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PHYSICAL ACTIVITY AND AGING

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SIR ADOLPHE ABRAHAMS

I am fully aware of the distinction bestowed upon me to participate in tonight's meeting held to honour the memory of Sir Adolphe Abrahams. Sir Adolphe was the founder of clinical sports medicine and I for one am greatly indebted to him for much he taught me. No one before him has brought to bear upon the study of athletics the same combination of comprehensive knowledge of internal medicine and of physical training.

Born in Capetown, South Africa, Sir Adolphe received his education in London. He and his two brothers contributed in a unique manner to English tradition and culture. Sir Sidney Abrahams joined the Civil Service and eventually occupied a high position in the Foreign Office; Harold, the youngest of the three, won the 100m race at the Olympic Games in Paris in 1924; for the better part of half a century he rendered great services to British Athletics.

During World War 1, Adolphe Abrahams was attached to the Royal Army Medical Corps. In 1919 he was appointed consultant at Westminster Hospital and lecturer in its Medical School of which he later became dean. He also belonged to the medical staff of the Hampstead General Hospital and of the Royal Chest Hospital. In 1931 he was elected F.R.C.P. and made censor of the Royal College of Physicians, delivered the Lumleian lectures, was Gale lecturer of the Royal College of Surgeons, and President of the Section of Medicine of the Royal Society of Medicine. Together with Sir Henry Dale he served as assessor of the Harveian Society of London which honoured me in 1942, precisely 30 years ago with its Buckston Browne Medal for an essay entitled "Evaluation of Methods of Physical Education, Sport and Exercise."

From 1912 to 1948 Sir Adolphe was medical officer of the British Olympic Teams. Among many distinguished physicians with whom he cooperated during his long and meritorious medical career were Sir James Purves Stewart, Sir Arthur Hurst and Sir Arthur Porritt, who in 1924 was a finalist in the 200m race at the Paris Olympic Games. He is now Governor-General of New Zealand.

A year before his death I had the privilege to attend a dinner arranged in honour of Sir Adolphe at St. Mary's College at Strawberry Hill, Twickenham during which The Rt. Hon. Philip Noel Baker gave a memorable speech alluding to historical reminiscences of Stockholm, 1912, of Brussels, 1920, of Paris, 1924 and of Amsterdam, 1928.

Sir Adolphe was a superb lecturer and writer. His command of the English language was exceptional. The *Lancet* benefited particularly from his contributions over several decades. His scientific enthusiasm was remarkable. At a medical meeting in London he showed sections of his radial arteries to demonstrate the principle of dissociation between structure and function.

As a young man Adolphe Abrahams won numerous athletic contests, among them the 100 yards and quarter mile races while he attended St. Bartholomew's Hospital, between 1907 and 1912. In his later years he ran regularly in Regent's Park. On his 70th birthday he covered a distance of 10 miles.

I conclude my remarks on Sir Adolphe with the following quotation from the obituary article that appeared in the *Lancet* of December 23, 1967: "He was a delightful and an unusual man who will be greatly missed by his many friends."

THE AGES OF MAN

The yearning after perennial youth is one of the eternal dreams of mankind, vividly expressed in Lucas Cranach's painting "Fountain of Youth": It shows old women being brought to a wondrous pool which restores youthful vigour and beauty: Once more they thus can partake in the pleasures of life.

The picture raises a question which modern science has tried to answer, namely that of alterability of the aging process. The question has broad implications in that until not so long ago life's chronological progress was thought to be designed as a fixed sequence of patterns so as Shakespeare has described them in "As You Like It":

ACTIVITY IN MIDDLE AND OLD AGE

*All the world's a stage,
And all the men and women merely players:
They have their exits and their entrances;
And one man in his time plays many parts,
His Acts being seven ages. At first the infant,
Mewling and puking in the nurse's arms.
And then the whining schoolboy, with his satchel,
And shining morning face, creeping like snail
Unwillingly to school. And then the lover,
Sighing like furnace, with a woeful ballad
Made to his mistress' eyebrow. Then a soldier,
Full of strange oaths, and bearded like the pard,
Jealous in honour, sudden and quick in quarrel
Seeking the bubble reputation
Even in the cannon's mouth. And then the justice,
In fair round belly with good capon lin'd,
With eyes severe, and beard of formal cut,
Full of wise saws and modern instances;
And so he plays his part. The sixth age shifts
Into the lean and slipper'd pantaloons,
With spectacles on nose and pouch on side,
His youthful hose well sav'd a world too wide
For his shrunk shank; and his big manly voice,
Turning again towards childish treble, pipes
And whistles in his sound. Last scene of all,
That ends this strange eventful history,
Is second childishness, and mere oblivion,
Sans teeth, sans eyes, sans taste, sans everything.*

Recent physiological and clinical studies with athletes have revealed that "the seven ages of man" are not rigidly fixed. That YOUTH is not necessarily characterized by physical and mental immaturity has become evident since many competitors as young as 14 reached Olympic finals in swimming, ice-skating, gymnastics and other sports. The biographic literature contains a number of individual descriptions of outstanding young musicians, chess players and performers in other fields. Mozart played before Empress Maria Theresa when he was 7. However, such cases are uncommon.

Several other determinants of human phenotypes were shown to be amenable to major changes through intensive physical training, among them the status of WOMEN. Simone de Beauvoir scornfully entitled her famous book written twenty years ago "The Second Sex". Today women's record performance standards in all branches of sport are beyond the reach of the majority of men. Another revision of established concepts became necessary when athletic excellence was achieved by large numbers of persons afflicted with irremediable PHYSICAL HANDICAPS. Fourthly, entire population groups whose SOCIAL ADVANCEMENT had been arbitrarily held back initiated their emancipation through sport. It is one of the most worthwhile achievements of the U.S. sports movement to have given special impetus to the liberation of the nation's black citizens.

Today's scientific session will be concerned specifically with yet another problem whose re-evaluation became necessary when more and more well-trained old men and women made their appearance in athletic contests: the problem of physical activity and AGING. Only 20 years ago, a comprehensive study of structural and functional changes in men and women between 30 and 90 years of age was conducted by the National Institutes of Health of the U.S. The investigators described a consistent trend of decline over the years of the parameters basal metabolic rate, work rate, cardiac output, vital capacity, maximum breathing capacity, nerve conduction velocity, body water content, filtration rate of kidney and kidney plasma flow. Like findings relating to single physiological parameters have previously been noted: Professor Sid Robinson of the Harvard Fatigue Laboratory reported forty years ago that the capacity of the heart to accelerate during exercise declines with age. Professor Hollman of Cologne noted in 1960 a steady reduction with aging of maximal oxygen intake capacity, a generally accepted indicator of physical endurance.

In sharp disagreement with these studies were observations of large numbers of middle-aged and old men and women who participated in sports. Of these observations textbooks of physiology and medicine took no cognisance until recently. In 1952 I compiled a list to show that the then generally accepted view that "aging" is invariably accompanied by a decline of physical power was untenable.

Dr. Savolainen of Finland won a bronze medal in the horizontal bar competition at Helsinki in 1952 at the age of 45; the Swiss 10-km. walking champion, Schwab, was 48 at the time of his start at the 1948 Games; the third in the 50-km. walk, Johnson of Great Britain, was 48; the second in the marathon, Richards, 49; the hurdler, Finlay, 40. The French tennis champions Borotra and Cochet, both close to their middle fifties, were finalists in several international tournaments in 1952. When he was 47, Tilden beat the 24-year-old champion, Don Budge. The British Oarsman Jack Beresford, five-fold Olympic winner in rowing, participated in a boat race on his 50th birthday. The Swiss mountaineer Chevalier of Geneva climbed the Jungfrau when he was 74 years old. The 49 year-old Tibetan Dawa Tondou was chief carrier for the British Everest Expedition. Two former world record swimmers, Arne Borg of Sweden and Johnny Weismuller of the U.S. swam the 100 m. around 60 sec. when they were 50 years of age.

These casuistic observations indicated the need to conduct systematic investigations of the problem of physical activity and aging: In 1952 I examined all of the 1,704 participants of the German National Festival

for Senior Gymnasts. Each carried out prescribed gymnastic exercises also track and field activities. The results of these investigations which were reported in a monograph that appeared in 1954 left no doubt that trained old people are fitter than untrained young people. Once this fact was established the question of nature and scope of the effects of sustained physical training upon the "aging process" offered itself for analysis. Over the past 20 years I have devoted several studies to its clarification. The present state of our knowledge can be summarised as follows:

1. Training inhibits the decline with the years of "form", specifically loss of lean body mass and increase of surplus fat - a common trend in our affluent society.

2. Training inhibits the decline with the years of a variety of functional parameters of which the ability to perform exercises such as those demanded from all participants in the 1952 Gymnastic Festival. The implications of physical fitness thus documented are far-reaching. They include physiological, psychological and social adjustments whose beneficial influences and socials on the status of "the old" have been demonstrated in much detail through comparative studies of "senior athletes" and inmates of old-age-homes.

3. Training protects against a number of illnesses that were believed to be "naturally" associated with "the aging process", chief among them the ischemic heart diseases.

* It is a matter of major interest that two recent summaries of the problem of aging do not deal with the modifiability through physical training: Simone de Beauvoir's voluminous monograph on aging, published in 1971, and W. Ferguson Andersen's contribution to the book "The Biology of Affluence," (Edinburgh, 1972). The issue has been fully discussed in a volume containing the Proceedings of the Symposium "Physical Activity and Aging", edited by D. Brunner and E. Jokl (Karger, Basel, 1970).

Two effects of training upon muscle tissue are hypertrophy and capillarization: Both are reversible. Discontinuation of training causes "inactivity-atrophy" as well as reduction of blood supply. Another ubiquitous accompaniment of physical inactivity is the deposition of surplus fat. With rare but noteworthy exceptions "fatness" and "fitness" are mutually exclusive attributes. Most well-trained athletes carry not more than 5-7% fat. By contrast, the body of the average American male at age 50 consists of 20-25% fat. In this context it is well to realize that on the whole obesity is not genetically programmed. If one looks at tracings of soft-tissue roentgenograms of chest and abdominal walls

of monozygotic triplets, that is of three adult individuals whose "design" is identical, the differences in the thickness of fat layers are due to different activity- and eating habits. Hypotheses of hereditary control of deposition of excess fat are clearly not tenable.

Another parameter of physique which is modifiable through exercise is the water content of the body. I have referred to this item before in connection with the findings in the "aging" study of the U.S. National Institute of Health. A reduction of blood volume accompanies "aging" in sedentary subjects. Vascularization of the brain is reduced in most old people. It is not as yet known whether this latter trend can be influenced through training.

In 1956 I reported that systolic contraction power of the heart is greater in trained than in untrained men and women. Since a decline of systolic contraction power was at that time considered an inevitable accompaniment of aging I examined old athletes' ballistocardiograms at rest as well as after exercise. The favourable effect of training on cardiac power proved to be the same in old and in young subjects. Professor Isaac Starr of Philadelphia has since presented data which demonstrated that the underlying variants of myocardial quality rendered indentifiable through ballistocardiography are not only of physiological but also of clinical significance: Middle-aged men whose ballistocardiographic tracings at rest were characterized by large systolic amplitudes remained free of heart disease during the ensuing 20 years; contrariwise, most of those whose tracings showed small deflections became victims of coronary or myocardial afflictions. An epidemiological finding of interest in this context was obtained by Professor Yudkin of London who noted parallel increases of incidence of coronary mortality, and of numbers of radio and television licenses in England between 1940 and 1960. Both trends reflected the extent to which lack of physical activity affected the bulk of the populations in all Western countries during these two decades.

The results of exercise tests conducted with fat and lean boys show that the latter's performance capacity was significantly superior. Differences of the same kind and magnitude can be demonstrated in exercise tests with adult and old subjects. The general statement is justified that *training exerts a more determining influence on form and function of the body than age.*

Obesity is a "coronary risk factor", one of several that have been identified in epidemiological studies conducted with large numbers of subjects, e.g., at Framingham. Likewise, high cholesterol concentrations in blood and electrocardiographic anomalies, e.g., inversion of the T-wave in several leads were thus implicated. The evidence was derived from retrospective

analyses of files of patients after they had suffered attacks of coronary infarction.

Some medical observations of athletes do not fit into the above concept. I present three examples:

1. During a study of physiological responses to exercise of women athletes a 21-year-old physical education student was found to have a serum cholesterol concentration of 445 mg. per ml. Medical examination excluded the presence of cardiovascular illness. Her father's blood cholesterol was 190 mg.; her youthful looking mother's 390 mg. The latter's parents, both alive and well in their eighth decade likewise had markedly elevated blood cholesterol readings; 390 and 344 mg.

2. In electrocardiograms obtained from an internationally known soccer player, T-waves were inverted in multiple limb and precordial leads, at rest as well as after exercise. The tracings are indistinguishable from those recorded from patients with myocardial infarction.

3. We have encountered during routine medical examinations of athletes several fat champions, among them marathon runners, channel swimmers, weightlifters, shot putters, ice hockey players and wrestlers.

The general relevance of these observations is that protection afforded by sustained physical training against ischemic heart diseases is not necessarily mediated through elimination or reduction of "coronary risk factors". Such protection becomes effective through physiological modalities of its own, all of which we do not as yet know. The pathogenetic role of the "coronary risk factors" that are currently discussed in cardiology must be evaluated specifically in reference to the fact that they were derived from retrospective analyses of records of victims of coronary infarction.

It is a matter of major practical and theoretical importance to point out at this stage that physical training does not bestow resistance against malignant tumours and against infectious diseases. As regards the former, Otto Warburg and Gerhardt Domagk considered such a possibility 25 years ago, arguing that the improvement through training of the oxygen supply to the tissues of the body may conceivably prevent the metabolic transformation of normal cells into carcinomatous cells that grow "irregularly" because of their ability to derive energy anaerobically. However, this hypothesis has been proved untenable. Also, it is now generally known that athletes are as susceptible to infections as non-athletes are, at times even more so.

Geriatric medicine is confronted with the problem of the effectiveness of a sustained exercise regime as a

prophylactic modality against ischemic heart disease, the most common cause of death in the U.S. today; while such a regime is ineffective against the second most common cause of death, the malignant tumours. It is also ineffective as a prophylactic modality against communicable illnesses.

Recent studies have demonstrated a genetically designed inter-relationship between intellectual and motor endowment. Whether or not both these endowments develop depends entirely upon the environment in which the individual is placed. In the light of the new knowledge of a hidden linkage of the two quality potentials under reference there is a need to initiate studies to elucidate the implications of the fact that many old persons excel in intellectual and artistic sectors. It is likely that many of them also possess motor capacities greater than is presently supposed. If the validity of this assumption can be proved a number of public policy changes in the field of preventive geratology would be called for.

As regards intellectual and artistic performances of an exceptional quality by old persons, three examples are quoted: During the 9th decade of his life, the Italian painter Titian (1477-1576) presented one of his best works, the self-portrait. At an age of 95, Sir Charles Sherrington (1857-1952) revised his book "Man on his nature"; and Arthur Rubenstein continues with his concert appearances at the age of 85.

Longevity, like mental and physical capacities are determined as part of each individual's hereditary endowment. The transformation of these capacities into reality depends upon "nurture". To exemplify: the genetic "driving force" for longevity has not changed during historical times. But the average European and American now live more than 30 years longer than their forebears did a century ago. Resources for the acquisition of knowledge as well as of motor skills are available today more readily than ever before. But programmes aiming at the improvement of the mode of living of the old do not as yet include efforts to maintain an adequate level of physical fitness.

Life is finite. However, the manner in which old people arrange their "declining years" reflects a great variety of choices of their own.

In 1966 I attended a scientific conference held under the auspices of UNESCO in Israel together with Dr. Paul Dudley White, the cardiologist and Professor Nelson Glueck, the archeologist. There we witnessed an annual event, "The 3-Day-March" to the nation's capital, in which more than 25,000 people participated. Among the walkers was a 100-year-old man to whom I said after his arrival: "Isn't it remarkable that at your age you joined in this strenuous venture?" He replied: "What better death could I have than die on the way to Jerusalem?"