FROM KNOWLEDGE TO POWER: THE SLOW BUT RESOLUTE PROGRESS OF ENGLISH AS THE LANGUAGE OF SCIENCE

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Abstract

This paper considers some of the possible reasons for the use of English as the international language of science. An exploration of the evolution of science in English culture is a decisive step in understanding why the language has become so prestigious in the communication of science, to the extent that non-native scientists learn it and use it as their principle means of expression. It is argued that events in the history of modern science, from its beginnings to the present time, have played a crucial role in the modelling of scientific English and its worldwide expansion. The picture painted here, it is hoped, will convince the reader that, at least in this case, history matters.

Keywords: scientific discourse, diachrony, register, external history.

Resumen

En este trabajo se analizan algunas de las posibles razones en las que se fundamenta el uso del inglés como lengua internacional de la ciencia. Estudiar la evolución de la ciencia dentro de la cultura anglo-sajona es un paso decisivo para llegar a comprender el prestigio que esta lengua ha adquirido en el terreno de la comunicación científica, hasta tal punto que los científicos no nativos la aprenden y la utilizan como su principal vehículo de expresión. Los argumentos con los que se intenta dar cabida a la realidad de la lengua inglesa en el momento presente hacen referencia a diversos acontecimientos en la historia de la ciencia moderna, desde sus inicios hasta la actualidad, que han desempeñado un papel crucial en el desarrollo del inglés científico y su expansión a nivel mundial. Con suerte, el lienzo pintado aquí con el color de los hechos históricos, será útil para convencer al lector de que, al menos en este caso, la historia importa.

Palabras clave: discurso científico, diacronía, registro, historia externa.

And who in time knows whither we may vent
The treasure of our tongue, to what strange shores
This gaine of our best glorie shal be sent.
T'enrich unknowing Nations with our stores?
What worlds in th'yet vnformed Occident
May come refin'd with th'accents that are ours?
Samuel Daniel, *Musophilus*, 1599

1. INTRODUCTION

When Francis Bacon and Robert Boyle struggled to combine the Nova Scientia and its methodology with a form of linguistic expression appropriate to the transmission of this emerging knowledge, they could not have predicted the global extension of the English language in the twentieth and twenty-first centuries.

The new methods embraced by Empiricism based scientific findings on facts and experiments, leaving little or no space for the intuitions of natural philosophers. For any study to be taken seriously, solid evidence on the observation of Nature had to be provided. Such broad principles situated the new science at the opposite pole from the previous scholastic tradition, which involved textual dialectic and abstract logic (Vallée). Scholasticism, intrinsically introspective in nature, relied heavily on the work of classical authors and the citation of these as authorities (Taavitsainen; Crespo, "General survey"). The scholastic model produced a firm and unchanging kind of knowledge, this fairly distant from reality. But it was not only the method that fostered a gap between knowledge and society, it was also the language used to convey it, Latin, and the reduced circles of power in which it was developed, particularly medieval monasteries and universities (Crespo, "La intervención femenina"). Indeed, changes in the way that society and science were understood are at the root of today's dominance of English in the field of science, although of course they are not the only reason.

In this paper I will explore the socio-historical causes for the imposition of English as *the* current language of science, as well as looking at the increasing suitability of English for this kind of scientific discourse. The paper has five sections. In the first of these I will briefly discuss the term 'imposition' in relation to the generally held view on the role of English at present and its imposition as such. In section 2 a historical outline is given, focussing on the seventeenth and the eighteenth centuries, with the aim of beginning the process of disentangling the position of the English language today. The effects of the Industrial Revolution up to recent times, both in socioeconomic development and scientific progress, will be discussed in section 3. Following this, section 4 deals with the imposition of a particular discourse on the scientific community, in both oral and written mediums, through generic conventions. Some final remarks will then be offered in section 5.

2. ON THE TERM IMPOSITION AND OTHERS

The historian of modern science Michael D. Gordin recently observed that "contemporary science is Anglophone" and that "science speaks English". He also talks about the "English dominance as a language of science" (Gordin, 310 *Scientific Babel*) and the "anglification of the sciences" (Gordin, 307 *Scientific Babel*). Elsewhere we can read about how "English dominates the formal dimension of international science" (Montgomery 3) and note the use of terms such as linguistic imperialism (Phillipson "Linguistic Imperialism", "Lingua Franca"), dominance, hegemony, monolingual monopoly (Montgomery) and imposition. Whereas some authors simply seek to find

an explanation for this (Crystal), others wonder about the pernicious effects for science of such monolingualism (Hamel). Indeed, some authors go a step further and venture that "if English is considered the default 'language of science', then the implication would seem to be that what is not in English is not scientific." (Seidlhofer 394). The situation, then, does not seem to be a trivial matter.

Interestingly, the Merriah Webster Dictionary online defines the *noun imposition* as:

a. a demand or request that is not reasonable or that causes trouble for someone;
b. the act of establishing or creating something in an official way: the act of imposing something.

In light of these two senses, the semantic prosody of the term seems to be fairly negative, in that with sense a) "not reasonable" and "causes trouble" convey clearly negative connotations, and sense b) refers to the official nature of the imposition itself, and thus to the obligatory nature of compliance. However, Drubin and Kellogg (1399) offer a much more positive and optimistic view:

> English is now used almost exclusively as the language of science. The adoption of a de facto universal language of science has had an extraordinary effect on scientific communication: by learning a single language, scientists around the world gain access to the vast scientific literature and can communicate with other scientists anywhere in the world.

Thus, researchers in this area certainly hold a wide range of opinions on the pros and cons of English as a lingua franca or as an international language. However, by turning briefly to the *British National Corpus* (*BNC,* 100 million words, 1970s-1993) and the *Corpus of Contemporary American English* (*COCA,* 450 million words, 1990-2012) we can get a glimpse of how, more generally, members of the English-speaking community view their tongue as the worldwide language of science. Thus, the noun phrase "English language" was assessed in these corpora, looking specifically at its collocation with words from the semantic field of 'imposition'. The results were manually disambiguated, and are as follows:

Table 1. *Results in BNC and COCA*

	BNC	*COCA*
Hegemony	1	4
Imperialism	1	6
Imposition	0	3
Dominance	3	30
Domination	1	0

A further search for the noun *science* and the adjective *scientific* showed that 'science' did not occur with *English language* whereas the adjective *scientific* did, three times in the *BNC* and just once in *COCA*. In principle, these findings do not

seem to lead to any significant conclusions but to mere speculation; yet some of the extracts returned in these searches provide interesting opinions on the role of English and the contexts in which it operates.

First, in the following excerpt taken from the *BNC* scientific English is seen as influencing equivalent registers in other languages through translation. Here the author hints at the strategic place scientific English occupies:

> (1) The use of the passive voice is extremely common in many varieties of written English and can pose various problems in translation, depending on the availability of similar structures, or structures with similar functions, in the target language. Because of its widespread use in technical and scientific English in particular, it has had a strong influence on similar registers in other languages through translation. The tendency to translate English passive structures literally into a variety of target languages which either have no passive voice as such or which would normally use it with less frequency is often criticized by linguists and by those involved in training translators. (Baker, 1992).

Second, other examples report on the causes behind the dominance and hegemony of English, this being taken for granted:

> (2) English is used as an official language in 60 countries and is the main language of international business – over three quarters of the world's mail is written in it. The only really significant inroad into the dominance of English in recent years has come from Spanish in the southern states of the US. Much of this is a legacy of the British Empire. [...] in the post-colonial era, the dominance of English has been more due to the commercial power of the United States. Faced with mutual incomprehension on one hand and linguistic imperialism on the other... (BNC, New Internationalist).
> (3) This media blitz contributes in its own right to the public perception of the hegemony of English in the global world. (Anthropological Quarterly, 2004).
> (4) Three factors have been quite instrumental in uplifting and boosting the role of English in the international arena: British colonialism, research productivity and mass global communication (Benson, 1994; Crystal, 2003). The power and dominance enjoyed by the English language in the changing scenario led to the upsurge of feelings of linguistic imperialism. (College Student journal, 2011).

Third, in reading the expanded fragments of these searches, it seems that *English language* and *power* is presented from the point of view of *TEFL* or *TESOL* in the *BNC* texts, whereas in *COCA* statements seem to be much more concerned with hegemony and imperialism. Clearly, these are merely intuitions, and would require the extensive analysis of empirical data for confirmation. However, we must leave this for future research, and return to the origins of the dominance of scientific English.

Looking at the history of English we might wonder whether this has always been so, or on the contrary, whether a kind of tacit consensus has arisen over the

course of time and events. At any rate, a journey through the history of English science and its relation to the language might shed light on the contemporary state of things (Siguán, Crystal). To know and understand the past can help us better understand the present as well as to predict likely changes in the near future.

3. FIRST STEPS TOWARDS "ENGLISH AS THE LANGUAGE OF SCIENCE"

My view as to the role of present-day English as a language of science is that it has its origin in the very roots of modern science, and as such I concur with Hyland (18) in claiming that the foundations of the language of science can be dated from the 1600s.

Prior to the emergence of the empiricist method among those devoted to the scrutiny of nature and all things natural, the abstract mode of thought of Scholasticism dominated the various fields of knowledge. Scholastic authors from the Western tradition, as well as their peers in the Arabic world, used the same language to communicate their claims about nature: Latin. But Latin was already a dead language, with no native speaker, and with a few exceptions was confined to the written medium. Learning the language, then, implied a certain degree of education, and hence of social position. Latin was a vehicle for the transmission of elevated concerns, used by the social elite for the purposes of control: the control of knowledge, the control of people, the control of power. But it was generally considered a fitting tool in science, given that it was a "cross-national" means of communication, and one which was well accepted among the members of the epistemic community. The Graeco-Roman tradition contained the wisdom of all classical authors who could be read directly without translations or further interpretation. The attraction of this language, and the benefits it was seen to offer, perhaps lay precisely in it not being the language of a particular people with defined geographical boundaries and political objectives; the converse, of course, is true of current-day English.

In the sixteenth and seventeenth centuries, authors, finding themselves immersed in the humanistic renaissance and also the wave of nationalism of the period, began to use their native tongues in academic issues. These vernacular languages and Latin coexisted for a period of time, in the case of England until well into the eighteenth century. Meanwhile, in Europe Galileo Galilei published his discovery of the moons of Jupiter in the Latin *Sidereus Nuncius* (1610), but following this switched to Italian, the language of his major works, not least because he needed to attract support and patronage. Newton's *Principia* (1687) appeared in Latin, but seventeen years later his *Opticks* appeared first in English, with the Latin translation published two years after this in 1706 (Gordin, *Scientific Babel*). The Renaissance culture paves the way for an incipient multilingualism in Western countries in which socioeconomic power will end up imposing its own rules. Particularly in England, there is an atmosphere of support for national interests that encourages and enhances the use of English and the development of all things necessary (instruments, objects...) to contribute to the nation's welfare. We cannot overlook in this

context the fact that the English language was used by the kings of England as a symbol of freedom and independence from France, a means of stirring the English people into war against France during the Hundred Years' War and later (Crespo, "Change in Life"). This, indeed, is the very essence of history, a sequence of linked past events which exerts its influence on further events, from which we inherit our current situation and probably also our future.

The current of empiricist thought developed by John Locke began to emerge early in the seventeenth century, guided by Francis Bacon, a man considered by some authors to be the very father of empiricism (Sgarbi). Bacon's philosophy defended learning through sensory experience as well as the observation of natural phenomena, which has to be systematized and conveyed through mathematical language. As Dear (69) puts it: "Bacon's stress on first-hand experience and experiment, together with his high evaluation of utility, subsequently promoted precisely the kind of pragmatic corpuscular mechanism that is so typical of the early Royal Society later in the century."

However, early post-Baconian natural philosophers were still imbued with vestiges of the scholastic style and preferred focusing on authorial statements rather than on the object of study itself. This is the reason why we can still find some linguistic traces of scholasticism in seventeenth and early eighteenth-century works. Some of these traces are evident uses of a prescriptive nature, as in constructions like "it is to be noted" or references to classical authorities in sequences such as "after NAME" or "by the authority of NAME", while some others are hidden in the construction of arguments (Puente-Castelo, forthcoming). Between 1500 and 1700 complaints were voiced by authors about the use of English in scientific texts, in that the polysemy of its terms sometimes resulted in ambiguity. They called for the creation of new terms with more appropriate referential meanings. Gotti (156) mentions how in *The Breuiary of Helthe*, Borde (1552) comments that "the field in which the English language proved to be particularly inadequate was that of names of art" where, he claims, technical terms that form the basic lexicon of a particular field are not adequate to transmit the corresponding content. This is also something Locke recalls of language in general in his *Essay Concerning Human Understanding* (online edition, The University of Adelaide):

> But to understand better the use and force of Language, as subservient to instruction and knowledge, it will be convenient to consider: First, To what it is that names, in the use of language, are immediately applied. Secondly, Since all (except proper) names are general, and so stand not particularly for this or that single thing, but for sorts and ranks of things, it will be necessary to consider, in the next place, what the sorts and kinds, or, if you rather like the Latin names, what the Species and Genera of things are, wherein they consist, and how they come to be made. These being (as they ought) well looked into, we shall the better come to find the right use of words; the natural advantages and defects of language; and the remedies that ought to be used, to avoid the inconveniences of obscurity or uncertainty in the signification of words: without which it is impossible to discourse with any clearness or order concerning knowledge: which, being conversant about propositions, and those most commonly universal ones, has greater connexion with words than perhaps is suspected.

The importance of language in scientific concerns is taken up by Lavoisier (asqueted in Barlett, 359) a century later (1789) when he writes:

> It is impossible to dissociate language from science or science from language, because every natural science always involves three things: the sequence of phenomena on which the science is based; the abstract concepts which call these phenomena to mind; and the words in which the concepts are expressed. To call forth a concept a word is needed; to portray a phenomenon, a concept is needed. All three mirror one and the same reality.

As Crossgrove and Pahta and Taavitsainen have explained, the Latin conventions of science writing were transferred into the vernaculars of Europe, especially in the late Middle Ages, but it was in the Age of Reason that scientific and technological issues were seen and treated as economically beneficial (Jardine). Economic advantage, and consequently economic power, may thus have motivated the publication of scientific works in English (sponsored by native speakers). At the same time, in the field of grammar, considerable debate raged on the enrichment of English and its validity as a vehicle of scientific communication (see Borde, above).

Apart from economic issues, some authors (cf. Martin 177) search for an explanation of the dramatic changes in the world of knowledge during the sixteenth and seventeenth centuries in religious dissension:

> The motivations of seventeenth-century innovators in natural philosophy, whether Protestant or Catholic, were deeply religious. Their abandonment of Peripatetic philosophy arose, at least in part, from the conviction that the best historical studies of the day demonstrated that Aristotle deviated from Christianity giving permission to seek more pious alternatives.

So far, social, economic and religious factors have all been credited with helping to initiate, and to a certain extent accelerate, the break with the medieval academic tradition.

Another relevant element here has to do with publication and dissemination. The distribution of the *Philosophical Transactions of the Royal Society of London* in the eighteenth century led to an explosion in scientific activity, largely written in English. But this was not the only language; other vernaculars were also used for the expression of science (Kaplan).

In seventeenth-century England, Boyle's works, echoing Bacon's claims, set the tone for the new paradigm of scholarly writing. The Baconian claim that scientific subjects had to be conveyed by means of a non-ornamental style, devoid of those figures of speech that could cloud or obscure the scientific message, was adopted by members of the *Royal Society* in the last quarter of the seventeenth century, and indeed by scientists in general. In fact, two types of proposals were involved; first, that a plain style should characterise scientific writings; second, that science demanded a style of its own, one capable of expressing objective truth. In the midst of this debate, Henry Oldenburg himself translated letters and articles that he had received into English to be published.

The main principles behind scientific work were truthfulness and reliability, and this was directly connected to the kind of people who could devote themselves to the pursuit of knowledge: the gentleman, who was "financially independent" and could afford these "socially approved pastimes" and who adhered to "genteel standards of conduct and communication" (Kaplan 8). Scientific development was, then, conceived of as a gentlemanly activity, one which generated a genteel discourse (Bazerman, Atkinson) in which certain discursive rules were also established. This discourse set the basis for modern scientific English.

Boyle was quite interested in making readers participants of his experiments as a means of gaining witnesses. At the same time, reporting experimental activities in detail reinforced the idea of reliability. Boyle's endeavours to use a plain, naked style was sometimes accompanied by apologies for being too long-winded, although as Shapin (483) has stated, verbosity and ornamented sentence structure formed "part of a plan to convey circumstantial details and to give the impression of verisimilitude". This method of transmission was in accordance with the moral and social values of Restoration England: simplicity and service to the community, the basic pillars of puritan religion.

The publication of the *Philosophical Transactions of the Royal Society of London* also contributed greatly to the spread of the use of English. This current extended across Europe alongside empirical research and the kind of discursive rhetoric it implied (Kaplan, Prelli). In Gordin's words (*Absolute English*), then, it can be said that "modern science emerged organically from the polyglot stew of the Renaissance."

4. THE NINETEENTH CENTURY AND EVEN CLOSER

By the end of the eighteenth century, works in chemistry, physics, physiology and botany had come to be published in a myriad of languages, not only in English but also in French, German, Italian, Dutch, Swedish, Danish and others.

However, European industrialization in the nineteenth century, in a quest for optimum efficiency, began to see this polyglot system of publication as an additional hurdle for scientists, who had to waste time learning languages so as to be able to learn about new discoveries, inventions or current theories instead of focusing their efforts on industrial or technical matters. This in turn led to a reduction in the number of languages which were habitually used as vehicles of communication, and also in a functional distribution among those that remained: English, French and German, the latter used mainly in Chemistry (Gordin, *Absolute English*).

The nineteenth century also saw a revival of national sentiments and the flourishing of national literatures under the umbrella of the Romantic Movement. Nationalism typically runs parallel to praise for the mother tongue and as part of a celebration of cultural and distinctive idiosyncrasies. In the case of Britain, infused by the rising dominance of the British industrial economy and the imperialist attitude of its citizens, the English language spread world-wide.

In nineteenth-century Britain science developed in the universities and at learned societies. It was also the subject of long and profound debate by clusters of individuals

in various clubs and associations who, while themselves anonymous, would come to see their thoughts, reasoning and formulations echoed in the formal centres of knowledge. Exchanges of information in their meetings were conveyed solely through English, and in addition to science, literature and politics were discussed (MacLeod). Such individuals constituted an elite that marked the progress of the country and its citizens. As long as the effects were beneficial for the population, the commitment to science and technology was supported and enhanced. And all this was done without recourse to Latin.

Broadly speaking, Britain dominated the industrialised world both in terms of international trade and technological development (rail networks and steamships), together with having a growing middle class that demanded material goods and was the driving force behind industrial expansion. Steam power dramatically improved the key British industries of coal, steel and textiles. It was also important for the mechanization of agriculture and the subsequent increase in food production.

Another explanation for this amazing growth can be found in the expansion of the empire and the process of colonization. The moral codes of Puritanism, encapsulated in the values of 'improvement' and 'self-help', played a significant role in the process by which the middle classes could rise up the social ladder, and such codes were, consequently, part and parcel of this scenario of socio-economic prosperity (Atterbury).

The imperialist ideology that dominated the discourses of nineteenth-century British society "demanded imperialization on moral, religious and scientific grounds" (Bratlinger, 168) which obviously included education in English, at least for a small part of the population, in that this education was further "constrained by economic concerns" (Pennycook 77). Yet, the English language was seen by contemporary authors as "the great medium of civilization, the language of law and literature to the Hindoo, of commerce to the African, of religion to the scattered islands of the Pacific" (Guest 703) and as "the grand medium for all the business of government, for commerce, for law, for science, for literature, for philosophy, and divinity" (George 6). All these observations seem to confirm that as the ideology became more nationalist the loyalty to the language of the speech community increased (Martel). The language, hence, becomes a cultural standard, a symbol of identity, an agglutinating element of a people and, at the same time, its distinctive feature. Contemporary authors not only reported on the current situation but also predicted the future of English as a world language. This was the case with the German linguist Jacob Grimm who in 1832 wrote: "the English language [...] appears destined hereafter to prevail with a sway more extensive even than its present over all the portions of the globe".[1]

In the nineteenth century science was exceedingly important for human thought, given that scientists tried to explain the grounds of any technological developments or apparatus, and this willingness for giving explanations brought about an immense growth of research in fundamental science. In addition, scientific advances were shown to benefit the general public. This is one of the reasons why the popularisation of science played a paramount role, in that it made people understand the "whys,

[1] The quotations from Guest, George and Grimm have been taken from Pennycook (99).

hows and what fors" of the scientific enterprise. After all, "the true and legitimate goal of the sciences is to endow human life with new discoveries and resources", as Bacon (Jardine&Silverthorne's edition, 66) had already claimed two centuries earlier. Scientific pedagogy, as well as scientific research, were conveyed in English at a time when this tongue was starting to be learned and thought of as dominant by speakers of colonised territories.

Scientific knowledge and economic progress run in parallel. National pride enshrined in geo-political success touched all spheres of life resulting in a feeling of superiority which extended throughout British culture and its language (Pennycook).

4.1. Closer to us: the past century

The dormant United States will emerge in the twentieth century as the spearhead of the linguistic dominance of English, with a variety of historical events clearly precipitating the demise of competing languages in the global scientific community.

The first of these was the Great War. The consequences for German as one of the languages of science were devastating. As Americans entered the war they issued public regulations to weaken the use of German in the German-speaking areas of the USA. An anti-German feeling spread in the country that would result in the study of foreign languages being neglected for an entire generation. Moreover, in the 1920s international associations for scientific research were established which barred German scientists from joining. The decay of German in science was inevitable (Knight).

The second event was World War II and its aftermath. Many German scientists fled to the United States and started publishing in English. While Europe was devastated by the effects of the war, scientific institutions in the US remained intact, and would begin to accept students from abroad, including third-world countries, who would end up writing in English and becoming leaders in scientific research and communication (Kaplan).

Russian had also been a significant vehicle of scientific communication, but ceased to be considered as such with the onset of the Cold War (Gordin, *Absolute English*). The Anglo-American model of science began to be exported with the compliance of non-English speaking countries from Europe and Latin America. All these external factors led to the rise in English to a position of dominance in the field of science.

More recently, and as an illustration of how far this dominance has extended, the official global record of plant species, the so-called "International Code of Botanical Nomenclature", officially replaced (previously compulsory) Latin with English in 2012. The current situation is one in which English is overwhelmingly used as the vehicle of scientific communication *par excellence*, as attested in a huge number of international forums and databases, although not without controversy. The benefits and flaws of this historico-political choice is beyond the scope of the present study, which focuses on scientific English as an evolutionary register. Hence, I will now complete the arguments on possible reasons behind the resolute pace of the rise of English as the language of science.

5. GENERIC CONVENTIONS

In this section I will briefly introduce the topic of generic conventions in English from the beginning of modern science to the present.

Scientific practice in the modern era required appropriate formats to channel empiricist voices. As already mentioned, after the emergence of the new methodology, scholasticism began to undergo a dramatic change, with authors beginning to cite evidence to support their arguments and basing their statements on observation and experimental procedures, what Boyle called the "rhetoric of immediate experience", as Atkinson (335) has already noted. The new methodology, then, involved a new discourse that emerged as a reaction to deductive logic from classical sources and demanded precision and objectivity in writing, specific terminology, the omission of rhetorical devices, and the avoidance of authorial presence. Writers of the early modern period represented a moral and social model to be followed. Scientific authors acted as guarantors of truthfulness and reliability which would give an "impression of objectivity" (Gross et al. 47). Boyle, one of the writers who produced scientific reports in precisely this way, also expressed some ideas of his own on the organisation of scientific writing, and these would come to constitute part of the origins of current scientific rhetoric. He defended the introduction of images in texts and the integration of new meanings in the semantic range of reference of old words; he claimed that findings should be the pure object of scientific dispute, experimental essays should be published in the form of letters, and that witnessing and trustworthiness were reinforced by reference to authorities. This was the basis for a system of citations to ensure the validity of scientific claims (Allen, Qin and Lancaster; Swales).

Thus, as science and its method progress, the genteel discourse of seventeenth-century science is rendered insufficient. The reliability and truthfulness which scientific rigor demands are no longer achieved by the credibility of the author alone but by the methodology of research and the way in which the practice of science is communicated (Crespo, "Astronomy"). From the late 1660s to the beginning of the nineteenth century scientific narratives are characterised by moving from authorial involvement in discourse (verbal structures) to the representation of a more informational and object-centred rhetoric (Atkinson xxvi; Crespo, "Astronomy").

Likewise, during the transition from the eighteenth to the nineteenth century some external factors exerted a downwards pressure on the genteel code in the scientific arena; these included an increasingly literate population and modern methods and technologies that had developed mainly during the industrial revolution. The linguistic corollary is that the discourse of science adjusts to accommodate new scientific settings, shifting from an involved to an informational tone. In this way science also comes to occupy a social role, and as a consequence its language becomes differentiated from that of other domains, creating a new

variety of English.[2] Scientific discourse was mainly presented in books in the seventeenth and eighteenth centuries, but in the following century the journal article would gain much more importance (Allen, Qin and Lancaster).

Originally, the journal article typically contained the description of a natural phenomenon which had been observed, in accordance with the Baconian tenets of simplicity and clearness of exposition (Harmon & Gross). Overall we might say that until the nineteenth century, scientific works were written according to the norms of general expository prose, a particular prose style with a corresponding lexicon, and that endeavours at specialisation were tentative. Specialisation and the institutionalisation of science, as well as the view that scientists were professionals, developed during the period of the industrial revolution and the great expansion of the British Empire. However, stylistically speaking, nineteenth century articles tended to be more impersonal, moving towards the consolidation of a "homogeneous communicative style" as Gross et al. (138) have shown in their analysis of English, French and German works. From a structural point of view, nineteenth-century articles are organised into sections and include recognisable introductions and conclusions. Indeed, Gross et al. (138) note the presence of "title and author credits, headings, equations segregated from text, visuals provided with legends, and citations standardized as to format and position", all of which points to the contemporary format. No doubt, the specialization and professionalization of science consolidates during the twentieth century alongside the IMRD article format. As David Knight (149) has explained:

> The language of science overlaps with that of ordinary life, but words like 'field', 'elementary' and 'family' came to be used in the later nineteenth century in rather different senses in physics, chemistry and biology. Learning science is in part learning a language. As scientific courses proliferated, so this aspect became more prominent; the people working in particular sciences came to expect of each other that they would speak the same language, and gaps between physicists, chemists, biologists, geologists and so on increased.

This implies a move closer to today's scientific register, modelled on disciplinary and generic conventions and described by some as "highly compressed, neutral, monotonal" (Gross et al. 137). It is a register conveyed mainly through nominal constructions, objectification or reification, specialised lexical items, and passive voice structures. Indeed, passivisation is one of the linguistic mechanisms used in scientific English that confers objectivity on the message

[2] Some 19th century authors included in *CETA* (*Corpus of English Texts on Astronomy*, 2012) are known to have coined new terminology within this emerging field of science. Whewell (1833), a founding member of the British Association for the Advancement of Science, devised the terms "anode," "cathode," and "ion" for the chemist Michael Faraday. He was also asked to conceive of a term to replace the then current expressions "natural philosopher" and "man of science", and thus the word "scientist" came into being. Similarly, the well-known mathematician Chauvenet (1871) is said to have invented a list of mathematical terms, which included "continuous function".

by positioning the writer at a distance from what is stated in the text (Baker). Its illocutionary effect has turned it into a distinctive feature in the communication of science, and its pervasive influence can also be traced in translations and even in works written in other languages.

It is the quest for objectivity by those carrying out scientific work from the seventeenth century onwards that endows the English language with the touch of neutrality used nowadays by writers of all nationalities to communicate scientific work on a global scale. Leaving aside the fact that the business of scientific publication is also largely in Anglophone hands, impartiality seems to prevail over the association of English dominance in science with "geopolitics, personal preferences, economic pressures, and a host of contingent twists and turns" (Gordin, *Scientific Babel*: 310). This association might also be understood as part of the key to success.

6. FINAL REMARKS

This swift walk through the history of modern science was intended to demonstrate that current statements and opinions on the spread of English worldwide are well rooted in the actions and ideologies of language users in previous periods. Simply put, the situation we are presently facing is a consequence of the past.

When we ask why Central and South American countries are Spanish-speaking countries, the answer is to be found in the history of Spain and the expansion of its empire through the discovery of new territories. Similarly, if we want to know why English has become the language of science, in all likelihood we will find the answer in the origin and evolution of science itself, in its main philosophical trends and the postulates of key figures, as well as in the socio-economic and political factors that have framed this progress. No matter what speakers do or think, their language will inexorably follow them.

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