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Parasites and the Quest for a Nation of Healthy and Prosperous People



A Lecture in Honour
of

Chief Sir Professor Alex D. W. Acholonu

PhD, FNSP, FRAES, FAS, OON

On The Occasion of His 80th Birthday

By

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**Chief Sir Professor Alexander Dozie Wozuzu Acholonu,
PhD, FNSP, FRAES, FAS, OON
(The Ogbuoro Uzo 1 of Amaigbo and Awaka,
The Ekwueme 1 of Ihitta Ogada and Awaka, and
The Omeroha)**





Profile of Chief Sir Professor Alexander Dozie Wozuzu Acholonu, FNSP, FAS, OON

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Preamble

I am pleased to offer my most heartfelt congratulations to a dear friend and respected colleague, Chief, Sir, Professor Alex D. W. Acholonu, FAS, OON, FNSP

The Ogbuhoro Uzo 1 of Amaigbo and Awaka,

The Ekwueme 1 of Ihitta Ogada and Awaka and

The Omereoha

as you mark the attainment of a major milestone in your long and illustrious life.

As we celebrate you on this memorable occasion which is resplendent with our deep respect for a life of remarkable longevity in our heritage, I am reminded of the statement credited to the famous black performer, athlete, and lawyer, Paul Robeson (1898-1976), "I have simply tried never to forget the soil from which I sprang". Indeed, throughout your sojourn abroad, amidst a brilliant and obviously eminently successful career, you have simply refused to forget your heritage. Over the years, you have not only given freely and abundantly but you continue to give to your fellow man simply because you care. Through caring, you have changed the lives of so many people, in many lands of the universe and through a protracted period of time. The famous African American lawyer and social activist, Marian Wright Edelman (1939) once said, "you really can change the world if you care enough" and you certainly do justice to that adage.

Education

Chief Sir Professor Alexander Dozie Wozuzu Acholonu was born at Awaka in Owerri North Local Government Area (LGA), Imo State, Nigeria, on November 30, 1932. He was the second son of a court clerk and counselor Wilfred Wozuzu Acholonu and Mrs. Esther Rose Acholonu, both late, but now the oldest of the living children. He got his Standard (elementary) six certificates in 1947 at Our Lady's School, Emekuku now known as Fr. Cloonan Primary School, Owerri, Imo State and his Cambridge School Certificate at Christ the King College, Onitsha, Anambra State, in 1952. He got his Bachelor of Science, B.Sc. degree at Howard University in Washington D.C. in 1958; Master of Science, M.Sc. at Prairie View A & M University, Texas, 1961; and a Doctor of Philosophy, PhD at Colorado State University, Colorado in 1964. He

also obtained a Certificate in Public Health and Tropical Medicine, at Tulane University, Louisiana in 1994.

Academic Administrative Experiences

Professor Acholonu is an academician per excellence. He is a man who has held practically all administrative positions in academia. He was Professor and Chairman, Department of Biology, Inter American University of Puerto Rico, 1970-1972 and Professor and Head, Department of Medical Microbiology and Parasitology of the College of Medicine, University of Lagos (CMUL); Consultant at Lagos University Teaching Hospital (LUTH), 1977-1991. He was Dean of Liberal Studies (Arts and Sciences) at the State University of New York, Oneonta, New York, 1973-77; Rector of the former Amaigbo College of Technology (now School of Health Sciences), Imo State, 1981-

1982; a Member of the Governing Council of Imo State University, 1981-83; and the Pro-Chancellor and Chairman of Governing Council of Imo State University, 1997-99.

Professional Accomplishments and Recognitions

Professor Acholonu is a seasoned and renowned educator and a scholar who has published one book, two booklets, four book chapters and over 90 scientific articles, and presented numerous papers to various scientific organizations (over 50). He has excelled in his field of expertise and has won many national and international recognitions and accolades. He is cited in the American Men of Science, Men of Achievement, International Who's Who of Intellectuals, Who's Who in America, and Who's Who in Nigeria. In 2002, he was cited as **one of 2000 Outstanding Intellectuals of the 21st Century**, and as **one of the Great Minds of the 21st Century** by the International Biographical Center, Cambridge, England. In the same year, he received a Universal Award of Accomplishments in Microbiology and Parasitology from the American Biographical Institute; He is the International Educator of the Year 2003; one of the Top 100 Educators of the year 2005, Who's Who Among America's Teachers, 2005; America's Registry of Outstanding Professionals, 2006-2007. Professor Acholonu is also listed in the **Global Directory of Who's Who, 2007**; Vicksburg's Prominent 400, Mississippi in 2006. He is a recipient of the Nigerian National Honors award of **Officer of the Order of the Niger (OON), 2003**; a Life Achievement Award in Microbiology and Parasitology, 2004 by the Nigerian Academy of Science. He is also a Fellow of the Nigerian Society for Parasitology (FNSP) and a Fellow of the Nigerian Academy of Science (FAS) - the highest honor given to a scientist in Nigeria. He was the Editor of the Nigerian Journal of Microbiology, 1982-90; and President of the Nigerian Society for Parasitology, 1980-81. He was an Executive Board Member of the World Federation of Parasitologists 1998-2002; 2002-2006; and re-elected in 2010, and a member of Council from 1998 to present. He was the Chairman of the Division of Zoology and Entomology of the Mississippi Academy of Sciences, 2002 – 2004; Vice Chairman and Board Member, 1998-2002;

Vice Chairman, 2006 – 2009, and re-elected Chairman 2010 - present. He served as President of the Faculty Senate of Alcorn State University in Mississippi from 1999 - 2004. He is currently the Editor-in-Chief of *Advances in Science and Technology*, an African Journal for Research, Innovation and Discovery (2006 to present). He received an award from the Mississippi Academy of Science for outstanding contribution to Science in February 2012.

Professor Acholonu is an intellectual giant whose research and quest for knowledge have taken him to many parts of the United States of America and the world. He was one of those selected to participate in the 2005 Academic Scholars Program in China as a visiting Scholar to teach at Huaiyin Teachers University from May 20 to June 5, 2005. He has supervised the research of many undergraduate and graduate students (B.Sc., M.Sc., and PhD). He has been doing good things on both sides of the Atlantic Ocean and getting recognitions. In 2002, he was appointed a Member of the Food Advisory Committee (FAC) of the United States of America's Food and Drug Administration (FDA) to serve in this capacity from 2002 to 2005, because of his expertise in Microbiology and Parasitology - a rare and prestigious appointment, and received a Distinguished Service Award in 2005 from FDA. He was selected as a member of Council of Elders in Imo State representing Imo indigenes in the diaspora by the Governor of Imo State and served from 2008 to 2011. He was also a member of Council of Elders of the World Igbo Congress (WIC) from 2006 to 2012. *One of his most outstanding research accomplishments is his discovery, naming and description of 14 new species of parasites.*

Service to Nigeria

Professor Acholonu has rendered service to Nigeria in many ways. He was a member of the National Expert Committee for the Control of Sexually Transmitted Diseases (STDs), 1990-92 (he was in-charge of the Eastern Region of Nigeria); Member of the Committee for the Control of Malaria, 1982-86; Member of the Governing Board of Nigerian Institute for Trypanosomiasis Research, Kaduna and Chairman of the Research Program Committee,

1981-1983. He established a prize for the best Medical student in Parasitology at the College of Medicine, University of Lagos, another prize at the Federal Polytechnic Nekede, Imo State for the best student in Architecture and another at Imo State University for the best student in the Biological Sciences. He donated five hundred thousand Naira (₦500,000) for annual lectureship in honor of his late father at Imo State University in 1999; delivered four (4) shipments of books worth ten million Naira (₦10,000,000) to Imo State University, one shipment of books and educational materials worth ten million Naira (₦10,000,000) to the Federal University of Technology, Owerri and one shipment of books and educational materials worth fifty-five million Naira (₦55,000,000) to Federal polytechnic, Nekede, Imo State and Christ the King College, Onitsha, Anambra State. He made a donation of ten thousand Naira (₦10,000) to the Red Cross Motherless Babies Home in Owerri, Imo State in January, 2002; twenty thousand Naira (₦20,000) in January 2007 and twenty five thousand Naira (₦25,000) in January 2008 and a big sack of used and new baby clothes. He awarded scholarship to a young man to study Engineering at FUTO through the Willy-Esther Foundation of which he is the Founder/President and Chief Executive Officer, the young man graduated in 2010. In 2004, he made a donation of seven hundred and twenty-six thousand Naira (₦726,000.00) to his *alma mater*, Christ the King College, Onitsha for the rehabilitation of the Physics Laboratory and another five hundred thousand Naira (₦500,000) in 2012. He sank a borehole for the Acholonu family and Awaka community to provide them with much needed potable water and donated fifty thousand Naira (₦50,000) to the Awaka Club 1 in 2003 and another three hundred and fifty thousand Naira (₦350,000) in 2004 for the construction of a civic center that will serve, among other functions, as a center for HIV/AIDS education and support services. This project is expected to continue. He has been instrumental in the education of many Nigerians both his relations and others - sponsoring and helping them to go to America to acquire knowledge for the betterment of his community, local government, state and Nigeria at large. Because of his national and international accomplishments and services to his community and Nigeria, Professor Acholonu was in 1992, conferred a chieftaincy title with the name:

Ogbuhoro Uzo 1 of Awaka and Amaigbo (that is, the one who opened the gateway to America for his people). On the 24th of December, 2002, a traditional ruler, His Royal Highness, Eze Godwin Nwankwere of Ihetta Ogada, Imo State, now late, conferred on him another chieftaincy title as a further recognition of his accomplishments and good deeds and gave him the title of *Ekwueme 1 of Ihitta Ogada and Awaka*. In 2007, HRH Eze Erownanuel Sonde Okoro conferred on him a third title as *Owereoha* because of his accomplishments and philanthropic activities.

Very much interested in continuing to help his people, his Local Government Area, his State, and Nigeria at large, Professor Acholonu in 2008 not only caused a medical mission to be conducted in his hometown, Awaka, and Emii, but also participated in it and screened people for HIV and AIDS. It was a very successful medical mission and was very much appreciated by the Government of Imo State which showed support for the mission. He conducted another one in December 2010 at Awaka and is planning another one.

Social Organizations

Professor Acholonu belongs to several religious and social organizations. He is a Knight (Knight of Columbus), which gave him the title of "Sir" which he uses rarely. He is a member of the Uratta Council of Chiefs and a member of Phi Beta Sigma Fraternity, Owerri Progressive Union in the United States of America, Christ the King College, Onitsha, Alumni Association in America (CKC-AAA), a group that gave him Exceptional Service Award in 2006, a member of Qwerri Progressive Union (OPU) since 2008 which gave him an award in July 2012 for his outstanding contributions to Science, Center Point, and Awaka Club One etc. He is a member of the Council of Elders of the World Igbo Congress, member of Imo State Congress of America in which he serves as Chairman of the Education Committee and member of Igbo Community Association of Mississippi since 2002.

The Acholonu Family

Today, the Acholonu family members in America number up to 100 and he is directly and indirectly

responsible for their living in the United States and flourishing. Their professions practically cover all walks of life. There are medical doctors, attorneys (lawyers), pharmacists, engineers, scientists (Biochemists, Microbiologists, etc), computer scientists, clinical laboratory scientists, accountants/CPA, Book keeping and finance experts, Public Health experts, nurses, etc. Many are in universities that include the Ivy League schools like Harvard and Stanford.

Professor Acholonu is a hard-working indefatigable man. He said that his motto is: "Take time to work. It is the price of success." He further said that the road to success is always under construction. At 80 years of age, he looks unbelievably strong and professionally agile.

Professor Acholonu has seven children - two males and five females and 14 grand children. He is married to Lolo Mrs. Mary Ekeoma Acholonu, (nee Atukpawu of Umuawaka, Emii) a former Vice-Principal at Herbert Macaulay Grammar School in Lagos, Nigeria. Professor Acholonu has many other National and international accomplishments which are too many to mention here, he is a man of many

fans, and a well known and celebrated philanthropist.

Conclusion

This world is indeed a much better place because the likes of Chief Sir Professor Alexander Dozie Wozuzu Acholonu, the Ogbuhoro Uzo 1 of Amaigbo and Awaka, The Ekwueme 1 of Ihitta Ogada and Awaka, and the Omeroha passed through it. At 80, Chief Professor Alex D. W. Acholonu is still educating, touching and changing lives, letting people, both young and old, in Africa and America and indeed the world, drink from his bottomless fountain of knowledge, acquired through an uncommon dedication to diligence, science and love of discovery, cemented with disciplined scholarship. Indeed, from your continued display of unbridled enthusiasm, boundless energy and love of education, there is no evidence that this giant of a world scholar is about to pack up his academic wares for the village in Awaka any time soon. What a man, what a resource for humanity, what a mentor for us all but especially in present day generation of professionals characterized by a paucity of the desirable gem of longevity in the work place.



Parasites and the Quest for a Nation of Healthy and Prosperous People

*A lecture at the Imo State University on the occasion of the 80th Birthday of
Professor Alex D.W. Acholonu, FAS*

Professor Anya O. Anya, Ph.D. (Cambridge) D.Sc. (Hon) FAS, OFR, NNOM
Chairman, Alpha Institute for Research in Science, Economics and Development (AIRSED)

Preamble

We are gathered today to celebrate a scientist of note Professor Alexander Acholonu, FAS on the occasion of his 80th birthday. The subject of our discussion in a sense summarizes the essence of his life time's contribution to the discipline of parasitology. Alex has been a worthy contemporary and colleague. He examined some of my students as I examined some of his. It was a healthy relationship that shared many an insight into the discipline of parasitology even as we share today the memories of happier and those halcyon times in Nigeria academia. Congratulations to you Alex and to the family who are deservedly proud on this notable and once-in-a life time experience, by the grace of the Lord.

Introduction

I have been asked to speak on the topic "*parasites and the quest for a nation of healthy people*". I have exercised editorial discretion to amend the title to read: *parasites and the quest for a nation of healthy and prosperous people*. For the layman, two questions arise from this topic – what are parasites? And under what conditions can we recognize anybody as healthy? Parasites are living organisms that live inside or outside the bodies of other organisms usually called the host. Hence, we have endo-parasites that live within the host and the ecto-parasites which live on the surface of the host organisms. The parasitic relationship is an interesting ecological relationship in which the endo-parasites depend totally on the host for both accommodation and nutrition. In the process the host may suffer discomfort of one kind or another which may include physical, physiological, mental or metabolic dysfunction. This is the basis for the pathologies which are often part of the sequela of the presence of parasites in a living organism.

Under normal circumstances the parasitic relationship is a balanced relationship in the sense that it is not in the parasites interest that the pathological condition should lead to the death of the host for that would also mean the death of the parasite. The successful parasite is one that takes from the host not more than what is needed to main-

tain the parasite while the host is in reasonable enough condition to survive.

There is, however, an important challenge for the parasite: how to run the gauntlet of the external environment in transiting from one host to another. Two strategies are adopted, either develop a special resistant stage that can survive the rather harsh conditions in the external environment until a suitable host comes along or a special stage is developed that can survive in a vector host which has a special relationship with the definitive (and final) host which provides therefore the basis for the transfer of the special stage into the final host, thus completing the life cycle. Since the period of transmission involves high risks for survival for the parasites, reproduction involves the production of large numbers of eggs or larvae, whichever is the transmission agent (see later).

Earlier the question has been raised as to what attributes can be considered when someone is pronounced as healthy. The World Health Organization (W.H.O.) has defined health as "*state of complete physical, mental and social well-being and not merely the absence of disease or infirmity...*" It is within this broader conceptualization that we must consider the relationship of the parasite and its host and the effects of the parasites on the host.

The Host Parasite Relationship

We have suggested that the relationship between the parasite and the host is first and foremost an ecological relationship. We need to understand the biological features of this relationship as a basis for understanding the health and economic implications of the relationship especially in relation to the larger issue of economic development. Four features of this relationship come to mind, namely:

- *The parasite is physiologically and biochemically dependent on the host.*
- *The nature of the relationship dictates that the reproductive potential of the parasite should be higher than that of the host.*
- *The relationship is under ideal conditions, in an equilibrium state despite the occasional perturbation.*
- *The process of infection involves the recognition that the parasite must encounter an over dispersed distribution of the parasite in the population of the host, such that the parasite is often segregated in hosts on the basis of age, habitat, ecology or even sex.*

These features have implications for the control of parasite populations which is often dictated if we are to maintain the balance between the host and parasite to the benefit of the host. The control is achieved through three main mechanisms:

- *Small changes in the parasite transmission rate lead to large changes in parasite population size tending to instability and wide fluctuations in population size.*
- *Parasite transmission can be achieved by increase in parasite numbers through sexual reproduction such that death of host at high population densities of parasites reduces transmission rate although the over dispersed distribution of the parasites ensures that only a small proportion of the host will die. In other words, while parasite numbers are regulated by host numbers, host numbers is regulated by the over-dispersed character of the parasite population.*

- *The response of the host to the presence of the parasite contributes to the regulation of parasite numbers hence an inter-linked and stable host-parasite system.*

Consequently, different strategies are adopted by the parasite to achieve successful propagation for transmission of the parasites: these may include high fecundity rates especially of protected dispersal stages, which may be egg or larvae, special sexual reproduction strategies and the modification of the generation time or the life cycle. Of particular interest is the change in behavior of parasite or host and which may include the synchronization of life cycles of both host and parasite.

Parasites and Health

Seventy six species of parasites mainly protozoa and helminth parasites are known to infect the human being. It is estimated that up to 1.2 billion people are infested with the large human roundworm *Ascaris* and up to 9.8 million people die (16.5% of all annual deaths) from various infections and half of these are children. Parasitology has generally dwelt on the morbidities and pathologies occasioned in various organisms including man by the presence of parasites. It has always been known that human parasitism because of the effect on nutrition especially of the young can have profound influence especially in brain development particularly in the young. Parasites can therefore have far reaching influence on the direction of development in a society by its effects on creativity activity and general behavior of the host organism. It has been suggested for example that infections with the protozoan *Toxoplasma gondii* which infects up to 12.5% of Americans above the age of 12 years old can lead to personality changes. Both men and women infected with this protozoan are more extroverted and less conscientious than infection free participants. For example, some studies have suggested that this change in behavior derives from the influence of the parasites on brain chemicals. Specifically, *Toxoplasma* by increasing the concentration of dopamine an important neurotransmitter and changing the levels of certain brain chemicals manipulates the behavior of the host animals. It has been noted that “*although humans*

can carry the parasite, its life cycle must involve cats and rodents. Infected rats and mice lose their fear of cats, increasing the chances that they will be eaten, so that the parasite can then reproduce in a cat's body and spread through its faeces..." In humans, an infected population has a slightly higher rate of traffic accidents, just as people with schizophrenia have higher rates of infection.

It has always been suggested that measures of intelligence often involved cultural factors. Nevertheless, such factors as nutrition, literacy, education and economic environment are suggested as important. Recent studies have also indicated that children who contract parasites *"devote more energy to fighting the infection. As a result they have less energy to devote to brain development through activity. In an analysis of W.H.O data on 28 infectious diseases including malaria, it has been found that the infection burden was more correlated to average IQ than other variables."* Parasites alone account 67% of the worldwide variation in intelligence", they conclude.

Parasites and Economic Development

It has always been taught in universities round the world that there exists an intrinsic relationship between economic development and the effects of parasites on their host. It is usually the case that older textbooks of parasitology dwelt on the loss of labour due to absence from work arising from loss of energy of infected humans through the loss of working days. Thus, the loss of productivity as a result of parasitic infections has always been recognized.

There has been in the twenty first century a fundamental shift in our understanding of the process of economic development. Economic growth until the 1950s was assumed to favour the nations who had a comparative advantage because they had natural resources. From the 1970s there emerged a new paradigm shift in our perception and understanding of the process of economic development.

Admittedly, the prosperity of nations depends on the productivity of its labour force. But in the digital age productivity has been upgraded a hundred, a thousand, tens of thousands- fold depending on the

area of study. This has shifted the fulcrum of the development paradigm from labour and capital which drove the first industrial revolution to knowledge, skills and expertise of the citizen driving the modern economy. Thus, nations which had no resources such as Japan could build up their comparative advantage by deploying the knowledge, expertise, skills (KES) of their citizens to the point where the vector of their development process was driven by the factors of acceleration defined by digitalization.

Against this background of new and emergent knowledge of economic development we are afforded new insights not only on how to fast-track the process of economic development but more importantly on how to gain new insight into the factors which can hinder economic development by fostering poverty and the regression of nations. The result is that many industrial nations are now transiting into knowledge economies in the post- industrial age while some nations of the developing world have reformulated their strategies in the light of the new environment driven by knowledge, skills and expertise and are now emerging into a prosperous stage with fast-paced economic growth driven by the new borderless world created by information and communication technology as we have seen in Brazil, Russia, India and China. These strategies have usually had a common platform of better quality education, easy access to new skills and new knowledge of the process of development. In this new environment, human capital has been at a premium with improved health and education as the foundation and the main instruments for fighting poverty.

As we observed earlier, new advances in parasitology have elaborated on the linkage between parasitic infections and changes in behavior of the host. What is more the diminution in intelligence levels which are now being associated with the parasitic load of communities challenges us to approach the problem of control of parasites more seriously since it has the potential to diminish the potential for progress through the insidious undermining of creativity and innovative capacity of the population. But these are the drivers of economic progress. The interphase of the new parasitology and the new economics is a wake-up call for us to rethink and

reformulate the grundnorm of our national development in the new global world driven by knowledge, skills and innovation.

Evolution, Ecology and the Control of Parasite

The central challenge of the parasitic relationship is how to balance the need of the parasite for effective and efficient transmission and the need for host survival. In the search for understanding of the relationship as a basis for the control of the parasitic infection, we need to remember that the relationship arises from the intersection of both evolution and ecology. Both parasite and host are products of their evolutionary history. In the process each has had to make adjustments to changing conditions in the environment, within and outside of the host. Thus the relationship depends also on their interacting environments and are to that extent products of an evolving ecological relationship. These considerations influence the manner in which interventions for the control of the parasite can be designed and pursued. Thus, intervention whether chemical or ecological can drive evolution of parasite. For example, the resistance of bacteria to antibiotics and the resistance of insect vectors to pesticides are examples of evolution driven by human intervention. New strains or variants of the parasite which are more resistant to these inconvenient agents may emerge in the process of the intervention.

We must remember that both parasite and host are the result of aeons of natural selection which can generate complex threats and responses on either side. A good example is the trypanosome which can thwart efforts at control by manipulating the host immune system by adorning a non-antigenic cloak or even by switching antigens. With helminth parasites some seem to have the capacity to monitor host immune interaction, thus enhancing their chances of transmission both in terms of timing and quality produced. Nevertheless, host adaptation can produce unexpected consequences, at times deleterious and sometimes beneficial. A good example being the resistance to malaria by sickle cell patients. An integrated knowledge of evolutionary biology and ecology can simplify our understanding of the interactive matrix between parasite and host and in the process aid the development of predictive models. For such knowledge has facilitated the

adaptation of the Lotka-Volterra model for the study of prey-predator system to the host-parasite system dynamics such that prediction of the timing of outbreaks of infection that can lead to heavy mortalities of host or parasite as the case may be is more accurate.

What Needs To Be Done

In what had been said earlier, it was emphasized that there has been a paradigm shift in the study of economic development. This paradigm has recognized that in the new environment driven by global market forces superior comparative advantage has been conferred on nations through the knowledge, expertise and skills (KES) of their population rather than their military capacity. In other words, creativity and innovative capacity of nations drive economic development and their ranking in the World Competitive Index. This has a direct impact on their ability to reduce poverty in the population and generally enhance the economic wellbeing and quality of life of their citizenry. Thus, good quality education and high quality health services can produce a degree of wellness that can propel the prosperity level and economic progress of the nation towards optimality.

It has been also indicated that there is now sufficient data to suggest a correlation between the parasite load of nations and the average intelligence quotient in a population through its insidious undermining of brain development in the young through the denial of appropriate nutrition and appropriate provision of the essential brain chemicals. This suggests that there may be more than a casual link between the intensive study of parasitology in Japan of the 1920s as documented comprehensively by Yamaguchi and his collaborators, which led to more effective control of the parasitic load in the population and the explosive outpouring of creativity and scientific innovation that launched Japan into fast-paced economic development through industrialization a generation later, 1950-1970.

All these taken together suggests that Nigeria needs to re-evaluate the policies that drive economic development. Given our tropical environment where 70% of the health problems of the population can be traced to the insidious effects of parasite on beha-

avior, personality and cognitive ability and the demographic reality that parasite-bearing youth (5-25) constitute more than 50% of the population, saving them from the tyranny of the ubiquitous tropical parasite and providing better quality education may be a surer path to economic transformation than all the econometrics and scientific theorizing of the last thirty years. We need to release the capacity of the Nigerian Youth in the Nigeria environment. As they say there is no alternative (TINA). In this manner, TINA the delectable lady

of the liberalization gurus of the 1980s can resurrect in pristine Nigerian colours in the Nigerian environment. In this manner, the labours of a lifetime of such distinguished Nigerian scientists and parasitologists as our own Alex can at last see the fruition of their labours in a better society. Once more congratulations Alex- history will record that your labours and those of your peers and contemporaries in Nigeria were not in vain. Nigeria will truly arise. Happy Birthday. I am done. May God bless you, bless this nation and all of us.



Comments on Prof. Anya O. Anya's Presentation titled: "Parasites and the Quest for a Nation of Healthy and Prosperous People" on the Occasion of Prof. Alex D. Wozuzu Acholonu's 80th Birthday Celebration, December 20, 2012.

Professor Ikechukwu N.S. Dozie

Dean, School of Health Technology, Federal University of Technology Owerri

Prof. Anya O. Anya in his introductory remarks affirmed proudly that Prof. Alex D. Wozuzu Acholonu, *FAS* is an accomplished scientist of note, a worthy contemporary and colleague and that his lecture captured the spirit and essence of his contributions to the discipline of Parasitology.

He said that for a layman, two questions arise from the topic, namely, what are parasites? Under what condition can we recognize anybody as healthy? He went on to define parasites as living organisms that live inside or outside the bodies of other organisms called the host. He said that they are divided into endoparasites (living within the host) and ectoparasites (living on the surface of the host). He added that the parasitic relationship is an ecological relationship in which the endoparasites depending totally on the host for habitat and livelihood may do harm to the host.

He made a case that a parasite does not normally enter a host to kill or harm it. But engage in "live and let's live" condition, that the damage or pathology caused to the host is incidental rather than purposeful as death of the host may mean death of the parasite. He opined that a successful parasite is one that takes from the host not more than what is needed to maintain itself while the host is in reasonable enough condition to survive - a case of coexistence.

Prof. Anya expressed the difficulties faced by parasites in their abiotic environment as they exit their hosts and try to get into another host to continue their propagation and not become extinct and how they combat them. They use two strategies. One is by developing a special resistant stage that can survive the unfavorable physical environment until a suitable host becomes available. The other is by the development of a special stage that can survive in a vector or an intermediate host which has a special relationship with the definitive host and this makes it

possible for the parasite to get into its definitive host and complete its life cycle. To facilitate this, most parasites have high fecundity, producing a myriad of eggs, larvae, or cysts, whichever is the transmission stage.

Commenting on the health aspect of the speech, Prof. Anya gave the definition of health as given by the World Health Organization (WHO): "state of complete physical, mental and social well-being and not merely the absence of disease or infirmity...". He used this as a basis to discuss host- parasite relationship and accentuated the effects of parasites on their hosts- their pathology and economic implications. He enumerated four biological features of this relationship and stated that these features "have implications for the control of parasite populations which is often dictated if we are to maintain the balance between the host and parasite to the benefit of the host." He also discussed the control of parasites and stated three mechanisms under which this can be achieved. He also discussed the strategies adopted by parasites to resist their elimination by the host, one of which is high fecundity. He thus brought out the tug of war between the parasite and its host and a possible "synchronization of life cycles of both host and parasite".

He touched on parasites and health. He stated the high prevalence of protozoan and helminth parasite in humans and singled out the large intestinal round worm *Ascaris lumbricoides* as infecting an estimated population of 1.2 billion people and said that half of people with various parasitic infections are children. He associated parasitic infections in humans to adverse brain development particularly in the young and direction of development in a society as it concerns creativity and general behavior. He particularly commented on *Toxoplasma gondii*, a protozoan parasite of cats but zoonotic in human beings. This parasite is believed to "lead to persona-

lity changes”. It manipulates the behavior of the host animals and is believed to cause schizophrenia in humans. WHO found that parasitic infection burden is more “correlated to average IQ than other variables”. Parasites alone account for 67% of worldwide variation in intelligence”.

Prof. Anya devoted sometime to parasites and economic development. He brought out the fact that there is an intrinsic relationship between economic development and the effects of parasites on their hosts. Before, the prosperity of nations depended on productivity of its labor force. But in the digital age, productivity has been upgraded. It is now based on knowledge, skills and expertise (KES) of the citizens leading to prosperous stage, brought about by information and communication technology (ICT). This is caused by better quality education, easy access to new skills and new knowledge of the process of development. He said that “human capital has been at premium with improved health and education as the foundation and the main instrument for fighting poverty”. He talked about evolution; ecology and the control of parasites.

Prof. Anya said that “the central challenge of the parasitic relationship is how to balance the need of the parasite for effective and efficient transmission and the need for host survival. Both parasite and host are products of their evolutionary history.” Both have been compelled to make adjustments to changing conditions in the environment especially the parasite which has to adapt to its biotic and abiotic environments. Both are products of an evolving ecological relationship. They influence the manner in which interventions for the control of the parasite can be designed and pursued and how, as a reaction, this can drive evolution of parasites. He cited example with the resistance of bacteria to antibiotics

and the resistance of insect vectors to pesticides caused by human intervention. As a consequence new strains or variants of the parasite more resistant to these unfavorable agents may evolve. With respect to the host, it can produce a reaction that can thwart the action of parasite. He cited example with the resistance of malaria by sickle cell patients. So there is a continuous tug of war between the parasite and host thereby obeying the law of Physics that says that in every action there is an equal but opposite reaction. Both parasite and host also obey the law of natural selection, the law of survival of the fittest... He said that an integrated knowledge of evolutionary biology and ecology can simplify “our understanding of the interactive matrix between parasite and host and in the process aid the development of predictive models.

Prof Anya concluded his impressive and erudite discuss by re-emphasizing his germane points and giving his opinion on what Nigeria as a Country needs to do. He ended by congratulating Prof. Alex Acholonu on his 80th birthday and added:” history will record that your labors and those of your peers and contemporaries in Nigeria were not in vain. Nigeria will truly arise”.

Prof Anya’s presentation was of high quality, thought-provoking and very educative. He addressed a target audience, his many fellow professors and scientists who attended Prof. Acholonu’s birthday celebration, and had much for the lay-people to their benefit. He did justice to his topic. His advice on what needs to be done by Nigeria should be heeded, especially to re-evaluate the policies that drive economic development. In this respect, Prof. Anya is confident that concerted effort aimed at parasite control with enhanced quality education could be the realistic blue print for economic transformation of Nigeria.



Cellular Drugs of the Future And Reversal of Aging: A Micro Review (In honor of Professor Alexander Dozie Wozuzu Acholonu at 80)

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Summary

Aging process or senescence is natural and results from temporal alterations of structure and function of human biology. Since cells make up tissues which aggregate in organs that form body systems, reversal of aging can naturally begin with cellular rejuvenation. Incidentally, isolated, refined, proliferated undifferentiated induced pluripotent stem cells have found use in cellular rejuvenation for reversal of aging. Application of biotechnology for development of insulin for diabetes mellitus or oxytocin for induction of labor will also be relevant to development of cellular drugs of tomorrow that will become clinically and commercially available for partial reversal of the aging process. Biotechnology process of sourcing, sorting and isolation, proliferation and sustenance of viability and proven efficacy, safety of the preparation, stability and high quality are challenges of today for the development of cellular drugs. Regulatory control, as usual, will be upheld in all of the development process. A possibility of using plant stem cell extracts or inducers also exist for manipulation of mammalian cellular regeneration.

Introduction

About five days post fertilization of the human egg, a colony of cells among the large number of dividing cells form and cluster (inner cell mass) in a portion of the sac containing all cells (blastocyst formation). This colony of cell cluster is known as embryonic stem cells, and they can give rise to over 200 specialized cells and tissues and organs in the human body (Evans and Kaufman, 1981; Thomson *et al.*, 1998, Xiang-Shun *et al.*, 2011). Embryonic stem cells are also capable of causing repair of all body parts damaged by disease including reversal of aging process (Silver and Conboy, 2008). Among the major characteristics of all stem cells is their ability to self-renew (proliferation while maintaining the undifferentiated state) into daughter cells, to differentiate into other types of cells and the possibility of formation of tumor-like cells (tumor genesis). Moral, ethical and religious rejection of the use of embryonic stem cells in research and treatment of diseases by many people around the world center on the fact that the developing embryo has to be destroyed to harvest these embryonic stem cells (For example, United States Conference of Catholic Bishops, Washington, DC. 2004).

However, cellular technologies have been developed that enable the transformation of adult cells into embryonic-like stem cells possessing similar anatomical, physiological and biochemical characteristics and capabilities as embryonic stem cells. These biotechnology-derived cells are called induced pluripotent stem cells (iPSC; Takahashi and Yamanaka, 2006; Takahashi *et al.*, 2007; Geoghegan and Byrnes, 2008). Cells of skin (Takahashi *et al.*, 2007), adipose tissues, neural tissues, liver tissue, umbilical cord stem cells (see Review by Ali and Al-Mulla, 2012) etc., have been derived from iPSC (see Reviews by Li and Xie, 2005; Pollina and Brunet, 2011; Ting Zhou *et al.*, 2012). Recently, Li *et al.* (2014) have reported an *in vivo* direct lineage conversion of pancreatic acinar cells into other endocrine subtypes as well as pancreatic cell interconversions between subtypes (Zhou *et al.*, 2008a; Zhou *et al.*, 2008b).

The promise of cellular therapy for the correction of disease states of the human or animal body in the near future seems feasible and exciting to the scientific world.

Experimentation and Development

The production of iPSC was carried out using rodents and most of the studies on development of stem cell technology have been done using small mammals. Mouse fibroblast was used to create iPSC (Takahashi and Yamanaka, 2006; Okeita *et al.*, 2007). This embryonic stem cell-like pluripotent stem cells has been reported to be derived from adult human fibroblasts (Takahashi *et al.*, 2007). Human urine (Ting Zhou *et al.*, 2012) as a possible non-invasive source of stem cells for reprogramming and for translation into clinical and commercial relevance will be worthwhile for experimentation and development.

Spermatogenesis seems to be one of the somatic processes that can be used as an index of temporal degenerative changes in mammalian structure and function (Brinkworth *et al.*, 1997; Pasqualotto *et al.* 2005; Miething 2005; Ehmcke *et al.*, 2007). Among these age-related changes include a decrease in the number of tubules capable of spermatogenesis as well as increased fibrosis (Wirth-Dzieciolowska and Czuminiska, 2000) and these changes are attributable to spermatogonial cells. Degeneration of the somatic (testicular) process of spermatogenesis may be associated with exponentially decreasing spermatogonial stem cells with age in the mice (Suzuki and Withers, 1978).

It has also been reported that the middle segment of the mature adult albino rat testis contains a highly enriched population of both single and multinucleated A-type spermatogonia-like cells and may be most suitable site for the harvesting of these cells (Osunkwo *et al.*, 2009). Spermatogonial stem cells which also differentiate into spermatozoa capable of fertilizing female eggs have been extensively used in stem cell research (De Rooij and Russell, 2000; De Rooij and Van Pelt, 2003; Kossack *et al.*, 2009). *In vitro* expansion of incubated neonatal germline stem cells was associated with multiple divisions into numerous structurally similar cells and transformation into clusters of multi-colored component rod-like cells (Osunkwo *et al.*, 2011).

Other sources of stem cells that can be applied to experimentation have always been a scientific challenge. Stem cell niches in mammalian species

have been reported for various tissue types including, mammary gland and breast milk (Visvader, 2009), uterine endometrium (Chan *et al.*, 2004; Teixeira *et al.*, 2008), urine (Ting Zhou *et al.*, 2012), skin (Takahashi *et al.*, 2007) and blood (Morrison and Weissman, 1994; Morrison *et al.*, 1996) have been sources of stem cells for experimentation. Conboy and colleagues (2005) have reported that aged progenitor cells can be rejuvenated when they are placed in a younger systemic niche.

Cellular Drugs

A major goal of stem cell research is to generate a non-contaminated and characterized stem cell line, effect its massive proliferation and sustained undifferentiated state packaged in a vial or other suitable container for possible intravenous infusion. The safety of this preparation, proven efficacy, stability and high quality are incorporated into current good manufacturing practice. Many biotechnology and pharmaceutical companies in North America, Europe, Japan and China have reported the results of clinical trials of this type of dream preparation.

It is noteworthy at this point that tissue specificity be seriously considered in the developmental process because of rejection (non self). Focus on the role of molecular entities that may assist in overcoming rejection when co-administered with cellular drugs may yield results in the near future. According to Turner's (2013) review, various regulatory agencies have granted different levels of licenses for different stages of clinical trials of stem cell based therapy. Regulatory agencies like, the United States Food and Drug Administration (FDA) and Belgian Federal Agencies for Medicines and Health Products (FAMHP) among others (Turner, 2013). A major objective of ongoing trials of stem cell based therapies in humans will always be to find out whether there is safety and superior efficacy when such cellular drugs are compared with placebo (non-active control agent).

Drugs of The Future

Biotechnology-derived drugs are commonplace in clinical and commercial settings. Insulin (important for treatment of type 2 diabetes mellitus) or human chorionic gonadotropin (applicable in obstetric and

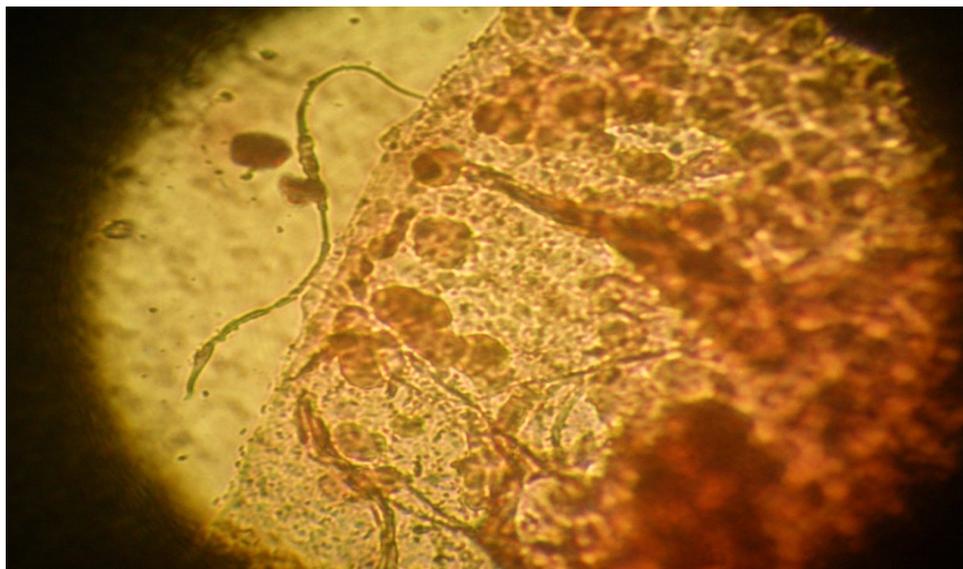


Figure 1: Showing mature spermatozoa in mixed adult rat spermatogonial cell population.

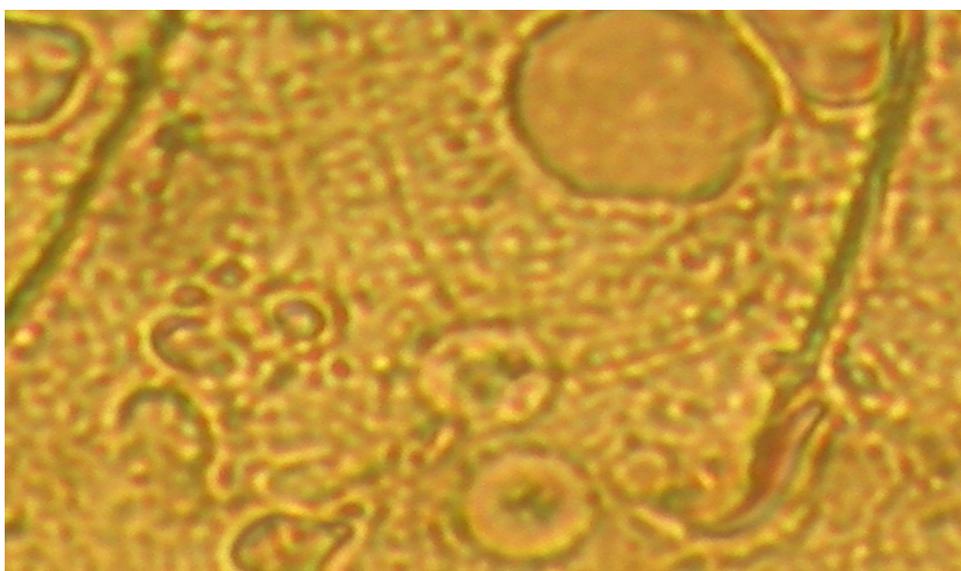


Figure 2: Showing adult rat mixed cell population.

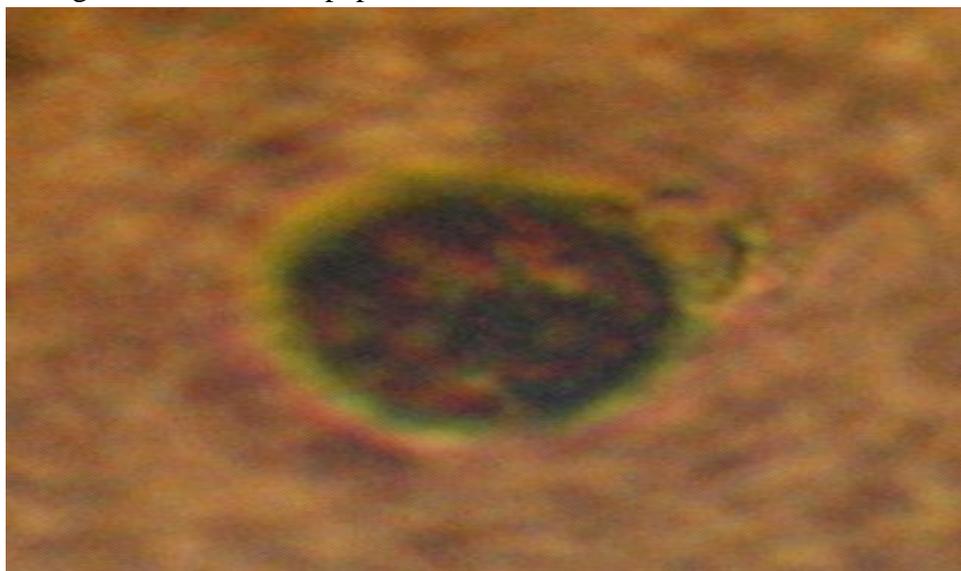


Figure 3: Rat spermatogonial stem cell from a proliferating colony expressing green coloration. Mezo stain was used for the studies.

Table 1: Sources of stem cell populations for experimentation and development.

Animal	Organ/Tissue	Stem cell type	References
Rat	Fibroblast culture	iPSC and embryonic	Takahashi and Yamanaka, 2006
Human	Skin fibroblast	iPSC	Takahashi <i>et al.</i> , 2007
Human	Testicular	Spermatogonial iPSC	Kossack <i>et al.</i> , 2009
Human	Urine	iPSC	Ting Zhou <i>et al.</i> , 2012
Mice	Pancreatic acinar cells	iPSC	Li <i>et al.</i> , 2014
Rat	Liver/Kidney	Intestinal stem cells	Abu-Zinadah and Hussein, 2011
Rat	Testicular	Spermatogonial cells	Osunkwo <i>et al.</i> , 2011

gynecologic practice) are two examples of drugs producible by industrial copying of naturally existing biochemical compounds. This lead-derived synthesis of naturally occurring chemical compounds is apparently shifting to using whole cells to produce cellular drugs of the future.

Virtually all organs of the human body have provided stem cell that were proliferated and differentiated into other cell types in the human body. A programmed scientific manipulation of the genetic resources of the mammalian cell is required for directing the structural and functional fate of the cell and other cells.

One aspect of the application of cellular drugs technology is the use of epigenetic progenitors of plants to influence animal natural stem cell reversal of senescence. It has been reported that stem cell extracts of Uttwiler Spätlauber tree (*Malus domestica*), are capable of causing increased viability and resistance against senescence and apoptosis of human stem cells thereby promoting regeneration of skin and hair, and delaying appearance of wrinkles (Schmid *et al.*, 2008). A world-class Company, STEMTECH Inc., has produced and commercially presented plant extracts capable of stimulating stem cellular formation in vivo (STEMTECH YouTube videos, Current, 2014).

Complimentarity of Old and New Drugs in Healthcare

Biotechnology development of cellular drugs for the future has largely depended on previously established

materials and methods of pharmaceutical development. One will therefore expect significant complementarity in structure, function (utility), presentation and delivery of newly developed cellular drugs. There may arise minor shifts in techniques such as in handling and administration to clients, however, these can easily be overcome.

Challenges Before The Future

Guidelines for regulation of stem cell research and development have been set by many countries like European Union and India (Indian Council of Medical Research Department of Health Research & Department of Biotechnology (2012) and by many corporate organizations (Connecticut Department of Public Health (2007).

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Chief Sir Professor A.D.W. Acholonu
(The Ogbuhoro Uzo 1 of Amaigbo and Awaka, The Ekwueme 1 of Ihitta Ogada and Awaka, and The Omeroha).



Professor Augustine Ezeruo with The Celebrant in a pose.



Chief Sir Professor A.D.W. Acholonu
 exchanging pleasantries with **Professor Aloysius Ukachukwu Awuzie, Ag. Vice-Chancellor, Imo State University, at the Vice-Chancellor's office.**



Professor Chidi Akujor and Lady Jane Akujor
 unveiling the cake for the celebration.



(L-R) Professor and Mrs Anya O. Anya, Professor Augustine Ezeruo, The celebrant, Professor Bath Nnaji, Professor Aloysius Ukachukwu.



(L-R): Prof. Chidi Akujor, Prof. Ukachukwu Aloysius Awuzie, Prof. Bath Nnaji, The Celebrant, Mrs Anya, Prof. Augustine Ezeruo and Prof. Anya O. Anya during the cutting of cake.



Members of the high table during the opening prayer



A cross section of friends and guests at the occasion.



Professor Bath Nnaji (Chairman on the occasion) with the Cola for the occasion.
(sitted L-R): Prof. Augustine Ezeruo, Mrs Anya, The Celebrant, Prof Anya O. Anya, Prof. Aloysius Ukachukwu Awuzie



A cross section of friends and guests at the occasion.



(L-R): His Royal Highness, Eze Emmanuel Sunday Okoro (doing justice to the kola as tradition demands) and His Royal Highness, Eze Michael Egbukole Olisakwe.



A cross section of friends and guests at the occasion.



Dance group of Holy Trinity Parish Awaka on display at the occasion.



Reverend Dr C.A. Amadi saying the Closing prayer at the occasion.



Choir Group of Holy Trinity Catholic Parish Awaka (led by Tochukwu Ekechi) on display at the occasion.



The Celebrant in a group photograph with members of the Organizing Committee.



Professor D.I. Osuigwe (L), The Celebrant (2nd R) and Prof Chidi Akujor (R).



The Celebrant in company of Professor Bath Nnaji leaving the venue of celebration.

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