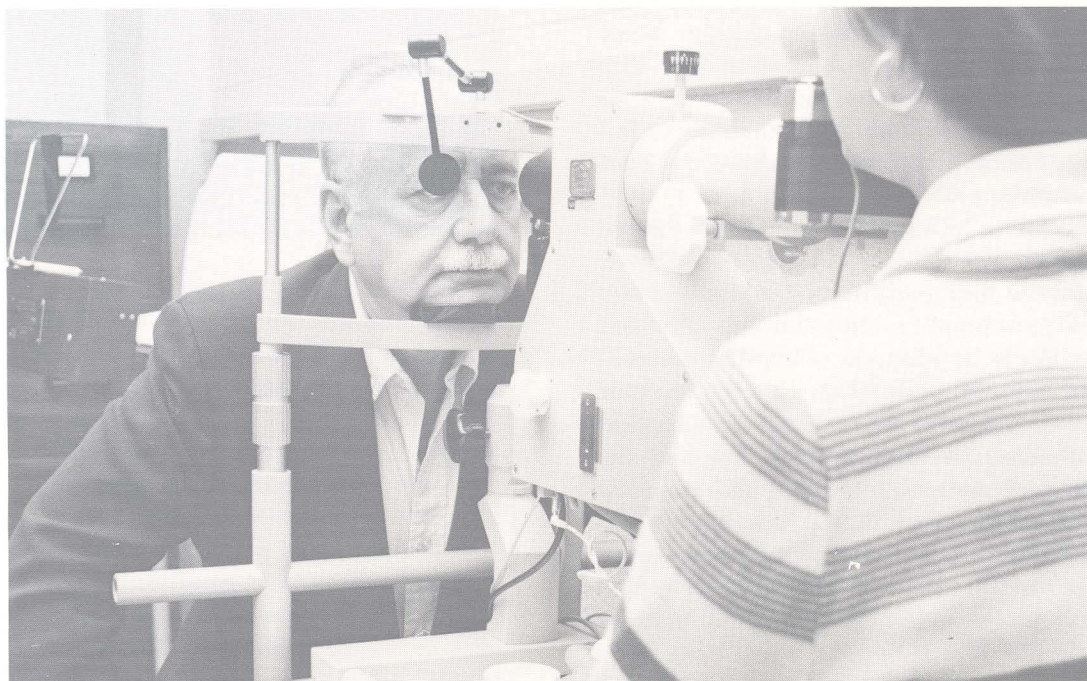
The Baltimore study is dynamic. It did not begin, as Dr. Reubin Andres, NIA



Measuring fat around the waistline is one of the body composition tests at Baltimore. The metal calipers are cold, sometimes they tickle, and they pinch a bit as they grab a skinfold, but they're also a good reminder of the tendency of the body to add fat as we grow older and the need to avoid second helpings at the table. Surprisingly, NIA/GRC research shows that a tape-measure check of my waistline circumference is a better indicator of fatness than the skinfold measure with the calipers. My body weight has been checked for nearly 20 years. This permits the researchers to correlate obesity measurements with many physiological changes.

Clinical Director, has noted, "with all the right questions." New ideas and new hypotheses occur all the time. They, in turn, lead to new studies of the aging process. There will always be fresh areas to investigate.

Photographing the back of the eye (retina) shows how the very small blood vessels in the body change with age. For medical investigators, the eye is the best window there is on the human vascular system. A blinding flash of light left me with only momentary discomfort.



Why More Research?

The study of the aging process is much more than the study of human decline, disability, or disease. It is also the study of the normal development processes which are fundamental to life—including creativity, life experience, perspective and judgment. The only way to gain new knowledge about these things is through research. Research is concerned with what old age will become as we eliminate disease, disability, and social adversity. Research alone cannot achieve a healthier and stronger older population; however, without it the solutions are only palliatives.

The value of what scientists call “basic” research is often questioned. Some seek instant cures, not trusting the long process of step-by-step basic research, considering it impractical and unrelated to human health needs. But it *can* be the most practical.

The NIA and its intramural research program, the Gerontology Research Center, continue the tradition of basic research—seeking answers to fundamental questions. No longer is research exclusively preoccupied with diseases. The direction now is toward inquiries into normal physiological and behavioral changes with age and the effects of the social, cultural, and economic environment in which we grow old. In the years ahead, these are the paths that gerontologists will follow to achieve their goal—an improved quality of life for all, particularly the aged.

*“To be seventy years young
is sometimes more hopeful
than to be forty years old.”*

—OLIVER WENDELL HOLMES

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