UNIVERSITY OF PORT HARCOURT

BLOOD IS THICKER THAN WATER

An Inaugural Lecture

By

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DEDICATION

"To God be the glory

Great things He has done"

1996 was a particularly difficult year for the university system in our country. Academic work was virtually ground to a halt for so long a time that even the certainty of this Inaugural Lecture, at this time, became doubtful. I could not imagine an Inaugural Lecture without your good selves for whom it is intended. I am therefore delighted to observe that after the stormy weather, some measure of calm is with us once again. We sincerely pray that it lasts. But, 1996 was also a memorable year because of the joy and national pride it brought to us as a result of the country's spectacular performance at the Centennial Olympic Games in Atlanta, Georgia (USA).

Each time I reflect on the phrase "*Inaugural Lectures*", my mind never stops underscoring the word "inaugural". I continue to reflect on its wider meaning….

When we inaugurate, we lay a foundation for a new phase like inaugurating the Committee of Vice-Chancellors, or the members of a new Governing Council, or a new Cabinet of Ministers or a new Students' Union Executive, and so on. So, when one is inaugurated for a situation, that is when one's task really begins. It is, therefore, at the point of inauguration that the formal authority to go "further ahead "is given. By implication, therefore, an academic Inaugural Lecture ought to confer on the Lecturer the urge to go on and produce even more academic lectures which can be meaningfully achieved through the breaking of new grounds and attaining of greater academic laurels.

Understand the far – reaching, almost inescapable influence of Biochemistry in our lives. You are not wrong in that assumption, for Biochemistry is the study and understanding of what life is all about. I shall come back to this concept later.

Let me now dwell a little on the topic of this lecture – Blood Is Thicker Than Water. This statement has two relevant angles to it. Universally, it is a well-known proverb; to the Biochemist and Biological Scientist, it is also a tested and proven scientific assertion.

As a proverb, the expression is conjuring. It is used to portray a sense of similarity; a common ancestry; similar stock; of a common lineage or percentage. "Whatever happens, they will not harm one another because they are of the same race – *blood is thicker than* *water"*. Of course, if you stand a bottle of blood and that of water side by side, the difference is clear, even to the uneducated. What we are really saying, and indeed what is intended in this proverb, from ancient times, right across the races, is that not only species differences but inter and intra racial differences are explained in the worm, fish or the snail. It is this similarity in blood, this genetic make-up, well – understood by Biochemistry, that prompts us to observe, with amazement, how closely some children resemble their parents physically and subtly; or, indeed, even more fundamentally, how we inherited our blood groups from either of our parents. If a mother has blood group A and the father has blood group B, the children would inherit either blood group A or B; not blood group AB or O. Similarly, in the well-known genetic blood disorder termed Sickle Cell Disease (SCD), if neither parent is the carrier of the sickle cell gene, none of their offspring will inherit the sickle cell gene. However, if one or both parents are carriers of the sickle cell gene, the chances are that some of the children will inherit this troublesome gene. Indeed, a case of matrimonial infidelity can be simply proved. Having researched for more than fifteen years in the area of SCD, I am reasonably sure of these facts. Now, you know why, for me, "blood is thicker than water" also: because of my involvement in blood research.

The concept of genetics, which is a major arm of Biochemistry, touches virtually every aspect of biological life, explaining scientifically, at least, the differences and similarities we observe among all living things.

Let us briefly consider the second angle to the title of this lecture. Indeed, blood is heavier than water. For the avoidance of doubt, here "heaviness" and "thickness" are interchangeable. By simply weighing equal volumes of human blood and water, we know that whereas the density of pure water is given the value of 1.00 that of blood is 1.05 to 1.06. The difference may appear rather small to the non-scientist, but this weight deference between water and blood is quite significant. Water accounts for about 83% of blood weight, the remaining 17% is accounted for by hundreds of other substances naturally present in blood. The significance of these "other components" of blood, in health and in disease will be discussed later. But let us draw some analogy between a

Nigerian pot of soup and a pot of blood. To prepare our soup, we start with a quantity of water which we bring to the boil. We now begin to add ingredients –salt, oil, pepper, fish, Okro, egusi, and so on – in any order we choose. At the end of cooking, we now have a nice, thick soup! Is it thicker than the water we started with or not? The difference is clear. In a similar vein, Mother Nature added hundreds of ingredients to water to produce blood. One of the most important of these ingredients is a protein called haemoglobin, whose major function is to transport oxygen (which we breathe into our body through our nostrils) into every part of our body system. Without haemoglobin, we cannot survive, and if its concentration is lower than it should, we may become terribly anaemic, and may die, if unchecked. It is also the haemoglobin that gives blood its red colour.

If a quantity of fresh blood is put into a suitable glass container, it is observed that within minutes the blood separates into two layers – an upper, watery layer (called the plasma) and a lower, dense, red layer, consisting predominantly red blood cells full of haemoglobin. This, again, is a single demonstration that even haemoglobin itself is heavier than water hence; blood is physically heavier than pure water in every respect.

Although, according to Professor C.O Anah, “Inaugural Lecture is one of those academic fulfillments that makes a new professor feel good”, I believe, however that it goes beyond this feeling. A Professor of many years standing, who, for some reason has been unable to present an Inaugural Lecture, even at the point of retirement, cannot be considered a new professor by any shade of imagination. But there is no doubt that the presentation of an Inaugural Lecture is a clear challenge to the innermost academic capacity of the lecturer. In the university of Port Harcourt, there is now the opportunity to present, on regular basis, what one “professes”, through several fora such as the newly established Graduate School Lectures Series, Faculty Seminars and by initiating inter-university academic interactions at several levels. One of the surest ways of enhancing the academic status of a university is therefore through the establishment of academic initiatives of this nature, on a regular basis, for internal and external awareness and consumption.

If the impetus has to be maintained, then the Inaugural Lecturer cannot afford to rest on his past glory, but must, despite the operational insufficiencies that abound, be resourceful and push further the frontiers of knowledge.

There is no doubt that a major dilemma that faces an Inaugural Lecture is the choice of a topic. That done, he is faced with another that of ensuring that the cross-section of his audience "goes along with him", rather than with sleep! It is only the audience that will judge. But considering the technicalities in explaining certain aspects of science (Biochemistry in this case), I promise to do my best to keep you awake, but cannot guarantee you one hundred percent awakeness! But if you begin to feel a little sleepy, feel free to ask me for some 'OSE-OJI' (alligator pepper) and 'OJI' (kola nut). These "chewable" are biochemical ingredients, you know, and we understand reasonably well how they operate in our system singly or when consumed together, to oppose sleep. If the person by your side begins to snore, just smile, "please do not disturb". Perhaps, he just took some calming drugs before coming here. It is simply the biochemistry of drug action that is in operation! Perhaps you are already beginning to

I was appointed a Professor of Biochemistry by this University in 1991. My area of specialization is Medical Biochemistry, in which I have gained over twenty-five years of research and teaching experience, especially in blood-related areas. The Creator is owed all the moderate contributions I have made in blood research, ranging from Endocrinology (studies of blood hormones) to blood disorders, such as Sickle Cell Disease (SCD). It is, therefore, my great pleasure to dedicate the topic of this Inaugural Lecture to the mystery of, and researches in blood.

II

BIOCHEMISTRY: A BRIEF HISTORICAL SURVEY

Knowledge is indivisible. It ends in one fine point. It is only intellectualism that tends to subdivide knowledge. History may belong to history books, but history also resides in arts, music, literature, the sciences, engineering and all facets of knowledge. While history emphasizes what it was, it also appraises what it is and may go on to speculate on what it may be later. Therefore, Biochemistry has a history of its own, a beginning, which it is worthwhile to mention so as to re-appraise the present and plan for the future.

Two periods have emerged in the development of Biochemistry, which, for want of better terms may be conventionally defined as Static and Dynamic. Static or Descriptive Biochemistry deals with the constituents of living matter, that is the structure and properties of biological materials. Dynamic Biochemistry studies the chemical transformations of these biological materials and elucidates the role they play in the maintenance of life. Undoubtedly, Static Biochemistry represents the earlier, more primitive era of Biochemistry, but later, both trends have followed a parallel course in the understanding of the subject.

Biochemistry is a relatively young science that emerged more strongly at the turn of the 19^{th} Century; however, it is deeply rooted in antiquity. It is defined as “the study of the organization and function of biological systems at the molecular and atomic levels”. More simply, it is the study of the chemistry of substances and processes present in living things.

In his great encyclopaedia, the Canon, the famous scholar and physician of the Middle Ages, Avicenna (Ibn Sina) (980-1073 AD) gave a classification of chemical compounds that were used in medicine. Specifically, he was able to name the substances contained in urine. This actually marked an important beginning for Biochemistry.

The 18^{th} Century witnessed a number of spectacular discoveries. In 1748, the Russian, Lomonosov discovered the law of the conservation of matter and motion, and emphasized its applicability to both living and non-living things. Later, oxygen, discovered by Scheel and Priestly, was shown to be essential to the respiration of humans and animals. Plants were shown to be able to absorb atmospheric carbon dioxide and give up oxygen which we breathe – a process of which actually signaled the discovery of photosynthesis – the synthesis of carbohydrates from carbon dioxide and water. Later, a large number of organic compounds such as acids, alcohols, cholesterol urea, and so on, were isolated form living matter. Special mention should be made of the experiments conducted by Italian Abbot, Spallanzani, who from his studies on gastric juice on the digestion of meat, proved that this process is of essentially chemical nature. Biochemistry had now entered the dynamic period of its development because it had now become more experimental in approach.

In 1828, the German Chemist, Wohler, synthesized urea from cyanic acid and ammonia. The laboratory synthesis of urea, a major product of nitrogen metabolism in many living organisms including man, was an accomplishment of great significance. It showed for the first time that a chemical compound excreted by mammals could be identical to that produced in the laboratory. The year 1828 may then be regarded as a turning point in the establishment of Biochemistry as a science. Official acknowledgement of biological or medical chemistry as an independent discipline came somewhat later. In Germany, F. Hopper-Seiler, a Professor of applied chemistry, was the first to head the Department of Medical Biochemistry at Tubingen University in 1866. In 1863, courses in Medical Chemistry were already introduced in Russian Universities, and the first Department Medical of Medical Chemistry was set up in the Medical Faculty of Kazan University. The first textbooks on biological (physiological) chemistry were written by Simon in Germany (1842) and by Khodnev in Russia (1847).

In the 19th Century, the major trends in Biochemistry were outlined, and the main classes of compounds occurring in the living system were identified. Notably, far-reaching progress was achieved in protein chemistry, since scientists became interested in proteins not only as common nutrients, but primarily as materials that are widely spread in living matter. Various proteins were then isolated from products of plant and animal origin.

The discovery of DNA, or deoxyribonucleic acid, the genetic material of most plants and animals, by the Swiss biochemist Miescher in 1869, passed rather unnoticed by his contemporaries. Only later did it become clear that DNA holds the key to the chemical code of life processes.

In the same century, a theory on the essential nutritive components known as vitamins, emerged, originating in the works of the Russian biochemist Lunin (1880) and other in Europe (Eijkman, Funk and Hopkins). The efforts of the French researchers Bernard, Berthold and Brown – Sequard laid foundation for a new discipline – the biochemistry of hormones –with the immediate prospects of using hormones as drugs in medicine. Incidentally, we cannot contemplate reproduction without certain hormones.

Deeper insight into the fascinating world of chemical conversions in the living organism has revealed the exceptional importance of enzymes and prompted a wider investigation of enzyme processes. Thus, Berzelius and Schenbein revealed that enzymes (which are essentially proteins of a unique nature) and inorganic catalysts function similarly. Further enzymes studies by several biochemists – Pavlov (Russian), Buchner and Liebig (Germans) and others contributed to the establishment of enzymology – a new sub-division of Biochemistry – that has provided a clue to unravelling the mechanism of chemical conversions and interconversions in living things.

Progress in Biochemistry in the 20th Century has not been less impressive. In 1902, Fischer was the first to achieve the laboratory synthesis of the protein the backbone – the peptide; and he was also the first to propose the peptide theory of protein structure. The major routes or pathways in the utilization of proteins, sugars (carbohydrates), fats, amino acids and other biochemical compounds were already studied by the 1950s.

A large number of enzymes have been isolated in the crystalline state, and their structures, reaction mechanisms and regulation investigation. By making use of special analytical tools such as the X-ray system, amino acid sequence analyzers,linear structures of the anti-diabetic hormone, insulin (F.Sanger, 1953), the three dimensional structures of the proteins myoglobin (Kendrew,1960) and haemoglobin (Perutz) were established.

All these biochemical compounds found in living matters – proteins, carbohydrates, vitamins, hormones, fats and so on require energy to construct them. We eat and breathe to create the source of energy to build them up from simple chemical substances, or to break them down, as the body requires. This has now introduced a new trend in

Biochemistry, called bioenergetics. This sub-division of Biochemistry emerged at the beginning of this century. In 1931, Engelhardt discovered oxidative phosphorylation – a major route of energy generation for living organisms and studies by European and American biochemists such as Engler, Keilin, Krebs, Lehninger, Chance and so on, considerably promoted the conceptual development of respiration mechanisms and bioenergetics. In 1961, the British biochemist Michell proposed the “chemo-osmotic coupling” theory for bioenergetics. This hypothesis has now been accepted.

In 1953, Watson and Crick (two British biochemists) established the secondary structure of DNA (the molecules that carry heredity) which enabled scientist to gain deeper insight into the principles of the transfer of hereditary information – “that which is responsible for what runs in the family”. This discovery actually heralded the advent of a new trend in Biochemistry – molecular biology – which is concerned with the molecular principles of the fundamental properties of all living matter, in particular, with the molecular basis of heredity. Later, in 1961, Nirenberg and Mattaei discovered the genetic code, that is the secret “point contact” arrangement between nucleic acid residues that enable the transfer of genetic information from parents to their offspring as well as in cell replication. In 1967, Konberg was the first to synthesize in the laboratory the DNA of a virus, and in 1970 Khorana (of Indian descent) synthesized an artificial gene. Thus, in the seventies, molecular biology gave birth to genetic engineering which is now the “in thing” in Biochemistry – a new discipline concerned with the chemical design of genes, their transplantation in cells, their use in the correction of genetic defects and engineering enzymology.

Thus, in under a century, Biochemistry has undergone much rapid transformation. It has brought glory and international recognition to several biochemists, many of whom are winners of the Nobel Prize. These include, to name just a few; Pauling, Perutz, Sanger, Monod, and Kendrew.

Between 1990 to date several other amazing discoveries have been made in biochemical research. For instance, intensive brain research is on to discover the biochemical substances that influence our moods. Thus, we now know, for example that both immunoglobulin A (a type of protein that helps to confer us immunity) and cytokines (the so-called “happy hormones”) uplift us during our happy moments. On the other hand, melancholy people have higher levels of another group of hormones, the cortisones, in their blood stream. That is, high levels of blood cortisones tend to be stress- associated.

Just as every aspect of science is rapidly evolving, so also is Biochemistry. The future of this subject is assured, and will continue to be so, so long as life exists on our planet. The next century (which comes on stream in less than three years from now) will see greater exploitation, by scientist, of the secrets of molecular biology and the “engineering” of biological molecules for the benefit of mankind, be it in medicine, agriculture or industry. Even space research is bound to make greater use of endurance effort was accomplished by An American biochemist in the on-going American-Russian space cooperation programme.

So, for the Biochemist,
Success on Earth;
Success in Space;
Maybe, in heaven

III

BIOCHEMISTRY: AN APPLIED SCIENCE

Advances in Biochemistry have found large-scale applications in various areas of industry, agriculture, medicine and pharmacy/ pharmacology. Currently, there have been promising results in raising improved strains of domestic animals and in cultivating valuable plants through genetic engineering. Attempts to transplant a group of “nitrogen fixation” genes from plant nodule bacteria to higher plants (wheat and maize) to enable these plants assimilate atmospheric nitrogen have been made. This appears to be a good alternative to the reduced utilization of nitrogenous fertilizers, whose yearly world production amounts to over 60 million tons. Although the introduction of nitrogen fixation through gene transplantation remains a task to be fully accomplished, some encouraging results have already been reported. It is a future challenge to the biochemist because of the impact this research will have on the world food situation. The era of biotechnology has already arrived.

The most desirable objects of investigation for the biochemist are micro-organisms such as bacteria and yeasts, whose biochemical processes may be influenced either by the transplantation of appropriate genes, or by the modification of their own genes. New strains or types of these organisms are being employed in the production of low-cost feed protein and essential amino acids for domestic animals; low-cost petrochemical paraffins can often be used as nutritional media for such micro-organisms. To protect cultivated plants from pests, biochemical preparations of superior quality that are not harmful to humans or animals are currently being manufactured. Biological methods for the disposal of industrial and domestic wastes and for cleaning up oil spills, common contaminants of the sea (using especially cultivated bacterial mutants) have proved to be of substantial value. Biochemical processes are widely used in the food industry (in preparation of bread, cheese, wine, etc.) and in the leather industry. Detergents with enzyme additives are also currently commercially available.

Biochemical methods are increasingly gaining acceptance in pharmaceutical practice. Biological catalysts (enzymes) are employed in technology for the synthesis of drugs such as steroid hormones. Genetic engineering offers promising prospects for the production of natural drugs. The application of bacterial techniques has enabled scientists to develop convenient and economical methods for the commercial synthesis of pharmaceuticals (amino acids, nucleotides, nucleosides, vitamins, antibiotics, etc.). Rapid and specific methods for drug analysis have been proposed using enzymes as analytical reagents.

Understanding the mechanism of drug action has been of exceptional importance. Investigations on drug metabolism using cellular enzyme systems enable one to suggest a rational dosimetry for drug application, to control drug metabolism, and to elucidate the nature of a medicinal effect on the individual.

Now, for instance, large amounts of insulin (used for the treatment of insulin-dependent diabetes) which used to be extracted from animal sources are now being produced form micro-organisms through genetic engineering method. The deeper insight gained into the mysterious machinery of living matter and into the complex processes that the living matter accomplishes with ease baffles even the most daring imagination; it opens vast perspectives before mankind and unfolds very exciting and challenging future.

Biochemistry, as an applied science, offers satisfying career prospects to biochemists; after all, this is what the long training and study session is all about, at least from the economic point of view.

The most senior posts in Biochemistry are usually filled by those who have taken a degree at a university or equivalent tertiary institution. Many biochemistry graduates proceed to research training and after obtaining a higher degree, may obtain posts in research. Others with less interest in pure research take up posts involving the application of their biochemistry to problem solving, for example, product or process development in industry or analytical work. Some, however, turn to occupations where the precise skills and knowledge they have learnt are not directly applied, but where they bring to a new environment the trained mind for which there is a sustained demand by employers in the public and private sectors. This flexibility in occupational appropriation gives the biochemist a unique advantage in career opportunity. A good qualification in Biochemistry, therefore, can lead to a good job either in science or outside it. The following are the main fields that the knowledge of Biochemistry can be applied; the information will certainly be beneficial and reassuring to biochemistry students.

i. *HOSPITALS.*

Substantial numbers of biochemists work in hospital laboratories and in university departments of chemical pathology and clinical biochemistry. The work is mainly concerned with the analysis of body tissue and fluids, such as blood, essential for the routine diagnosis of diseases in the monitoring of the treatment of patients, and research. There can be many facets to such work, for example, developing new analytical tests or techniques; carrying out complicated analyses of biochemical substances; checking the computer-controlled automatic analysis equipment or discussing results with doctors or colleagues. The satisfaction of playing a vital role in the hospital team that provides medical care for the sick is very rewarding.

ii. *INDUSTRY:*

This is the second largest area of employment for the biochemist; in fact, it is fast overtaking the hospital area. Here the biochemist is exposed to several opportunities. – Practical scientific talents to sales, marketing, purchasing and production – eventually attaining managerial status. About half of biochemistry graduates who go into industry go into laboratory- based jobs. Biochemists find themselves in high demand particularly in pharmaceutical, food and brewing industries. Other industries that employ the services of the biochemists include cosmetics and detergent, agrochemical, fine chemical and now environmental-oriented establishments.

iii. *EDUCATION*

This is a major area of employment, again, covering a wide spectrum of activity. I am interested because this is where I belong. In terms of numbers, most graduate biochemists that follow an educational career enter secondary school teaching for which a recommended route now is via the Postgraduate Diploma in Education. Such people teach chemistry or biology or integrated science. At the upper end of the academic spectrum there are openings in universities as lecturers for which the normal preparation would be at the least the M.Sc degree with some postgraduate experience. These posts enable biochemists to engage in fundamental research as well as in the teaching of undergraduates.

iv. *SCIENTIFIC CIVIL SERVICE AND RESEARCH COUNCILS.*

There are a few biochemists employed as civil servants. They may work for the Ministries of Agriculture, Education and Science and Technology. Another field of interest to biochemists is forensic science. This is an area of Biochemistry that is involved in carrying out chemical and biological tests as a service to help in crime detection. Employment opportunities also exist in the Medical Research Council (Lagos), Institute for Pharmaceutical Research (Abuja), Federal Institute for Industrial Research (Oshodi) and so on. Now, Environmental Science is growing very rapidly; there is hardly any environmental study that will not involve the experience of the biochemist.

v. SELF-EMPLOYMENT

In spite of the usual initial teething problems, young and enterprising biochemists, realizing the applied nature of the subject, should try their hands at self-employment and job creation. They can achieve this by setting up businesses, singly or in partnership. Suggested areas include: diagnostic (medical and industrial) laboratories; fine chemicals sales; extraction and sale of natural products such as plant oils and perfumes; commercial preparation of spices; the isolation of enzymes for the food and drug industries; production of alcoholic and non- alcoholic beverages, etc.

This country spends millions and possibly billions of naira in the importation of much needed biochemical. We can reduce this trend by practically participating in the manufacturing process, using locally available raw materials, thereby becoming employers of labour ourselves. I must say that I am also challenged too!

To further widen job opportunities for graduate biochemists several, institutions overseas have recognized the need to combine Biochemistry with another subject as joint honours degree programmes. Thus, in the United Kingdom, for instance, the University of Newcastle offers Biochemistry/Bacteriology; University of Manchester Institute of Science and Technology offers Biochemistry/Chemical Engineering; University of Salford, Biochemistry/Education; University of Aston (Birmingham), Biochemistry/French; as well as Biochemistry/Mechanical Engineering; University of Kent, Biochemistry/Management Science, etc. In this country we seem to have ignored joint honours programmes, or even Major/Minor combinations in a world where knowledge is gradually becoming an indivisible whole. Perhaps, our education planners will have to rethink on this so as to give the future generation a wider educational plan to choose from. Certainly, biochemist who also studied some French would fit in more easily in the ECOWAS Sub-region, job-wise, at least.

As I ponder over the unifying power of knowledge, I cannot help but agree with our friend Professor Chidi Maduka's observation (Inaugural Lecture No. 14, 1994)

Kukukuku kuku
Kukukuku kuku

Human beings are crazy
Human beings are crazy

Where do they see boundries?
Where do they see boundries?

Indeed, where do we see boundaries in knowledge? Should we then create boundaries in our interrelationships?

Vice Chancellor, Sir, let us now turn our attention to some aspects of applied biochemistry of blood which I have, *Deo volente,* continued to "profess" I am talking about the practical application of the biochemistry of blood in health and disease

IV

BLOOD BIOCHEMISTRY IN HEALTH AND DISEASE

I want to return to the topic of this inaugural lecture, now, practically speaking. A quick glance at the accompanying Table 1, "Some Biochemical Indices of Blood", will reveal, in greater details, those other "ingredients "or "condiments" responsible for the density or viscosity of blood. For brevity, only some relevant items have been tabulated. To the novice or uninitiated, that so many discretely different biochemical substances are present in blood (which we spill at will whenever we kill an animal!) may prove too much to be believed. But it is true. To now further say that the absence of haemoglobin (a major component of blood) also means cessation of life, may prove rather incomprehensible to some. This is equally true. All these substances, suspended in the "water of blood" as it were, are strictly accounted for, one by one in quality and quantity, and a clear balance sheet established (like in Accountancy) by Mother Nature. Take the case of total average haemoglobin value for a human adult. Haemoglobin concentration ranges between 115.0-180.0 grams per liter of blood. Serious departure from this range of values will be considered unhealthy or pathological. If the lower limit is significantly reduced, say, to 80 grams per liter, he will be regarded as being anaemic, with the attendant consequences. The upper hemoglobin limit of about 180 grams per litre is rarely exceeded by adults, except the newly born of less than six months of age whose hemoglobin concentration could be up to 200 grams per litre, but may drop to less than 120 within the first year of birth. This is a case of natural adaptation.

Let us take a few biochemical indices to press home the interrelationship between biochemistry, health and disease.

Blood maintains the right pressure (called osmotic pressure) inside the blood vessels that convey the blood. This function of maintaining the proper blood pressure in the blood vessel is carried out by the blood proteins, chiefly the albumin as well as sodium (which we include in our foods as salt). If the blood protein concentration is significantly lower than the lower end of the normal range (65-85 grams per litre), the outcome is a pathological situation called hypoproteinaemia or kwashiorkor. This situation leads to a decrease in the osmotic pressure in blood vessels and to oedema (or swelling). Oedema has been observed in severe cases of malnutrition or in those cases where the liver, as a result of disease, is unable to produce enough proteins such as albumin. An undue increase in proteins – opposite of hypoproteinamia- also creates its own problems. In this case, undesirably large amounts of water are drawn into, and retained by tissue and vascular beds. So, low blood serum protein concentrations could connote poor nutritional status or liver function impairment.

The globulins are another set of blood proteins that are worth mentioning. Gamma globulin is particularly important because it is, simply put, the type of blood protein that confers immunity to animals including man. When we are deliberately immunized, or when nature does so through various types of infection, the levels of the globulins, in the form called immunoglobulins, increase. Next time that we encounter similar infections we are better protected. Therefore, significantly raised immunoglobulin concentrations could imply the presence of certain types of infection.

Fibrinogen, another blood protein, must be present in the right concentrations too to ensure that our blood clots promptly when we have cuts, it also ensures that the blood that flows in our veins and arteries does not unduly clot. If blood clots in the heart or brain, the result could be fatal. So, there must be adequate level of fibrinogen in blood; low levels could be a source of concern.

A number of blood enzymes are of great diagnostic importance too. A lot of enzymes present in blood are not actually produced by blood itself. Rather they are produced by organs such as the liver, the pancreas and the muscle, and then released into the blood stream. Take the case of the enzyme alanyl aminotransferase. In a normal, healthy person's blood, this enzyme is usually present at a concentration range of about 2-15 international units per litre of blood. However, in the case of acute hepatitis, there is a marked increase in the blood concentration of this enzyme. Another liver enzyme, present in blood, which can be used for diagnosis is gamma glutamyltransferase. This enzyme can also be used to diagnose acute hepatitis, chronic hepatitis and liver damage resulting from drug and excessive consumption of alcohol, obstructive jaundice or liver damage due to cancer.

We can go on and look at a few more blood elements, but sometimes we have to be careful at interpretation. If for example, urea in blood is found to be higher than normal, it may not necessarily indicate ill health or pathology. It may sometimes mean that a high protein diet has been consumed. However, higher than normal level of blood urea may result from some form of kidney dysfunction or outright kidney failure. Other additional tests may, however, be carried out on the kidneys for more conclusive diagnosis.

The case of abnormally high blood sugar is well – known. When we talk about high blood sugar, we almost always talk about diabetes mellitus. High blood sugar, consistent with diabetes, reflects on the poor performance of our pancreas. Test for blood sugar and/or insulin levels may then be called for the physician.

The diagnostic importance of blood cholesterol has to be carefully interpreted too. High blood cholesterol is of course considered generally dangerous because of the risk it can have on the heart. But specific types of cholesterol or fat may even be more dangerous to health than just the total fat or cholesterol content of blood. Thus, those fractions of blood lipid called "low density" and "high density" lipids may be interpreted more seriously in diagnosis. The biochemist's concern is to do the analysis, provide the data, and by and large, allow the physican to take it from there. Just one more word about cholesterol. Cholesterol may sound like a taboo to many. But how many of us know that cholesterol is almost indispensable as a source of many vitally important hormones, such as the sex steroid hormones, without which reproduction would be almost impossible? Even the classes of hormones called the _glucocorticoids and mineralocorticoids, which play such vital roles in our ability to assimilate sugars and minerals (such as sodium and potassium) for survival depends on cholesterol as their starting material. Cholesterol also plays another life-protecting role by ensuring that our nerve fibres maintain their electrical potential essential for all living creatures like us.

It is, I presume, already becoming obvious to us that every blood constituent has a role to play in health and disease. Blood is the most popular and convenient body fluid taken from a patient for clinical investigation; this is because blood performs faithfully and, when properly handled, yields the desired results. Blood establishes a tripartite contact between the clinician, analyst and the patient. As the patient anxiously awaits for the result of his blood; as the doctor is equally anxious to complete his diagnosis, so is the analyst anxious to get the analysis successfully off his hands with minimum delay. Where blood and blood values are central in a life-threatening situation, speed, dedication and diagnostic accuracy are of paramount and parallel importance.

What do we know about the red blood cells (the erythrocytes) in health and disease? Science knows quite a lot about this. First of all, each red blood cell, biconcave in shape, is made of two major components – the haemoglobin (there red coloured protein that conveys oxygen around our tissues) and a rather complex membrane or bag, made primarily of proteins, sugars and fats. Both the haemoglobin and the baggy membrane that contains it are each unique. In sickness and in health variabilities can occur in the structure and function of haemoglobin and the membrane. For instance, severe reduction haemoglobin concentration causes severe forms of anaemia, jaundice and excessive production of bile pigments. Low haemoglobin values may also indicate that he bone marrow is incapable of manufacturing enough of the blood cells. If there is severe haemolysis or breakdown of the red blood cells, the membrane may be found to be fragile and unstable, as in the case of sickle red blood cells.

The haemoglobin is important in the diagnosis of blood gene defects (the haemoglobin pathies), the most notable being the various forms of sickle cell haemoglobins – HbSS, HbSC, and so on. These haemoglobinopathies have taken over twelve years of our research efforts at the University of Port Harcourt. The research efforts are therefore important to us and will be briefly discuss further.

The red blood cells membrane itself is of immense diagnostic importance too in a number of ways. It holds the biochemical attributes that give the blood groups A, B, AB, O, and other rare blood groups as well as the rhesus factors (negative and positive) their uniqueness and confers on them the role they play. We all know that before blood is transfused, it has to be properly cross-matched; otherwise there could be disasterous consequences for the blood recipient. For instance, a person whose blood group is A must not be given a group B blood. Furthermore, knowledge of the rhesus factors (positive and negative) is very important, not only for transferable blood, but also for females of child-bearing age. The membrane is also studded with a number of important enzymes: some ensure that the right amounts of nutrients, such as salts enter into and move out of the red blood cell; other enzymes ensure that the fats in these blood cells are not "fried up" too much a process biochemically referred to as peroxidation. High level cell peroxidation introduces a significant measure of inefficiency in its cellular function through poor energy conservation and early cell death.

Just as the red blood cells float in the medium of whole blood, so also do several other biochemical substances float inside the liquid environment of the red blood cell itself.

Thus, if blood cells are thrown into, say pure water, they will take in water, swell and burst. As they burst, they release their content, which include haemoglobin, salts such as sodium and potassium, iron and so on. In anaemia, red blood cells may get destroyed, and in so doing lose many such vital substances. We can now understand, even more vividly, how it is that blood is thicker than water. But blood is not unreasonably thick – not as thick as honey or trickle otherwise, it would be impossible to be pumped so effectively by the heart to all parts of the animal. What we say is that it is comparatively thicker than water, whilst at the same time performing the functions of water, and beyond, by virtue of its constituents. Marked variations not only in the water content of blood, but also in one or more of its large array of these constituents, are capable of generating pathological conditions which are identifiable by the trained biochemist or haematologist.

Blood is the effective monitoring medium of the performance of our vital organs - the heart, brain, liver, kidneys, pancreas, gonads and so on. In health and disease, the status of these organs is generally mirrored in blood. Therefore, regular blood check-ups constitute one good way of monitoring one's health profile. So, all those attitudes and practices that tend to destroy blood like consuming dangerous drugs should be avoided.

TABLE 1: Some Biochemical Indices of Blood.
Sources: Stroev and Makarova and Author's Research Data.

	INDEX	CONCEN-TRATION	INDEX	CONCEN-TRATION
A.	WATER	83%	**IV. Non-Protein Nitrogen Compounds**	
B.	OTHER "RESIDUES	17%	1. Creatinine	40-150 mmol/Litre
			2. Urea	3-6.8mmol/Litre
			3. Uric acid	0.12-042 mmol/Liter
			4. Bilirubin (T)	2-14 mmol/Litre
			5.Bilirubin (U)	8 mmol/Litre
	I. Total Heamoglobin	115.0-180.0 g/Litres		
	II. Total White Blood cells	4,000-10,000 per c.mm	V.Carbohydrates & Metabolites	
	III. Proteins			

1.	Total Protein	65-85g/Litre
2.	Albumin	35-60g/Litre
3.	Globulins	25-35g/Litre
	α1	2.5-5%
	α2	7.0-13%
	β	8.0-14%
	ϒ	12.0-22%
4.	Fibrinogen	2.0-7.0g/Litre
5.	Some Enzymes	
	Alanyl amino transferase	
	Aspartate aminotransferase	1-12 iu/Litre
	Alkaline phosphase	20-48iu/Litre
	Acid phosphatase	0.0.23 iu/Litre
	Gamma glutamyl-Transferase	up to 7 iu/Litre
	Lactate dehydrogenase	230-460 iu/Litre

1. Glucose	2.8-4.0 mmol/Litre
2. Lactate	0.5-2.0 mmol/Litre
3. Pyruvate	0.1 mmol/litre
VI. <u>Lipids &Metabolites</u>	4-8g/Litre
1. Total lipids	5.6-7 mmol/Litre
2. Cholesterol	0.3-0.8mmol/Litre
3. Free fatty acids	100-600mmol/Litre
4. Ketone bodies	
VI. Mineral Materials	
1. Sodium	135-145 mmol/Litre
2. Potassium	3.5-5.0 mmol/litre
3. Cholrides	97-108 mmol/Litre
4. Calcium (total)	2.3-2.8 mmol/Litre
5. Inorganic phosphate	3.0-5.0 mmol/litre
6. Iron	14-32 mmol/Litre

I will not end this section without recording the importance of blood analysis to the pregnant woman, because of the unique nature of this natural condition. In addition to the use of blood in checking the overall well-being of the pregnant woman, certain blood hormones are extremely important in the monitoring of the development and well-being of the foetus. Thus, at least four blood hormones, when regularly monitored during pregnancy indicate this well-being. These hormones include oestradiol, oestriol, progesterone, and human placental lactogen. Oestriol and human placental lactogen are very sensitive indicators of foetal distress and/or foetal death. Hormonal information so obtained will assist the doctor to decide whether to terminate the pregnancy before time and save the mother’s life.

Table 2. Some Haematological Parameters during oral ingestion of Sicklervit. Source: G.I. Ekeke.

Haematological Parameters	Periodic Assay Values ± ISD					
	Baseline	1 Month	2 Month	3 Month	6 Month	12 Month
1. RBC ($x10^6/mm^3$)	3.4 ± 0.	.05 ± 0.3	3.7 ± 0.2	3.8 ± 0.2	3.7 ± 0.	3.8 ± 0.2
2. WBC($x10^3/mm^3$)	12.6 ± 0.3	11.5 ± 1.0	10.8 ± 0.5	10.4 ± 0.5	9.8 ± 4.0	8.5 ± 2.3
3. Hb (gm %)	7.5 ± 1.0	7.9 ± 0.9	8.1 ± 1.1	8.4 ± 0.1	8.6 ± 1.2	9.0 ± 1.3
4. Differentials						
Neutrophils (%)	41 ± 13	43 ± 10	47 ± 13	46 ± 10	39.0 ± 8.3	40.8 ± 10
Lymphocytes (%)	54 ± 12	51 ± 13	45 ± 12	44 ± 4	6 ± 6.5	49.5 ± 5.0
Monocytes (%) + Basophils	2 ± 1	2 ± 2	3 ± 2	3 ± 2	2.1 ± 0.9	2.2 ± 0.8
Eosinophils (%)	7 ± 6	8 ± 6	7 ± 7	7 ± 5	5.9 ± 4.5	6.0 ± 4.5
5. % Sickled cells	10.4 ± 2.0	6.0 ± 4.0	4.0 ± 3.0	2.0 ± 1.0	<1.0	<1.0

The findings indicate an overall improvement in the blood of the sickler resulting from Sicklervit consumption.

Table 3. NADH-Ferricyanide Reductase Activities.
(Ekeke, G.I. And Uwakwe, A)

Oral Consumption Time (Months)	Enzyme Activity (I.U. /g Hb)	Relative % Activity
0 (Baseline)	20.6 ± 3.44	100.0
1	15.98 ± 1.09	77.4
2	13.97 ± 2.87	67.7
3	13.01 ± 2.16	64.0
8	13.00 ± 1.81	63.0
12	10.40 ± 1.06	50.4
<12	6.88 ± 0.88	33.3

Typical Enzyme Activity Changes during Oral Consumption of the Antisickling Nutrient Sicklervit^{TM}. The result shows that effectiveness of Sicklervit in inhibiting the damaging influence of high levels of this enzyme in sicklers can be drastically reduced by up to 67% within a year.

Table 4: The in vitro Effect of Three Nutritionally based Antisickling Agents on the Enzyme Activity of NADH-Ferricyanide Reductase (Ekeke, G.I. and Uwakwe, A.)

System	**% of Enzyme Activity**
Controls	100.0
Phenylalanine	42.5 ± 4.8
Sicklervit	39.06 ± 5.1
Cajanus canjan Bean Extract	65.6 ± 5.7

The three antisickling agents are effective in improving sickle cell by reducing the enzyme activity of NADH-Ferricyanide Reductase. However, the synthetic preparation, Sicklervit, is the most effective.

V

THE UNIVERSITY OF PORT HARCOURT EXPERIENCE

The inaugural Lecturer is naturally happy to have contributed to, and witnessed the graduation of the first batch of biochemistry graduands here on the 6th of February, 1982. There were eighteen of them out of a total of two hundred and eighty eight that graduated that day, amounting to approximately six percent of the total. In the following year, precisely on the 5th of February, 1983, thirteen biochemists graduated out of a total of two hundred and seventy two, representing about five percent; a slight fall compared with 1982. Ten years later, on the 22nd of February, 1992, forty seven biochemists, out of two thousand graduands (excluding diplomas) graduated. This number represented just about two and a half percent of graduands. Clearly, within ten years, the percentage graduating biochemist had been cut in half. Could it be interpreted as a dwindling interest in Biochemistry in particular or in Science in general? I do not think so.

However, records also show that between 1981 and 1988, the number of graduating biochemistry students had remained fairly steady at an average of about eighteen students per annum. Therefore, the marked increased to forty seven graduating students in 1992 needs to be further explained. Although this represented about two and a half percentage of the overall graduating number, it would be erroneously interpreted as a drop in biochemical interest. Indeed, what had happened was that there was admissions explosion in several departments of this University more so in some departments than in others. Even the Department of Biochemistry was not left out in this over-admission exercise, since, in perspective, the Department had actually more than doubled its student intake four years earlier. But this was not commensurately matched with needed resources. However, since 1990, admissions have dropped slightly, but for Biochemistry (UNIPORT) student's admission has remained around the thirty marks annually.

Our Biochemistry Department is also a "service department" because it offers biochemistry courses to students of microbiology, Zoology, botany, medicine and education (integrated science). To that extent, the services offered by the Department have tended to overstretch the rather few members of staff as well as the scare teaching and research materials. Nevertheless, the department has continued to operate as a family; staff has continued to co-operate with one another, and the record of academic achievements has been highly commendable. It is now left to the present and future leadership of that Department, working closely with the University system, to further enhance the overall academic leadership that is expected of us, so as to move Biochemistry forward into the next century. I hereby salute all my colleagues and students who have been a part of our life here. I also acknowledge that human interrelationship that has joined together the academic and non-academic sectors of this University, ensuring the oiling of the wheels of progress and the maintenance of the sanctity and integrity of the university system. We depend on one another all the time.

I have often wondered how far an Inaugural Lecturer like myself can go in talking about himself without sounding arrogant, especially with regard to his moderate academic contributions. Should he do so at all, or leave that judgment to others? I have, however, come to the conclusion that there is no need "hiding the light under the bushel" where it can light nobody's path nor provide the necessary leadership expected of the academia. But while putting that light on the table, it must be so done with all sense of responsibility, humility, truthfulness and steady hands.

It is expected of the academic staff to teach, research and to perform such duties that are assigned to him from time to time. It is consequently on this platform that his progress is largely judged. By the time one is elevated to the professorial status, it is obviously expected that one has been able to achieve quite a bit of each of these assignments.

Our departmental teaching arrangement is this University is as much as possible, patterned on the course-sharing principle. Our postgraduate supervision, in line with regulations, also ensures that at least two academic members of staff look after each student. This approach ensures academic continuity, even when one of the supervisors is unavoidably absent. The arrangement stabilizes the student and widens the scope of staff-staff interaction, especially in co-researching and co-publication of research findings. I have adopted this policy of academic co-operation strongly and satisfactorily in my research approach, even when the original research ideas could have emanated from me. I have found the experience very rewarding. I am proud to recall that my research collaborators in this University and elsewhere include fellow biochemists, chemists, pharmaceutical chemists, physiologist, anatomists and botanists. In this way, the unity of knowledge has been further underscored, and a richer more lasting bond of relationship established through liberal scientific approach. We have carried on as if we are of same blood – same family.

To me, this Inaugural Lecture would be incomplete without some mention being made of sickle cell research experience so far. Sickle cell research, to me, relates to the topic of this Lecture in all its ramifications: (i) Sickle cell is a genetically inherited disorder of the blood (“ like parents, like children”); (ii) this blood disorder is present in the red blood cells, which as we have already observed, are some of the components that contribute to the physiological thickness of blood; (iii) the research findings scientifically explain that this blood disorder is not “OGBANJE”: it has scientific basis to which scientific solution must be proffered; (iv) it presents a vibrant and challenging research future whose surface has hardly been scratched.

The Inaugural Lecturer’s earliest encounter with sickle cell phenomenon was between 1969-1972, at the School of Medicine, University of Zambia, where as the Chief Laboratory Technologist and Research Assistant, I was involved in the screening of over three thousand Zambians for the incidence of the sickle cell gene. The SCD research interest was later renewed in this University in 1983 – eleven years later. Since then the research has been actively pursued, not only for SCD diagnosis, but even more relevantly, for its effective management through medicaments and genetic counseling.

1983 was a memorable year in the history of sickle cell research in this University. It was that year that, leading a research group, I was able to scientifically demonstrate, for the first time, that an edible and locally available beans (pigeon peas or *vio-vio* – as it is known locally) possesses effective antisickling, antigelling, red blood cell membrane stabilizing, and other beneficial properties to the sickle cell sufferer. This finding was first presented by Ekeke, Shode and Ogunranti at an International Symposium on Sickel Cell which was held in Lagos in 1983. This marked the beginning of a systematic research programme that has continued to remain active and vibrant, resulting in more than seventy national and international scientific publications, symposia/conference presentations and higher degree projects. Later, primarily arising out of this research area, the Inaugural Lecturer was awarded the Senior Fulbright Research Fellowship of America, tenable at the University of Houston, Texas, between 1988-1989. While in the United States, I was invited to be the Guest Speaker at a number of Sickle Cell Anaemia Foundations. Notably, I was Guest Speaker at the Mardi Gras Awards Banquet sponsored by the South Western Sickle Cell Anameia Foundation on 7th March, 1989, in the Lake Charles Hilton Grand Ballroom, Lake Charles, Texas. The Fellowship Award also made the chemical analysis of the active ingredients in the pigeon peas possible, and opened up other research possibilities that were to take place later. In particular, this was probably the first scientific demonstration that an edible, non-toxic legume, locally available, offered great promise in the management of this disease. This finding has also been corroborated by other researchers' inside and outside this country.

Greatly spurred by the success already achieved, research efforts have been intensified since 1989 to date, at great personal financial cost, to investigate other food materials for their effective antisickling potential. Consequently, we have shown that virtually all species of our locally available legumes are recommendable nutritional materials for sickle cell management. We have since added a long list of other foods to this category.

Through in-depth literature searches as well as research approach, totally non-toxic highly nutritious syrup called *SICKLERVIT* has been formulated and packaged by me. This nutrient is now being consumed by hundreds of sicklers with tremendous benefits and well-being, and is at its final stages of clinical studies. This product has now formed an antisickling research model that has enabled researchers in the Department of Biochemistry in particular to gain deeper understanding of the aetiology of sickle cell disease even at the molecular level. This syrup model has, for example, helped to explain the basis of the fragility of the sickle red blood cell; why some of its membrane enzymes are functionally deficient; why there are abnormally high phosphate and low calcium concentrations in the sickler's blood and so on. The syrup has also proved useful as a model to test out the claimed antisickling properties of other drugs or medicaments. Sicklervit is, as expected of any effective antisickling preparation, able to reverse sickled red blood cells to near-normal shapes. It also possesses easily demonstrable membrane stabilizing property, with visible reduction in the overall aneamic status of the patient. The potentials of this antisickling preparation remain vast, begging for utilization. Purely from the theoretical consideration at the present time. The syrup, when consumed at the right time by carriers of the sickle cell gene, may well play a suppressing role in the production of homozygous sickle cell zygotes. This is a major line of research that is being contemplated for future execution, which if positive, will have a far-reaching effect on the sickle cell malady.

Sickle cell problem is very serious one, affecting not only the physical well-being but also the psyche of the sufferer as well as that of his immediate family members. But this problem is not, as generally and erroneously believed, a disease of the black race alone. It is, in fact, quite world-wide, ranging in some forms, from Turkey to Israel, the Arabian countries, through to India and then Africa. It then spread over the centuries to the Americans largely through the slave trade, and more recently to Europe by emigration. It is estimated that there are probably about fifty million sicklers world-wide. In Nigeria alone, there are about one to two million sicklers; about thirty percent of our populations are carriers of the sickle cell genes. So far, there is no effective cure for the disease, even though, recently, genetic engineering has raised some hope for eventual cure. What has been reported a few months ago in the newspapers about some British researchers who have successfully cured one or two sicklers through bone marrow transplant is certainly a breakthrough, but the high risk, cost and other possible side effects, including cancer, must not be underestimated. Furthermore, the sheer number involved, together with the ever-continuing reproduction of sicklers, casts serious doubts on the possible use of genetic engineering in the eradication of this disease. Research should seriously be geared towards the use of less toxic medicaments in effective management of this problem. It is strongly believed that the nutritionally-based regimen I have formulated is a major step forward in this regard.

Due to constant or frequent painful crises, the sickler is generally psychologically and physically low. The parents of the sickle cell patients must do everything possible to raise their spirit, not to continue blaming them for the problem. After all, they most ably represent the genetic attributes of their parents: “like parents, like offspring.” They must be loved, cared for and pampered like the rest of the family. Many sicklers have survived to be parents and to be successful in other areas of endeavour – we know some of them who are lecturers, doctors, journalists and so on. The myth that sicklers rarely live beyond five to ten years should truly be discarded into the dust bin of the ignorant! In spite of their handicap, sicklers are highly intelligent and would want to succed where others have.

Over the years, we have continued to experimentally monitor the observed well-being of those sicklers who have been consuming Sicklervit. We have monitored, among other things, the time-dependent improvement in certain important indices such as red blood cell number; white blood cell number; types of white cell and their percentages; the levels of jaundice (as determined by bilirubin values) total blood protein and some relevant enzyme activities. We have discovered that there is general improvement toward normalcy in each of these biochemical/haematological indices. All put together, we now have a good answer to why the sicklers who consume Sicklervit show progressive improvement in health, which also includes drastic reduction in the number of sickled red blood cells in circulation (Tables 2-4).

In blood, there is also a "meeting point" between human and non-human. If one places certain quantities of blood from fish, chicken, goat, dog, cow, monkey, and man in different glass containers, the simple eye may not be able to tell the difference. We know that this is true. There are yet more surprises: these blood samples, irrespective of source, also contain just about the same types of substances such as red blood cells, white blood cells different proteins and enzymes, minerals such as sodium and potassium, and so on. The differences between them, fish blood and human blood, say, are very subtle indeed. For example, virtually all the enzymes present in fish blood are there in human blood: "Blood is certainly thicker than water", irrespective of source! No wonder then that we have made the follow recent discovery in our laboratory here. About three years ago, just by a chance, but inspired search, I came across two species of fish in our local waters whose haemoglobin, on suitable treatment, behaved like human sickle cell haemoglobins SS and SC. Initially, of course, I was taken aback. Further research has now revealed, the presence of virtually all the human genotypes AA, AS, SS, SC, and CC equally presents in different fish species. I have been asked whether SCD came from eating fish! I can categorically say no. indeed; I believe that sickle cell genes may also be present in other animals- it is a matter of researching. We are happy that this finding was first made here, and we believe that it may yet turn out to be a significant finding. We are already designing research projects which will enable us to exploit it fully for the better understanding of SCD. Indeed, this finding should enable us to put forward a more acceptable theory about the origin of the genetic mutation responsible for this haemoglobinopathy.

I have summarized SCD in the following seven verse poem. "Seven" is intended not only to emphasis the "mysterious" nature of this malady, but also to express our sympathy to the poor sickler who may suffer pain all the seven days of the week, and even more. Only sicklers and those who look after them appreciate what a gnawing nuisance it is.

Sickle cell disease you know,
Is a disease of the blood
Not just of the black race,
But some other races too.

The one we call sickle cell trait,
A half gene of this blood ill,
Has slight ill-effect, we know,
And protects against malaria

Was malaria the reason
Why mutation once occurred?
If so, blessing in disguise
Now appears a curse for man?

Beginning was sickle cell trait-
What else could mutation give?
Adults made their mating choice:
Unknown to them came this ill.

Non-existent the disease
Would have been, if those carriers

Had never raised a child:
No sickle cell, none at all!

Now, the stigma once unknown
And so too, much aches and pains
Be advised, susceptible
Be genotyped right away!

With this advice, one fine day,
Hundreds of years though it takes,
The battle for sickle cell
Will be won, one fine, fine day.

VI

THE NIGERIAN BIOCHEMIST AND NATIONAL DEVELOPMENT

Attempts have been made above to direct the focus of the biochemist to the fields of his practical usefulness. Biochemistry as a discipline is primarily based in the tertiary institutions; however, its ingredients actually manifest much earlier. Biology, chemistry, mathematics, and physics are the ingredients of Biochemistry, and they are introduced earlier at the secondary school level. It is at this level that the basic qualifications to embark in the study of biochemistry are acquired, unfolding eventually in meeting the requirements to study the subject at the tertiary institutions.

I cannot think of any university that has not been established for other than national development through individual self-actualization. The curricula must, therefore, of necessity, be structured so as to ensure that the courses taught are of such practical nature to ensure the much needed fruits of national development. This cannot be different of Biochemistry.

The biochemist stands to be integrated into the wider realms of Science and Technology. He must understand, and be current with, the ever-evolving programme philosophies of the various Ministries – Science and Technology, Agriculture and Water Resources, Education and Health, as well as those of the Private Sector. He should be very alert regarding changes in the environmental policies, especially as articulated by the Federal Environmental Protection Agency, through its state counterparts. The biochemist must look critically where he fits in, so as to contribute his quota proudly in the solution of national problems.

The brilliant biochemist needs his brain, tools and available raw materials to take off. In the area of health his training and experience are needed in the clinical and veterinary areas as a researcher and analyst. The potentials in medicinal plants are there for him to exploit. In the exploration of the potentials off our limitless plant, animal and even inanimate raw materials, he is indispensable. This country spends huge amounts of money importing finished products some of whose raw materials emanate from here. For example, enzymes, such as papain, whose only known major source is the paw-paw fruit (*Carica papaya*) used medicinally and as meat tenderizer, can be very simple produced here by the biochemist – even in partially purified form – and exported or used locally. The raw palm oil is not only the source of various fats, but also can be treated for the extraction of vitamin A which is now being prescribed widely to young children by the Health Ministry. Out other foods are degraded and lost annually as a result of poor preservative techniques. This area of food preservation poses a great challenge to our biochemists because of its significant impact on our living standard.

The biochemist singly or in a manageable team can set up small scale industries to handle several productive areas – foods, drugs, chemicals/biochemical, detergents, perfumes or even in the production of medical supplies such as syringes and plastic medical containers from petrochemical raw materials.

Environmental impact assessment strategy is the area that can hardly operate without the biochemist. Here, he is involved in site inspection, sample collection and analysis, quality control (which forms a part of his statistical training) and report preparation. His experience in the theory and practice in the area of radioactivity introduces and extra advantage to environmental liquid/solid material monitoring – whatever the source of the material. He can set up on his own or be absorbed by the labour market in an area that is growing so fast in awareness and practicality, nationally and world-wide.

I have met at least three of our students of Biochemistry who are currently doing well in the banking sector. They work closely with the management on the agricultural section of the banking sector, where they participate in reasoned policy decisions that affect the commitment of large sums of resources to productive agricultural ventures. Even generally speaking, their sound scientific training gives them much confidence and they are not necessarily 'lost' or embarrassed in the company of financiers.

Likewise, I have seen some biochemists in other areas of the economy. Here, in Port Harcourt, the present Area Manager of one of the largest oil companies in Nigeria holds an honours degree in biochemistry. There is hardly a productive area of the national economy that the biochemist is not found – even in the engineering sector.

One major area in the agricultural sector where the biochemist is indispensable is in the livestock feed production. The ingredient sourcing, balancing, mixing and formulation is virtually the exclusive preserve of the biochemist. The reason why the cost of poultry products has risen astronomically is because of the prohibitive cost of feed ingredients, which are also in very high demand. The more basic ingredients in livestock feeds are all biochemical in nature – carbohydrates, proteins, minerals, vitamins, etc. the various proportions of each of these to produce the desired formula is the duty of the biochemist to oversee. The implication of the agricultural sector to national economy and development cannot be overemphasized.

As intelligent, educated and trained sector of the populace, biochemists should, and are capable of, accepting community and national responsibilities. They should be prepared to serve Government or the international community in various capacities. They are in fact doing so, just as I had the opportunity to do a few years ago.

Because of the cardinal roles that the biochemist plays in national development, it is duty bound of the Nigerian Universities to continue to produce quality biochemists. This can be achieved:

(i) By improving the infrastructure in the university system. This involves the refurbishing of classrooms, setting up of the proper visual aid gadgets, etc.

(ii) By improving the laboratories through regular supplies of water, electricity, gas and the repair of equipment.

(iii) By updating research tools, including the availability of a maintenance and laboratory assistance personnel.

(iv) By ensuring the maintenance of standard animal house, well stocked for experiments

(v) By ensuring the procurement of recent books and relevant journals in this subject area.

(vi) By encouraging staff to research, to attend seminars and conferences and to participate in such programmes that will enhance the production of high quality biochemists.

(vii) By encouraging the establishment of inter-university (and international) research collaborative scientific programmes to ensure modernity in the subject area.

The time has long gone when academic emphasis, based on the British colonial masters, was on Classics, History and Literature. Later, especially post-independence, it shifted to Law and Medicine; Engineering and the Pure Sciences took the rear. Now, it is clear that true national economic self-sufficiency has to embrace the availability of man-power from diverse areas of knowledge of which Biochemistry is an important component.

VII

SYNOPSIS

An assertive statement may only be the summary of a much wider, deeper situation. Thus, for instance, when we say, “this is a very tasty dish”, we immediately appreciate what is meant. But there are several discrete, but continuous events that culminated in the eventual preparation of that dish. First of all, the financial resources must be available; then the ingredients must be sourced for; finally, the expertise of a culinary experience must be sourced for; finally, the expertise of a culinary experience must be brought to bear by the cook. This is true of any successful research experience. Time will not allow me to go on – a lot remains to be said and to be done. I must conclude. With this short poem I beg to summaries. There are still many questions begging for answers. I will try to answer some. The rest will generate even more questions, but they will be left for posterity.

You may think it’s all over?
We’re still searching!
It becomes more mysterious
As we proceed!
    This life,
    This blood,
All its elements and things.

What is it we are searching?
A little health.
Maybe some diseases too.
    Sodium.
    Sugars.
What does the diagnosis say?
Does your blood tell everything?
Health things it may.
Parental inheritance
It does convey.
    Gene power,

It's true,
May be embedded in blood.

May I have a little rest?
No, not quite now!
That fish you are observing –
It's blood and all –
Your link?
More work!
Mysterious! More work, more work…..

Blood in indeed more complex than water.

Vice Chancellor, Sir, distinguished ladies and gentlemen,

I thank you very much for sharing my sweat and blood with me most patiently.

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