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SPECIALISED LANGUAGE VARIETIES: WHEN A COGNITIVE FRAMEWORK CAN EXPLAIN SEMANTIC CHANGES

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ABSTRACT

The aim of this paper is to explore the role of semantic change in the creation and development of scientific, and the interaction between this and common everyday language. To this end, the theoretical tenets of Dik Geraeerts's Diachronic Prototype Semantics plus ideas on the influence of cognitive linguistics (George Lakoff) on semantic change as developed by Györi Gabor have been taken into account. The analysis of terms found in astronomy and history texts from the eighteenth and nineteenth centuries reveals that metaphor is the fundamental cognitive mechanism involved in meaning shifts from scientific to common core vocabulary use.

KEYWORDS: Semantic change, metaphor, semasiology, diachronic semantics, scientific English.

VARIACIONES DEL LENGUAJE DE ESPECIALIDAD: CUANDO LA INVESTIGACIÓN COGNITIVA PUEDE EXPLICAR LOS CAMBIOS SEMÁNTICOS

RESUMEN

El propósito de este artículo es explorar tanto el papel del cambio semántico en la creación y desarrollo del lenguaje científico como la interacción entre este y el lenguaje común de todos los días. Para alcanzar este fin, se tomarán en cuenta los principios teóricos de la semántica diacrónica de prototipos de Dirk Geeraerts, junto con las ideas sobre la influencia de la lingüística cognitiva (George Lakoff) en el cambio semántico que ha desarrollado Györi Gabor. El análisis de términos encontrados en la astronomía y en textos históricos desde los siglos XVIII y XIX revela que la metáfora es el mecanismo cognitivo fundamental involucrado en los cambios semánticos que van del lenguaje científico hasta el vocabulario de uso común.

PALABRAS CLAVE: Cambio semántico, metáfora, semasiología, semántica diacrónica, inglés científico.

1. INTRODUCTION

Until relatively recently the study of historical semantic change had been neglected, with lexical studies tending to focus on the onomasiological nature of words. Prototype Theory, developed by Rosch and Mervis in the 70s and supported by Labov, as well as the application to language of the tenets of human cognition from Cognitive Linguistics by Lakoff (1972) and Lakoff and Johnson (1980), Langacker (1986, 1987) and later developed by many others (Geeraerts 1995, 1997, 2010, Györi 2002, 2005, Cymbalista and Kleparski 2007, 2013 and Grygier 2012), all contributed to the growing interest in semasiological aspects of meaning.

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Scientific language has in many ways become "the dominant mode for interpreting human existence" (Halliday and Martin 1993: 11), and in historical terms can be said to be a variety that emerged following the rise of Empiricism. Prior to this, writing about science in English had required a huge intake of words from other languages, mainly Latin and Greek, to cover the lexical vacuum that authors found when attempting to explain natural phenomena using the vernacular. If this can be regarded as true of the linguistic reality of those times, it is also true that scientific discourse complied with the parameters of the medieval scholastic tradition. Although English began to be used as a learned language around the fifteenth century with the process of vernacularisation, it was not until the seventeenth century that authors became fully aware of the change that was necessary in the transmission of natural philosophy (as science was referred to until the nineteenth century). As we will see, this change involved both methodological tools and discursive patterns.

The transformations brought about by the new empiricist methodology in science were paralleled by changes in corresponding discourses. As is often the case, the accelerated development of human knowledge resulted in a comparable growth in the number of referents to be named. One of the solutions which authors found was borrowing from classical sources, and another was to expand the meaning of existing words.

In this paper I will analyse items from the scientific lexicon, these extracted from two corpora of late modern astronomy and history texts written in English, in order to trace the sort of semantic change involved in such words and the interaction between everyday and specialised vocabulary. To this end, the paper is organized as follows: the first section below will briefly explore the ways in which insights from cognitive linguistics can help in explaining semantic change. In line with the encyclopaedic approach developed by diachronic semantics, the following section will present contextual information on the language of science to illustrate some of the extralinguistic circumstances relating to the process of change in this specialized lexicon. In the next section a description of the material and the methodology used in the study will be given, and after this the analyses of specific terms will be presented, plus a discussion of these. Finally, some concluding remarks will be offered.

2. SEMANTIC CHANGE IN THE LIGHT OF COGNITIVE LINGUISTICS

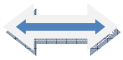
The meaning of a word can be understood as constructed as a result of contextual information; that is, it is determined by the circumstances around production. This means that the meaning of a word is not a mere block of fixed sememes, but these semantic features are shaped and selected by the context in which they are used. Flexibility, or what Robert (2008) calls plasticity, is a notable characteristic of lexical meaning, which Györi and Hegedüs (2011: 318)

have recognised as the "open ended nature of meaning". But meaning is not only "open ended", it is also "subjective" (Lichtenberk 1991). It can vary according to the speaker's perceptual framework. Moreover, words do not possess meanings in themselves, but rather their understanding hinges on the fixing of conceptual categories.

Therefore, lexical units are associated with the conceptual category they represent and with the informational structures users of a language evolve in their minds when they confront external realities, that is, when they encounter the world (Geeraerts 1995).

It can then be argued that semantic changes, explained on cognitive grounds, develop primarily from a recycling process of previous operative meaning structures in human cognition, ones which speakers reorganise when the socio-cultural context demands the expression of new namings, these being concepts connected in the minds of speakers through shared cognitive rules.

However, meanings are not rigid structures but variable in nature, moulded onto the encyclopaedic knowledge of speakers (Langacker 1991 a, b). Meanings might be graphically represented as conceptual mind maps in which core senses can develop peripheral ones, and which themselves may later turn into core senses from which other peripheral meanings emerge, and so on. The coexistence of various senses at one stage in the life of a word results in polysemy, which, according to Anttila (1989: 181) "depends on the psychological reality or awareness of the speaker". The polysemous nature of word meanings represents the flexibility of human mental organisation and, in linguistic terms, can explain the phenomenon of semantic change (Györi, 2002: 27) and the subsequent lexicalization of items associated with specific meanings. Lee (1990) argues that polysemy evolves diachronically through metaphorisation and that frequently used words are more likely to develop polysemy. This, as Geeraerts (1997: 6) has noted, is "the synchronic reflection of diachronic-semantic change". In the case of scientific vocabulary it is not frequency of use but range of application, the need of convenient analogies, and the speaker's proximity to the term that brings about semantic change. I will try to show in this paper that the transition from everyday language to scientific terminology is not a univocal concept, and that the relationship between these two big lexical areas is bidirectional:

everyday language  scientific terminology

Regular cognitive patterns lie behind the innovative use of a term and are responsible for its dissemination. In the development of these cognitive mechanisms, Prototype theory plays a significant role.

According to this theory, the prototype is considered the most representative instance of any category, in that it is the example that first comes to mind and is typically the one most likely to be found in different contexts.

Thus, the prototypical meaning of a lexical category can be identified as the first meaning a speaker thinks of when a word is uttered in isolation. This meaning occupies a central position within its prototype structure, while other meanings are more peripheral within this structure (Carpenter 2013: 5). This is what Rosch (1973) called varying degrees of "prototypicality".

When speakers perform cognitive operations on entrenched meanings to reinforce communicative efficiency, the linguistic representations of these operations may become conventionalized and new concepts of cultural relevance may become established. It is at the end of this process that we can say that semantic change has taken place (Györi and Hegedüs 2011: 318). Meaning shifts are often guided by the cognitive mechanism of analogy, which in turn lies at the root of metaphor. Two meanings are linked together by a common semantic schema, what Langacker (1991 a) calls an "image schema". A term used in an application domain can also be used in another domain through shared cognitive principles. Consequently, the referential value of the term shifts depending on the context of use.

When a word can designate two related meanings, it is because they share a common semantic space, the abovementioned image schema or schematic form, but the referential value of the term shifts according to the domain in which the word is applied. These different values may exhibit "a more or less high degree of schematicity" (Robert 2008: 63, from Langacker 1991b). One of these is the prototypical referential value, the central or core meaning; the other is the less prototypical or peripheral meaning. The use of a word in a context different from the habitual one, but analogous at some point or in some way, provokes the transfer of its semantic properties and the mental inference of only those that can be at work in a particular environment. That is how metaphorical transfer functions. A metaphor has been defined by Geeraerts (2010: 63) as "referential co-occurrence of association of source concepts and target concepts". These processes of association evoke a blending of conceptual domains from which a new meaning originates (Coulson 2001: 165). Metaphors categorise reality by similarities which are essential to human understanding and communication since metaphors help humans in their attempts to understand new problems in terms of existing cognitive resources (Barcelona 2003, 2005; Odlin 2008: 325). The vocabulary of human anatomy is a case in point. Through the similarity of the senses, that is, by the use of a cognitive mechanism, language users make reference to concrete concepts in order to arrive at the expression of abstract ones (*head* as in "departmental head").

3. CONTEXTUAL INFORMATION: THE LANGUAGE OF SCIENCE

The language of the "Nova Scientia" brought about by the Empiricist movement since the seventeenth century was characterised by

> a constant resolution to reject all the amplifications, digressions, and swellings of style; to return back to the primitive purity, and shortness, (…) a close, naked, natural way of speaking; positive expressions; clear senses; a native easiness: bringing all things as near the mathematical plainness as they can; and preferring the language of artizans, countrymen, and merchants, before that of wits or scholars. (Sprat 1916 ed., online).

Thomas Sprat, the former historian of The Royal Society of London, thus describes what was a more referential language, one devoid of long and adorned sentences, and which was called for to account for the new science of the times (Gotti 2001: 221-239). Empiricism, the Enlightenment or Age of Reason, transformed many of the pillars of culture in relation to the explanation of natural phenomena and Nature itself. It also yielded a deep shift in the discourse used to communicate this, in terms of both form and content.

Halliday (2004: 145) dates the birth of scientific English to the last quarter of the seventeenth century, and describes scientific English as highly metaphorical in the sense of grammatical metaphors at the lexico-grammatical level (Halliday 2004: 158). Changes at the lexico-semantic and structural levels reorganised the written medium in order to better convey science. From this period onwards, the language of the sciences was intended to correct previous "excesses in natural philosophy" (de Spratt?). In fact, the central style of scientific prose was now not rhetorical or poetical, but rather a simple style, even though some writers did not use it or indeed approve of it (Barber 1993). With an increasing interest in science, a subsequent expansion in the English vocabulary took place. However, the lack of a specialized lexicon in written scientific texts was a notable handicap here (Gotti 1996), in that scientists needed new technical terms to express new technical phenomena and discoveries (Barber 1993). The main solution came from an intake of vocabulary from different sources. Thus, the English lexicon was enlarged with borrowings from other languages (those arising from commerce and colonization, among others processes), the invention of new items derived from languages such as Latin and Greek (Barber 1993), and also through adapting the meaning of already existing word stock, the topic under study here.

The Enlightenment gave birth to and subsequently strengthened a Utilitarian ideology in the eighteenth century, according to which scientific discourse had to be grounded in reasoning, deductions, anti-rhetorical usage of linguistic forms, clarity and brevity (Scollon-Scollon 1995:107). In this sense semantic shifts (rather than borrowings or newly invented terms) provided a simple and clear way of expressing those new meanings arising from the collective mind of the scientific community. And, of special relevance, this was a means of limiting the incorporation of new word stock; it was a process or reorganization of meanings already in use. As Gotti (2002: 65) put it:

> "The great epistemological and methodological developments taking place in [the 17th-century] determined the need for corresponding changes both in the ways of

> communicating the new discoveries attained by means of innovative procedures and apparatus, and in the expressive tool to be used to describe and argue about the new phenomena observed and analyse".

When we consider scientific terminology and analyse those existing words, or even borrowed words, which later adapted their original meanings, we find that the creation of specialised lexical items naturally tended to avoid polysemy, synonymy or homonymy so as to render accuracy, effectiveness and clearness in the transmission of the message (Elvira, 2003). And, as Geeraerts (1997) and Györi (2005) have pointed out, expressivity and efficiency are two basic forces that motivate language change. Such forces are rooted in the cognitive-communicative needs demanded by the socio-external context. This is the reasoning behind Sager's claim (1990: 89-90) that "a good term should be neutral and unambiguous". However, this does not necessarily mean that an intervening stage of polysemy could not originally form part of the future scientific meaning of a word or that this intermediate step was not necessary for the word to be used by speakers in everyday conversation.

In addition, words used in a colloquial, everyday context could acquire a scientific meaning, but the opposite could also happen. Borrowings, mainly from Latin and Greek, were first used as specialised ways of naming processes, objects, phenomena, concepts and so on, but after a settling period in which a word lost its novelty and became culturally disseminated, such words would enter the realm of general usage. The popularisation of science, understood as a phenomenon of collective psychology, thus played an important role here. Cognitively speaking, there is a necessary metaphorical process between the scientific sense of the term and its popular use, and vice versa. The conceptual domains of a scientific term are figuratively transferred to a new reality by associative processes within the human mind; the reverse of this process is also possible. As Geeraerts (2002: 442) has observed: "motivation often results from cultural changes. More often than not, the background image that motivates the figurative shift is an aspect of the material or the immaterial culture of a language community...". In the same vein, Györi (2005: 134) proposed that "the change in material culture will trigger a most probable automatic metaphorical transfer, which undoubtedly requires cognitive motivation".

These terms were introduced "by means of literary or scientific works in accordance with the scientific or technical concepts they denote such as names of new sciences, object qualities and conditions, etc." (Elvira 2003: 176). They were terms that could be qualified as "purely technical" in nature, and formed one of the significant sources of scientific vocabulary. Another source is that of originally common or ordinary words which have undergone a change in their range of reference to become specialised. Some of the mechanisms for this semantic transformation include generalisation, transfer of meaning, and figurative and metaphorical uses (Elvira 2003).

Robert (2008: 64) claims that one of the semantic changes operating in present-day scientific vocabularies is that of metaphorical transfer, since it allows for the process by which something already known is taken as a basis and is transformed so as to identify something yet unknown but which requires a name. He illustrates metaphors of this kind by alluding to expressions such as "black hole", "software" and "the milky way"; the metaphors here rest on the shared properties between the prototypical meaning of the source concept and the designation of the target concept.

In the following section I will present the data and methodology used in the present study.

4. MATERIAL AND METHODOLOGY

I will be working here with two of the sub-corpora of the *Coruña Corpus of English Scientific Writing*: the *Corpus of English Texts on Astronomy* (*CETA*) and the *Corpus of History English Texts* (*CHET*). These contain texts on astronomy and history, respectively, published between 1700 and 1900, from which two ca. 10,000-word samples per decade have been selected, yielding a total of around 800,000 words.[1] These works were written by men and women who acquired their linguistic habits in writing science in an English-speaking country (www.udc.es/grupos/muste). The selection of these two disciplines, falling within the field of Natural and Exact Sciences for the former and Humanities for the latter, according to the UNESCO classification of science (1988), will allow for the analysis of any similarities or differences between the hard and the soft sciences (Hyland 2005).

The sort of specific vocabulary used in the astronomy texts can be classified into several semantic fields, encompassing not only astronomy terms proper but also lexical items pertaining to geometry, units of measurement, and instruments:

Astronomy proper: *constellations, cometa, cloud-canopy, azimuth, cosmic, cosmography, astro-theology, satellite, sidereal, sphere, trajectory, stellar, sun-beam, sun-dial, sun-set, latitude, longitude*
Geometry: *rectangle, rectangular, cylinder, cylindrical, ellipse, ellipsoidal, cube, cubic, angular, triangle*
Names of instruments: *microscope, telescope, spectroscope, thermometer, micrometer, chronograph, astrology (horoscope)*

[1] Information about authors, titles of works, date of publication and exact number of words of each sample can be found in the Appendix.

Names of planets and constellations: *Uranus, Ursa, Venus, Orion, Neptune*
Units of measurement and related terms: *decimal, centesimal, sextile, sextant, quadrant, proportion, kilogramme*

TABLE 1. Specialised language in astronomy texts

However, the vocabulary of history can be hardly considered "history-specific" *stricto sensu* since, as historians themselves recognise, history develops in close contact with other disciplines, such as economics or philosophy. Thus, historians from the American Historical Association (Jan E. Goldstein, Francesca Trivellato, and Andrew S. Sartori) have written on the association web page that "No discipline is an island", adding that:

> Since then [the interwar period], social history has existed in close dialogue with economics, demography, and anthropology. Intellectual history has long had ties with political theory and philosophy, and political history with political science. In the 1980s, literary theory, cultural anthropology, and psychoanalysis nourished the new cultural history. Ecology served as an inspiration for environmental history. Some world historians today seek the aid of neuroscience, genetics, and archaeology to recast the millennial history of the human species.

This means that the lexicon of history is in the main an assorted set of items from several fields used to refer to historical facts. The semantic sets of items found, then, may belong to society, religion, geometry, war, etc. as Table 2 below shows.

Society, especially those nouns denoting rank or position: *duchess, countess, baronet, chieftain, esquire, alderman, aristocracy, bailiff*
Religious terms: *altar, concillium*
War terms: *battle, defence, barricade, convoy, bayonet*
Terms with contemporary reference only: *corsairs, balls, apothecary, burgo, chariot, colony*
Geometry: *circumference*
Time-past: *anachronisms, chronolog*
Written documents: *charter, article, deposition, exordium, annals, appendix, biography, breviary*

TABLE 2. Vocabulary in history texts

In astronomy I have mainly found specialized terminology, previously adopted from the classical languages, combined with common core vocabulary items. The reverse applies to history where I have found mostly common core vocabulary with a few items that could be regarded as specialized in a variety of other fields. The semantic evolution of some of the words used in samples

from both disciplines has been detailed in the following analysis and discussion from a cognitive perspective, as set out above.

5. ANALYSIS AND DISCUSSION

Meaning in scientific terms, as mentioned above, can originate from two possible sources:
a) It may have been transferred from everyday usage to specialised domains.
b) A borrowing or a new coinage is used to designate specific content and this is later moved to everyday usage.
In any case, extra-linguistic factors may have enriched the variety of meanings of source words, increasing their polysemic possibilities which could eventually generate new changes.

Within the terms from writing in history, the noun *convoy* illustrates a case of semantic change: it was introduced into English early in the sixteenth century to indicate "the act of guiding or escorting for protection". It was formed from the verb convoy (adopted in the late fourteenth century) from OF *convoier* < L **conviare*, literally "go together on the road". The meaning "train of ships or wagons carrying munitions or provisions in wartime under protection of escort" dates back to the beginning of the seventeenth century. The shift operating here is known as narrowing or specialization, with the original general meaning becoming restricted to military contexts. This is a case of extralinguistic motivation.

As Traugot and Dasher (2002: 3-4) have described, the lexicon is subject to changes in the lifestyles of speakers and the artefacts around them:

> [...] the nominal domain [...] is particularly susceptible to extralinguistic factors such as change in the nature or the social construction of the referent.
> It also happens that "the referents of battle, duchess, bailiff. For example, the referents of towns, armor, rockets, vehicles, pens, communication devices, etc., have changed considerably over time, as have concepts of disease, hence the meanings attached to the words referring to them have changed [...]

Within the group of nouns denoting rank or position the item *aristocracy* illustrates a case of pejoration (Crespo 2013). Social changes compelled the collective subjectivity to incorporate value judgements into the primary meaning of *aristocracy*; the result of this is the addition of negative connotations.

> **1.** (Government, Politics & Diplomacy) a privileged class of people usually of high birth; the nobility
> **2.** (Government, Politics & Diplomacy) such a class as the ruling body of a state
> **3.** (Government, Politics & Diplomacy) government by such a class
> **4.** (Government, Politics & Diplomacy) a state governed by such a class

5. A class of people considered to be outstanding in a sphere of activity.

The evolution of *aristocracy* illustrates how language can reflect the emotional interests of the society it represents (Kastovsky, 2006).

The word *colony* can be said to have undergone a change from general to specialised. It was adopted in Middle English *colonie*, < (partly through Old French *colonie*) Latin COLŌNIA, < COLŌNUS meaning "tiller, farmer, cultivator, planter, settler in a new country". This original sense was rendered into English to describe settlements in the sixteenth century when new lands were discovered. This meaning, "A settlement in a new country; a body of people who settle in a new locality, forming a community subject to or connected with their parent state; the community so formed, consisting of the original settlers and their descendants and successors, as long as the connection with the parent state is kept up", expanded and was metaphorically applied to "a group of fossil forms" in a nineteenth-century geological context, and in biology to "An aggregate of individual animals or plants, forming a physiologically connected structure". The general referent came to be applied to more specific contexts within scientific disciplines through analogy and metaphor.

In the study of astronomy texts, loanwords that move from specialized to non-specialised language can explain many cases, and is reflected in my data. It is a metaphorical expansion, a re-structuring of the speaker's cognitive modelling. An instance of such metaphorical expansion can be seen in the word *Irradiation from* F *irradiation* < L IRRADIATIONEM, adopted into English in the 1580s. Its primary meaning belongs to the field of optics and indicates "The apparent extension of the edges of an illuminated object seen against a dark background". This core meaning, mainly physical, shifts to a figurative one, interpreted as "Intellectual or spiritual enlightenment". In this meaning change, an abstraction process is also taking place: the referent of the term moves from concrete to abstract in the speakers' mind by the application of associative mechanisms. Metaphor has been shown to be a cognitively-grounded mechanism of meaning construction and change (Sweetser 1990: 64).

Another example is *meteorite.* It was adopted around the last quarter of the seventeenth century from L. METEŌRUM < Gr *metéōron* "meteor, a thing in the air". The physical object became a metaphorical expansion of the object qualities by means of a humanization process in which it came to mean "quick" in 1818. This is a new process of abstraction caused by the anthropocentric perception of an external reality (Cymbalista and Kleparski, 2013: 58).

The astronomical sense of the word *meteorite* is that of "A piece of rock or metal that has fallen to the earth's surface from outer space as a meteor". The velocity of its fall to earth was in principle a peripheral feature, yet came to be considered central in its figurative use: "Any person or object that moves, progresses, becomes famous with spectacular speed". The new meaning is the result of a metaphorical projection of image schemata by the speaker's

experience and interaction with surrounding realities; it involves the projection of one of the object's characteristics that fits well into the human conceptual framework.

Trajectory < Mod. L TRAJECTORIUM illustrates another case of metaphorical expansion. This term was primarily used in physics, meaning "The line or curve described by an object moving through space", and in mathematics, "A curve or surface that passes through a given set of points or intersects a given series of curves or surfaces at a constant angle". There is, then, a new blending of two different image schema. The current meaning is evoked by the new mental space emerging in the minds of speakers, aided by their world knowledge and the mechanism of analogy. There seems to be an androcentric tendency to take vocabulary which describes nature and apply it to the description of human actions.

An anthropomorphic explanation also seems in order in the case of *eclipse.* The form *eclipse* (c. 1300 < OFr *eclipse* < L ECLIPSIS <Gr ekleipsis) functions as a technical astronomical term referring to "the obscuration of the light of the moon by the intervention of the earth between it and the sun (lunar eclipse). Two kinds of meaning changes can be traced here: one of generalization by using eclipse to refer to "any obscuration of light"; the metaphorical expansion signifies "a reduction or loss of splendor, status, reputation, etc.", which came to be applied to people. In all likelihood this was also the order followed in the term's evolutionary path, as it maybe cognitively simpler to apply the qualities of a general concept to something in particular than to associate a non-human multi-referential concept to an aspect of human life.

Tangent, tangential from L. TANGENTEM was adopted into English in the 1590s, with the meaning of "meeting at a point without intersecting" (a geometric function) and its extended sense of "slightly connected with a subject" was first recorded in 1825. There is another sense of "divergent, erratic" that first occurred in 1787. My guess is that the popularisation and dissemination of science made speakers familiar with new words which were not easily assimilated. The frequency of occurrence of these terms contributed to a broadening of this familiarity and, consequently, brought about speakers' ability to mould the meaning of the term according to their conceptual frameworks. The figurative extension is generated by the transfer of a core feature through shared cognitive principles, the very function of tangents, geometrically speaking, into the familiar context of speakers and their common communicative needs. As Györi (2005: 145) points out:

> Analogies will provide an economical but effective motivational basis for the speaker's own representational process and for guiding the hearer's understanding, i.e., for serving communicative ends, and, at the same time fulfilling the requirement of intelligibility.

The word *Atmosphere* was introduced into English in the 1670s from modern Latin ATMOSPHAERA, < Greek *atmos* 'vapour'. Greek *atmos* "vapor, steam" + *spharia* "sphere" < PIE *awet-mo-, from root *wet- "to blow" (also "to inspire, spiritually arouse") with its well-known, specific sense of "The envelope of gases surrounding the earth or another planet". This term has also been commonly employed in physics to refer to "A unit of pressure equal to mean atmospheric pressure at sea level, 101,325 pascals." A figurative sense of this first meaning then expanded into non-technical varieties of English coming to mean "The pervading tone or mood of a place, situation, or creative work." The physical evidence that *atmosphere* initially represents shifts through human conceptual modelling to a non-tangible referent by transferring the same qualities. It is a metaphorical transformation that yields a new framework developed by the mechanisms of human cognition. The new word meaning is not purely denotative but elicited from the meaning potential (Allwood 2003) which is formed, once again, by speakers' extralinguistic knowledge (Cymbalista and Kleparski, 2007).

The emergent meaning is again a consequence of applying the primary meaning to a human-centred situation. It is a non-physical extrapolation of physical characteristics, a shift from technical to non-technical contexts.

In the 1540s the term a*mplitude* from L AMPLITUDINEM (nominative AMPLITUDO) "wide extent, width," from AMPLUS, was adopted into English. The various senses that accompanied this form were characteristic of several specialised domains: in astronomy, "The angular distance of a celestial object from the true east or west point of the horizon at rising or setting. The arc of the horizon measured from the east or west point to the point where a vertical circle through a heavenly body would intersect the horizon"; physics, "The absolute value of the maximum displacement from a zero value during one period of an oscillation"; and in electricity, "The maximum deviation of an alternating current from its average value."

Although in principle the scientific senses illustrated were the first ones assigned to the term *amplitude*, processes of both abstraction and generalisation operated in these uses so as to yield the new sense of "the state or quality of being ample, especially as to breadth or width; largeness; greatness of extent, large or full measure; abundance; copiousness, mental range, scope, or capacity". The use of this term in specific domains was expanded to a general more conceptual image. The range of application thus widened. The direction of the change, then, went from specific to general, a generalization process working in the cognitive modelling of the human mind.

Cluster from OE *clyster* "cluster" illustrates the generalisation process as well. Its earliest use referred to stars and was introduced in 1727. But the meaning "A group of similar things or people positioned or occurring closely together" was useful not only in astronomy but also in disciplines as disparate as linguistics, statistics and chemistry. Thus, the core meaning or semantic

invariant became concretised in four different meanings or actual usages of the term:

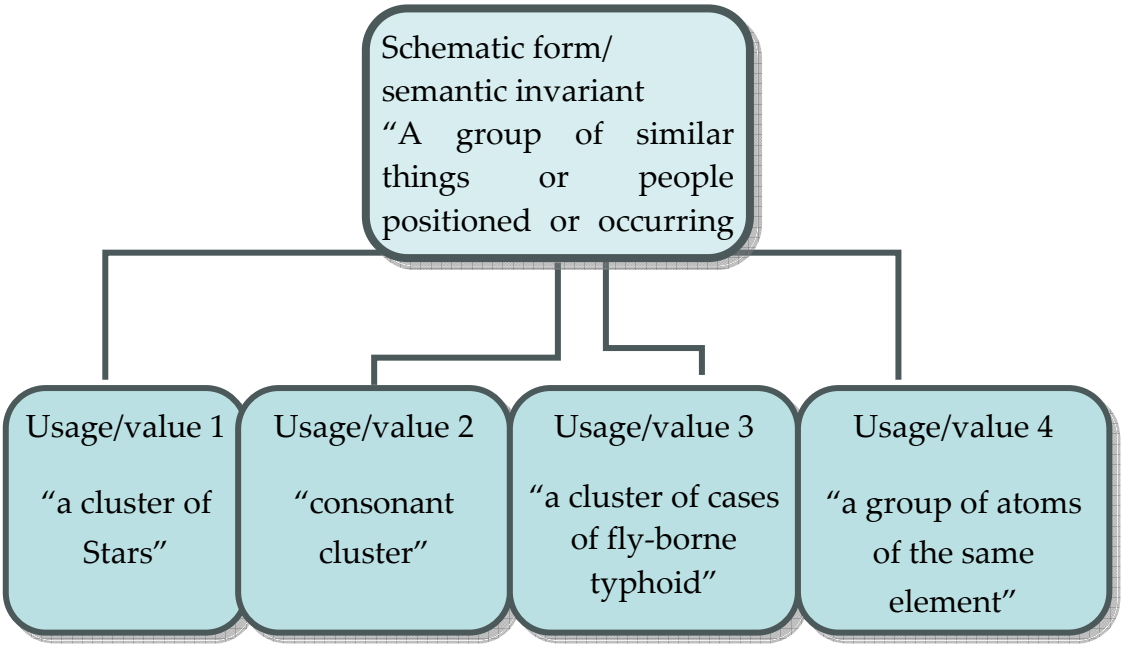


FIGURE 1. *Cluster* (adapted from Robert (2008: 63))

The human perception of the referential value of a term varies depending on the extralinguistic reality. Hence, its plasticity and flexibility play an important role in the creation of semantic relations.

The causes behind narrowing and generalisation in scientific terminology can be seen through looking at the social context around language use, that is, the needs of the discourse community which, through groupal cognition, serve to generate collective conceptualisations since speakers tend "to interpret linguistic structures and categories in terms of our perception and experience of the world" (Trask, 1997:45). The meaning of *cluster*, then, has undergone a process of generalisation or democratisation.

> Semantic development does follow the paths delineated not by the language itself, but rather by the *language-external mechanisms of human cognition*, such as conceptualization, categorization, embodiment, etc. Thus, one may claim that such semantic developments are *extralinguistically motivated*, as their origin is not motivated by some language-dependent patterns, e.g. of figurative speech, but by the language external mechanisms grounded in human cognition (Cymbalista and Kleparski 2007: 79-80).

The case of *ephemeral* illustrates another instance of meaning expansion and metaphorical use. The word was first used in the 1560s to refer to diseases and lifespans, particularly those of a very short period of time. This sense evolved, by extension, into that of "transitory", first recorded in the 1630s.

The word *gravitate* < Mod. Lat. GRAVITARE entered English around the 1640s via the field of physics meaning "force that gives weight to objects". Only thirty years later it was attested with the figurative sense of "act of tending toward a center of attraction". This figurative sense developed as a result of an abstraction process, from a concrete to an abstract conceptual domain: the property of "attraction" was transferred from the primary domain denoting a more concrete referent to the abstract idea of "moving as being attracted by a secret/hidden force".

The existence of opposite changes, that is, narrowing or specialization, can be attested in the item *Degree*. Its history reveals that it was first introduced into English early in the thirteenth century from OFr, meaning "a step (of a stair), pace, degree (of relationship), academic degree; rank, status, position," said to be from Vulgar Latin *degradus "a step". Many of the modern senses that are attributed to the word degree date from Middle English, especially from the notion of "a hierarchy of steps". The influence of this direction in the meaning is easily identified in the technical sense of "a unit of temperature" developed during the first quarter of the eighteenth century. But there are many other modern senses used in various scientific disciplines, including mathematics, physics, grammar and astrology. The general reference it embodied was moulded into different specific meanings through use in context. It became specialised at the same pace as that of scientific development and the accompanying linguistic needs of science.

This example illustrates a shift from general to specific which implies that it fits into the category of narrowing. Similarly, *Fusion* from < L *fusionem*, adopted in the 1550s, underwent a process of specialisation that would be seen in the nineteenth and twentieth centuries (to refer to politics, psychology, physics, etc); by 1776 it could already be used to mean "union or blending of different things; state of being united or blended". The adoption of vocabulary items which are quite vague in meaning allows the user to fit them to the needs of their particular variety of language. Thus, the widespread use of a term in a variety of fields is possible, as long as the primary meaning remains invariant and serves to embody the speaker's intentions.

As was the case with *cluster*, an example of generalisation such as *fusion* can also be schematically represented:

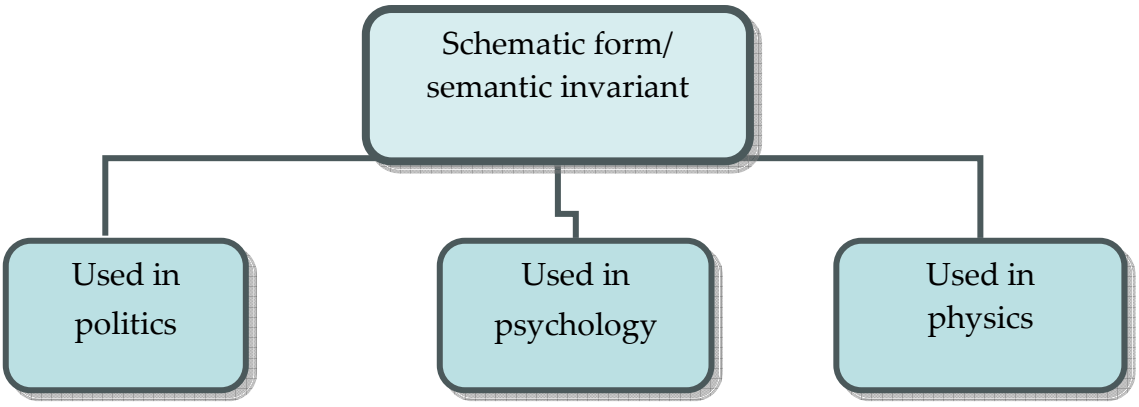


FIGURE 2. *Fusion* (adapted from Robert (2008: 63))

On narrowing, Williams (1976: 177) claims:

> ...it is harder to find a pattern for widening than it is for narrowing. It is not entirely certain, but meanings seem to widen somewhat less frequently than they narrow. As a culture becomes more diversified and more complex with more areas of knowledge and activity, those areas require a vocabulary. Because every language has a finite number of words and because speakers are not inclined to coin completely new forms for new concepts, the simplest way to deal with new areas of knowledge is to use current vocabulary. Borrowing, derivation, compounding, and so on operate here. But perhaps even more frequent is narrowing.

In light of Williams' observations, we should also argue that those general tenets which may apply to language in a broad sense may not be as accurate when focusing on specific varieties, as we have seen. The tendencies in scientific language, at least from the standpoint of loans, appear to support the omnipresent force of metaphor.

6. FINAL REMARKS

Evidence here suggests that, although in principle in scientific English the discourse community had to adopt a considerable number of words from the classical tongues to cover the lexical needs of the vernacular, the primary role of the processes of semantic change is undeniable. In this sense, ordinary and specialised languages have been in constant interaction. The conceptual framework of terms has been manipulated to either expand or make their referential value more specific, according to the extralinguistic scenario. Yet it is not only narrowing or specialisation that has played a part here, but also metaphorical transfer, usually implying an abstraction process in which the subjectivity of the speaker is at play. It is the speaker's cognitive mechanism that decides how analogy should work and this is the basis of metaphorical

transfer. In this sense we can confirm Closs-Traugott's (1990: 499-500) proposal for the general operation of a cognitive pattern: '[m]eanings based in the external described situation > [change to] meanings based in the internal (evaluative/perceptual/cognitive) situation'.

To explain this semantic interaction between ordinary and specialized language through metaphorical transfer we need to consider one of the tenets established by cognitive semanticists: that "instead of thinking in terms of words as expressing "concepts", we should think of them as tools that cause listeners to activate certain areas of their knowledge base, with different areas activated to different degrees in different contexts of use" (Lee 2001: 10). So, a fundamental principle to take into consideration here would be the importance of changing cognitive mechanisms, that is, the inference of appropriate properties by the listeners regarding the use of a term in context.

In focusing on the vocabulary of scientific discourse I have found instances of both narrowing and widening. However, in light of the examples mentioned above there seems to be a tendency to go from specialisation to generalisation through metaphorical extension. Specialised meanings extended mainly in a figurative sense but retain the original meaning, which becomes popular. Scientific saliency or relevance motivates changes in specific-technical vocabulary. The figurative use of terms implies an emotional component of human categorization. Metaphorical uses imply proximity; the subjectivity of the speaker needs this proximity to assimilate concepts. Formal, social and attitudinal aspects can be seen to interplay (Görlach, 2003). Indeed, changes originate these mainly as a function of the subjectivity of speakers, who tend to transfer their own perceptions onto language, however much these perceptions may have been influenced by social circumstances and the needs of discourse.

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APPENDIX I

Author	Date	Title	Words
Morden, Robert	1702	*An introduction to astronomy, geography, navigation, and other mathematical sciences made easie.*	10,154
Curson, Henry	1702	*The Theory of Sciences illustrated, or the grounds and principles of the seven arts;grammar, logick, rhetorick, musick, arithmetick, geometry, astronomy accurately demonstrated and reduced to practice..*	10,247
Whiston, William	1715	*Astronomical lectures, read in the publick schools at Cambridge.*	9,939
Harris, John	1719	*Astronomical dialogues between a gentleman and a lady: wherein the doctrine of the sphere, uses of the globes, and the elements of astronomy.*	9,907
Gordon, George	1726	*An introduction to geography, astronomy, and dialling. Containing the most useful elements of the said sciences, adapted to the meanest capacity, by the description and uses of the terrestrial and celestial globes with an introduction to chronology.*	10,437
Watts, Isaac	1726	*The knowledge of the heavens and the earth made easy: or, the first principles of astronomy and geography explain'd by the use of globes and maps.*	10,407
Fuller, Samuel	1732	*Practical astronomy, in the description and use of both globes, orrery and telescopes. ... with ten curious copper-plates.*	10,232
Charlton, Jasper	1735	*The Ladies Astronomy and Chronology in four parts.*	10,358
Hodgson, James	1749	*The theory of Jupiter's satellites.*	11,106
Long, Roger	1742	*Astronomy, in five books. By Roger Long.*	10,474
Ferguson, James	1756	*Astronomy explained upon Sir Isaac Newton's principles.*	10,519
Hill, John	1754	*Urania: or, a compleat view of the heavens; containing the antient and modern astronomy, in form of a dictionary: illustrated with a great number of figures (Vol.I. Being the first of A compleat system of natural and philosophical knowledge.' - No more published.).*	10,044
Costard, George	1767	*The history of astronomy, with its application to geography, history, and chronology; occasionally exemplified by the globes.*	10,315

Stewart, Matthew	1761	*Tracts, physical and mathematical : containing, an explication of several important points in physical astronomy and a new method for ascertaining the sun's distance from the earth.*	12,180
Lacy, John	1779	*The universal system: or mechanical cause of all the appearances and movements of the visible heavens.*	5,908
Wilson, Alexander	1774	*Philosophical transactions - Observations on the solar spots.*	4,240
Adams, George	1777	*A Treatise describing the construction and explaining the use of celestial and terrestrial globes.*	10566
Nicholson, William	1782	*An introduction to natural philosophy, Illustrated with copper plates. .*	10,268
Bonnycastle, John	1786	*An introduction to astronomy in a series of letters from a preceptor to his pupil.*	9,975
Vince, Samuel	1790	*A treatise on practical astronomy.*	10,540
Bryan, Margaret	1797	*A compendious system of astronomy.*	10,263
Robert Small	1804	*An account of the astronomical discoveries of Kepler: including an historical review of the systems which had successively prevailed before his time.*	10,435
John Ewing	1809	*A plain, elementary and practical system of natural experimental philosophy: including Astronomy and chronology.*	9,985
David Brewster	1811	*Ferguson's Astronomy explained upon Sir Isaac Newton's Principles: with notes and supplementary chapters.*	9,824
William Phillips	1817	*Eight familiar lectures on Astronomy: intended as an introduction to the science : for the use of young persons and others not conversant with the mathematics.*	10,130
John Gummere	1822	*An elementary treatise on Astronomy. In two parts. The first, containing a clear and compendious view of the theory. The second, a number of practical problems. To which are added, Solar, Lunar and some other Astronomical Tables.*	10,507
Thomas Luby	1828	*Introductory Treatise on Physical Astronomy.*	10,704
John Frederick William Herschel	1833	"A treatise on Astronomy". *The Cabinet Encyclopedia. Conducted by the Rev. Dionysius Lardner ... Assisted by eminent literary and scientific men. Natural Philosophy.*	10,224
Landon Campbell Garland	1838	"An Address on the Utility of Astronomy".	9,608
Denison Olmsted	1841	*Letters on Astronomy, addressed to a lady in which the elements of the science are familiarly explained in connexion with its literary history. With numerous engravings.*	8,742
Duncan Bradford	1845	*The wonders of the heavens, being a popular view of Astronomy, including a full illustration of the mechanism of the heavens; embracing the Sun, Moon, and stars.*	10,268
William Holms Chambers Bartlett	1855	*Elements of natural philosophy (Spherical Astronomy.*	10,858
William Whewell	1858	*The plurality of worlds. With an introduction by Edward Hitchcock. I- Astronomical discoveries - p17/ II Astronomical objection to religion.*	10,079
Ormsby McKnight Mitchel	1860	*Popular Astronomy. A concise elementary treatise on the Sun, planets, satellites and comets.*	10,183
Elias Loomis	1868	*A treatise on Astronomy.*	10,323

William Chauvenet	1871	*A manual of spherical and practical Astronomy, embracing the general problems of spherical Astronomy, the special applications to nautical Astronomy, and the theory and use of fixed and portable astronomical instruments, with an appendix on the method of least squares*.	9,895
Dorman Steele	1874	*Fourteen weeks in descriptive Astronomy.*	9,979
George Howard Darwin	1880	On the Secular Changes in the Elements of the Orbit of a Satellite, revolving about a Tidally Distorted Planet.	5,181
Charles Augustus Young	1880	"Recent Progress in Solar Astronomy" *The Princeton review*. Volume 1: 88-104.	6454
James Croll	1889	*Stellar Evolution and its relation to Geological Time.*	9,390
Agnes Mary Cerke	1893	*A Popular History of Astronomy in the Nineteenth Century.*	10,530
Percival Lowell	1895	"Mars: Canals".	8,531

TABLE 1. Astronomy texts

Author	Date	Title	Words
Tyrrell, James	1704	*The General History of England both Ecclesiastical and Civil: containing the reign of Richard II, taken from the most ancient records, manuscripts and printed historians, with an appendix… vol III, second part.*	10,089
Anderson, James	1705	*An historical essay, shewing that the crown and Kingdom of Scotland, is imperial and independent. Wherein the gross mistakes of a late book, intituled, The superiority and direct dominion of the imperial crown and kingdom of England, over the crown and kingdom of Scotland, and of some other books to that purpose are exposed. With an appendix. Edinburgh : printed by the heirs and successors of Andrew Anderson. To be sold by the booksellers of Edinburgh, 1705.*	10,066
Crawfurd, George	1710	*A Genealogical Hiſtory of the Royal and Illuſtrious Family of the Stewarts, from the Year 1034 to the Year 1710. Giving an Account of the Lives, Marriages and Iſſue of the moſt Remarkable Perſons and Families of that Name. To which are prefixed, First, a General Deſcription of the Shire of Renfrew, the Peculiar Refidence and ancient Patrimony of the Stewarts: and, secondly, a Deduction of the Noble and Ancient Families, Proprietors there for upwards of 400 Years, down to the preſent Times: Containing the Deſcent, Original Creations, and moſt Remarkable Actions of their reſpective Anceſtors; alſo the Chief Titles of Honour they now enjoy; with their Marriage and Iſſue, continued down to this preſent Year, and the Coat of Arms of each Family in Blazon.*	10,111
Oldmixon, John	1716	*Memoirs of Ireland from the Restoration, to the Present Times.*	10,076
Strype, John	1721	*Ecclesiastical Memorials; Relating chiefly to Religion, and the Reformation of it, and the Emergencies of the Church of England, under King Henry VIII. King Edward VI. And Queen Mary the First. In three volumes. Volume I.*	10,085
Penhallow, Samuel	1726	*History of the Wars of New England with the Eastern Indians.*	10,216
Horsley, John	1732	*Britannia romana: : or, The Roman antiquities of Britain: in three books. I. History of all the Roman transactions in Britain, also description of the Roman walls. II. Collection of the Roman inscriptions and sculptures discovered in Britain. III. The Roman geography of Britain, in which are given the originals of Ptolemy, Antonini Itinerarium, the Notitia, the anonymous Ravennas and Peutinger's table, so far as they relate to this island. To which are added a chronological table, and indexes to the inscriptions and sculptures. Also geographical indexes both of the Latin and English names of the Roman places in Britain,*	10,131

		and a general index to the work.	
Justice, Elizabeth	1739	*Voyage to Russia: describing the Laws, Manners, and Cuſtoms, of that great Empire, as govern'd, at this preſent, by that excellent Princeſs, the Czarina. Shewing the Beauty of her Palace, the Grandeur of her Courtiers, the Forms of Building at Petersburgh, and other Places: with ſeveral entertaining Adventures, that happened in the Paſſage by Sea, and Land.*	10,005
Bancks, John	1740	*The history of the life and reign of the Czar Peter the Great Emperor Of All Russia And Father Of His Country in India.*	10,057
Hooke, Nathaniel	1745	*The Roman History, from the building of Rome to the Ruin of the Commonwealth. Illustrated with Maps and other Plates. Vol. II. Book IV.*	10,006
Chapman, Thomas	1750	*An essay on the Roman Senate.*	10,187
Birch, Thomas	1760	*The life of Henry Prince of Wales, Eldeſt Son of King James I.*	10,056
Scott, Sarah	1762	*The History of Mecklenburgh, from the Firſt Settlement of the Vandals in that Country, to the Present Time; including a Period of about Three Thouſand Years.*	10,114
Adams, Amos	1770	*A concise, historical view of the perils, hardships, difficulties and discouragements which have 84olumen the planting and progressive improvements of New-England; with a particular account of its long and destructive wars, expensive expeditions, &c. : With reflections, principally, moral and religious. : In two discourses, preached at Roxbury on the general fast, April 6. 1769. : And published at the general desire of the hearers.*	10,070
Anderson, Walter	1775	*The History of France. From the Commencement of the Reign of Henry III. And the Riſe Of the Catholic League; to the Peace of Vervins, and the Establiſhment Of the famous Edict of Nantes, In the Reign of Henry IV. Together with The moſt intereſting Events in the Hiſtory of Europe.*	10,020
Cornish, Joseph	1780	*The life of Mr. Thomas Firmin, citizen of London.*	10,035
Gibbon, Edward	1788	*The history of the decline and fall of the Roman Empire. Volume the tenth.*	10,014
Gifford, John	1790	*The History of England from the earliest Times to the Peace of 1783. Vol. I. Book III.*	10,319
Adams, John	1795	*A view of universal history, from the creation to the present time. Including an account of the celebrated revolutions in France, Poland, Sweden, Geneva, &c. &c. Together with an accurate and impartial narrative of the late military operations and other important events. Vol. II.*	10,116
Stock, Joseph	1800	*A narrative of what passed at Killalla, in the County of Mayo, and the parts adjacent, during the French 84olumen84 in the summer of 1798. By an eye witness.*	10178
Adolphus, John	1802	*The history of England from the accession of King George the Third, to the 84olumen8484n of peace in the year one thousand seven hundred and eighty-three. Vol. III.*	10,079
Warren, Mercy Otis	1805	*History of the rise, progress and termination of the American revolution. Interspersed with Biographical, Political and Moral Obſervations. In three volumes. Vol. I.*	10,214
Bigland, John	1810	*The history of Spain, from the earliest period to the year 1809. Vol.1.*	10,065
Britton, John	1814	*The history and antiquities of the 84olumen84 church of Salisbury; illustrated with a series of engravings, of views, elevations, plans, and details of that edifice: also etchings of the ancient monuments and sculpture: including biographical anecdotes of the bishops, and other eminent persons connected with the church..*	10,017

Hardiman, James	1820	*The history of the town and county of the town of Galway, from the earliest period to the present time. Embellished with several engravings. To which is added a copious appendix, containing the principal charters and other original documents.*	10,255
Callcott, Maria /lady	1828	*A Short history of Spain. In two volumes. Vol. II.*	10,332
Aikin, Lucy	1833	*Memoirs of the Court of King Charles the First. In two volumes. Vol. I.*	10,013
Petrie, George	1839	*On the History and Antiquities of Tara Hill.*	10,117
Smyth, William	1840	*Lectures on Modern History, from the Irruption of the Northern Nations to the Close of the American Revolution. In two volumes.Vol II.*	9,933
D'Alton, John	1844	*The history of Drogheda, with its environs; and an introductory memoir of the Dublin and Drogheda railway. Vol. I*	10,008
Masson, David	1855	*Medieval history.*	10,166
Sewell, Elizabeth Missing	1857	*A first history of Greece.*	10,037
Freer, Martha Walker	1860	*History of the reign of Henry IV. King of France and Navarre.*	10,102
Bennett, George	1862	*The History of Bandon.*	10,040
Gray, John Hamilton	1872	*Confederation; or, The Political and Parliamentary History of Canada, from the Conference at Quebec, in October, 1864, to the Admission of British Columbia, in July, 1871. In two volumes. First 85volumen.*	10,051
Killen, William Dool	1875	*The ecclesiastical history of Ireland. From the earliest period to the present times. Vol. II.*	10,087
Breese, Sidney	1884	*The Early History of Illinois, from its Discovery by the French, in 1673, until its Cession to Great Britain in 1763. Including the Narrative of Marquette's Discovery of the Mississippi.*	10,048
Kingsford, William	1887	*The history of Canada. Vol. I. [1608-1682.]*	10,047
Cooke, Alice M.	1893	*The Settlement of the Cistercians in England. The English Historical Review, Vol. 8, No. 32. (625-648)*	10,761
Burrows, Montagu	1895	*The History of the Foreign Policy of Great Britain.*	10,188

TABLE 2. History texts