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BOTANY: ROOTS OF THE PAST, ROUTES TO THE FUTURE

By

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by

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The Vice-Chancellor, Deputy Vice-Chancellor (Management Services), Deputy Vice-Chancellor (Academic & Research), Registrar, Provost College of Medicine, Dean of the Faculty of Science, other Deans, Members of Senate, Ministers of God, my Colleagues, dear Students, distinguished Guests, Ladies and Gentlemen

I give God all the honour, glory and adoration for today, because whatever I am now, it is by His grace.

INTRODUCTION:

Professor Williams W. Sanford, the erudite Professor of Botany at the then University of Ife, in one of his lectures when I was his students, narrated the story of some children who were playing in school and they were talking about their fathers' professions. These children, innocently one after another, were enjoying discussing about their fathers until it got to the turn of one of them who said that his father was a Botanist. One of the children asked innocently "What does that mean?" The child of the Botanist said "I don't know but all I know is that my father is a Botanist". Another child then said, "It is either your father is a herbalist or he loves playing with flowers". This is the impression of many people that I have come across since I decided to stay in this profession. However, I am sure that at the end of this lecture, most of us will have a better understanding of Botany.

In the year 2002, during one of the Holy Ghost services, I was praying about my promotion to Professorship and God told me that I should start preparing my Inaugural Lecture. It looked funny to me, because I could not imagine how one could give an Inaugural Lecture without being a Professor. God then gave me the topic to be 'Botany: Roots of the Past, Routes to the Future' which is the topic of this Second Inaugural Lecture to be delivered by a Botanist in the University of Lagos. This is the first inaugural lecture for 2005/2006 session. I thank the Almighty God for fulfilling this wonderful revelation today.

WHAT IS BOTANY, ITS ORIGIN AND USE?

It may seem interesting that someone who has just been appointed a Professor would want to explain or justify the meaning of Botany and why the teaching of the subject for which he is given a chair is important.

The teaching of Botany started around the 16th century, and it arose from the foundation of a botanic garden. The first botanic gardens in the western tradition were physic gardens attached to schools of medicine. They were created for the use of students and for the production of medicines. Examples include the 16th century botanic gardens of Pisa, Padova and Florence in Italy. Even in the 18th and early 19th centuries, most botanical instructions in universities in the USA were for medical students (Rudolph, 1996). The teaching of Botany in China, as a formal subject, began in the early part of the 20th century and only during the last 60 or so years that its teaching began in some parts of Africa.

The teaching of Botany started mainly to inform people about how drug plants might be appreciated. Scientific Botany, as it emerged in Europe during the Renaissance, was closely tied to Medicine and Pharmacy (Heywood, 1991). The guiding genius in the development of Cambridge Botany was John Ray, who was said to be passionate about Botany and searched the University for someone to instruct him,

"But to my astonishment, among so many masters of learning and luminaries of letters I found not a single person who was deeply versed in Botany, and only one or two who had even a slight acquaintance with the subject so why should not I, endowed with ample leisure, if not with great ability, try to remedy this deficiency".

He shored up Cambridge Botany by giving instruction himself and by publishing material, including the first flora of Cambridgeshire (1660) and of England (1670) (Anon, 2004;

Then, Botany was mainly the study of plants useful for medicine or food, and not the study of plants in general. Written records of the uses of plants, especially as medicines, date much further back in China, Ancient Greece, India and, comparatively recently, the medieval Arab world (Dash, 1995; Eldin & Dunford, 1999; Hernandez Bermejo & Garcia Sanchez, 1998). It was mainly a descriptive and not experimental study.

Botany has been defined as the study of plants. Plants are fundamental to life on earth. Starting with the single-celled algae to the planet largest living organisms, they all contribute to our world's biodiversity and generate oxygen, food, fibres, fuel and medicine that allow you and me to exist. The study of plants allows us to develop an understanding of fundamental processes and substances, our impact on the ecosystem, developing new cures for disease and strategies for feeding a growing population.

Organisms are distinguished as animals, fungi and plants, and a corresponding **division of Biology** is made into the sciences of **Zoology** and **Botany**. **Botany** may be divided into a number of parts. **Morphology** is concerned with the recognition and understanding of the external and internal forms of plants. **Physiology** investigates the vital phenomena of plants. Both morphology and physiology take into consideration the relationship of plants to the environment and the external condition, and endeavour to ascertain whether and how far the structure and special physiology of each plant can be regarded as adaptations to the peculiarities of its environment. These parts of morphology and physiology are often separated from the rest under the name **Ecology**. **Systematic Botany** deals with the description of the kinds of plants and with the classification and understanding of the evolution of the vegetal kingdom. The geography of plants has its object determination of the distribution of plants on the surface of the earth and the elucidation of the causes for this. Extinct plants form the subject-matter of **Palaeobotany**. All these are subdivisions of pure or theoretical botany.

Botany is also concerned with rendering knowledge more directly and is quickly useful to mankind. Apart from pure botany, we also have numerous branches of applied botany, e.g. the study of medicinal plants and drugs, of vegetable food-substances, or technically valuable plants and their products, agricultural botany, and plant-pathology which is concerned with the prevention and treatment of diseases. In the 1950s, molecular and cell biology, followed by plant biochemistry came into the fold.

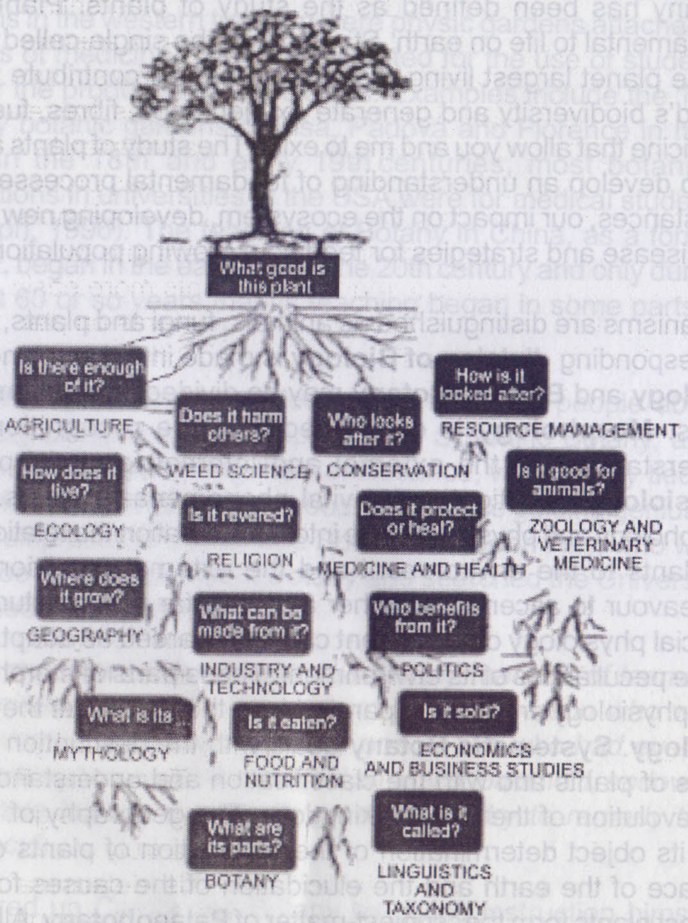

Fig. 1. Some key questions and disciplines relevant to Botany

IS BOTANY STILL ALIVE?

The general public that believes that Botany begins and ends with the naming of plants naturally has plenty of opportunity for misunderstanding this subject. Botanists have also some reasons to look inwards because Botany has grown up with us independent of its practical uses which are neglected. But now a lot of research is going all over the world on plants. The reason for this widening and deepening importance of plant studies is that plants are simpler than animals. Their development and differentiation are simpler than the development and differentiation of animals. Their nutrition is simpler; however, in spite of their apparent simplicity they, nonetheless, protect themselves from viruses, bacteria and other pathogens and do so without enormous complexity. Also in certain crucial respects the chemistry of plants has proved t be simpler than that of animals. My saying that they are simpler does not mean you just pick them up to divide them into two and get your result, but that you can manipulate plants more easily than animals in many respects. Also our experiments on plants are simpler than that of animals because plants offer us the means of simplification needed for the study of life.

Botany today has gone beyond the description of useful plants for drugs, or the descriptive study of plants, it is seen now as the means of understanding some of the deepest principles of life. To put it in another way, scientific discovery is a process such as pulling out a stiff drawer. If it sticks on one side, you have to pull on the other side. Taxonomy is a dynamic branch of Biology, and this is supported recently by Prance (2001a) when he stated that the last half century has been a most rewarding time to be involved in systematics despite the frequent complaints by many Taxonomists about diminishing interest in Taxonomy. Prance (2001b) emphasised the fact that the three most significant developments have been the introduction of a truly evolutionary approach through the use of cladistic methods, determination of new relationships based on molecular data, and the application of systematics to problems of conservation. Also there is great progress in Computer Science, which has been put to good use in systematics both for research and for the storage and manipulation of huge amounts of data contained in our Herbaria. In 1998, a phylogenetic classification of the angiosperms was published by the Angiosperm Phylogeny Group (APG). This was largely based on genetic (DNA) data which was the first major group of organisms to be so re-classified. All these are contributing to the production of the phylogenetic tree of life of all species on Earth. Also, the popular tobacco plant *Nicotiana*, according to Chase, has become in recent years a minor model organism for the study of a number of evolutionary phenomena. This includes studies of genome rearrangements following hybridisation and naturally occurring insertions of viral DNA, which occurs in many species (Anon, 2003). Despite the advances made by molecular systematics, which is profoundly informative in testing hypothesis of phylogenetic relationships, the collection of herbarium specimens and their alpha taxonomic study remain a cornerstone of modern Biology (Smith, 2004). Botanists are working with Computer Scientists, Mathematicians, Medical Doctors, Pharmacists, Chemists and other related fields to keep plant sciences alive.

DOES A PLANT SPEAK?

In 1988 during my field trip to Northern Nigerian with my supervisor, he asked me a question that I thought was unnecessary. While we were in the field collecting plants, he asked "Did you hear that plant speaking?" I thought he wanted to ask me for the name of the plant next to me and I told him it is *Acacia senegal (gum arabic; bonni)*. He replied, "I know it is *Acacia senegal* but did you hear the plant speaking? I said no. Then he said "Do you know that plants talk? I told him that plants are dumb. I did not know that I was looking for trouble on that day. So for two hours, my supervisor lectured me on how plants speak. After some years of interaction with plants I found out that plants really talk, and are not dumb. Humans often consider plants to be passive organisms, even though individual plants display directed responses to light and nutrients. Such responses have recently been interpreted as behaviour or foraging in plants (Silvertown &Gordon, 1989). It

has been found that plants actively respond to anthropoid herbivores by producing toxins in leaves and with the emission of volatile chemicals that are exploited by herbivores (Farmer, 2001). The ability to emit volatile chemicals has been referred to as the ability of plants to talk, that is, to emit information about their state of attack. There has been skepticism about plants responding to information from their damaged neighbours ever since it was first reported (Baldwin & Schultz, 1983). However, there is convincing evidence to demonstrate plants response to such information. Given that plants universally emit induced volatiles in response to herbivores (Dicke &Van Loon, 2000), it is apparent that undamaged neighbours could benefit from exploiting this information. There are some plants that resist information from their surrounding or neighbourhood to which other plants can adaptively respond but perhaps indirectly. This is due to chemical information emitted by their neighbours which is demonstrated by highlighting in plant to plant communication and gene expression.

In plant to plant communication networks, recent field evidence was shown in tobacco plants (*Nicotiana tabacuum = tobacco, taba*) that plants grown next to damaged, sagebrush plants (*Artemisia tridentate*) had higher level of the defensive enzyme polyphenol oxidase. They also have reduced levels of insect damage compared with control plants next to undamaged sagebrush plants (Karban *et al*, 2003). Evidence of gene expression comes from the elaborate and fine-tuned responses of plants to volatile information from their neighbour and from the assessment of gene expression in a laboratory study. Lima bean *(eree)* plants (*Phaseolus lunatus*) induce the expression of several defence-related genes in response to exposure to individual odours from spider-mite damaged co-specific plants (Chon *et. al.*, 2004). It is known that plants also use alarm systems as part of their strategy to protect themselves against pests and pathogens. These rely on chemicals to transmit a signal around the plant that alerts cells that the plant is under attack. Plants have several options when defending themselves: they can sense the invader before attack, they can sense the attack and mount a rapid defence and/or they can sacrifice part of a leaf, or a leaf or two, to protect the rest of the plant. The first step in any plant's defense response is to recognize the attacker or that it is under attack. Plants detect chemicals produced by the invader. These are called elicitors because they elicit a defence reaction. Plants have evolved a 'lock and key' system that can match up elicitors from the pathogen with plant protein called resistance, or R, proteins. The correct match will activate a defence mechanism, called the hypersensitive response, which closes the door to further attack by the pathogen. This also activates the third layer of defence, resistance acquired after the initial attack. This response is systemic (it spreads throughout the plant) and is called Systemic Acquired Resistance or SAR. The SAR system alerts cells throughout the plant to switch on defences that make them resistant to pathogen infection. SAR thus prevents the invader from spreading throughout the plant or establishing new sites of infection. Some of the key genes, proteins and other chemicals involved in the SAR response have been noted, and they include natural aspirin-salicylic acid. The cells around an infection site, which is involved in the hypersensitive response, accumulate high concentrations of salicylic acid (the active ingredient in aspirin is sodium salicylate). It has also been discovered that a gene (SGTI) makes an essential part of the 'lock and key' recognition system. Plants in which this gene does not work (due to mutation) are unable to resist pathogen attack. Plants in which this gene is damaged do not develop SAR in response to pathogen attack (Mathias, 2003). Why I have taken you all through this is to let us know that understanding how plants and their pathogens interact is crucial in breeding and managing crops to reduce both crop losses and our dependence on chemical controls. This is important if we are to develop economically and environmentally sustainable agricultural systems. It is estimated that 20-40% of the world's food production is lost to pests and pathogens, even after a range of controls have been applied, and that without these controls losses would approach 80%.

Apart from direct chemical defenses, which include production of toxins, repellents, and digestibility reducers, there are the morphological defenses that include spines, trichomes (Fig. 2) and thorns, waxes (Fig. 3)and tough foliage. Plant protection by means of natural body guards is well documented and has led to the development of biological control practices in many crops (see DeBash and Rosen, 1991, for a historical review). Ladies and Gentlemen, I believe that you now agree that plants talk and are not dumb but when a plant speaks we do not put ourselves in its position, to sense what plant is saying. The Yoruba adage says "Bi a ba nge igi nigbo, a o fi oro ro ara eni wo" (Whenever something happens to someone (e.g. a bad event), we should remember to put ourselves in the person's position). So we can see that even in our local setting we believe that a plant speaks.

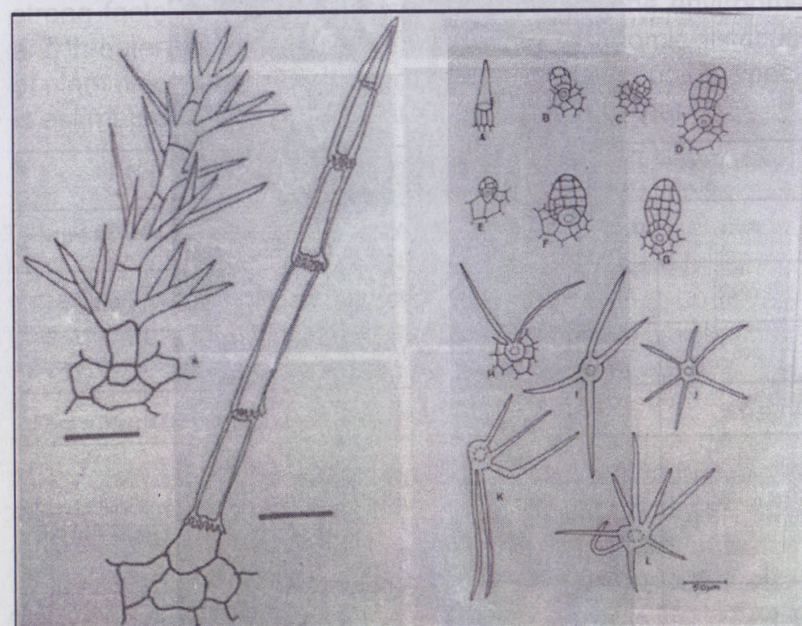

Fig. 2. Line drawings of differenct types of trichomes in the species *Alternanthera* and *Bombax* (Ogundipe 1996 & Ogundipe & Perriera-Sheteolu 2003)

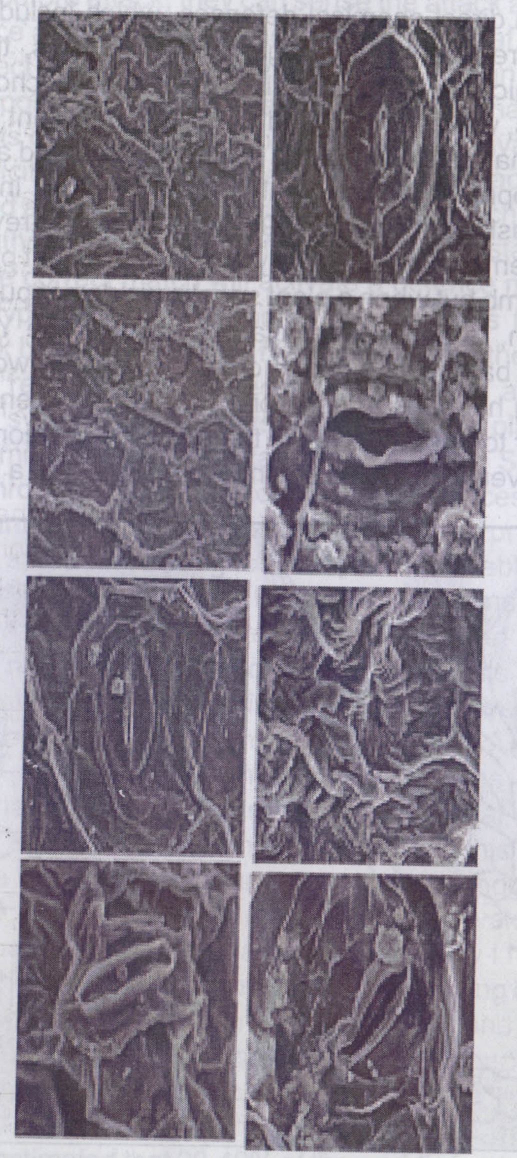

Fig. 3. Scanning Electron Micrographs showing different types of waxes on the epidermal surface of the species of Bignoniaceae (Ogundipe & Wujek, 2004).

HUMAN ASSAULT ON PLANTS LIFE

Based on the 1991 census figures and an estimated growth rate of 2.83% per annum, (Federal Office of Statistics, 1998) the country's population has been estimated at nearly 140 million. This would give a national density of about 120 per KM^2. As in other West African countries, 65% of the Nigerian population is rural dwellers (World Resources Institute, 2002). The increase in growth rate implies an increased demand for food, fuel wood and other vegetal resources. This also directly or indirectly implies increased demand for arable land leading to deforestation, shortening of fallow period, soil deterioration, and increasing application of fertilizers, pesticides and herbicides for agriculture. The environment can be put in jeopardy because of all these demands. Thus, increasing population growth has become a strong factor among the factors that degrade the environment and threaten biodiversity. Table 1 shows the taxonomic distribution of plant biodiversity. The total number of vascular plants species is estimated to be 4715 (Frodin,2001),whereas, that

Flora	Countries	Area (km2)	Vascular plants species
Conspectus florae Angolensis (1977-)	Angola	1,245,790	±5,00
Flora de Mozambique (1969-)	Mozambique	789,800	5,500
Flora of Egypt (1941-1969: 1999-)	Egypt	1,00,250	2,094
Flora of Nigeria (1970-1989)	Nigeria	923,850	4,715
Flora of West Tropical Africa (1953-1972)	Benin, Burkina Faso, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Lone, Togo	3,150,000	≈7,000
Flora of Southern Africa (1963-)	Botswana, Lesotho, Namibia, South Africa, Swaziland	2,677,616	±23,000
Flora du Cameroun (1963-)	Cameroun	475,439	8,000

Table 1. Major current and recently completed floras in Some Africa countries (Frodin, 2001).

of gymnosperm and ferns is approximately 101 species. The number of endemic species in Nigeria is approximately 205, and the percentage of species endemism is 4.3%.

In Nigeria, majority of the population rely on non-cultivated plant resources for a wide range of products. Cunningham (1997) stated that about 80% of all people in Africa inclusive of Nigeria depend on plants for healthcare needs. Firewood supplies 95% of heating requirements in rural areas. Some non-timber forest products are from *Functunia africana (flase rubber, ako-ire)* and *Hevea brasilensis* (Rubber, roba), from which rubber can be made and *Rauvolfia vomitoria (swizzle-stick, asofeyeje)*, which contains the alkaloids reserpine and rescinnamine, these are exported from Nigeria. Forest clearance for agriculture and grazing lands as well as repeated burning for hunting and other purposes have all led to degradation (sometimes severe degradation) of the original vegetation and its species content. The current annual deforestation rate is about 14.3% in kilometer square, every year (Table 2) (FAO, 2003).

A major contributing factor causing the loss of many of the remaining areas of natural vegetation is the growth of the human population. Higher population has led to the clearance of more land for agriculture or increasing intensity of use in areas already under cultivation or grazing. Most agricultural productions are based on methods that give low yields per unit area. However, as the land available for subsistence agriculture has become increasingly scarce in most parts of the country (related to population growth or land being used for cultivation of cash crops), intervals between clearings have become shorter. In some cases, fallow periods have been eliminated entirely and the cultivation of the same areas is continuous, giving rise to serious decline in soil fertility and crop yields. This is particularly the case in some parts of the Sahel. In Nigeria, soil degradation or desertification is acute. In Savannah areas, the Guinea, Sudan and Sahel, there were decreases of 69,907 km^2; 32,186km^2 and 11,983km^2 of total area respectively between 1976 /78 and 1993/95 (FORMECU,

1996). Other ways in which man has assaulted plants are by commercial logging, dry land destruction, fire, urbanisation, fuel wood harvesting and the harvesting of medicinal plants.

We unfortunately carry out this massive destruction, and the consequences are soil erosion, desertification, extinction of species, silting of water courses, dams and lakes, and alteration of local and global climates through dramatic disruption of the carbon and water cycle. The planet might be irreversibly devastated in less than a decade.

COUNTRY (in sq km)	ORIGINAL FOREST COVER sq km	PRESENT PRIMARY FOREST COVER sq km	CURRENT ANNUAL DEFORESTATION (in sq km /% per year)
Bolivia (1,098,581)	90,000	45,000	1,500 (2.1%)
Brazil (8,511,960)	2,860,000	1,800,000	50,000 (2.3%)
C. America (522,915)	500,000	55,000	3,300 (3.7%)
Columbia (1,138,891)	700,000	180,000	6,500 (2.3%)
Congo (342,000)	100,000	80,000	700 (.8%)
Ecuador (270,670)	132,000	44,000	3,000 (4.0%)
Indonesia (1,919,300)	1,220,000	530,000	12,000 (1.4%)
Ivory Coast (322,463)	160,000	4,000	2,500 (15.6%)
Laos (236,800)	110,000	25,000	1,000 (1.5%)
Madagascar (590,992)	62,000	10,000	2,000 (8.3%)
Mexico (1,967,180)	400,000	110,000	7,000 (4.2%)
Nigeria (924,000)	72,000	10,000	4,000 (14.3%)
Philippines (299,400)	250,000	8,000	2,700 (5.4%)
Thailand (513,517)	435,000	22,000	6,000 (8.4%)

TABLE 2: Tropical Deforestation in some African countries, 1990 - 2000

Source: Food and Agriculture Organization of the U.N.: The State of the World's Forests 2003

THE SOCIAL RESPONSIBILITY OF BOTANISTS

Globally, there is an increasing awareness and recognition that maintaining the diversity and richness of species and the ecosystem is essential for the protection of viable and dynamic natural and even artificial systems. Central to this realisation is the appreciation for nature conservation in its broadest definition. However, to adequately conserve these resources we need to have comprehensive knowledge of what should be protected, so we need to have the knowledge of the species around us. In 2001, our President, Chief Olusegun Obasanjo, with some other African leaders, announced the Millennium Africa Plant (MAP) in which it was stated that there is the need to conserve our resources. This is one of the areas where the Botanists are very relevant. They must give detailed information about conservation areas and other related places that would be of use to the community and the country at large. Botanists, in their social responsibility, are involved in global health and wellness, which include traditional healing phytomedicines modalities, organic and eco-friendly agriculture, sustainable ecotourism and environmental preservation . Botanists are key to the future of the planet but the rest of the society must act in environmental friendly ways as well.

BOTANY AS ROOTS IN THE PAST

In the beginning, Botany was thought of only as the study of useful plants and up till now a lot of people still see Botany as the study of useful plants around them. To the herbalist, Botany is the study of herbal plants, to the Horticulturist Botany is the study of ornamental plants; while the women in the rural area using wood for firewood see Botany as the study of wood for making fire.

1	PRE - HISTORY - Folk classifications
2	ANCIENT GREEKS THROUGH LINNAEUS - essentialism
3	NATURAL SYSTEM - overall resemblance; 'importance'
4	DARWIN - evolution language added (only a superficiai effect)
5	NUMERICAL PHENETICS - computers added (only a special effect)
6	PHYLOGENETIC SYSTEMATICS (CLADISTICS) - synapomorphies monophyly

Table 4: Historical periods in biological systematics

Whichever way people look at it, Botany is the root of the past. All comers see Botany from different perspectives based on their interests. . Systematics has always played a central role throughout the history of Botany. The recognition of basic kinds of organisms, their properties and 'relationships' in higher categories, was the earliest botanical discipline. Developments in Botany as a whole have interacted with systematics throughout its history. The historical stages are briefly outlined in Table 4.

There really have only been three revolutions, in the Kuthnian sense (Kuhn, 1970), in the history of systematics. Early folk taxonomies came out of prehistory and were oriented towards practicality and human uses of organisms. Organisms were grouped by their relationship with human affairs. The first scientific revolution was provided by the ancient Greeks in many fields of science, they justified a new logical framework within which to view that natural world. The effect of this on systematics was nicely discussed by Hull (1988), an essentialistic approach that gripped biology for 2,000 years. In this approach taxa were viewed as defined by the possession of necessary and sufficient defining traits.

Actually in the past, the study of Botany has concentrated on alpha taxonomy and the intricacies of nomenclature. The comparative study of plants' structure, morphology and anatomy, which is the backbone of plant systematics, was used to elucidate plant diversity, phylogeny and evolution. What makes taxonomic relationships so interesting is its relationship to Applied Botany. In Applied Botany we have plant breeding, paleobotany, crop science, horticulture, etc. To the plant breeder, taxonomic relationships tend to reflect genetic similarity: two species of the same genus are more likely to be similar in their genetic makeup than two species of different genera, and the difference is expected to be even greater if the two come from different families. A good classification system, therefore, provides an approximate measure of genetic compatibility and likelihood of hybridising various species. Also, why taxonomy is interesting has been shown in a series of case studies which highlighted Taxonomy's value to society (see appendix).

Permit me to use an example of why the study of Taxonomy is interesting to medicine, human health; plant toxicology; phytochemistry; herbal medicine; trade; and botanical nomenclature. In the United Kingdom, two cases of kidney failure resulting from the use of a Chinese herb called *Aristolochia manshuriensis* (Chinese name: Guan Mu Tong) prescribed by practitioners of Chinese herbal medicine was reported in 1999. A Botanist identified the contents of two herbal prescriptions (comprising a variety of loose dried plants) using gross morphological characters (i.e. characters visible to the naked eye). Key to the successful scientific naming of these plants was comparison with reference plant material, which included herbarium specimens whose identity had been confirmed by plant taxonomists. Once one of the ingredients, *Aristolochia manshuriensis* had been identified in both prescriptions, the Aristolochia material underwent chemical chromatographic analysis to check for the presence of renal toxins called aristolochic acids. These were found in both prescriptions. The

patients involved underwent a thorough toxicological investigation to eliminate all other possible causes of renal failure. The outcome was the recognition of the potential severity of adverse reactions to these plant species. The then Medicines Control Agency (MCA) of the UK Department of Health passed a new legislation in 2001 banning the manufacturing, import, sale or supply of any unlicensed medicine in the UK which contained herbs in the *Aristolochia* and Mu Tong group. The Royal Botanic Garden Kew undertook a further research to improve detection methods of aristolochic acids, especially in unlicensed multi-ingredient patent herbal remedies. The lesson here is that the design and implementation of scientifically rigorous herbal authentication systems are vital, if herbal medicine is to be safely practiced in the UK. Without such systems, herbal medicine has the potential to cause life-threatening adverse reactions. Further, plant taxonomic expertise is an essential prerequisite for the construction of such herbal authentication systems (http:www.rbgkew.org.uk).

The classification of plants and animals in hierarchically defined groups are combined into larger, more broadly defined groups; species are collected into genera, genera are grouped into families, families are gathered in orders, orders into classes, and classes into divisions (phyla). Each of such group, large or small, is called a taxon (plural, taxa). The classification scheme creates a branching, treelike structure of implied evolutionary relatedness among the taxa. Traditionally, taxonomy left too many unanswered questions. The past saw accelerated plant collection but the future would focus on improving of the level of inventory and areas that are particularly threatened, collection of rare species and gathering of material for ancillary studies such as molecular work and evolutionary development (Prance, 2001).

Botany has always been relevant to our existence. In spite of being a systematics, I choose not to bore you with taxonomic language. But let me talk about the construction of evolutionary history. I found out that recently some families are more interested in their family tree. If you have given it a thought, I would like to advise you to start doing something about family tree (or phylogeny).

BOTANY AS ROUTES TO THE FUTURE

Continued availability of plant resources for food and agriculture is clearly essential for global food security. Conservation of such resources is also of paramount concern given the alarming rate of loss of plant genetic diversity and the need for new varieties to meet the requirements of a growing population and the demands of changing agro-ecological and social conditions. I wish to say that Nigeria is highly favoured with a diverse range of indigenous plants that have great potential for commercialisation. Most of our plants are used for food, traditional medicine, cosmetics, flavouring, and ornamental purposes. Commercialisation of these plants will create a steady income for the rural and semi-urban unemployed people of Nigeria. Also, a small portion is used for pharmaceutical and food industries. The potential for commercialisation of our plants is enormous, and that is the reason why they are routes to the future. Somewhere in this country an expatriate started the farming of lemon grass with the view to extracting the oil for export. Also in this same country, people engage in the export of fruits and other crop plants. Recently, it was reported that in Pakistan, the leaf of Cassava is good in making cooking kerosene. I would like to say that researches like that have been carried out in this country but we are not interested in encouraging our scientists. Rather, we are only interested in 'imported knowledge'. That was the reason why information like that looked new to the government official and news reporter.

But there is also the need to increase levels of production and marketing of Nigerian vegetable and food crops. It is not only *Manihot esculenta* (cassava, ege) or *Discorea* spp (yam, isu), *Elaeis guineensis* (oil palm) we need to be talking about. We

have *Telfairea occidentalis* (fluted pumpkin, ugu, aworoko), *Aframomum meleguata* (alligator pepper, atare) and many other useful plants (Table 5) we can export to other nations of the world

Geographic range: Region	Number of Medicinal and aromatic plants species found only in the region	Number of Introduced medicinal and aromatic species	Total number of medicinal and aromatic plants species found in the region
Europe	16	71	605
Africa	63	16	343
Asia-temperate	248	13	849
Asia-tropical	90	10	318
Australasia	8	18	[illegible]5
Pacific	1	1	13
North America	124	186	454
South America	106	25	207

TABLE 6: Geographic Range of 1,464 Medicinal and Aromatic Plants in Trade in Germany, 1997

Source: Lange 1997: Geographical regions according to Holli and Brummitt (1992).

Product	Botanical name	Plant part	Activity
Ginseng	Panax quinquefolium	root	Increase energy and sex drive
Wild yam	*Dioscorea spp*	roots	Alleviate PMS and menopausal symptoms
Aloe	*Aloe vera*	leaves	Treats wound and skin problems
Garlic	*Allium Sativum*	bulb	Boosts the immune system, lowers cholesterol
Ginger	Zingiber officinale	Rhizomes	Treats nausea; inflamed joints
Soybean	*Glycine max*	Seed	Rich in protein.

TABLE 5: Claimed Activities of Selected Top-Selling Botanical Medicines

Apart from crop plants, the botanical medicine industry is experiencing a rapid growth world-wide (Table 6). It has been estimated that the annual growth rates are between 10 to 20 per cent in most countries, with the highest rates in relatively immature markets like that of USA (Table 7). One of the reasons for this wonderful growth is that in the USA and European countries, the sale of botanical medicines can be found in wide range of outlets ranging from drugstores to supermarkets. At the same time, the industry is experiencing consolidation of distribution channels and vertical integration as larger companies acquire smaller companies along the production and marketing chain (Laird, 1999). Botanical medicine or botanical drugs (crude drugs as we call them) are produced from whole plant material, which is different from pharmaceuticals. Because of the whole use of the plant, they contain a large number of constituents and active ingredients working in conjunction with one another, rather than a single isolated active compound. The term 'drug' is linguistically

related to 'dry' and is presumably derived from the Middle Low German *droge* (dry) (American Heritage Dictionary 1997). Isolated pure natural products such as the numerous pharmaceuticals used in Pharmacy are thus not 'botanical drugs' but rather chemically defined drugs derived from nature (Heinrich *et al*, 2004). Because the drug approval process and patenting systems do not provide incentives for companies to conduct (expensive and time-consuming) research on the synergistic and collective function of active ingredients in whole plants or plants formulas, botanical medicines are often scientifically poorly understood (Steinhoff, 1998). However, it is known that many botanical medicines have long histories of traditional use, which confirms safety and efficacy, and as documented, are used in many regulatory systems to guide approval of commercial products. Brevoort (1998) stated that in the 1970s in USA, for example, the industry was made up of a handful of dedicated individuals who began selling herbs to each other and a limited consumer.. But in China and India where they have longer life expectancy than Nigeria, botanical medicine is developing every year. In the USA, botanical medicines are part of larger markets in dietary supplements. In fact the use of these remedies is extensive and increasing. In a survey carried out in Western Europe and the USA, it was found that consumers spend in the range of US$ 4 billion (approx. £2.56 billion) per year on herbal medicine products. In year 2000, the UK market for herbal medicine was estimated to be almost £65 million, an increase of 50% over the previous 5 years (Heinrich *et .al.* 2004).

Table 7: Historic and Projected Growth of Botanical Medicine Markets

Country	1985-90	1990-95	1995-9
Germany	8	6	7
France	6	8	9
UK	15	14	16
Italy	15	11	14
Denmark	8	10	14
Spain	15	9	11
Netherlands	8	13	16
Belgium	15	8	10
Portugal	15	9	11
Greece	5	12	15
Ireland	12	10	9
Luxembourg	5	66	8
India	20	25	15
Pakistan	10	8	12
Japan	15	15	12
Taiwan	12	15	15
Korea	15	13	15
Singapore	12	9	10
Malaysia	10	8	10
Indonesia	10	8	10
Philippines	0	0	0
Thailand	8	5	10

Source: McAlpine, Thorpe, and Warrier Ltd, November 1996

Now botanical medicines are sold in a variety of forms. These include capsules, tablets, herbal teas, extracts, tinctures, and dried and fresh herbs sold in bulk. Some of these products may be standardised active ingredients in an herbal base, known as

phytomedicines. Others are sold without specification as to the amount of active chemical compound or chemical group (Laird, 1999).

This is the time for us to go into the exportation of some of our plants on the world market but there is a need to have a constant supply of products. This can be achieved by having semi-commercial to commercial farms for growing selected species. People who are interested in medicinal plants can establish simple cost effective extraction and processing techniques. This technique is being used by some people now. Also there is the need to use attractive and durable packaging for products, standardising of most products, analysing relevance of the products, scientific marketing, creating good advertisement for medicinal or ornamental plants, creating sustainable local and export markets through our embassies, trade fairs, flowers shows, supporting of recombinant DNA technologies to improve crops and identify gaps, determining which genotypes are of high priority and identify other plant families with similar traits.

About 200 medicinal plant species have been added to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) appendices. Therefore conservation is vital, because of high exploitation many people have become conscious about the medicinal use of plants, environmentally unfriendly harvesting techniques, loss of growth habitat of many of our indigenous plants, unmonitored trade in medicinal plants, predominance of introduced crops that are more vigorous than indigenous crops and high demand for plant-based therapeutic products.

The scientific basis for the use of plants in pharmacy is called pharmacognosy, and the main characteristic of herbal remedies is phytomedicines; the clinical use is called herbal medicine or phytotherapy. The historical aspects of medicinal plant use by different societies is ethnobotany or ethnopharmacology and the role of plants in a variety of popular 'non-scientific' medical systems is traditional medicine (Heinrich *et. al.*, 2004).

Horticulture embraces a wide range of activities from high-intensity, large-scale commercial production of vegetables to the hobby of gardening pursued by the enthusiastic (or even the reluctant) amateur. In Nigeria, we have some horticultural products that are in commerce. Rabobank (1994) stated that in 1994, annual global sales of horticultural seed, including flower and vegetable seed for the commercial and private markets, were approximately US$1.75 billion. Two years later, Rabobank stated that the market for vegetable and flower seeds had grown and sales of horticultural seed by the top seven companies alone were some US$1.8 billion. The ornamental horticulture industries comprises four main areas:

1. Foliage plants
2. Woody ornamentals
3. Bulbs
4. Herbaceous ornamentals.

I would like to state here that the major players in ornamental horticulture do not include African countries, but of recent Kenya, Cote d'Ivoire, South Africa, Tanzania, Uganda, Zambia and Zimbabwe were able to get into the market.

Mr. Vice-Chancellor Sir, a lot of people may wonder why our University is not involved more in horticulture, and I want to say this is because of limited space. The historical role of botanical gardens in the introduction of new species and cultivars of vegetable and ornamental varieties is well documented (Desmond, 1998). I would like to plead with the government to appropriately fund the National Horticultural Institute, Ibadan (NIHORT) so that it can produce the desired results for which it was set up.

The application of biological organisms, systems and processes to the provision of goods and services is termed biotechnology. Biotechnology companies apply enzymes and use biologically

active compounds derived from genetic resources as an integral part of processes and products in almost every industrial sector. The methods in biotechnology are divided into: methods used before the discovery of the structure and function of DNA such as those used for millennia to make bread, cheese, beer and wine, and recombinant DNA technology developed subsequently. The second part refers to the modification of genes (DNA) within cells and organisms by incorporating genetic material from other sources (ten Kate, 1999). The techniques for both categories of biotechnology co-exist now, and genetic modification uses certain enzymes to cut, trim, join and copy DNA in very selective ways. Biotechnology continues to search for enzymes that are available in micro-organisms and that can also be found in plants and animals. Taq DNA polymerase is one of the famous enzymes used to copy DNA, which forms the basis of genetic fingerprinting. This enzyme is derived from a thermophilic bacterium *Thermophilus aquaticus*, originally found in the hot springs of Yellowstone National Park, USA. Apart from the health sector, which is the largest market for biotechnology, agricultural biotechnology is the second important market.

Part of biotechnology is molecular systematics which provides an independent source with which to test hypotheses on the evolution of form. Molecular systematic studies have led to a new and better supported framework of angiosperm phylogeny (e.g., Chase *et.al.*, 1993). Systematics will continue to be part of science and part of art. With the unending revisions in the plant phylogeny, and in spite of all the theoretical and methodological disputes, the classifications in use have been remarkably effective in predicting the likelihood of successfully crossing various plants. This is the reason why plant breeders regard taxonomy as much more than an art for art's sake, it is an inexhaustible source of ideas and information and the very best predictor we have for the success of a proposed cross.

In the early 1990s, the Botanical Association of Nigeria issued a release asking for National Botanical Garden and Arboretum.

Around the same time, Botanists in Southern Africa initiated a Network of Southern African Plant Scientists (NESAP) in Mozambique. In 1994, the Southern Botanical Diversity Network (SABONET) was established (Willis & Huntley 2002). In 1999, substantial funding was granted for use in the network after 2 years of campaigning (Huntley *et .al.*, 1998). The project is primarily aimed at developing human capacity and upgrading the facilities in selected Southern African national and university herbaria and botanical gardens. This is to ensure the development of strong professional Botanists, Taxonomists, Horticulturists and Plant diversity specialists within Southern Africa, who are competent to inventory, monitor, evaluate and conserve the botanical diversity of the region in the face of specific developmental challenges and to respond to the technical and scientific needs of the Convention on Biological Diversity. SABONET has been able to change the belief that herbaria and botanical gardens have only a minor role to play in activities related to sustainable development. With this project the member of staff of the various herbaria and botanical gardens in Southern Africa are able to share their expertise and skills with one another. In Nigeria, most if not all of our herbaria have little or nothing to write home about because of limited resources although this is not peculiar to Nigeria but is true of other African countries (Smith, 2004). Even the Federal Herbarium Ibadan (FHI) which used to be the toast of the taxonomist is living on past glory. Indeed, many of the needs of the users of botanical information generated by herbaria can be met only if taxonomy is adequately supported (Steenkaml & Smith, 2003). We need to think of having our own published flora on the web, that is, the flora of Nigeria. Although we have the Flora of West Tropical Africa, we need our own flora.

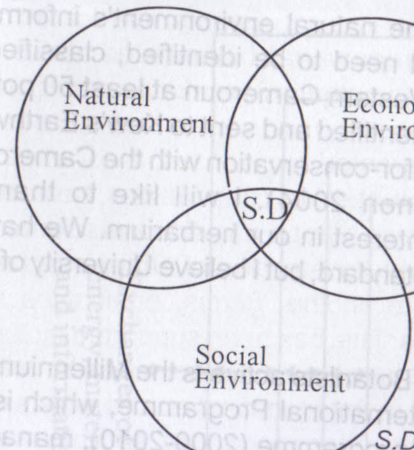

Fig. 4. The Interactive model of sustainability

I will like to say that true sustainable development requires the integration of three stages, viz: conservation of natural environment, social environment and economic environment (Fig. 4). The problem we have in our country is that we are busy talking about the economic environment and leaving our social environme it and conservation of the natural environment. Figure 5 is a model of an ecosystem-based approach to conservation and sustainable development. The centre of attention is the local ecosystem of people and nature, the local level being selected because it is here that people are active and at which practical on-the-ground management is achieved. The potential implications of local actions on wider ecosystems are demonstrated, as well as the effects of external influences on the local. Since biological diversity has a geographical dimension, and since sustainable development must be based on responses appropriate to local environments, it is clear that both conservation and sustainable use are dependent on the existence of an appropriately matching cultural diversity.

There is the need for the government to develop our botanical gardens, herbarium for total plant identification and database because this is part of the natural environment's information. There are plants that still need to be identified, classified and given proper names. In Western Cameroun at least 50 potential new species have been identified and sent to Kew's Earthwatch-Darwin supported survey-for-conservation with the Camerounian National Herbarium (Anon 2004). I will like to thank the Vice-Chancellor for his interest in our herbarium. We have not reached the international standard, but I believe University of Lagos will get there soon.

Other activities that keep Botanists active is the Millennium Seed Bank Project (MSBP) International Programme, which is a ten year global conservation programme (2000-2010), managed by the Seed Conservation Department at the Royal Botanic Gardens (RBG), Kew. The main objective of the programme is to collect and conserve 10% of the world's seed-bearing flora mainly from the dry lands, by the year 2010, and to develop bilateral research and training programmes throughout the world to support and advance seed conservation. Another project is DNA banking for conservation in South Africa. The objectives of the project are to achieve in a DNA bank, the genetic material from at least one species of all about 2200 South African flowering plant genera. Also, to allow researchers to have to plant DNA extracts to be used in applied and fundamental science, through collaboration with Royal Botanical Garden CBD Unit. Furthermore, to implement the necessary legal agreements for material transfer and benefit sharing of these genetic resources, train South African researchers and students in high-profile biotechnologies, produce a phylogenetic 'tree of life' of South African plant genera and identify areas of endemicity and high priority for conservation. Nigeria also requires all these.

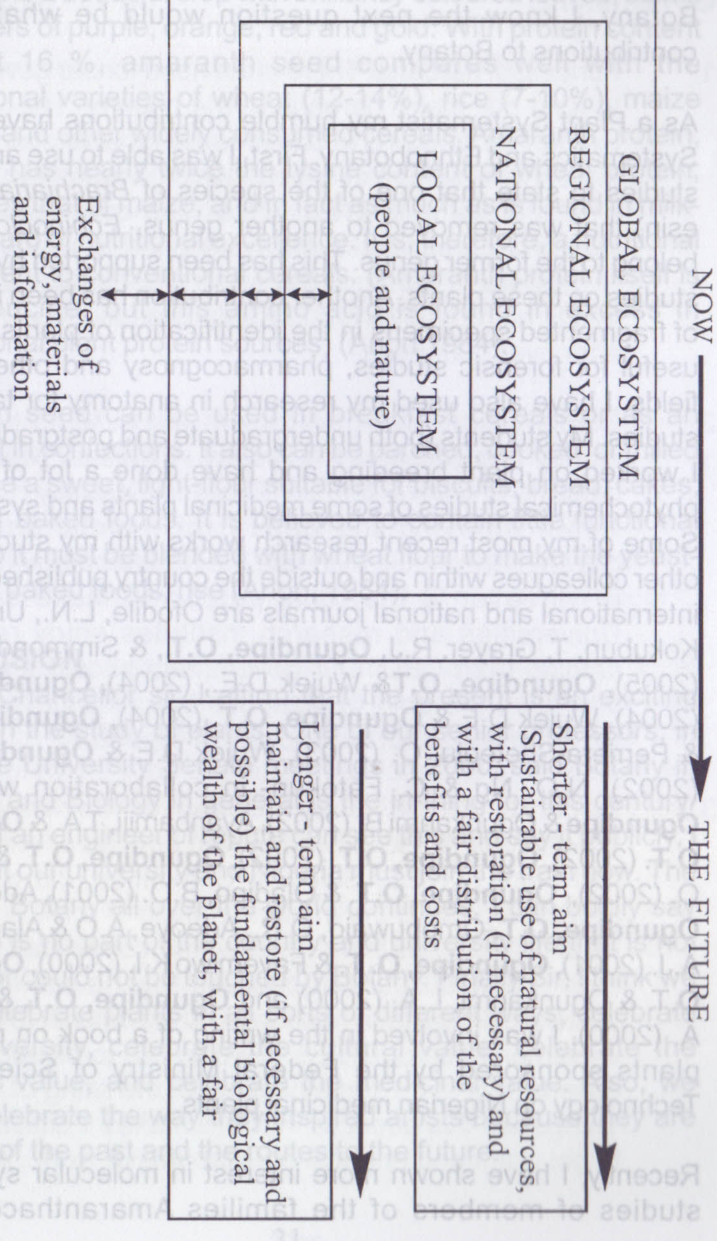

Fig. 4 Model of an ecosystem-based approach to conservation and sustainable development, incorporating an ethical dimension

MY CONTRIBUTIONS

Mr. Vice-Chancellor Sir, from what I have stated above about Botany, I know the next question would be what are my contributions to Botany.

As a Plant Systematist my humble contributions have been in Systematics and Ethnobotany. First, I was able to use anatomical studies to state that one of the species of *Brachiaria* (agbado esin) that was removed to another genus, *Echinocloa* should belong to the former genus. This has been supported by the DNA studies on these plants. Another contribution has been in the use of fragmented specimens in the identification of plants, which is useful for forensic studies, pharmacognosy and other related fields. I have also used my research in anatomy for taxonomic studies. My students (both undergraduate and postgraduate) and I worked on plant breeding and have done a lot of work on phytochemical studies of some medicinal plants and systematics. Some of my most recent research works with my students and other colleagues within and outside the country published in many international and national journals are Ofodile, L.N., Uma, N.U., Kokubun, T, Grayer, R.J, **Ogundipe, O.T.**, & Simmonds, M.S.J. (2005), **Ogundipe, O.T**& Wujek D.E., (2004), **Ogundipe, O.T.** (2004), Wujek D.E & **Ogundipe, O.T.** (2004), **Ogundipe, O. T.** & Perriera-Sheteolu, O. (2003), Wujek D.E & **Ogundipe, O.T.** (2002), N.O. Ng & C. Fatokun- in collaboration with **O. T. Ogundipe** & Ogunkanmi B. (2002), Ayanbamiji, T.A. & **Ogundipe, O.T.** (2002), **Ogundipe, O.T.** (2002), **Ogundipe, O.T.** & Ajayi, G. O. (2002), **Ogundipe, O.T.** & Oladipo, B.O. (2001), Adebajo, A., **Ogundipe, O.T.** Omobuwajo, O.R., Adeoye, A.O & Aladesanmi, A.J. (2001), **Ogundipe, O. T.** & Fayemiwo K.I. (2000), **Ogundipe, O**.T. & Ogunkanmi, L.A. (2000) and **Ogundipe, O.T.** & Ayodele A. (2000). I was involved in the writing of a book on medicinal plants sponsored by the Federal Ministry of Science and Technology on Nigerian medicinal plants.

Recently, I have shown more interest in molecular systematic studies of members of the families Amaranthaceae and

Acanthaceae. Amaranthaceae family includes the genus *Amaranthus* (Efo tete) that would be the plant of the future. Amaranth is a beautiful crop with brilliantly coloured leaves, stems and flowers of purple, orange, red and gold. With protein content of about 16 %, amaranth seed compares well with the conventional varieties of wheat (12-14%), rice (7-10%), maize (9-10%), and other widely consumed cereals. Amaranth protein, however, has nearly twice the lysine content of wheat protein; three times that of maize, and in fact as much as is found in milk-the standard of nutritional excellence. It is, therefore, a nutritional complement to conventional cereals. (Amaranth protein itself is low in leucine, but this amino acid is found in excess in conventional plant protein sources) (Anon 1984).

Amaranth seed can be used in breakfast cereals or as an ingredient in confections. It also can be parched, cooked or milled to produce a sweet, light-flour suitable for biscuits, bread, cakes, and other baked foods. It is believed to contain little functional gluten, so it must be blended with wheat flour to make the yeast-leavened baked foods, rise (Anon, 1984).

CONCLUSION

Mr. Vice-Chancellor sir, I affirm that the present is an exciting moment in the study of plants. One of our senior professors, in one of the University Senate meetings in 2000, said Botany in particular and Biology in general is the in-thing for this century/ decade. If an engineer of repute can see this and say it publicly, I enjoin that our university and Nigeria must join the train now. The growth of Botany all over the world continues. I can boldly say that there is no part of the country and university life that is not touched or could not be touched by Botany. Finally Sir, I think we should celebrate plants in all sorts of different ways, celebrate the biodiversity, celebrate the cultural value, celebrate the economic value, and celebrate the medicinal value. Also, we should celebrate the way they inspired artists because they are the roots of the past and the routes to the future.

RECOMMENDATIONS

Government:

1. Funding of herbaria. There is the need for our government to fund our major herbaria in the country. The Federal Herbarium Ibadan is in dare need of rehabilitation. This is the only herbarium in Nigeria which houses most of the type specimens in West Africa. The development of a standard herbarium is always a pride to a nation. The Royal Botanic Gardens Herbarium in UK is still in existence and is actively involved in researches all over the world after over 500 years.

2. Conservation. Our government will need to put more money into conservation project in Nigeria. Nigeria is a member of Convention on Biological Diversity (CBD) but is not enjoying the benefit of membership. The government should mandate the Minister of Environment or whoever is the focal person to make sure the Universities and research institutes enjoy research funding from CBD. Our government should also make sure they are able to disabuse the mind of the British Government about the security of Nigeria.

3. Recently at the 53rd meeting of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Standing Committee, the report on Nigeria regarding the implementation of the Convention in, and illicit trade from Nigeria was considered and the country was suspended because Nigeria has not made sufficient progress in relation to its action plan to improve implementation of CITES. I would like to plead with our government to do something about the lifting of the ban. Things like this affect us in that it makes it difficult for us to get grant and engage in collaborative work . Also, the government should make sure that the plants and animals that are listed as endangered plants should not be exported out of Nigeria.

4. Fund the production of the Flora of Nigeria.

5. There are so many reports on Nigerian Forestry Action Programme and all other related subjects on forestry and biodiversity awaiting implementation. Government should look onto these reports and act on them. The international organizations of all of these committees are awaiting Nigeria to do something about them.

University

1 Make funds available for the establishment of a DNA Bank in the University. Sir, I applied for research grant with a colleague for the past three years but we have not heard anything about it. This project is supposed to lead to the development of a DNA bank for the University. I hope that after this lecture, the University will do something about it.

2. Presently, we are trying to put the scientific and local names of the plants in Nigeria on our departmental web page on the University of Lagos web site. We will appreciate if the University can fund the other part of the project which includes taking and posting the pictures and the ethnobotany of the plants on the web page.

3. The University can look at the bodies that are ready to collaborate with us in the establishment of Botanic Gardens. This will not cost the University any money, but we can use the place as an outstation for teaching and research.

ACKNOWLEDGEMENTS:

Mr. Vice-Chancellor Sir, permit me to read a summary of my appreciation.

First, I want to thank the Almighty, Omnipresent, Omniscient, Omnipotent God who has made me what I am today. THANK YOU GOD.

I grew in an environment where love is expressed in many ways and an envious environment which I am always proud of. I would like to appreciate so many people who have touched my life in one way or the other and have contributed to my progress in life. I am indebted to my parents Evang. James Ogundipe and Madam Juliana Jemidope Oyebanjo. They provided all the love, support and guidance needed in all my endeavours in life. My father died over twenty-six years ago, but my mother who died about twel e years ago was so anxious about my success in life that when I got my Ph.D in1990, she said there was one more step for her before she would depart in peace. When I got married in 1992 she then said she could now depart in peace, and on October 28, 1993 she departed in peace. I thank all the Ogundipes of Isara-Remo and Oyebanjo of Mobalufon for being there. I wish to thank my siblings, including Mr. Babatunde Ogunlase, Abayomi Gbolade, Kunle Gbolade and Mr Braimo Ogundipe; they have always given me all the moral support I needed. My aunty and her husband (Mr. Kole and Mrs Bimbola Payne), you have been wonderful.

I am grateful to Late Mrs. AnuOluwapo Akinpelu, Mr. and Mrs. Bayo Akinpelu Mr. and (Dr.) Mrs. Olakunle Akinpelu, Dr. and Prof. (Mrs.) Yemi Sanya and Mr. and Dr (Mrs) Ayo Akinlade who touched my life in my earlier days. I appreciate Mr. Olawale and Mrs. Titi Akinpelu for their support. Mr Olawale Akinpelu in 1985 asked me to write an essay of what I would like to be in five years time and where I would like to be in ten years time. He has been our source

of inspiration in the family. I am grateful to Chief Daniel Akinpelu and my late aunty Chief (Mrs.) Felicia Adeoti Akinpelu (Mama Bariga) who was always there for us.

Chief Samuel Tayo Oyebanjo and his wives contributed immensely to my progress. I am thankful for your contributions. I wish to specially show my gratitude to Mr Olumide and Mrs. Bioye Oyebanjo. Olumide and I grew up together and he has been my confidant since childhood.

I appreciate the love, and support bestowed on me by my 'mother', Chief (Mrs) Olaitan Kuyoro. She is more than a mother-in -law to me. Damola, Motolani, Ololade, Jumoke and their spouses; all the Kuyoros and Sanwoolus, I thank you for your love and support.

My spiritual brothers and sisters especially Pastor Oluwole and Pastor (Dr. Mrs) Mopelola Olusakin and all my brethren in RCCG-Christ the Lord, I am grateful to you for all your support and encouragement. Pastor Azuka Ogbolumani, Dr. and Mrs H. Akinduro, Dr. & Mrs A. Adekunle, Engr. and Mrs Niyi Odutola. Mr. & Mrs A.K. Akinbode and Pastor and Mrs Femi Obembe and all my brethren in Chapel of Christ our Light, I am grateful for your support. Also, I appreciate Late Mama G.M. Idaomi and Prof. &Mrs Akinwande.

I need to mention specifically, my mentor and supervisor in the University, Late Dr. Olanrewaju Adebayo Olatunji and his wife Mrs Felicia Olatunji. He discovered me and imparted in me academic excellence. In fact I became his adopted son that he was so proud of. I am grateful to Professor Omotoye Olorode, Dr . J. A. Faluyi and all my lecturers and course ates in the University of Ife (now Obafemi Awolowo University).

My colleagues and staff in the Department o Botany and Microbiology and Faculty of Science ave been so wonderful to me. B pardon me to mention Profes rs Adetokunbo Sofoluwe

(**my brother and friend**), Dele Olowokudejo, Babajide Alo, Kayode Amund, Oluwole Familoni, Drs, Hansel Erhie, A. Akinsoji, Mrs N.U. Uma, Bola Oboh, Mrs. M.A.Taiwo and Mrs. B. O. Odukale. Professor O.T. Okusanya I say thank you for having confidence in me and recommending me for appointment in this University. Professors Kola Kusemiju, G. O. Williams, Saida Mabadeje (Mama). Dr. A.W.A Edwards accept my appreciation for always being there for me. I appreciate Dr. Yemi Daramola for his kind assistance in reading the final write-up. Prof. Oyebande and the group of Sub-Deans (1998-2000), I enjoyed working with you.

I thank all my project students in particular and all the students that have passed through my tutorship at both the undergraduate and postgraduate levels. During my academic pursuit, I have enjoyed working with Professor Dan Wujek (now Emeritus Professor) of the Department of Biology, Central Michigan University, Michigan State, U.S., and Professor Mark Chase, Drs. Michael Fay and Vincent Savolainen of Jodrell Laboratory, Royal Botanic Gardens, Kew, Surrey, UK.

I thank the Vice-Chancellor, University of Lagos, Professor Oye Ibidapo-Obe, all the past Vice-Chancellors from 1990 and the Registrar, Mrs. C.F.A. Olumide, for the support I enjoyed from them. I greatly enjoyed the researches in have carried out within and outside the country with financial assistance from the University of Lagos and other institutions like the Lennoix-Boyd Memorial Trust, Royal Society of London, Royal Botanic Gardens, Kew, Central Michigan University, etc. Also, am grateful to Prof. Mike Bernett, the Keeper of Jodrell Laboratory, Royal Botanic Gardens, for his support. I am indebted to my country Nigeria for investing in me.

I express particular appreciation and gratitude to this lady who in 1987 was studying for her first degree in Economics and I was studying for my Ph.D whom as a taxonomist I was able to identify, classified and named when we met. She accommodated me so

much that one of my friends (Mr. Humble Aghughu) would always ask her how she was able to cope with me. She is my amiable, loving sister and wife, Mrs. Oluwaseun Olubusola Ogundipe. I thank you for all your spiritual, financial and emotional support to my success in life, especially for standing in the gap each time I am away on my academic adventures. The Almighty God gave us three precious gifts; MoyosoreOluwa, MorounfOluwa and MoriyanuOluwa. Thank you for being sources of joy to us.

I remember the words of one of my favourite verses in the Bible: "Trust in the Lord with all your heart, and lean not on your own understanding; in all your ways acknowledge Him, and He shall direct your paths" (Prov. 3:5-6). The Psalmist says "I will praise the LORD with my mouth; yea, I will praise him among multitude". I stand before you to praise the LORD and thank the real Roots of the past and the Routes to the future. He is my strength in time of need. He is the root of my past and the route to my future. **He is Christ The Lord.**

Mr. Vice-Chancellor Sir, with joy I lay my Inaugural Lecture as sacrifice on the academic altar. Thank you ladies and gentlemen for giving me part of your time. May the good Lord be with you all and make your joy to be full.

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APPENDIX

***Compiled by* BioNET-INTERNATIONAL**

Implementing the Global Taxonomy Initiative of the CBD

CASE STUDY 17

Timely identification of water weed indicates there is no need for a costly control programme

Relevant Sector: Fresh water ecosystems, invasive alien species

Geographic Location: Thailand

Problem Statement: *Salvinia molesta* occurs naturally in South America but has become a serious invasive water weed in Africa, Australia, Papua New Guinea, Indonesia, Malaysia, Sri Lanka and Southern India. In the mid 1980s, an entomologist from the Department of Agriculture, Thailand, upon a directive from the Ministry of Agriculture & Cooperatives, proposed a project on biological control of this weed in Thailand. The weevil *Cyrtobagous salviniae* (from South America), successfully introduced as a biological control of *S. molesta* in Australia, was proposed for testing and release. The proposal was sent to local taxonomists for review and evaluation.

Methods: Locally available taxonomic experts were able to show that *S. molesta* did not occur in Thailand. The locally occurring *Salvinia* species had been misidentified and was in fact *S. cucullata*, a species very similar in morphology and appearance to *S. molesta*, but smaller in size and less weedy.

Outcomes and Impacts: The local taxonomists informed the relevant government officials that *S. molesta* did not occur in Thailand and that an eradication programme was therefore

unnecessary. The proposed biocontrol project was thus withdrawn. Should the correct and timely identification of this weed not have been made, the Royal Thai Government could have spent at least the budgeted US$5million and a period of no less than 5 years implementing a wholly unnecessary biocontrol project.

Lessons: The timely use of taxonomic expertise resulted in the prevention of government spending millions on an unnecessary biocontrol programme.

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Implementing the Global Taxonomy Initiative of the CBD

CASE STUDY 8

Correct identification of fungus saves $5 billion/year US wheat export market

Relevant Sector: Agriculture (wheat industry), invasive alien species, trade

Geographic Location: South-eastern United States, but impact on the entire wheat industry

Problem Statement: In 1996 and 1997, much of the $5-billion/year U.S. wheat export market was threatened by the supposed discovery of a fungus, Tilletia indica (which causes the disease Karnal bunt in wheat) in wheat crops in Arizona and a small part of California. It is estimated that about one third of countries that might buy wheat from the United States will not buy Karnal-bunt-infected wheat. During the U.S. national Karnal bunt survey of 1996, T. indica-like fungal spores (teliospores) were found in wheat grain washes from the south-eastern United States. However, no bunted i.e. blackened and foul-smelling, wheat seeds were found. Ryegrass seed infected with a similar fungus sometimes gets harvested along with the wheat. Initially, available tests incorrectly identified this fungus as Karnal bunt. As a result, in 1996-97, restrictions were placed on the movement of suspect wheat from Alabama, Georgia, Florida, and Tennessee.

Methods: While the wheat grain wash samples in the south-eastern United States, were testing positive for the Karnal bunt fungus using the then-available molecular test, because no bunted wheat kernels were found an incorrect identification was suspected by taxonomists. After close taxonomic re-examination of the bunt fungi family using light and scanning electron microscopy of the spores, it was determined that the Tilletia species on the ryegrass was an unnamed species new to science. With these techniques, it was determined that, with experience, visual characteristics could be used to tell the two fungi apart.

Outcomes and Impacts: The new techniques quickly showed that 100 percent of each of the wheat samples collected from south-eastern farms in 1996 were contaminated with the new fungus (named T. walkeri) and not Karnal bunt. As a result, in March 1997, restrictions on the movement of the suspect wheat were lifted. Federal plant quarantine officials now use the new technique as a first cut, to decide if possible quarantine actions are needed.

If Karnal bunt had been incorrectly confirmed in the south-eastern US wheat crop, it would have indicated that Karnal bunt was widespread in the US and that all wheat produced in the US was potentially infected. This would have threatened the entire US $5 billion export market, with disastrous consequences.

Lessons: Taxonomic expertise allowed for the distinction between the different fungal species. The correct identification of a new fungus led to the lifting of the ban on movement of the wheat crops from the south-eastern United States and prevented the wholesale rejection of all wheat export produce from the US. What could have been a trade and agricultural disaster was avoided.

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The conviction of child-abusing parents

Problem Statement: A mother whose baby had died of starvation, neglect and maltreatment claimed she had fed the baby fruit cocktail just before the baby died of accidental causes.

Methods: Police and prosecuting attorneys brought samples of the stomach contents of the dead baby to taxonomists at the University of Colorado, Boulder. The taxonomists were able to state positively that the stomach contained no evidence of peaches, pears, pineapple, grapes or cherries.

Outcomes and Impacts: The parents were convicted on several counts of child abuse and one count of murder. They are currently serving prison terms.

Lessons: The use of taxonomy proved that the mother was trying to mislead the police and the courts.

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