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Inaugural Lecture Series 47

LAWS OF ARRANGEMENT

by **A. O. SEGUN**

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"LAWS OF ARRANGEMENT"

What in this world can more delight
Than the nobility of creatures studied as they really are?
What can excite joy and wonder in the soul
More than viewing the reality of nature?

C. F. Neichlius (1727)

Many people including even some of the most learned here may be puzzled about a zoologist giving a lecture on any aspects of law. I hope that during the course of this lecture, it will become increasingly clear that the topic, laws of arrangement, concerns the most fundamental and inclusive aspects of life sciences. It will deal with the scientific term, taxonomy – a word derived from two Greek words, "taxis" which means arrangement and "nomos" law. A branch of biology which used to be called "natural history" deals with the diversity of organisms within their environment. This is now split into the two separate branches of systematics and ecology. Systematics is involved with the descriptions, classification and all relationships among species. It therefore, includes taxonomy which is the theory and practice of classifying all organisms, both living and fossil, into a grand overall scheme. It should be noted that classification of organism is not the end of a taxonomist's concern, he is also interested in species formation, factors of evolution, structure of natural populations, biogeography, and the entire broad field of comparative biology.

In this lecture, I will confine my remarks to the study of taxonomy as it relates to animals. Collecting natural history objects like shells, beads, pearls etc must be as old as man himself, and it is a reflection of man's inherent curiosity. At first, these objects were primarily of utilitarian interest to him, then the importance of their aesthetic values (colour, forms etc.) surfaced, and ultimately these values became recognized as important documentation of various kinds of organisms and of their geographic distribution, variability and evolutionary history. Today, whenever a collection of unknown organisms is made, a taxonomist's first task is to sort out the diversity of individuals into easily recognisable and internally homogenous groups which are known as *phena*. Then his knowledge of biological phenomena enables him to assign the phena to species, the lowest taxon or category routinely used in classification. As soon as the basic units are discriminated sufficiently, detailed description must be made which would enable other zoologists to recognize these species whenever other specimens are found. After this, it becomes necessary to supply identifying distinctive "names" to each of these groups. This aspect of systematics is known as zoological nomenclature.

Naming of animals facilitates communication among zoologists, and like every language, universality and stability are two of its most important qualities. But unlike ordinary languages which grow spontaneously in innumerable directions, zoological nomenclature represents an exact tool that conveys a precise meaning to all scientists of all generations.

The taxonomic system in use today is founded on the work of Carl Linnaeus (1707-1778), the son of a Swedish clergyman and subsequently Professor of Botany at the University of Uppsala. In 1758, the 10th edition of his book, *'Systema Naturae'*, was published and, due to the utmost importance of this work, 1st January, 1758 has been arbitrarily regarded as the starting point of zoological nomenclature and for his contribution, Linnaeus is regarded as the father of taxonomy.

The valid rules of zoological nomenclature are contained in an authoritative document of Code of Laws entitled the "International Code of Zoological Nomenclature". The idea was first proposed by the Secretary-General of the 1st International Congress of Zoology in Paris in 1889. Since then, there had been series of congresses which reviewed the Codes by making additions and changes until the current Code of Laws was adopted by the XV International Congress of Zoology in London in 1958. It is published in English and French and it constitutes the only complete text officially to supersede the original *'Regles Internationales'*. This Code of Zoological

Nomenclature consists of a "Preamble" followed by 87 consecutively numbered "articles" which are mandatory rules to which some "recommendations" are attached. These 87 articles or "laws" deal with the number of words permissible in zoological names, criteria of publication, criteria of availability, date of publication, validity of names, formation and emendation of names, taxa of family-, genus-, and species-group and their names, authorship etc. I will like to point out that Regles, unlike secular laws, can neither compel acceptance nor punish transgression. This means that one cannot be dragged to a law court for violating the Code.

The object of the Code as stated in its Preamble is to promote stability and universality in the scientific names of animals, and to ensure that each name is unique and distinct. The basic principle of zoological nomenclature is priority for usually the valid name of a taxon is the oldest available name which has been applied to it (Article 33). But exceptions to this law of priority are made if:

(i) the senior name, although valid, has remained unused for more than 50 years, in which case it is regarded as a *nomen oblitum* (forgotten name);

(ii) the species occurs in several different forms (e.g. sexually dimorphic forms) and each form was described as different species before the relationship between them was discovered; and

(iii) the original description is so inadequate that it is impossible to know whether other specimens found subsequently, should be referred to the species or not.

Quite naturally, there are local names for the various living organisms in the different languages of the world by which the people in the area refer to these organisms. In Nigeria, there are common local names for plants and animals. For instance, earthworms are known as *'Ekolo'* (Yoruba), *'Tana'* (Hausa), *'Idide'* (Igbo), *'Iyenmi yin'* (Ora) and *'Ideneku'* (Ighalla). In Hausa, *'Tana'* not only refers to earthworms alone but also to the other completely different worms such as the ascarid roundworms found parasitic in the human intestine. This is really an example of the dangers of using local names which are very inadequate for scientific purposes. Besides, these names may be different in the hundreds of dialects existing in this country. In effect, this means that a zoologist must have a working knowledge of these dialects to be conversant with those local names. To avoid this kind of situation, zoologists by international agreement, adopted not only a single set of names for animals but also a single language to be used on a worldwide basis.

The scientific name must be either in Latin or it must be latinized (Article IIB) because Latin was the international language of European scholars of the Middle Ages and the majority of scientific papers up to 18th century were written in that language. It then follows that some knowledge of Latin is very desirable in zoological nomenclature.

Zoological names must be words. Symbols, numbers and formulae have no status in nomenclature. The name of a species consists of two words (binomen) and that of a subspecies of three words (trinomen); in each case the first word is the generic name, the second is the specific name, and the third, when applicable, is the subspecific name, e.g. *Hyperiodrilus oshogboensis oshogboensis* - *Hyperiodrilus* (generic), *oshogboensis* (specific) and *oshogboensis* (subspecific). This name must be accompanied by a description or definition and it must be properly published in a scientific journal. The generic name is the most important because it is the main name to which the specific names are attached and it is also the foundation for the names of possible higher categories. Hence the generic name must be different from every other generic name ever proposed for an animal and it must be presented with a diagnosis which contains a clear statement of the characters in which the new genus differs from previously described genera. It is a single word in the nominative singular written with a capital initial letter. The specific name is most often adjective which must agree with its noun in gender e.g. *Libyodrilus violaceus* (masculine,) *Fasciola hepatica* (feminine) and *Distomum hepaticum* (neuter).

But it may be a noun in the genitive case particularly when it is patronymic and based upon the Christian or surnames of people such as the original collector of a specimen or an outstanding contributor to a particular field e.g. *Nsukkadrilus mbae* after Dr. C. C. Mba of University of Nigeria who first sent me the specimens and *Iridodrilus tonyii* after Professor 'Tony Adegbola of this University with whom the collection of these earthworms was made. It is conventional in zoology to print proper names of person or places not with a capital but with a small initial letter when treated as specific names. In all cases, however, specific names should strictly be followed by the name of the scientist who first gave the animal its name, and very often this is followed by the date e.g. *Vomia prima*, Segun 1976. But this practice is invariably not followed in the general literature. Once a valid name has been published for a species, it cannot be changed even by the original author.

The use of brackets or parentheses in zoological nomenclature has specific meanings. Firstly, if a species has been transferred subsequently to a different genus from the one to which the author originally assigned it, the author's name is shown in brackets. Thus, *Lumbricus eugeniae* Kinberg, 1866 is now known and written as *Eudrilus eugeniae* (Kinberg), 1866. Seondly, the name of a subgenus, when used in combination with the generic and specific names is placed in parentheses between those names e.g. *Archachatina (Calachatina) marginata,* the giant land snail. It should be noted that a subgeneric name is not counted as one of the words in the binominal name of a species or trinominal name of a subspecies.

Should the taxonomist be satisfied merely with alpha-taxonomy which deals with the initial description of new species and their preliminary arrangement in comprehensive genera, he would be left with total chaos, considering the estimated ten million species of living organisms in existence today. He thus replaces this threat of chaos by embarking on the beta-taxonomy whereby relationships on species level and on higher categories are worked out and emphasis placed on development of a sound classification. Animal classification is a scientific theory, and like all theories, it is provisional being subjected to continuous testing, and the moment it becomes inadequate, it is rejected. Taxonomy is explanatory, it has a high predictive capacity in its ability to accommodate the findings derived from new characters and newly found species. It also serves to discover and test various types of characters.

Animal classification can be either by the archetypal method when each group of animals consists of those that show common charateristics and each such group contains within itself other groupings similarly composed of other common characteristics, or by the hierarchic or the graded system, invariably used by zoologists. In the hierarchic classification, each group is defined by a number of features, the majority of which are shared by all its members. Linnaeus (1758) arranged groups of animals (taxa) in four steps of increasingly inclusive range: an assemblage of related species constitutes a genus, similar genera were put in an order, and similar orders in a class. Then the term 'family' was introduced by Butschli in 1790 to bring related genera together and it was placed between genus and order. Haeckel (1886) introduced 'phylum' to associate related classes. This highest-ranking category covers all animals constructed on the same fundamental body plan. The six taxa, phylum, class, order, gamily, genus species are known as obligate taxa. Recently, 'cohort' is interposed between class and order and 'tribe' between family and genus to improve the precision of the system. Prefixes to the names of these eight taxa are also being used so as to meet the demands of the taxonomists, e.g. Sub-phylum, Super, Infra-class, etc.

Now that this is the age of the computer, quantification of classifying characters was introduced to animal taxonomy in 1975. This numerical taxonomy or taximetrics is based on a phenetic approach and it utilises 'unit charaters' which are of an all-or-none nature and which are listed in the form of a data matrix. There are 3 types of coefficient of similarity based on the analysis of the association of pairs of taxa (Q-type)-co-efficient of association, of correlation and of distance. The most satisfactory method for expressing the difference between 2 taxa is to calculate the total 'distance' in a multidimensional space. Apart from this computational method being very time-consuming, its greatest practical difficulty is the scarcity of taxonomically useful characters in most groups of organisms. It should be pointed out that taximetrics is not a method of identification. For instance, one cannot count the various parts of a strange animal, measure its bits and pieces, feed the resultant data into a computer and receive an answer such as *Parapolytoreutus obiensis* Segun, (scientific name of one of the earthworms described). However, when there are several competing biological classifications, a phenetic analysis (taximetrics) may be illuminating. Numerical taxonomy may fortell a breakthrough, but in the present state of its development, it is unable to provide stable classification.

Another type of taxonomy known as chemical or biochemical taxonomy, owes its existence largely to recent developments in two laboratory techniques-chromatography and electrophoresis. For instance, paper chromatography has been used to compare the chemical composition of closely related species with particular attention to amino acids and peptides which are revealed by ninhydrin treatment, and both purines and pyrimidines or other substances that either flouresce or absorb ultraviolet light (Wright, 1966). Furthermore, amino acid composition of haemoglobin is compared with that of closely or more distantly related species as patterns of replacement often indicate whether or not 2 organisms belong to the same phyletic line (Handler, 1964). One other branch of chemical taxonomy, cytotaxonomy involves chromosomal studies of various glands and this has been used successfully to separate valid cytospecies particularly of sibling species.

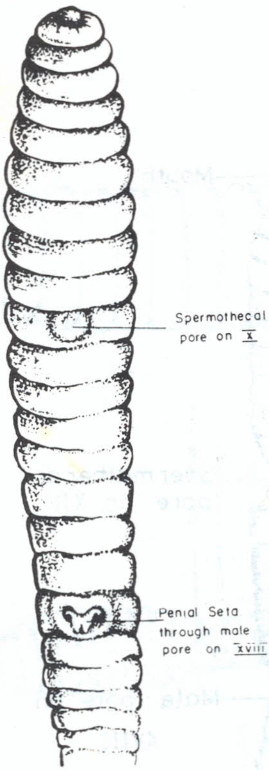
The preamble of the Code of Zoological Nomenclature stresses that none of the Codes shall 'restrict the freedom of taxonomic thought or action.' This means that differences of opinion must abound as they do in art or politics because no taxonomist is forced to accept a particular classification. It also means that there is no impartial systematist, just as there is no impartial historian, because the characters used in classifying must be judged and compared to determine their values or significance. As classical or conventional taxonomy is both qualitative and subjective, it is little wonder why there is so much discontent with the present state of conventional taxonomy.

Systematic biology is an additive science and does not make strides forward to major unifying natural laws. It does not lend itself to the sporadic quantumlike great leaps forward that have characterized the history of the physical sciences. It generally moves forward at a crawl. In Nigeria particularly, systematics has almost always been at a standstill, for taxonomic problems are a matter of taste among zoologists. These problems are loved by very few specialists, tolerated by a few more broad-minded individuals, actively disliked by some others, but essentially ignored by the majority of these scientists. And yet as G. G. Simpson of Harvard University (1945) said, systematics is the most scientific of all the sciences, and the terms 'systematics' and 'scientific' should be interchangeable. It is however, very heartening to add that some departments in this University, notably Zoology, Botany and Plant Science (Entomology) are contributing, howbeit little, to the development of this basic science. Although I am not totally unaware of some of these works, I will restrict myself to my contributions so as not to deprive others the pride of talking about their own work.

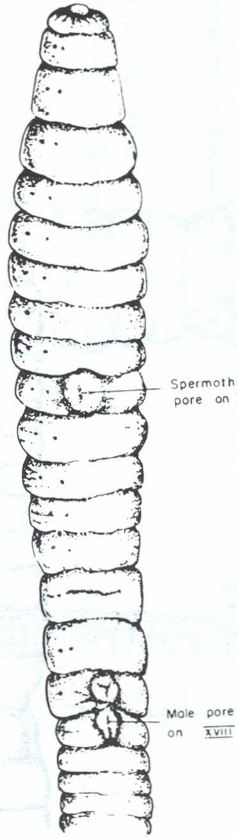
Taxonomy of animal groups is not made without long and painstaking study of many specimens of the animals concerned. As a postgraduate research assistant in London, I worked on the 'systematics, occurrences, host-specificity and possible mode of transmission of acephaline monocystid species of British earthworms'. Thirty monocystid parasites including 4 new species were described and eighteen of these were found to be monobiotic (species-specific), eleven oligobiotic (genus-specific) and only one was of very low specificity, being polybiotic (family-specific). On my appointment as a lecturer in this University, I planned to undertake a similar work on Nigerian earthworms. But like most other groups of invertebrate animals in this country, their taxonomy was virtually unknown. This inability to identify the earthworm host species coupled with the sad fact that preserved specimens of European earthworms were being imported into this country from Britain, at one shilling each, for class intructions, compelled me to embark on the taxonomy of Nigerian earthworms. As I pointed out at the Faculty of Science lecture in January 1978, 'one can imagine the cost to us, as a nation, of such imported specimens in terms of our economy (foreign exchange for the material and relevant textbooks), psychological inferiority and most especially academic dependence'. Perhaps one should state here that beside the theoretical necessity of knowing all local animals, the earthworms are probably the most familiar annelids and they are of particular practical importance in litter decomposition, soil aeration and mineral cycling. They are even used as food and medicine in some parts of the world.

This 'enforced' diversion from monocystid parasites to earthworm hosts has yielded good dividends to science within the last ten years. Apart from providing information used in one of my monographs designed to popularise the use of locally available material for undergraduate studies on *Libyodrilus violaceus* Beddard and *L. mekoensis* Clausen, it has led to the description of new genera, species, subspecies, identification/record of other species of Nigerian earthworms. These earthworms are collected from arable and garden soil by digging and hand sorting or by the application to the soil of either dilute solution of formaldehyde (18 mls. of 40% formaldehyde in 4.5 litres of water) or potassium permanganate during rainy seasons. The various localities sampled for earthworms in this country include: Ile-Ife, University of Ife Campus - (charity begins at home!), Oshogbo, and Ibadan in Oyo State, Aiyetoro (Abeokuta) in Ogun State, Igede Ekiti, Owo and Okitipupa in Ondo State, Vom and Jos in Plateau State, Borgu and Ilorin in Kwara State, Calabar and Oron in Cross River State, Benin, Sapele, Warri and Ughelli in Bendel State, Zongokara and Abuja (Suleja) within the Federal Capital Territory, Umuagwo near Elele, Abachebe, Egbema, Ila-Ehudia on Ahoada-Omoku Road, Orlu, Obibi, Aba, Umuahia, Eziachi, Owerri and Oguta I in Imo State, Ekwuagbe, Enugu and Nsukka (University of Nigeria) in Anambra State. These earthworms were later identified using both external and internal characters of sexually mature (clitellate) forms. As a taxonomist, I had to detect not only the differences and the similarities between these animals, I also had to decide whether observed differences are due to anything more than adaptation to different environments. The difficult question of weighting characteristics must be faced. For instance, before a described species is pronounced new to science, its characters have to be carefully compared and contrasted with those of existing species. The extrinsic or monogenetic variations such as age, seasonal, social (polymorphism), traumatic (post-mortem changes) and intrinsic or genetic variations also have to be considered. The assignment of a newly discovered species to the right genus raises queries such as 'is it possible to accommodate it in an established genus or is it necessary to erect for it a new genus'? One can then imagine the amount of work that goes into erecting new genera within a family which already embraces several genera. It is relevant to point out that some of these genera are polytypic (i.e. with several species) and so the diagnostic characters of numerous species have to be known.

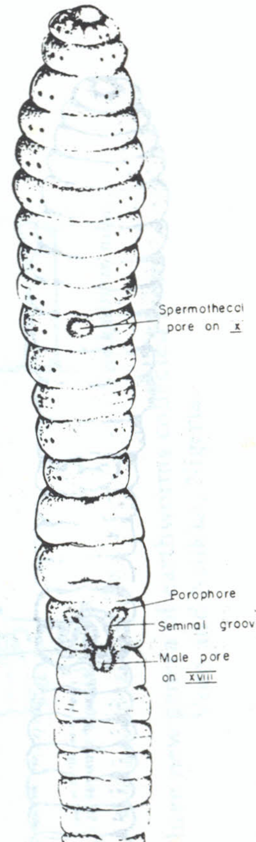
At present all over the world, 48 genera of earthworms are recognized within the family Eudrilidae. Sixteen of these genera occur in Nigeria. In my investigations, I erected five of these genera, described thirteen new species and four new sub-species while fifteen other species have been identified and recorded from various localities in Nigeria. Segun (1976) described two new species, *Hyperiodrilus oshogboensis* and *H. malakai* from Oshogbo and Ughelli respectively, and also two other new species belonging to two genera, *Vomia prima* from Vom and Jos, and *Agrotoreutus nyongii* from Nsukka. Segun (1977) described a new species belonging to a new genus *Nsukkadrilus mbae* from Nsukka and also two new species, *Iridodrilus tonyii* from Ekwuagbe near Nsukka and *I. vomiensis* from Jos and Vom. Segun (1978) identified fourteen different species of eudrilid earthworms from this



Hyperiodrilus oshogboensis f. oshogboensis

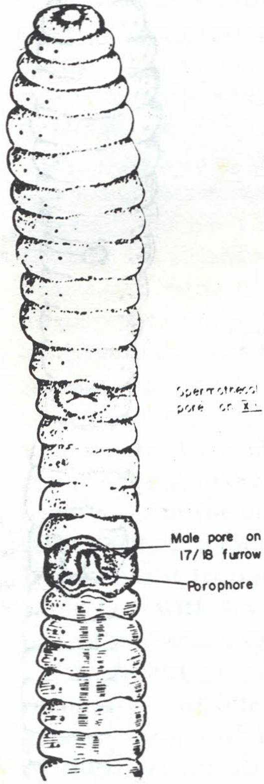


Hyperiodrilus oshogboensis f. kwara

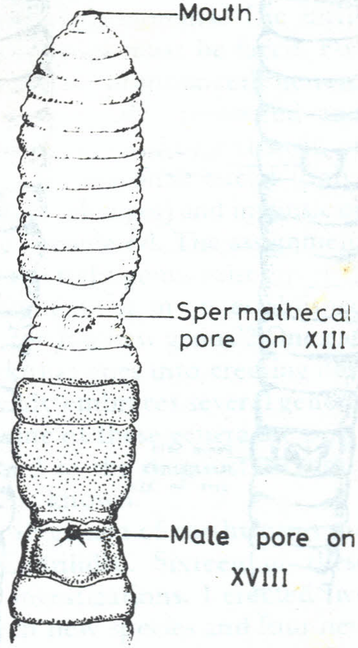


Hyperiodrilus oshogboensis f. africanus

Three new subspecies of *Hyperiodrilus oshogboensis*

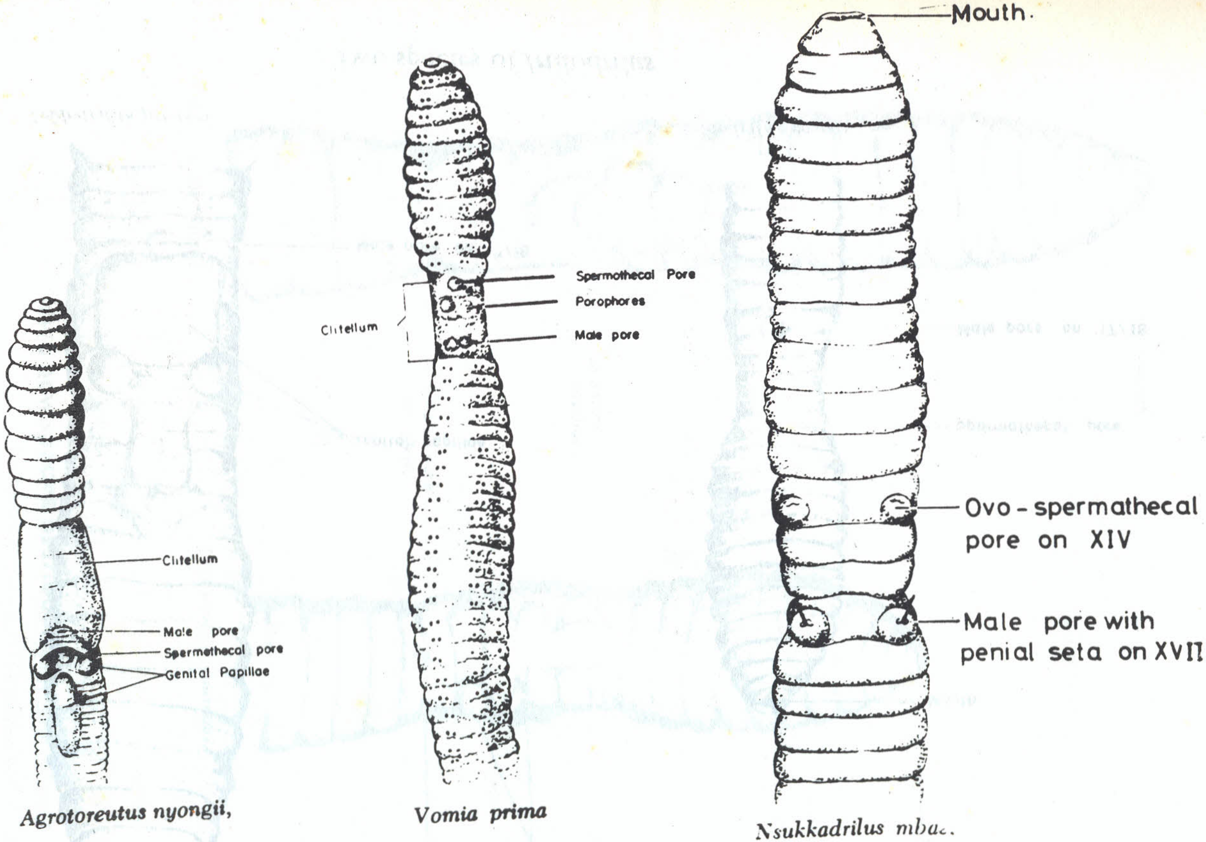


Hyperiodrilus malakai

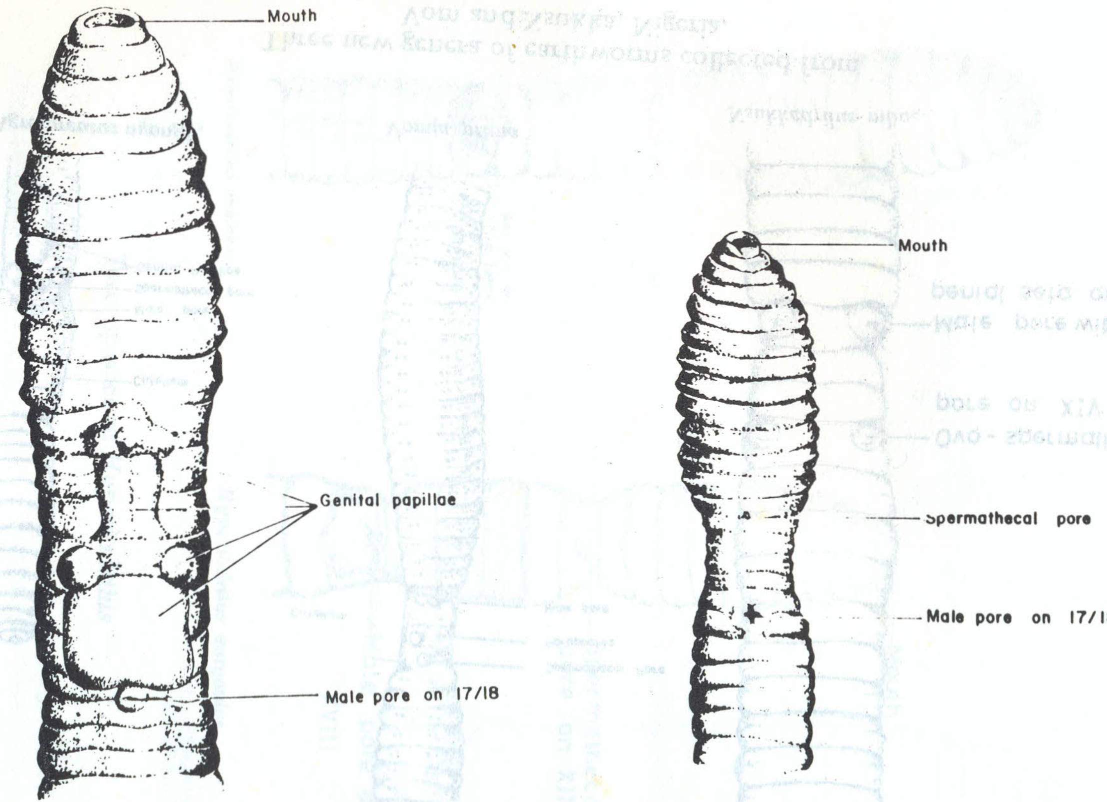


Hyperiodrilus euryaulos,

Two species of *Hyperiodrilus*



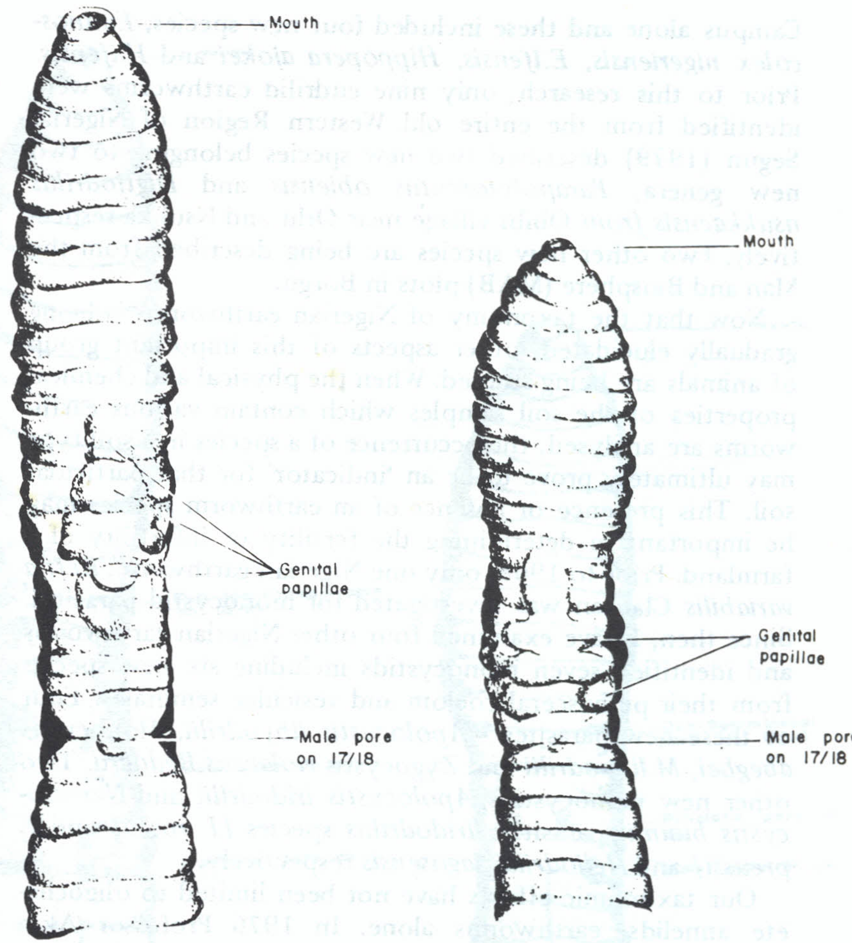
Three new genera of earthworms collected from Vom and Nsukka, Nigeria.



Iridodrilus preussi

Iridodrilus roseus

Two species of *Iridodrilus*



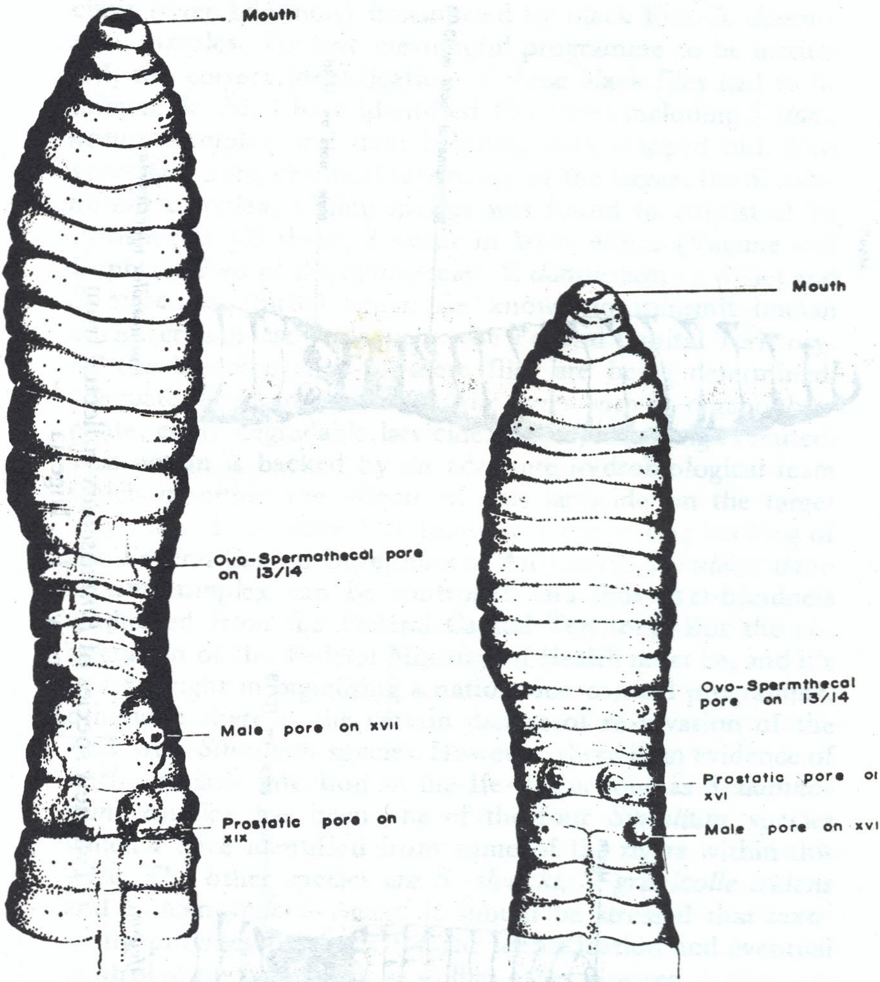
Iridodrilus tonuii *Iridodrilus romiensis*

Two new species of *Iridodrilus*

Campus alone and these included four new species, *Eminoscolex nigeriensis, E.ifensis, Hippopera ajokei* and *H.ifensis.* Prior to this research, only nine eudrilid earthworms were identified from the entire old Western Region of Nigeria. Segun (1979) described two new species belonging to two new genera, *Parapolytoreutus obiensis* and *Digitodrilus nsukkaensis from* Obibi village near Orlu and Nsukka respectively. Two other new species are being described from the Man and Biosphere (MAB) plots in Borgu.

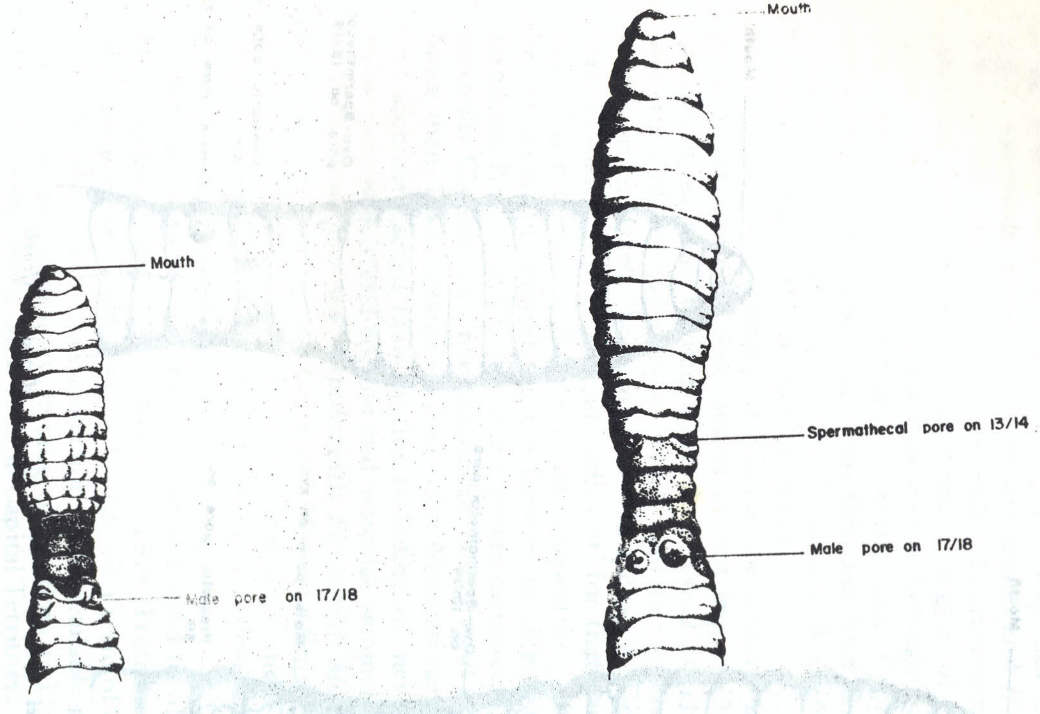
Now that the taxonomy of Nigerian earthworms is being gradually elucidated, other aspects of this important group of animals are being studied. When the physical and chemical properties of the soil samples which contain various earthworms are analysed, the occurrence of a species in a soil type may ultimately prove to be an 'indicator' for that particular soil. This presence or absence of an earthworm species may be important in determining the fertility or infertility of a farmland. Prior to 1968, only one Nigerian earthworm, *Keffia variabilis* Clausen was investigated for monocystid parasites. Since then, I have examined four other Nigerian earthworms and identified seven monocystids including six new species from their perivisceral coelom and vesiculae seminales. Four of these new parasites - *Apolocystis libyodrilii, Monocystis abegbei, M.libyodrilii* and Zygocystis *violaceus Beddard.* Two other new monocystids, *Apolocystis iridodrilii* and *Nematocystis bunmii,* parasitise *Iridodrilus* species *[I. roseus* and *I. preussi]* and *Heliodrilus lagosensis* respectively.

Our taxonomic efforts have not been limited to oligochaete annelids, earthworms alone. In 1976 Professor Akin Mabogunje of the University of Ibadan led a team of experts to undertake a systematic collection of all available data on the climate, soil, hydrology, hydrogeology, flora and fauna of the then newly demarcated Federal Capital Territory. A team from this University led by Professor A.M.A. Imevbore surveyed the disease vectors - *Simulium* species, tsetse and other flies. After submitting our report in 1977, the Federal Capital Development Authority retained the services of our team with



Hippopera ajokei *Hippopera ifensis*

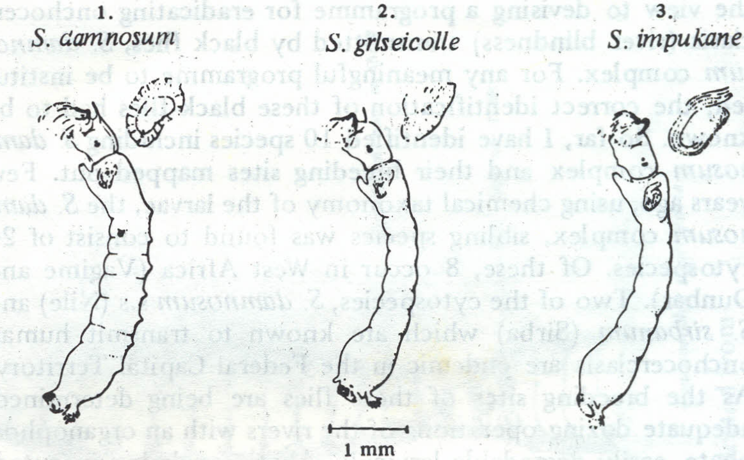
Two new species of *Hippopera* collected from University of Ife, Nigeria



Eminoscolex ifensis *Eminoscolex nigeriensis*

Two new species of *Eminoscolex* collected from University of Ife, Nigeria the view to devising a programme for eradicating onchocerciasis (river blindness) transmitted by black flies, *S. damnosum* complex. For any meaningful programme to be instituted, the correct identification of these black flies had to be known. So far, I have identified 10 species including *S. damnosum* complex and their breeding sites mapped out. Few years ago, using chemical taxonomy of the larvae, the *S. damnosum* complex, sibling species was found to consist of 24 cytospecies. Of these, 8 occur in West Africa (Vagime and Dunbar). Two of the cytospecies, *S. damnosum* s.s (Nile) and *S. sirbanum* (Sirba) which are known to transmit human onchocerciasis are endemic in the Federal Capital Territory. As the breeding sites of these flies are being determined, adequate dozing operations of the rivers with an organophosphate, easily degradable larvicide, Abate, are being executed. This action is backed by an adequate hydrobiological team which monitors the effects of this larvicide on the target organisms. I am confident that, with the strong backing of the Federal Capital Development Authority, *Simulium damnosum* complex can be controlled and thus river-blindness eradicated from the Federal Capital Territory. But the co-operation of the Federal Ministry of Health must be, and it's being sought in organising a nationwide control programme, otherwise there is the certain danger of re-invasion of the FCT with *Simulium* species. However, there is an evidence of onchocerciasis infection in the Ife-Ijesha zone as *S. damnosum* complex has been one of the four *Simulium* species which I have identified from some of the rivers within this zone. The other species are *S. alcocki, S. griseicolle tridens* and *S. schoutedeni.* Again, it should be stressed that taxonomy provides the basis for the identification and eventual control of onchocerciasis as well as other diseases.

I would like to associate myself with Crowson (1958) who stated that the pursuit of taxonomy not only gives great pleasure to its devotees, it also conveys a reverence for the wonders of living nature which should be part of the outlook of every human being. Fortunately, Nigeria with its tremendous



Larvae of *Simulium* species occurring within Federal Capital Territory (FCT)

range of habitats – varying from the mangrove swamps of the south to the Savana in the north – is a country of great natural history potential in all aspects of its native fauna, flora, rocks, and fossils. Unfortunately, at the present moment, most of the animal species can neither be identified by name nor classified. What is more disturbing is that man (Nigerians not excluded) as usual, continues to modify the earth with increasing vigour with the result that animal species which were once so commonly found and were barely worth preserving may now only be found in collections tomorrow. As much of the ultimate value of collections lies in what we do not know about them, these collections should be kept for purposes of documentation and scientific verification. Specimens that may be considered today as candidates for the trash-can, could be our only pre-pollution record (whether chemical, nuclear or thermal) of a disappearing environment and thus constitute a biological baseline of irreplaceable value. As long as this nation refuses to recognize the scientific importance of Museum of Natural History where scientists such as curators, associate and assistant curators devote all their time and energy to collecting specimens, identifying existing species, describing and classifying new ones, so long shall we continue to leave 'undone those things which we ought to have done' and there will be no taxonomic health in us. This university, with its usual foresight, selected the establishment of a Natural History Museum to be one of the four main objectives of the University's endowment fund launched in 1973. Thus with the collection of the then Zoology Department as its nucleus, University of Ife Museum of Natural History was established as an autonomous unit in January 1974. This young unit enjoyed every encouragement and support for about two years during which its building was designed (a design that won an architectural award in London) and its building site chosen. Then there came a change in the administration of this University and unfortunately with it, a lack of continuity. The autonomy of the museum, the only one of its type in Nigeria at the moment, was lost, its growth stifled, and its scientific importance relegated. Until this University reinstates the scientific importance of the Museum of Natural History for taxonomic research, exhibition and education, and develop it to one of the leading research museums in Africa, the opportunity to provide leadership in this critical aspect of our development objectives would have been completely lost. Besides, the natural history museum will serve as a repository for scientific material. Whenever new taxa are described, the author is recommended by the International Commission to deposit the type – species in one of the museums with major holdings. Until our museum is regarded as a standard type repository, the invaluable and irreplaceable type specimens from Nigeria will continue to be housed and curated in institutions in Britain, Europe and America. Personally, I have had to deposit most of my earthworm type species in the British Museum of Natural History in London. University of Ife should stop regarding its natural history museum as a hall of dead and stuffed animals in exhibition cases, but direct its effort to the more lively aspects which will involve the students and the public through changing exhibitions, reference collections of specimens, photographs, lectures, films and discussions. It is needless to add that all these require adequate financial support. Whatever investment is made in this direction, it is bound to improve considerably not only the quality and standard of teaching, but also the prospects for many to enjoy their leisure through the admiration of nature's bounteous beauty.

The implementation of public policies will always be the responsibility of the government. Nevertheless, the unversities have an obligation to ensure that the government is made aware of important issues in the society. In the case of utilising our natural resources, serious problems remain from the ignorance of our taxonomic resources. All over the world, more than a thousand vertebrate species and subspecies are threatened with extinction. Two of the most serious threats to animal species in Nigeria are habitat destruction and overexploitation. The former includes replacement of the entire habitat of these animals by settlements, harbour, cities and other human constructions, by cropland and plantation, and by mines, quarries, etc. Wild animals, particularly small mammals, form an important source of animal protein and sometimes the only source of income for our rural communities. Consequently., these animals are being indiscriminately hunted and slaughtered for their meat and other products such as skin. Unless such threatened species are identified and adequate legislative steps taken by the governments of this country to stop this overexploitation, these animals may be in danger of extinction.

In the field of education, the scientific problems facing biological education in Nigeria include the dearth of knowledge of the basic taxonomy of our plants and animals. It is about time that Nigeria realised the utmost importance of taxonomy as the basis for other aspects of biology. Unfortunately in Nigerian universities, classical discipline of systematics that once formed the backbone of zoology degree programme now receive scantier and scantier treatment in undergraduates courses. This is because most of us who are in charge of biology today were either trained at a stage, in Europe or North America where alpha taxonomic work had more or less been completed as far back as the end of the 18th and 19th centuries and where biology departments concentrate their teaching and research on the cellular, physiological, biochemical, immunochemical aspects of plants and animals. It is sad but true, that the taxonomic knowledge of our animals today is, at best, probably at the level that obtained in Europe during the era of John Ray (1627-1705), Carl Linnaeus (1707-1778), Michael Adanson (1727-1806) and Jean Lamarck (1744-1829). If one went into the nearest bush outside this lecture theatre to collect insects, millipedes, worms, snails, birds even mammals, not to mention soil micro-fauna, I am sure that the number of species one can confidently identity by names, will be astonishingly low, if not nil! And yet the primary purpose of taxonomy, according to Simpson (1945), is to provide a convenient practical means by which zoologist may know what they are talking about and others may find out. Most of the animals cannot be talked about because they have not been identified. Although in this part of the world, a taxomomist is often met with contemptuous sneer of being old-fashioned and out-of-date in this modern world, yet my colleagues who are quantum biologists (under-taking molecular and cellular studies), mathematical ecologists, physiologists, plant and animal scientists will definitely agree with me that their results and conclusions would be valueless if the animals and plants on which they worked were either wrongly identified, classified or not named at all. Besides, as more and more of the local fauna are known and their morphology, anatomy and physiology worked out, the teaching programmes in zoology will take full advantage of their own special opportunies and this will invigorate this aspect as a whole. It will enhance not only the academic excellence of local scientists but also lead to some academic independence in that curriculum in our schools, colleges and universities need not depend on available European and North American textbooks which are naturally oriented to the study of their own fauna. There is no doubt that this nation needs honest-to-goodness, 'old-fashioned' zoologists who will literally 'return to earth' and undertake to solve the enormous taxonomic problems that face the nation.

To tackle this important issue, the Federal Government should establish a National Museum of Natural History and engage full-time taxonomists to man it. This point was first stressed years ago by Professor C.O. Olaniyan in his inaugural lecture as Professor of Zoology, University of Lagos. Since then, other senior colleagues had made similar appeal to the government. It may be pertinent to refer, at this juncture, to an article, 'Taxonomy classified' published in the *New Scientist* of 19th April, 1979, pg. 172 which states that in the United Kingdom 'taxonomy costs about £6 million annually— not much compared with the whole research budget. This sum is divided roughly equally between the universities, the research councils, the British Museum of Natural History and other institutions . . . .' If this statement refers to a nation like Britain whose bulk of animal and plant species had been largely named and classified by the end of 19th century, then one can imagine the magnitude of financial assistance taxonomy will require in this country with virtually unknown fauna and flora. To put it simply and bluntly, we just don't know what animals and plants occur in Nigeria in terms of scientific description and possible exploitation. The Entomological Society of Nigeria (ESN) advocated the establishment of a National Entomological Museum and Taxonomic Centre in 1967. In 1974, the Nigerian Council for Science and Technology (NCST) agreed that a National Museum of Natural History should be established incorporating Entomological Museum and Taxonomic Centre. The Federal Department of Antiquities obtained approval for the establishment of a National Museum of Natural History with an allocated sum of ₦600,000 for 1975-80 economic plan period. Some of us were invited to serve on the NCST Advisory Committee on the National Museum of Natural History in April 1976. After a couple of meetings at which proposals were discussed, the proposed Museum suddenly 'died' before it came into existence. Now that the Federal Government, in its wisdom, has created the Ministry of Science and Technology which is saddled with the scientific needs of the country, I will like to appeal to this Ministry to establish a National Museum of Natural History as a matter of urgency. It should be realised that there is very little or no joy in our ability as a nation to join the league of nuclear nations, ability to manufacture this gadget and that, ability to unlock the mysteries hidden in a single cell and yet be unashamedly ignorant of the surrounding diversity of life on which the applied aspects of biology are, to a large extent, dependant. It cannot, therefore, be overemphasized that the taxonomic problems in this country must be tackled now as further delay may be very costly.

Finally before I end this lecture, let me implore my fellow biologists, biological students and naturalists to join me in saying to the whole nation in the words of my composition:

'Let the merchant, if he pleases
Look for naira and kobo
I will look for worms, parasites, insects, crabs, snails, shells, bats and other animals
To name and to classify
For this is taxonomy (laws of arrangement)
My academic love and life'.