

The Essence of Scientific Terminology and Terminological Elaboration

I undertake to conduct a bifurcate study in which a theory of scientific terminology is to be formulated and its application to a hypothetically accelerated elaboration of the scientific lexicon of Luganda is to be set up and examination. Historically, the need for terminology has always been a response to cognitive growth and, therefore, conceptual articulation. Picht and Draskau report:

The 19 th century was remarkable for the giant strides with which scientific progress advanced scientific progress advanced and found practical application. This situation led to the vast need for terminology, and it soon came to be realized that these explosive developments likewise called for the organization of knowledge, if progress was not to be neutralised by stagnation. At this time another development occurred which was to have importance for terminology: the standardization of objects, for example, the gauge of railway tracks or certain types of screwthreads.

But parallel to the standardization of objects-measurements, units, sizes etc. - there arose the problem of linguistic realization, that is to say, the problem of terms.

In the second half of the last century, the necessity of ensuring professional communication became increasingly urgent, especially in respect of the mutual comprehensibility of experts within the same subject field but from different linguistic backgrounds.

Picht & Draskau (1985: 24)

Every natural language has two major categories: one for general purposes and the other for special purposes. The LGP (Language for General Purposes) category is used by all members of the language community, whereas the LSP (Language for Special Purposes) category, or categories, to be more exact, are used by groups of the community in their professional communication on matters pertaining to hunting, animal husbandry, science, technology or divinity. Terminological elaboration, i.e. the development of special expressions for LSP, consists in assigning an expression to an entity. When an expression is clearly delimited in terms of its meaning content, we talk of a term. The sum total of terms in a subject field or the study of those terms in a particular subject field or all subject fields is what is generally conceived of as (a) terminology. As I have stated, terminological elaboration is always a response to cognitive growth. Versalius (1514 - 64; anatomy), Lavoisier and Berthollet (18 th century; chemistry), Linnaeus (1707 - 78; botany and zoology), Frege (1848; mathematics, logic and philosophy) and Eugen W-ster (20th century; engineering) are some of the most acclaimed terminologists or terminological elaborators in the documented history of terminology.

In order to distinguish LSP from LGP let the following statements serve as examples:

1) Newton's law of universal gravitation states that

any two bodies attract one another with a force which is proportional to the product of their masses and inversely proportional to the square of the distance between them.

2) $\text{NH}_3 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow (\text{NH}_4) \text{HCO}_3$
 $\text{NaCl} + (\text{NH}_4) \text{HCO}_3 \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$
 $\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$

3) A broad taxonomy of the housefly (*Musca domestica*) is:

Animalia	(Kingdom)
Chordata	(Phylum)
Insecta	(Class)
Diptera	(Order)
Muscidae	(Family)
Musca	(Genus)
Domestica	(Species)

In (1) 'law', 'bodies', 'attract', 'force', 'masses', and 'distance' are expressions which, even when used in their various senses like the legal, political, administrative or ideological sense, are not likely to present considerable problems to the LGP user. The expressions 'proportional', 'product', 'inversely' and 'square' are likely to have been met at the upper primary school level (at least in the Kenyan educational system). Nevertheless, one would have to have had some lower secondary school physics if the appreciation of Newton's law of universal gravitation were to be ensured. All the concepts occurring in the law are precise to the physicist and are systematically interconnected in the expressionally economical formula

4) $\mathbf{F} = [-G m_1 m_2 / r^2] \mathbf{U}_r$

where \mathbf{F} is the force, m_1 and m_2 are the masses, r is the distance, G is the gravitational constant and \mathbf{U}_r is the unit vector along the line of force. That the value of G in the Système International d'Unités [SI] is $6.67 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2}$ bears out the internationally sanctioned convention among physicists which regulates the system of units in mechanics.

Statement (2) hardly presents any problem to an upper secondary school pupil. He will have learnt about the Solvay process used for the manufacture of sodium carbonate decahydrate. Even if in German $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ is *Natriumkarbonat-10 Wasser*, the

internationality of chemical symbolism and the systemicity of the suffix - *at* (E.-*ate*) are left intact.

Statement (3) goes to underpin the internationally binding nature of biological taxonomy. The seven broad taxa are rendered in neo-Latin. Irrespective of the natural language in which a biologist may write a scientific paper, he will be required to refer to the housefly (Ger. *Hausfliege*, Lgd. *ensowera*) as *Musca domestica* in order to facilitate communication in just the same way as the chemist will use formulae which are understood the world over.

In the forgoing I state my intention of pursuing the double-pronged problem of a theory of scientific terminology on the one hand, and applying the theory to the lexical extension of Luganda on the other hand. Statements 1-4 deal at a preliminary stage with some of the criteria for terminology. These are precision, economy, internationality and systemicity. Before taking up the issue of criteria for terminology again, let me set the background to the second strand of the study.

Writing on the problem of expressional elaboration of African languages, Bernd Heine claims:

Up to now the dimension of modernisation has not yet been attained by any African language. It is true that some of these languages, which, like Arabic, Swahili or Hausa, are backed by the state, are on the way to modernisation, but further efforts are required before the goal is achieved..

This is my translation of

Die Dimension der Modernisierung ist bisher von keiner afrikanischen Sprache erreicht worden. Zwar befinden sich einige dieser Sprachen, die von staatlicher Seite unterst-tzt werden, wie Arabisch, Swahili oder Hausa, auf dem Wege zur Modernisierung, jedoch bedarf es weiterer Anstrengungen, bis dieses Ziel erreicht ist.

Heine (1979: 11)

In a footnote Heine quotes what another linguist, Charles A Ferguson, understands by "modernisation".

the development of intertranslatability with other languages in a range of topics and forms of discourse characteristic of industrialized, secularized, structurally differentiated, modern societies. (ibid).

In Heine's view and, by implication, Ferguson's view, Luganda has not yet reached the dimension of elaboration. This is indeed true for it is not yet intertranslatable with English, Greek, French, Japanese, Italian, Spanish, Portuguese, Russian, Hungarian or Finnish in a serious range of topics and forms of discourse. Modern science, technology and economics cannot be articulated in Luganda. Hence, only a small portion of human knowledge is impartable in Luganda. As Heine observes, Swahili is backed by the state: it is accorded official status in Tanzania and Kenya. Nevertheless, at the secondary and

tertiary levels of education Swahili is not the medium of instruction, especially in the sciences.

It would be interesting to merely imagine that it were not only an economically but also socially, demographically, politically and culturally sound proposition to turn any of the languages explicitly mentioned by Heine into a full-fledged vehicle of modern science, technology and economics at the University level of education. How would this be brought about in the shortest time possible? To answer this question I sketch a four-premise argument.

First, the last three centuries have witnessed very remarkable cognitive growth. Talking about this 'knowledge explosion', John Ziman writes:

...the 'size' of science has doubled steadily every 15 years. In a century this means a factor of 100. For every single scientific paper or for every single scientist in 1670, there were 100 in 1770, 10,000 in 1870 and 1,000,000 in 1970.

Ziman (1976: 56-57)

Second, I stipulate that the desire for linguistic autonomy among the speakers of the language concerned is overt. In Tanzania, for example, the National Swahili Council *Baraza la Kiswahili la Taifa (BAKITA)* and the Institute for Swahili Research *Taasisi ya Uchunguzi wa Kiswahili (TUKI)* at the University of Dar-es-Salaam are charged with the task of developing Swahili to a level of expressional maturity in the sciences and humanities.

My third premise is constituted by the time factor. If one were to characterise the pace at which the lexicon of Swahili or Arabic is growing, one would most probably find that it is revolutionary at the primary and secondary levels of education on the one hand, and evolutionary at the tertiary level of education on the other hand. If, then, we bear in mind that literally millions of expressions are required to name natural phenomena, chemical substances, living organisms, and diseases, it will probably take a long time for Swahili or Arabic to be adequately rich in the requisite terminology. To date there is no plan to turn Swahili into a medium of University education by the year 2000.

The fourth premise is a set of criteria for specialised terminology. Nybakken (1959: 15-23) presents a good account of the criteria. The most important criterion for specialised terminology is precision. By precision of an expression X' in a target language in relation to a term X in a source language I shall understand a relation of mutual semantic inclusion which I shall symbolise as $X \approx X'$ (following Wessel (1977: 7))

Thus, for a sample of German and English expressions:

- 5) Gleichrichter \approx rectifier
Beschleunigung \approx acceleration

Kernreaktor	↗	nuclear reactor
Schnittmenge	↗	intersection set
Alkan	↗	alkane

For a language whose scientific lexicon is being expanded it is of cardinal importance to ensure that this criterion is satisfied. An interesting example of expressional imprecision could be taken from one of the word-lists that have recently been compiled in Dar-es-Salaam and published by the BAKITA. There, 'hydrotropism' is rendered into Swahili as *ubadilihali* as reported by C.W. Temu, the then Director of TUKI, in his '*Taasisi ya Kiswahili na Uundaji wa Maneno Mpya ya Kiswahili - Kichocheo cha Mjadala*' (p.4). The expression *ubadilihali* means 'change of state'. It is obtained by dropping the particle of relationship in the nominal phrase

6a) ubadili wa hali 'change of state'

Since besides hydrotropism, geotropism, phototropism and other tropisms are also changes of state i.e. processes, *ubadilihali* is imprecise. Symbolically,

6b) hydrotropism k ubadilihali
 hydrotropism / ubadilihali

In chemical and biological nomenclature systems the criterion of systemicity of expressions is absolutely fundamental. In chemical nomenclature groups of compounds are assigned generic names and systemic indicators.

7) <u>General Formula</u>	<u>Generic Name</u>	<u>(Morphemic i.e Systemic Indicator)</u>
C_nH_{2n+2}	alkanes	-ane
C_nH_{2n}	alkenes	-ene
C_nH_{2n-2}	alkynes	-yne
$C_nH_{2n+1}OH$	alcohols	-ol
$C_nH_{2n+1}NH_2$	amines	amine
C_nH_{2n+1} _____	alkyls	-yl
____CO.NH ₂	amides	amide

Similarly, in biological nomenclature, the biologist divides all living things into the Plant and Animal Kingdoms. For each Kingdom six broad taxonomic categories stipulated are as follows.

8)	Kingdom	K
	Phylum	P
	Class	C
	Order	O
	Family	F
	Genus	G
	Species	S

where K,....., S are descending taxonomic categories of membership such that

$P_i \subset K_j$	(a Phylum is a subset of a Kingdom)
$C_i \subset P_j$	(a Class is a subset of a Phylum)
$O_i \subset C_j$	(an Order is a subset of a Class)
$F_i \subset O_j$	(a Family is a subset of a Order)
$G_i \subset F_j$	(an Genus is a subset of a Family)
$S_i \subset G_j$	(a Species is a subset of a Genus)

Larger or smaller sets can be formed so that categories like Superfamily, Subfamily and Infrafamily become applicable. It is still a big task to coin neo-Latin expressions with systematic indicators that capture the concepts of order and set inclusion, especially in zoological nomenclature.

Phonographic consistency of co-shared expressions is related to the criterion of systemicity. Consider, for example, the following expressions which have been co-shared by Swahili during the last fifteen years.

9)	atom	-->	atomi ~	atomu
	geography	-->	jiografia ~	jografia
	chromium	-->	kromi ~	kromiamu
	chromate	-->	krometi ~	kromati
	chloride	-->	kloraidi ~	kloridi

Clearly, there seems to be some inconsistency as to how the expressional elements

- 10) geo-
-ium
-ate
-ide

are to be co-shared through swahilisation. The third criterion for terminology is that of expressional internationality. Expressional internationality manifests itself, for instance, in the use of symbols and abbreviations irrespective of the natural language of the scientist. The following symbols and abbreviations are used internationally:

- 11) $\forall, \exists; \cup, \cap, \rightarrow, \neg, \text{B}$ (in logic)
 $\sqrt{\quad}, \circ, \int, \partial/\partial_x$ (in mathematics)
 g, F, A, m, ms-1, Nm, J, (in physics)
 NaCl, H₂O, Xe (in chemistry)

The fourth criterion may carry the label 'antitaboo criterion.' What is to be ensured here is the strict avoidance of so-called taboo words which, otherwise, hamper the process of terminologisation. In Luganda and Swahili these are words connected with the urogenital extremities and the anus. Expressional modernisers of Luganda would find it more rewarding to avoid

- 12) vagina emmana
 penis embolo
 anus ekinyo

as terms. Even in all Luganda translations of different versions of the New Testament (Rev. 2:17), sensitivity to taboo words is shown, for we find

- 13) Aramaic *man hu* "what is it?" τ
 Gk *manna* \rightarrow Lat. *manna* \rightarrow E. *manna* \rightarrow Lgd. *Emmaanu*,

where the arrow signals a transformational process. So, even translation from English would have *emmaanu*, for *manna* can only be Lugandised as *emmana*. This accords with the Meinhof-Ganda Law. Another example to show the avoidance of taboo words is

- 14) Sw. *kufuli* \rightarrow Lgd. *ekkufulu* "padlock"
 Here *ekkufuli* would be suggestive of *enfuli* 'labia majora'

Expressional productivity, as a criterion, is related to terminological systemicity. An expression or expressional element that occurs in many expressions is said to be productive. In pure and applied physics, for instance, the expressional element 'electr (o)' is known to be very productive, for it occurs in more than 900 words, cf. Dorian (1978: 367-378). It is therefore employed so as to articulate a large term cluster.

Expressional economy, as a criterion for terminology, has to be viewed in terms of the language concerned. By expressional economy I mean the tendency to use as few expressions for a term as possible; or if it is a word for a term, the tendency to prefer short to long expressions. While "Civil Air Travel Insurance Company" and "oversea range television direction radio connection" are not intolerably too long, their German equivalents *Zivilluftfahrtversicherungsgesellschaft* and *berseereichweitenfernsehrichtungsfunkverbindung* are considered to be unbearably too long.

Expressional transparency, as a criterion, is of interest to a certain group of language users. In Swahili *elimunyota* is generally more transparent than *astronomia*. The former is undoubtedly transparent to most Swahili speakers whereas the latter is only transparent to those who know the Greek expressional elements *astr (o)-* and *nomia*. *Elimu* - "knowledge, study" and *nyota* "stars" are everyday expressions. At the primary school level one expects the use of *elimunyota* (Ger. *Sternkunde*) while at higher levels of education *astronomia* (Ger. *Astronomie*) is perhaps to be expected. The propensity of German to form expressions from its own expressional stock rather than assimilating from Greek and Latin results in welcome transparency of expressions especially to the less tutored. *Sternkunde* (i.e. 'star knowledge') is transparent to all German speakers: not so *Astronomie* (from Greek).

The last criterion for terminology is that of language-relative acceptability of expressions.