LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY

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9th INAUGURAL LECTURE SERIES 2012

TITLED:

THE QUEST FOR DEVELOPMENT: WHY MATHEMATICS MATTERS

By:

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The Quest for Development: Why Mathematics Matters

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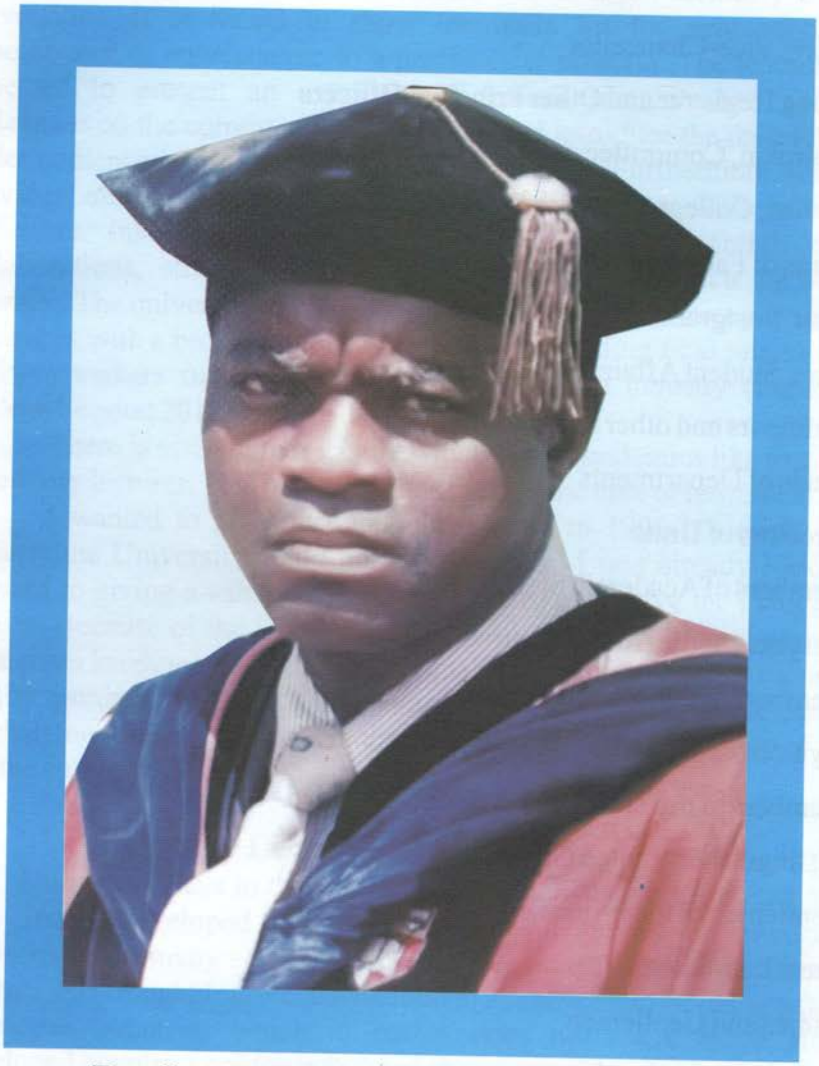

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My Lords Spiritual and Temporal

Members of my family: nuclear and extended

Distinguished invited Guests

Gentlemen of the Print and Electronic media

Great Ladokites,

Ladies and Gentlemen

1.0 PREAMBLE

An inaugural lecture is a lecture that is taken seriously in all universities. It is meant to show the basis for the promotion or appointment of an academic to a professorial position. The lecturer is expected to present an overview of his/her research and update colleagues on the current and future plans, and introduce the research to wider audiences (Imperial College, London 2012). Furthermore, it also provides an opportunity for departments to engage with broader audiences inside and outside the institution to establish new collaborations, strengthen existing relationships and catch up with allumini. The university could also use inaugural lectures to engage with audiences with a broader interest in research, including fund raisers and decision makers from government, academic and industry (Imperial College London 2012).

There is also another lecture which many academics like to give: Valeditory lectures. This is a lecture one gives at the time of retirement.

I wanted to give my inaugural lecture in 1990 but could not because the University could not arrange it. So I was already looking forward to giving a valedictory when I was asked to give the inaugural lecture. Because of the length of time, this lecture will be given under three main headings: contributions to quality education, contributions to quality training/ supervision and contributions to research. By research, we shall mean discoveries and innovations that improve the quality of life and the environment.

2. The title of the Lecture

During my days in the primary school, nations were grouped into two classes: developed countries and the underdeveloped countries. However when many countries gained independence from the colonial masters, they fought for re-classification of countries into developing and developed countries which in reality does not mean much since developed countries continue to develop and some developing countries remain permanently underdeveloped. All the same, the assumption of the lecture is that every country would strive to develop.

3. What is the real use of Mathematics in real life?

There are 83 answers in Google. Let us consider responses of two anonymous:

A. 10 of the uses of mathematics are:

1. To measure
2. To pay
3. While driving
4. Calculating sales tax
5. Medical measurements
6. Measuring temperatures
7. While cooking
8. In architecture
9. While dividing the pizza equally
10. While numbering these points = D

B. Mathematics is very important for life since it helps us to qualify all the visible and invisible things with which we are dealing in daily life. It is human nature that they do not have complete confidence in the subjective or relative things, in the modern day of today the objective things are preferred and trusted more than the subjective things. Mathematics helps us to have an objective view of the different things we are dealing with. It helps us in making calculations about the thing which are not physically developed like for buildings before construction.

We do calculations and ensure if their design is safe or not, similarly mathematics helps us to plan things for future either is any production environment for products or services. It helps us to have an idea that how much earning or spending has been done and would it be beneficial to do a certain activity or not. In today's world mathematics is being applied everywhere like in the economy of a country, construction of building, marking and evaluation of persons. It would be approp.iate to say that mathematics has helped a lot in achieving the fast speed life with all its comforts and delights.

Moreover, two Indian Scientists, Thomaskutty and George (2011) identified seven areas on the impact of mathematics on civil society:

1) Practical or utilitarian values

2) Disciplinary values
3) Cultural values
4) Social values
5) Moral values
6) Aesthetic values and
7) Recreational values

The two anonymous responses A and B above would fall under practical or utilitarian values of mathematics. A person may belong to the lowest or the highest class of the society, but he/she utilizes knowledge of mathematics in on form or another, not to speak of an engineer, a businessman, industrialist or banker. One area that is not very ovious is the disciplinary value of mathematics. Mathematics enhances logic skills and exercises that part of the brain. It enhances the ability to reason correctly. Whenever a theorem is formulated, its proof must be based on the hypotheses. This is why in the developed countries, the national security agencies are largest single employers of mathematicians. Compare this with a security adviser, who urged Nigerians to be patient because suicide bombers will soon run out of men even when the hypothesis suggests otherwise. But the advisers comment is based on his reasoning power. The mental power one gets from learning mathematics is the acquisition of the art of proper thinking and effective reasoning.

4. Research results

The three responses of the above may not suggest that we need much mathematics, but until we prove that a knowledge is optimum we cannot stop. I was fortunate to have received excellent education from three Universities: university of Lagos, university of Ife and Cornell University.

In Lagos, I was in the College of Education undergoing a Nigeria certificate in Education (NCE) under the leadership of UNESCO experts. On the completion of NCE, I felt that my educational background would carry me through life and so I applied to study B.Sc physics in University of Ibadan and B.Sc Mathematics in University of Ife. Though I got admission for both, I decided to go to Ile-Ife.

The department of mathematics at Ife was blessed with good mathematicians around my third year. These included two Nigerians R.F.A. Abiodun, E.A. Akinlerele and an Indian B.L. Sharma and a Russian L.V. Sabinin. The four played active roles in my life at Ife and beyond. I graduated in June 1973, the year Nigeria commenced the National Youth Service Corps scheme. After three Months Orientation in Kwara States, Youth corpers who obtained first class and second class upper honours degrees were recalled by their various universities for Master's degree programmes. So I was recalled to Ile-Ife. The department quickly arranged an M.Phil programme in algebra and this gave me a good background in pure mathematics since I had to take courses in real and complex analysis as well as algebra. The minimum length of time for an M. Phil programme is 2 years while a Ph.D programme could be finished in 3 years. So I decided to seek alternative programmes for 3 years. I got a Commonwealth Scholarship for Ph.D in Mechanical Engineering at University of Glasgow and a Western State Scholarship for Ph.D Mathematics at Cornell University. I was to specify how long I need the Scholarship, so I chose Cornell.

At Cornell, I was interested in two areas: artificial intelligence (design and manufacture of robots) and combustion (how do chemicals react and burst into flames even when naked flame is introduced?). A student in the centre for applied mathematics could pursue a Ph.D in pure mathematics or use mathematics to solve problems arising outside mathematics.

Let us consider an exothermic reaction between two substances x and y. The reaction normally leads to partial differential equations

$$\frac{\partial 0}{\partial t}+u\frac{\partial \theta}{\partial x}=\frac{1}{\rho}\frac{\partial}{\partial x}\left(\rho D\frac{\partial \theta}{\partial x}\right)-\frac{w}{\rho}, \qquad (1)$$

where θ stands for x/v, y or $_{c}cpT/Q$ and w is the overall mass rate of fuel given by

$$\frac{w}{\rho}=M_2B\left(\rho x/M_1\right)^a\left(\rho\, y/M_2\right)^b\exp\left(-\frac{E}{RT}\right)$$

c_p = specific heat at constant pressure
Q=heat release per unit mass of fuel
v=Stoichiometric mass ratio oxidizer/fuel
T=temperature
x=Oxidizer
y=fuel
a=reaction order for species x
b=reaction order for species y
M=mean molecular mass
B=pre-exponential factor.
How do reactions burst into flames?

A break through came from the recognition that the term

$e-\frac{E}{RT}$ could be written as $e^{-\frac{E}{RT_0}}e^{\frac{\theta}{1+\epsilon\theta}}$, (2)

where $\theta=\frac{E}{RT_0^2}\left(T-T_0\right)$ and $\epsilon=\frac{RT_0}{E}$ and in most combustion problems, $0<\epsilon\le 0.25$. So as $\epsilon\to 0$.

We could replace exp $\exp\left(-\frac{RT^0}{E}\right)$ by δe^{θ},

where $\rho cp\frac{dT}{dt}=e^{-\frac{RT}{E}}, T(0)=T_0$

becomes

$$\frac{d\theta}{dt}=\delta e^{\theta},\ \theta(0)=0 \qquad (3)$$

giving $\theta=In\frac{1}{1-\delta t}$ and flame occurs when time $t\to 1/\delta$. The hazard of holding bu lk reacting materials in storage or in transit

hazard of holding bulk reacting materials in storage or in transit became clearer and the means of preventing auto-ignition became better known.

The Ph.D thesis gave as a solid background to investigate multiple step reactions. In the early days we investigated chain thermal reactions and our major findings were published in the Nigerian journal of natural sciences (1981) and the Australian journals of mathematical society (1982). These papers highlighted the differences between one and multiple reactions.

A second look at mass rate

$\frac{w}{\rho} = M_2 B\left(\rho x / M_1\right)^a \left(\rho y / M_2\right)^b e - \frac{E}{RT}$ shows that the fact that

w = w(T) (depends) on temperature) plays an important role in the auto-ignition or thermal runaway. We then examined a flow between concentric cylinders.

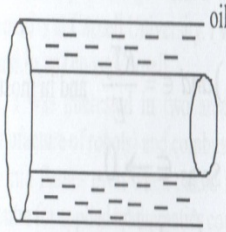


Figure 1.
flow of oil between two cylinders

The momentum and energy equations are of the form

$$\rho\left(\frac{\partial u}{\partial t}\right) = -\frac{1}{r}\frac{\partial}{\partial r}\left(r\mu\frac{\partial u}{dr}\right) - \frac{\partial p}{\partial r} \quad (4)$$

$$\rho c_p\left(\frac{\partial T}{\partial t}\right) = k\left(\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right)\right) + \mu\left(\frac{\partial u}{\partial r}\right)^2 \quad (5)$$

Under certain conditions equation

(4) could be approximated as

$$\left(\frac{\partial u}{\partial r}\right) = \frac{rc}{2\mu} \quad (6)$$

$$Or\left(\frac{\partial u}{\partial r}\right)^2 = \frac{r^2 c}{4\mu^2} \quad (7)$$

where c is a constant and (5) becomes

$$\rho c_p \frac{\partial T}{\partial t} = \frac{k}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right) + \frac{r^2 c}{4\mu} \quad (8)$$

If the oil viscosity takes the Raynolds form $\mu = \mu_0 e^{-\gamma T}$, $\gamma > 0$

Then, in practical terms for a given oil

$\frac{\partial T}{\partial t} = \frac{rc^2}{4\mu_0} e^{\gamma T}, T(0) = T_0$ (9) *is*

Feasible and

$$T = \frac{1}{\gamma} In \frac{1}{e^{-\gamma T 0} - \delta\gamma t} \quad (10)$$

And thermal runaway as the time t tends to $\frac{1}{\delta\gamma} e^{-\gamma T_0}$ and this were published in ZAMP in 1982. and further results in Mathematika in 1985. This explains why an engine oil in a car has to be changed after sometime. Because as becomes very large the viscosity μ tends to zero.

The implication of viscosity on oil influenced our next line of research. We were aware that the blood of an SS patient is almost ten times as viscous as that of of AA patient. The interest was to find out if the viscosity of blood has a role in the sickle cell anaemia crisis. This research was undertake with a senior colleague, Professor E.A. Akinrelere and our findings confirmed our fears: Viscosity of blood is not irrelevant and we published the result in the journal of Theoretical Biology. This many

mean that when a drug reduces the viscosity of an SS, the relief may be temporary since new blood with the previous viscosity will be created within months.

We continue with the use of some further examples in biology. I knew about the need to measure a man's sperm count when I was about to wed in New York State in 1977 because the measurement is mandatory by law. I did not know that a woman's primordial follicle population decreases with age. We discovered that a female that has 701,000 follicles at birth and may be left with only 2, 380 follicles at the age of 48 years and finally nothing at menopause. Our research in 2005 showed that many scientists had been interested in the subject. Block made a quantitative investigations of the follicles system in newborn female infants in 1952. Wallace and Kesley showed that ovarian reserve and reproductive age may be determined from measurement of ovarian volume. Moreover Faddy and Gosden presented a mathematical model that confirm the decline in follicle numbers to the age of menopause in women (1996).

In particular the mathematical model of Faddy and Gosden is

$$\frac{dx}{dt} = -x\left(a + \frac{b}{x+c}\right), \qquad (11)$$
$$x(0) = x_0,$$

where

a, b, c are constants obtained from data in medical literature on menopause. There is no general agreement on whether the constants depend on the female in context. x is the number of follicle and t measures the age in years.

The simple ordinary differential equation (11) has no exact solution, although approximate solutions could be obtained by finite differential scheme or maple scheme.

In 2006, we proposed a new model

$$\frac{dx}{dt} = -\lambda x^{\alpha}, \; 0 < \alpha < 1 \qquad (12)$$
$$x(0) = x_0,$$

and (12) has an exact
Solution

$$x = \left[(1-\alpha)(c-\lambda t)\right]^{\frac{1}{1-\alpha}}, \qquad (13)$$

where $\lambda = 0.91576$, $\alpha = 0.8$, $c = 73.8097$

So

$$x = \left[(0.2)(73.8097 - 0.91576t)\right]^{5} \qquad (14)$$

Do the value of the constants depend on the female in context? We suspect that they do, at any rate there is a way to estimate when menopause may set in.

Mathematicians from the department of Pure and Applied Mathematics have received much collaboration from medical doctors in LAUTECH College of Health Sciences. We mention specifically our collaboration with Drs A.O. Olowu and O.O. Eweoya.

Human immunodeficiency virus (HIV) and the related Acquired Immune Deficiency Syndrone (AIDS) have been of much research since 1980's when AIDS became an epidemic. Medical doctors, biologists laboured to control the disease. I have supervised Master's and Ph.D theses on the subject. Of particular interest is the research of Dr. (Mrs) T. Oluyo and many of our collaborations with her are cited in this lecture.

In (2004) Tullis presented a mathematical model that seemed to show the effect of affinity hemodialysis on the T-cell depletion which ultimately leads to AIDS in the journal of Blood Purification. As a follow up to this paper, Professor Ogunmoyela (Federal University of Technology, Akure), Dr. A.O. Popoola (Osun State University, Osogbo) and I investigated how affinity hemodialysis could lead to T-cell recovery this ensuring that an HIV patient never developed full blown AIDS.

This results were published in the journal of Bacteriology Research in 2010. The mathematical system of equations are

$$\frac{dT}{dt} = \pi - d_1 T - k_1 TV + \mu T_i, \; T(0) = T_0 \qquad (15)$$

$$\frac{dT_i}{dt} = k_1 TV - d_2 T_i - \mu T_i,\ T_i(0) = 0 \qquad (16)$$

$$\frac{dV}{dt} = k_2 T_i - cv \quad , \quad v(0) = 0 \qquad (17)$$

where

π is the rate of production of T cells

d_1 is the natural death rate of healthy cells

k_1 is the viral infection rate of CD4+Tcells

μ is the infected T cell recovery rate

d_2 is the death rate of infected T cells

k_2 is the viral production for T cell

c is the clearance rate of the virus

T_i is the infected Cd4+Tcell

v is the virus produced by T cells and macrophage.

This paper showed beyond earlier papers the effect of affinity hemodiaysis on HIV/AIDS as a potential treatment option for HIV patients resistant to drugs. The paper showed that if recovery is possible for an HIV/AIDS patient. Surprisingly is being cited by many scientists.

Many papers on diseases as still listed in the references, but we cannot discuss each in detail. Our focus continues to be: The quest for development: why mathematics matters. One major interest in development plans is the issue of weather. Do pollutants affect weather? Does atmospheric temperature rise depend on pollutants and if yes, what are the implications on agriculture? This question we answered in a research paper in collaboration with a lady at the Tai Solarin University of Education, Ijagun, Ijebu-Ode. The lady, F.R. Sodique is in department of Agriculture. By considering momentum and energy equations in the form

$$\mu \frac{d^2u}{dy^2} - \sigma B_0^2 u = 0,\ u(0) = U,\ u(\infty) = 0 \qquad (18)$$

$$k \frac{d^2T}{dy^2} + \mu \left(\frac{du}{dy}\right)^2 + \sigma B_0^2 u^2 = 0, \qquad (19)$$

$$T(0) = T_i \text{ and } T(\infty) = T_2$$

where μ is the viscosity of the fluid.

σ is the electrical conductivity

B_0 is the magnetic field

u is the velocity field

k is the thermal conductivity and

T is the temperature field.

By letting $L = \frac{\mu}{\rho U}, \phi = \frac{u}{U}, z = \frac{y}{L}$ and

$\theta = T/(T_2 - T_1)$, we obtain

$$\frac{d^2\phi}{dz^2} - H_a^2 \phi = 0 \qquad (20)$$

$$\frac{1}{p_r}\frac{d^2\theta}{dz^2} + E_c \left(\frac{d\phi}{dz}\right)^2 + E_c H_a^2 \phi^2 \qquad (21)$$

together with the boundary conditions $\theta(0) = 1,\ \theta(\infty) = 0$ and $\theta(0) = \alpha,\ \theta(\infty) = \beta$, where H_a is the Hartman number and P_r is the Prandtl number, Ec is the Eckert number.

So

$$\frac{d\theta}{dH_a} = \frac{p_r E_c}{2} 2\, e^{-2H_a z} > 0 \text{ for all } z > 0$$ That is, temperature

rises, there is a warming of the atmosphere as the Hartman number, due to the pollutants increases.

Agriculture is highly sensitive to climate variability and weather extremes, such as droughts, floods and severe storms. The forces that shape our climate are also critical to farm productivity. While food production may benefit from a warmer climate, the increased potential for droughts, floods and heat waves will pose challenge for farmers.

5. Mathematics Curriculum

Is mathematics better taught in a native language? Of all the pre-college curriculum, the highest level of mathematics one studies in secondary school has the strongest continuing influence on bachelor degree completion (Stanford University's Bridge Project, Betraying the College Dream).

Moreover, Charles Vanden Eynden in the preface to his book Elementary number theory wrote "It us not sufficient for the writer to believe it, enough details must be given so that the reader will also understand and believe. The burden of making oneself understood rests with the writer.

Curriculum needs revision from time to time. Research results that only exist in journal today need to find ways into text books and these come largely through revision of curriculum. In radio, television or print media one gets the information " the standard of education is falling or has fallen." The point is, how much truth is in the statement and what is to be done?

5. Contributions of Mathematical Sciences to Some Other Sciences

In 3 above we gave some contributions that have immediate applications but in this section we intend to consider contributions whose applications to development may not be so obvious.

We consider a reaction between a reactant A, an active centre C and a sensitizer M of the form.

$$A + C \rightarrow (I + n)\,C + \text{product} \quad (22)$$

$$C \rightarrow \text{wall} \quad (23)$$

$$C + C + M + \text{products} \quad (24)$$

Above is a branched chain explosion in which one active centre reacts with A to produce additional n active centres. The ordinary differential equations for the system is

$$\frac{dy}{dt} = -\left(yz/\lambda\right)\exp\left(\alpha\left(\theta-1\right)/\epsilon\theta\right), y(0)=\lambda \quad (25)$$

$$\frac{dz}{dt} = \left(yz/\lambda\right)\exp\left(\alpha\left(\theta-1\right)/\epsilon\theta\right) - dz\exp\left(\left(\theta-1\right)/\epsilon\theta\right) bz^2, (0)=\epsilon^{1/2} \quad (26)$$

$$\frac{d\theta}{dt} = bz^2,\ \theta(0)=1 \quad (27)$$

where y is the reactant, z is the active intermediary and is the temperature. So the equations are non-linear and there are no analytical solutions and we resort to approximate solutions. Hence the method of solution is important. When is assumed small, an equation

$$\frac{d^2\theta}{dx^2} + \delta e^{\theta} = 0 \quad (28)$$

satisfying

$$\phi(0) = \phi(1) = 0 \quad (29)$$

Result for temperature. This gives a solution

$$\phi = 2In\left\{e^{\phi(0)/2}\sec h\lambda x\right\} \quad (30)$$

$$with\ \lambda^2 = \frac{1}{2}\delta e^{\phi(0)},\ \sqrt{\delta/2} = e^{-\frac{1}{2}\phi(0)}\cosh^{-1}\left(e\frac{\phi(0)}{2}\right)$$

and δ depends on $e^{-1/\epsilon}$, that is , $\delta = \frac{a}{\epsilon}e^{-1/\epsilon}$ and

$$e^{\phi} = \exp\frac{(\theta)}{1+\epsilon\theta} \; as \; \epsilon \to 0$$

$$\delta = \frac{a}{\epsilon} e^{-1/\epsilon} and \; e^{\theta} = \exp\frac{(\theta)}{1+\epsilon\theta} as \epsilon \to 0$$

Note that taking $\epsilon = 0.001$ gives $\delta = 0.00$ and $\epsilon = 0.1$ gives $\delta = 0.09$ and $\epsilon = 0.25$ gives $\delta = (0.073)$

figure 2 gives the relationship between $\theta(0)$ and δ .

θ (0) has two solutions for $0 < \delta < 0.878$ and no solution for $\delta > 0.878$. So how approximate is very important, a reaction may have a solution and we may conclude that it has no solution if the approximation is not properly done.

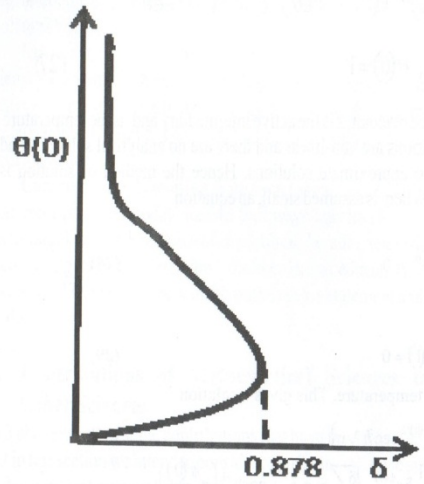


Figure 2

Figure 2 gives the relationship between max and .

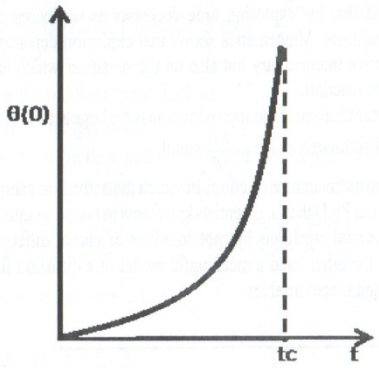


Figure 3

Figure 3 gives the graph of temperature against explosion time

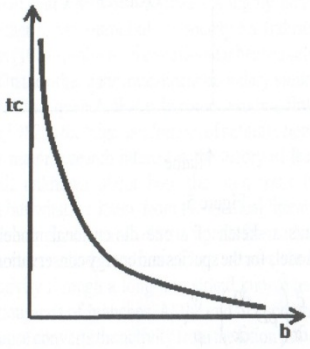


Figure 4

Figure 4 gives the graph of explosion time against active intermediary b.

Figure 4 shows that the explosion time decreases as we increase the amount of sensitizers. Mathematics shows that explosion depends not only on the active intermediary but also on the sensitizer which is not consumed in the reaction.

One important feature of the approximation is the large activation energy E which ultimately made $\epsilon = \frac{RT_0}{E}$ small.

However chemists encounter reactions in which the activation energy is small. Prior to our Ph.D thesis, Scientists know how to bound solutions of ordinary differential equations but not solutions of partial differential equations. On the other hand a meaningful model of a diffusion flame involves time and space variables

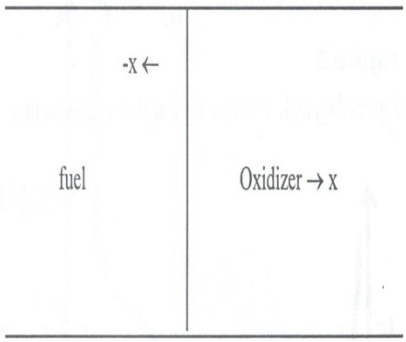


Figure 5.

Figure 5 presents a sketch of a one dimensional model flame. The mathematical models for the species and energy conservation are

$$\frac{\partial \theta}{\partial t} + u\frac{\partial \theta}{\partial x} = \frac{1}{\rho}\frac{\partial}{\partial x}\left(\rho D \frac{\partial \theta}{\partial x}\right) - \frac{w}{\rho}, \qquad (31)$$

where θ stands for Y_i/ν, Y_2 and $-c_p T/\theta$ and

$$\frac{w}{\rho} = M_2 B(\rho Y_1/M_1)^a (\rho Y_2/M_2)^b \exp\left(-\frac{E}{RT}\right)$$

Y_1 is the oxidizer mass fraction,

Y_2 is the temperature.

Here both the time and the space variable x are important. A major bound for the temperature $\Phi(z,\tau)$ (Ayeni and Ludford 1982) is

$$0 \le \phi(z,\tau) \le \frac{1}{\epsilon}\left(\left[\epsilon(a+b+1)\tau \exp\left(-1/\epsilon\right)+1\right]^{(a+b+1)^{-1}} - 1\right) \qquad (32)$$

for $0 < \epsilon \le (a+b)^{-1}$, $\tau = t/t_1$

$$z = (\rho^2 D t_1)^{1/2} \int_0^x \rho \, dx$$

$$t_1 = (M_2 B)^{-1} (M_1/pY_{10})^a (M_2/pY_{20})^b C_p T_0/Q \exp(E/R)$$

The above flame diffusion problem is highly nonlinear but as we show in another in the journal of the society for Industrial and Applied Mathematics (1984) problems for semi-linear heat equations blow up in a finite time. On the other hand, non-linear boundary value problems could have solutions that quench, that is become zero in a finite time. This we published in 1982 in the Nigerian Journal of natural sciences.

Another major research interest is the theory of learning. Although much is still unknown about how the train trans itself to process information but what we know from the medical literature is that in the human brain, as typical neuron collects signals from others through a host of fine structures called dendrites. The neuron sends out spikes of electrical activity through a long thin strand known as an axon, which splits into thousands of branches. At the end of each branch, a structure called a synapse converts the activity from the axion into electrical effects that inhibit or excite activity in the connected neurous. When a neuron receives excitatory input that is sufficiently large compared with its inhibitory input, it sends it to its axon and learning occurs by changing

the effectiveness of the synapses so that the influence of one neuron on another changes. Based on the simple theory, a mathematical area of research could be on a the method of teaching to obtain optimum learning results. So in 2002, I encouraged a master's student, Oluyombo Popoola, studying fundamentals of computer science, to investigate effects of neural networks in the theory of learning. One major outcome of the investigation is the paper titled the effect of hidden nodes in the theory of learning which we published in the volume 21 of Abacus of 2004.

Drugs have prescriptions but how do pharmacists and medical doctors come about the prescriptions? We should allow one of the professionals to explain in detail. It sufficient to mention in this lecture to say that the process involved a lot. But of recent, we in mathematics, ask if we can contribute to the process. At the beginning of the 1980's scientists began efforts to control HIV/AIDS through the manufacture of drugs. However the issue of using the most optimal amount of medicine in illness control program is important because of the high cost of drugs and high risk of side effects (Poisoning) A mathematical system of equations that take into account the drug intake is of the form:

$$\frac{dx}{dt} = \frac{s}{1+v} - \mu_1 x = -k_1 vx + rx\left(1 - \frac{x+y+z}{N\max}\right) \quad (33)$$

$$\frac{dy}{dt} = k_1 rv - \mu_2 y - k_2 y \quad (34)$$

$$\frac{dz}{dt} = k_2 y - \mu_3 z, \text{ and} \quad (35)$$

$$\frac{dv}{dt} = (1-u)L\mu_3 z - k_1 vx - \mu_\alpha v, \quad (36)$$

together with the initial conditions

$$x(0) = x_0,\ y(0) = y_0, z(0) = z_0 \text{and } v(0) v_0,$$

Where
x is the uninfected CD4+T cells,
y is the latently infected CD4+T cells
z is the actively infected CD4+T cells
V is the virus and u is the medicine intake. The object function in the chemotherapy of HIV involves maximizing x and minimizing u. In particular the target function is

$$J(u) = \int_{tstart}^{tfinal} \left(x(t) - \frac{1}{2} Bu^2 \right) dt,$$

where $t_{final} - t_{start} < 2$ years and B>0. Recently Ayeni, Gbadamosi, Olaniyi and Olopade obtained an optimum value for u and the entire paper will appear in the next edition of Science Focus.

6. Mathematics Curriculum

The content of a curriculum has a lasting influence on knowledge of mathematics. Stanford University has this to say "Of all the pre-college, the highest level of mathematics one studies in secondary school has the strongest continuing influence on bachelor degree completion" (Stanford University's Bridge Project, Betraying the College Dream).

In 1979, I was invited by the Nigerian Educational Research and Development Council (NERDC) to participate in the review of mathematics curriculum for primary schools. The review was led by two senior colleagues and former teachers, Professors A.O. Kalejaye and G.A. Badmus. It was a good initiation. I later developed a good workin g relationship with the Mathematical Association of Nigeria (MAN). MAN had published text books for primary schools using University Press. Ibadan as the publishers and when I was the president of the Association 2002 2004, we wrote and published the remaining work books for primary one to primary six. I stayed with NERDC even Professors Kalejaye and Badmus left and later chaired the review of the syllabuses for secondary schools.

A nation must review the curriculum from time to time but the standard of education may not depend on the curriculum alone and it is normally a product of several factors.

7. Postgraduate Training

I have concentrated on post-graduate supervision (Supervising around 50 Master's these and 29 Ph.D theses) as a priority because Nigeria needs it. It is recommended that a University should employ academic staff from all nations, but the low value of the naira has made employment of non-Nigerians difficult. So in the present circumstance the best way to ensure that our universities continue to have academic staff would be for old generation of universities train postgraduate students for old and new generation universities.

8. Conclusion

We have shown in this lecture that mathematics is important for national development. What we have not shown is that mathematics is more important than history or geography or political science. What we have not also not said is that mathematics is not as important as mechanical engineering, pharmacy or medicine, and we could not have said either because have laboured through research that some system have unique solutions and some have multiple solutions. This, by implication would mean that all subjects are important and all subjects are important and all subjects should be studied. The essential goal is knowledge. Moreover, for optimum development in a nation, right people should be used in right places. A square pag is not approximate for round hole.

Recommendations

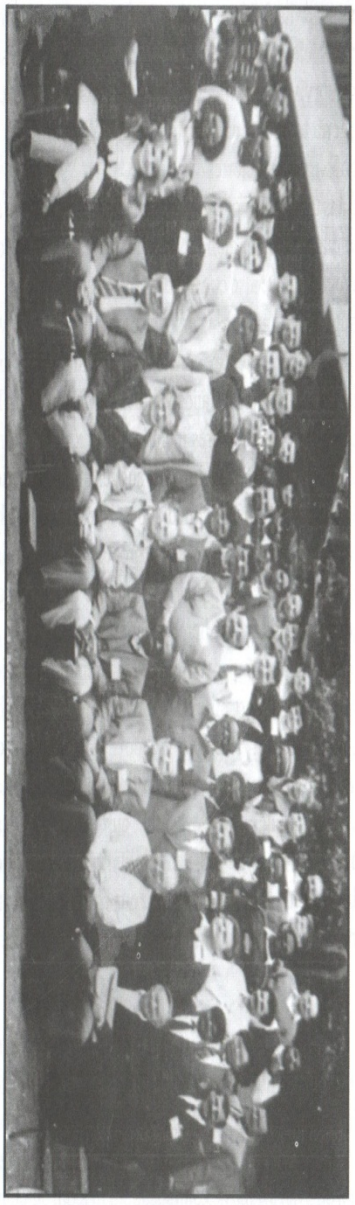
Nigeria's progress from an underdeveloped nation to a developing nation and finally to one of 20 developed economies would require that the Universities play to the fullest their mandatory roles. That is, Nigeria needs the genuine input of the academics. What we have now is vision 20,

2020. This means what? Of the present first 20 developed economies, all manufacture vehicles and are self sufficient in food, in the sense that such countries can survive for a while if a ban is imposed on them. Are there plans for Nigeria to be self sufficient in food? When will the first set of cars roll out of Nigerian factories?

The point is that when politician make their plans they use some of us and we should advise them on how to go about realizing the objectives. This may involve that we also consult our colleagues.

I have supervised many Master's theses and Ph.D these which may mean that we have competent people to leave behind in my area but the process of a student studying for and eventually receiving a Ph.D requires, the cooperation of several lectures including the external examiner who ensures that the quality is right and suggests modifications when necessary. In actual fact the so-called supervisor only spear headed (or with some specified colleagues) the process of supervision. The Universities need qualified staff and postgraduate training is of priority. The nation deserves this and we hereby recommend it.

I have high lighted my involvement in preparing curriculum for Nigerian schools to support my recommendation on strengthening the quality of education in Nigerian Schools. Curriculum cannot be permanent and it must be reviewed from time to time especially in the light of new knowledge. However the current falling standard of education has much to do with the instability in the academic calendar than with the curriculum. Due to strikes, our children are not spending enough months. Learning



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