SCIENTIFIC AND TECHNICAL NEOLOGY

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Abstract

Our "Knowledge Society" is justification enough for the great interest allotted to scientific and technical neology, as examples of lexical creativity. The paper discusses Chomsky's argument concerning the two forms of understanding pertaining to science and common sense and the chief means of scientific neology, with comments centered on the medical vocabulary as well as on Darwin's *Origin of Species.* In guise of conclusions, a few questions which seem to me relevant at the beginning of the new century and millennium.

Keywords: *compounds; information; metaphor; nouns; terms.*

The 1.5 exabytes of unique new information currently generated worldwide every year and the fact that the amount of new technical information is doubling every two years are proof enough of the fact that we are witnessing exponential times. The term *information* is in fact sometimes used as a synonym of *knowledge*, as our society is deemed 'The Knowledge Society'. The Knowledge Society has spawned the epistemological communities which are the repositories of the knowledge of each particular branch of science/speciality and are responsible for its expression and the creation of new terms. Information has also led to the creation of virtual communities and their key-words – *the Net, cyberspace, digital /virtual/ electronic information, online* and others – used in practically all European languages as such. And while we are at it, note the very 'in' terminology associated with contemporary Euro-craze: *Eurail; Eurobabble; Eurobin; Euro-sceptic; Eurosclerosis; Eurostyle* etc. Thus change is constantly heralded by the appearance of new terms.

It could be argued that the current perspective is quite similar to that faced by the men who struggled to make English capable for scientific discourse some 300 years back, a time when science required a precise and standardized language in which, ideally, there were only as many words as things. Nowadays, facts about the world are paradigm-relative and change when paradigms change. Thus the creation of new lexical units is absolutely necessary for the accurate communication between experts.

Chomsky (apud McGilvray 2000:20) talks about two different forms of understanding found in fundamentally different mental capacities that yield the different cognitive domains of science and common sense, a point which is central to his thinking. In his discussion of the contrast between common sense and science, McGilvray 2000:20 maps the differences between the concepts belonging to the two domains as follows:

Common sense concepts	**Scientific concepts**
1. Intrinsically rich	1. Austere
2. Anthropocentric	2. Objective
3. (Apparently) domain-general	3. Domain-specific
4. A priori (innately specified)	4. Artifacts (created)

McGilvray (2000:21-24) further identifies categories of scientific concepts: noun (*kaon, H2O, lepton, phonological feature*), verb (*bond, reduce, Spell-Out*), and magnitude (*Hertz, electron volt*), plus some of the sentence type ($E = mc^2$). Scientific concepts are extrinsically specified by appeal to their roles in the theories of which they are a part and limited in their combinatorial properties by the theory. These concepts, which do not figure in common sense understanding, are grasped by very few people. Nevertheless, in view of the work of authors such as Isaac Asimov, who have gone a long way towards popularizing the words of science and increasing awareness of their ever-expanding character, one might be led to question suggestions by Knorr and Knorr (1978), among others, that scientific language serves to establish and maintain the authority of science, largely through exclusion and intimidation.

To achieve the status of generic knowledge, information must be realized in the lexicon of the language. Generic information, according to Givón (1984:265) is stored in the lexicon "as the meanings of words which stand for various types of states, events, objects, persons, institutions, customs, behaviour patterns, ideas etc". The lexicon represents meanings which are used as "the building blocks of sentences in which specific information is communicated" (Givón 1984:48). Complex semantic information, on the other hand, requires the development of formal disciplines to be realized, and with them the technical lexis with field-specific meanings. The distinction between general language and specialized languages presupposes reference to the whole lexis of a language, made up of subsets. Division is made according to several interdependent criteria, such as circulation and the functional-stylistic criterion. The subsets/verbal repertoires are the obligatory lexis (fundamental vocabulary: general-active); current literary language (standard language - virtual) as well as the vocabularies of special languages (terminologies).

Most terms are nominal group constituents, usually Thing or Classifier ^Thing compounds, which is not accidental, for in order to classify and organize with language, we need first to turn phenomena into things or nouns (Halliday and Martin 1993:145; Sager 1990:58). Thus classifications and the technical lexis which they involve constitute a taxonomy which, according to Martin, is "an ordered, systematic classification of some phenomena based on the fundamental principles of superordination [...] or composition [...] (Martin 1986:27). Thus hierarchies of information (terminologies) work with entities rather than processes. Nouns and nominal groups, with their ability to be modified indefinitely, have a much greater potential for organizing and expressing information. Language embodies a number of lexical and grammatical resources for creating the taxonomic relationship of superordination (*a* is a kind of *b*) and meronymy (*a* is a part of *b*) (Martin, in Halliday and Martin 1993). Concepts which are linguistically realized as adjectives and verbs in specialized languages are frequently found only in the corresponding noun form while some theorists deny the existence of adjective and verb concepts. The category of noun characteristically involves the loss of certain semantic elements of clauses, such as tense (e.g. *destruction* can cover *was/is/will be destroyed*) and modality or participants. For this reason, noun is an irreducible resource for nominalising and abstracting in special languages.

Denning, Kessler and Leben (2007:8) note that specialized and technical terminology, which generally involve the use of elements borrowed from Latin and Greek, are the most frequent sites of vocabulary innovation, and quote a truly remarkable such creation, namely the forty-five-letter word *pneumonoultramicroscopicsilicovolcanoconiosis*, which has been cited as the longest word in English ('lung disease (caused by) microscopic volcanic silicon dust'). Denning et al (2007:8) further comment that "this word seldom sees serious use, but it illustrates the lengths to which innovation using foreign word elements may be taken". In fact, scientific and technical neology relies on innovation and innovators, i.e. scientists, experts, specialized translators, and as such it connotes prestige, as specialized neologisms turn into social objects. Alain Rey (1995), for instance, emphasises among other things the social and pragmatic aspects of linguistic neology. Neological needs according to Rey can be 1. subject related (thematic onomasiology); 2. semantic (componential onomasiology) or 3; translation related. A need for neologism may be *language-internal*, i.e. within one language area, or because of *external pressure*. One example of the latter case is diffusion of technical innovations, e.g. computer terminology from English to other languages (Rey 1995:79-90).

It would appear that the typical trait of modern terminology inheres in its removal of surface distance, such that the words of common language are readily available for specialized usage. Thus, words used daily such as *frequency*, *success* and *solution* have specific connotations in given contexts. What, for example, counts as 'success' for stock brokers and experimental psychologists are two different things. However, beyond obvious differences, the unexplored use of common words by different groups can lead to unwarranted assumptions and groundless agreement. **Acronyms** and **blends** are particularly characteristic of modern scientific and technical terminology, e.g. *bit* (*bi*nary dig*it*); *ethacrynic acid* (*eth*ylene + *ac*etic + buty*ry*l + phenol*ic acid*); *intron* (*in*frared + spec*tr*um + *-on*, as in prot*on*); *gluon* (*glu*e + *-on*); *pulsar* (*pul*se + qua*sar*); *wimp* (*w*indow *i*con *m*ouse *p*ointer); *abzyme* (*a*nti*b*ody + en*zyme*). The Graeco-Latin model is likely to go through 'irresistible' transformations implying reduction, including abbreviation and initialisms. "When initialisms are pronounced with the names of the letters of the alphabet, they may be called *alphabetisms* or *abbreviations*. But when they are pronounced like individual lexical items, they are *acronyms*, from Gr. *akros* 'tip' and *onyma* 'name' " (Jackson & Zé Amvela 2000: 89). Examples of alphabetisms include *AI* 'Artificial Intelligence'; *BP* 'blood pressure' BrE; also 'beautiful people' AmE; *SARS* 'Severe Acute Respiratory Syndrome'. As Harley (2006:96) aptly remarks, "the proliferation of initialisms was a natural outgrowth of a proliferation of bureaucratic institutions named with long, unwieldly compounds and phrases, in particular in the US Army".

Several types can be distinguished according to the type of morphophonological reduction applied to components. American physicians John Hugues and Hans Kosterlintz termed *endorphines* the endogenous substances susceptible of attaching themselves to the specific receptors in the brain; the term is significant – *morphines, endogenous morphines* → *end[om]orphines*. In 1959 Karlson and Luescher discovered *pheromones*, substances exhuded by exocrinous glands in very small quantities on the outside of individuals, carriers of behavioural messages addressed to other individuals of the same species who perceive them by smell or taste and react by physiological alteration. This term is made up of *pher(o)* (<Gk "to bear") and *hormones*. When additional substances ensuring information transfer by means of chemical signals were discovered, new terms were created according to the same pattern: the whole of the first item and the second part of the second item, thus dropping the essential part of the root *hor-*, from the Greek verb *hormaô* 'to move; push; direct; excite'. Thus *kairomones* (= kairohormones); *allomones* (=

allohormones); *ecomones* (= ecohormones) etc. A novel suffix has thus been created: *-mone*; similar to *–rama*; *-matic* by analogic suffixation. Note also *osteo-*, which occurs in term compounds denoting ailments of the bone: *osteolysis; osteopathy; osteotomy* etc.

Direct analogy between the genetic code and the alphabet, initially made because letters were used to classify gene types, has led to a series of terms in the field of genetics which draw on the terms of an already established field: *morphology, punctuation, word, sentence, synonym, error, instruction, marker, insertion* and *deletion.* Antibodies and interferons (a protein that interferes with the virus's attempt to reproduce inside the cell) are compared to a 'defence system' that 'attacks' an 'invading virus'. To extend the metaphor and the impressions it leaves, the virus is 'bad' because it 'attacks' the human body when its 'defences' are 'down'. To 'combat' this 'invader', you devise a 'battle plan' that may include rest, aspirin and lots of fluid. Doctors describe viruses as 'sneaky', 'tough' and 'resilient'. Of course, the virus itself does not embody these characteristics, but the treatment of viruses and diseases follows from a model of 'attack' and 'defence'. In computer science, storage backup procedure follows the genealogy of *grandfather, father* and *son*, while the analogy to disease is evident in *bug* and *virus;* it would thus appear that computers are thought of as living beings (consider also terms such as *infect, client, refresh, clinet, compatible*). According to David Leary (1990:2), "all knowledge is ultimately rooted in metaphorical (or analogical) modes of perception and thought". Of course, volumes have been written about analogies and metaphors in science, so perhaps one ought to leave it at that.

One more example: the nucleus of the atom, a tightly bound collection of protons and neutrons, can be usefully compared to a drop of water that can fission by splitting in two. This analogy is the basis of the 'liquid drop' nuclear model of Aage Bohr and Ben Mottelson, for which they shared the 1975 Nobel Prize with the aptly named James Rainwater. Nevertheless, the atomic nucleus is not a liquid drop at all. In a limited range of circumstances, though, it is an apt analogy and a successfully predictive model.

Compounds and their latent metaphors frequently occur as tools of terminology in specialized fields which explore tentative and mysterious phenomena, such as astronomy and particle physics. For example, a number of observed and hypothetical phenomena in space have been vividly described by compounding colour and other physical attributes, the colours normally suggesting qualities of light, heat, absorption or emission, activity or inactivity, while other words suggest aspects of size or appearance, e.g. *red giant* (the phase of a star when intense reactions cause it to puff up its size by several hundred times); *black dwarf* (a dense matter phase when no light is emitted);

black hole (a hypothetical region of intense gravitational field which engulfs everything, resulting from the collapse of a star; also called *collapsar*).

Compounds may involve lexemes linked by means of a preposition, units known in French as 'synapsies', which characterize technical nomenclatures, as they allow the detailed specification of the referent. This type of analytical naming is characterized by a syntactic rather than morphological link between its units, e.g. *reference retrieval system* (Fr *système de recherche automatique de références)*, and by the use of synaptic links – prepositions indicating destination, distinctive trait, class etc. French is the epitome in the use of such prepositions, which set up hierarchies, e.g. *multiple-access system* (Fr *système à accès multiple*); *information transmission system* (Fr *système de transmission de l'information*). English does make use of synapsies, but much more sparingly, since English composition is characterized by juxtaposition in the order determiner – determined, which it shares with Graeco-Latin composition, e.g. *nozzle gas ejection ship altitude control* (Fr *réglage du degré d'inclinaison d'un vaisseau spatial par l'éjection de gaz par les tuyères*); *character spacing reference line* (Fr *axe de référence d'espacement*). Thus in English the piling up of modifiers in prenominal position is a salient feature and the length of the nominal group correlates with formal and functional complexity. (1985:172) refers to this recursive aspect of the modifying relation in terms of 'univariate structures', which are "generated by the recurrence of the same function: *is modified by, which is modified by, which is...*" (see also Trimble 1985:133).

This terminology allows for automatic equivalence in other languages, which represents an important asset. Also, some occupational terminologies begin to filter into the core vocabulary, because the professional areas concerned impinge more extensively on the lives of lay people and are mediated by newspapers and other journalism. This is the case, for example, with some medical terminology such as *carcinoma* and *cardiac arrest* and with physical jargon, such as *bull and bear markets; inflation; money supply*. The increasing use of word processors has brought printing terminology into everyday use: we now know about *fonts; point sizes; run-on text; justification, windows* and *orphans*. There still remains, however, much printing terminology exclusive to the printing profession, both formal (*mackle; quoin; shank; slug*) and informal (*screamer* = exclamation mark and *idiot tape*).

One of the latest and fastest growing domains appears to be that of computer technology/ 'computerese'/ 'tech-speak', a domain which has registered an outburst in Romania as well, leading to the appearance of new terminology and cultural concepts, as well as to the configuration of new social groups, such as chatters and hackers. Like other new jargons, deficient of vocabulary, it tends to convert nouns into verbs, e.g. *to access* and *to format.* It then converts the verb back into a gerund noun again by adding *–ing.* For example, *window* is a vogue word and a metaphor of tech-speak referring to the latest technology that allows the keeping of a dozen or more items on the computer screen at the same time. This has created the verb *to window* and the gerund *windowing.* Other examples include *a-gating (event)* (a crux or a turning point); *bandwidth* (the breadth of information in certain computer devices) and *core store* (the computer memory). The computer screen is thought of as an office, e.g. Microsoft *Office, clipboard, bin, desktop, wallpaper, notepad, folder.*

According to Howard (1984:62), "computerese is a classic example of how the vast and hurried strides of modern science and technology are changing the English language". By taking on a specialized meaning, these become terms, capable, in conjunction with various modifiers, of yielding complex lexical structures such as *random access* (Fr *accès direct;* De *Direktzugriff*) or *sequential access* (Fr *accès séquentiel;* De *Sequentielle Zugriff*). What makes computer jargon especially difficult to understand is the extensive use of abbreviations and acronyms, e.g. *ASCII, BIT, CAD, CAL, CAM, CAT, CPU, DOS, SQL, SSADM, WYSIWYG* (Jackson & Zé Amvela 2000:129).

The extensive use of highly modified compounds in the scientific and technical register can be seen as an extreme of lexicalization. However, highly modified nominal compounds tend to present conceptual and linguistic difficulties, e.g. *stability augmentor pitch axis actuator housing support.* Halliday (1987: 176) makes reference to ambiguities which arise in strings of nouns, "leaving inexplicit the semantic relations (mainly transitivity relations) among them". English premodification by means of direct juxtaposition is gaining ground in French terminology, e.g. Fr *tube compteur cloche; programme-produit; code carte* (E *card code*). Note however the principle set down by the French linguist E. Benveniste: "un composé comporte toujours et seulement deux termes" (a compound will invariably comprise only two units).

Scientific thinking is characterized by its use of models. A theory is a description of the nature and workings of a model, in the development of which **metaphor** plays a fundamental role. Models are systematic descriptions based on an underlying analogy thought to be existing between one explicative domain and using a target (known to be scientific). In this sense, models are like extended metaphors, developing from an original metaphor into a series pertaining to the same semantic domain. Through metaphor scientists draw upon existing cognitive resources to provide both the model and the vocabulary in term of which the unknown mechanisms can be conceived and so investigated. Metaphor thereby performs a cognitive role in scientific theorizing. While good literary metaphors are expected to be surprising and unexpected, scientific metaphors, on the contrary, are to be overused, writes Bicchieri (1988:107). Thus, *a bull market* is a prolonged period of rising prices; *to catch a cold transaction* means to lose money in unprofitable business; *an orphan stock* is a stock ignored by research analysts, while *a wildcat enterprise* is a business taking unreasonable risks.

In *Illness as Metaphor*, Susan Sontag (1978) notes that in the 18th and 19th centuries tuberculosis was associated with romantic metaphors of delicacy and sensitivity, while military metaphors in medicine "first came into wide use in the 1880s with the identification of bacteria as agents of disease. Bacteria were said to "invade" and "infiltrate." But talk of siege and war to describe disease has now, with cancer, a striking literalness and authority." It is Sontag's contention that "illness is not a metaphor, and that the most truthful way of regarding illness–the healthiest way of being ill–is one most purified of, most resistant to, metaphoric thinking." But the very pervasiveness of the metaphors she describes makes this unlikely.

Figurative language, the language of metaphor, is often constitutive. In other words, figurative language shapes the conception of the field in which it exists, often producing an immediate and profound effect. One example is the metaphor of the gene as a 'master molecule' which is the key to controlling human development. Although the metaphor may or may not accurately represent its subject, its rhetorical power is undeniable: the metaphor helped persuade Congress to funnel huge sums of money into the human genome project (Collier and Toomey). We should perhaps heed Nietzsche's warning, and remember that metaphors illuminate as they conceal.

In an engaging account of metaphor in the language of science, Khurshid Ahmad (2006:198) describes the way "scientists literally and metaphorically create a world of make-believe through a web of words – some borrowed, some invented, endorsing self-belief here and suppressing the belief of others there". Beyond make-believe, however, science metaphors can also "make extremely complicated molecular processes intelligible by highlighting their functional components in a human, or rather, semiotic reference frame" (Chew and Laubichler 2003:52, apud Ahmad 2006:198). Jacob Bronowski too (1978) asserts that "the whole of science is shot through and through with metaphors which transfer and link one part of our experience to another, and find likenesses between the parts".

According to Hoffmann (1985), metaphors can be divided into three major categories: (i) metaphors for describing *novelty* at different levels of scientific description, including hypothesizing, theorizing, conceptualizing; (ii) metaphors used for *interpreting* extant theories; and (iii) metaphors for *explaining* and predicting the consequences of theoretical concepts and experimental measurements. Hoffman suggests that the best metaphors in science are those that spawn theoretical ponderings over many years, such as the metaphor of light as a 'wave' or a 'particle.'

Metaphors and lexicogenesis have played a significant part in physics as well as the consolidation of the body of knowledge now called physics relies critically on the metaphor of force. The key term 'force' in fact originally referred to armed men/ violence or physical coercion: "a people-centred term requiring vitality and volition was transferred to the target domain to mean 'the agency that tends to change the momentum of a massive body' (Ahmad 2006:201). Besides gravitational force (which Einstein argued is determined by the curvature of space and time), in modern physics two radically new types of forces were postulated: a strong nuclear force, exerted through the agency of mesons and a weak nuclear force, which manifests itself when atomic nuclei decay or transmute. Although the notion of force in post-modern physics is at considerable variance with that in Newtonian physics, the metaphor of force "is preserved in the meaning in a vague historical sense" (Ahmad 2006:207). Jonathan Miller (1978) contends that William Harvey would never have conceived of the heart as a pump if water pumps hadn't come into use in 16th-century mining, fire-fighting and civil engineering: "It seems unlikely that Harvey would have departed so radically from the traditional theory if the technological images of propulsion had not encouraged him to think along such lines." Miller also notes that while primitive societies draw their metaphors about body function from nature–tides, winds, harvests–technologically advanced societies use more mechanistic metaphors such as that of the heart as a pump.

The most prevalent literary technique used by Darwin throughout his *On the Origin of Species* is the use of metaphors. Darwin's entire argument seems to take on the form of one large metaphor as he compares the theory of natural selection to the domestication of animals – something that his readers would be more familiar with. The most powerful metaphor used by Darwin is the use of a tree to describe the evolution of life throughout time, and another popular one is the 'struggle for existence' metaphor. It can also be argued, of course, that the 'Tree of Life' has a deep formative meaning in Western Culture long before Darwin, as in *Genesis:2*, and the symbolisms associated with it are strong and prevalent (see also Richards 2009). Darwin also compared evolution metaphorically to human warfare and to artificial selection. As stated by Gillian Beer in *Darwin's Plots* (2000), "metaphors become part of a continuous truth-discovering process...the power of metaphor in all kinds of narrative depends precisely upon the 'stretching to a radically new situation' that she associates peculiarly with scientific metaphor". These metaphors allow the reader to step away from the scientific aspect of the text and read the book for what it simply it-a piece of descriptive. By allowing the reader to consider his text a poetic, on-fiction piece, Darwin is allowing his reader to attribute intentional fallacy to his text. As the metaphors allow the reader to interpret the text as they wish, his text becomes more approachable and agreeable with a reader of the particular time period.

As *On the Origin of Species* is saturated with metaphors and comparisons very similar to the tree of life, the use of metaphors is probably the most vital aspect of Darwin's text that contributed to the evolution of scientific writing. Note, however, that more recently biologists have seen evolution as much more about mergers and collaboration than change within isolated lineages (see, for instance the *New Scientist* of January 2009). The 'tree of life' metaphor, they say, is actually an expression of mechanistic Enlightenment thought. It is, perhaps, only to be expected that Darwin – a product of the Enlightenment – would envisage evolution as linear progress, while his 21st century successors would embrace post-modernity's critique of meta-narratives and pose an understanding of evolution which emphasises diversity and complexity.

More recently, particles have been studied with the help of cosmic rays and accelerators, also called *atom smashers: mesons* (intermediate *meso*-particles), between the heavier *nucleons* and the lighter *electrons, K-mesons* and their antis, called *strange particles* because of their actual behaviour, while a fundamental property of matter was thought up by physicists – that of *strangeness.* As the number of particles grew (*baryon, fermion, hyperon, hadron, lepton* ...), "there was a need to categorise the growing *zoo*" (an affectionate term actually used in the particle physics literature), which was ultimately classified in *families.* Thus "the family metaphor led to the elementary particle *zoo* in the 1960's: the zoo metaphor was complete with the announcement of particles' *births* and *deaths* (Ahmad 2006:209). Ahmad subsequently remarks that the terminology used by the new physicists had "an element of parody and subversion" and quotes the scientist Murray Gell-Mann, the inventor of the concept of *quark* (yet another elementary particle), who, in naming his invention, turned to James Joyce's *Finnegans Wake*, in which he came across the phrase '*three quarks for Muster Mark*'; nevertheless, a *quark* is also the cry of a gull, besides being intended to rhyme with 'Mark'. Thus naming combines with having fun.

Scientific inquiry is hampered without good terminology, and good scientific terminology is itself an achievement of inquiry, dense with theory: a non-proteinaceous substance in the nucleus of cells is dubbed *nuclein,* and later comes to be known as *nucleic acid*; then *desoxyribose nucleic acid,* later called *deoxyribose nucleic acid,* then *deoxyribonucleic acid* "or just plain *DNA,* is identified; then *pentose nucleic acid* is specified as *ribose nucleic acid,* then *ribonucleic acid,* subsequently acknowledged to be acid*s*, in the plural (and to be found mostly not in the nucleus but in the cytoplasm); and then—almost a century after *nuclein* was coined—we have *transfer RNA, messenger RNA*" and so on (Haack 1999).

At the beginning of the 21st century, surgeons do not speak of human organs being cut from a body; rather, they are harvested. Public aquariums are careful not to say their large marine mammals were captured; rather they were acquired, and hospitals tell the heart attack victim not that he will require operation -- but a procedure. Are such metaphors comforting and merely polite? Are they deceptive? Are they in some sense both? Scientific metaphors run the gamut from merely picturesque speech to serious speculative instruments. The cognitive usefulness of metaphors, in scientific inquiry as elsewhere, is to direct speculation into new avenues; their worth, therefore, depends on the fruitfulness of the intellectual territory to which those avenues lead.

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