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# ABBREVIATIONS IN ENGLISH AND ITALIAN SCIENTIFIC DISCOURSE

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## Abstract

Several studies on English and Italian specialized discourse have demonstrated that in scientific, legal and technical language there is a general tendency towards complex noun phrases (Altieri Biagi 1974; Cortelazzo 1990; Gotti 1991, 2003, 2005; Williams 2004; Garzone 2008; Mattiello 2010). However, due to the increasing popularization of some forms of scientific discourse (Mattiello forthcoming b), there seems to be also an opposite tendency to use abbreviations such as initialisms (e.g. *MRI* ← *Magnetic Resonance Imaging*, *SSI* ← *Stazione Spaziale Internazionale* ‘International Space Station’), acronyms (e.g. *CAT* ← *Computerized Axial/Computer-Assisted Tomography*, *GAVI* ← *Global Alliance for Vaccines and Immunization*, *TAC* ← *Tomografia Assiale Computerizzata*), clippings (e.g. *chimp* ← *chimpanzee*, *psi* ← *parapsicologia* ‘parapsychology’), and related items to condense information into smaller units, especially when they are highly accessible to the whole community, or even lexicalized (*AIDS*, *DNA*, *HIV*, *lab*, *NASA*, *UFO*) (Brinton & Traugott 2005).

Although these formations are generally neglected by morphologists (Aronoff 1976; Scalise 1984; Spencer 1991; Haspelmath 2002), or marginalized to expressive (Zwicky & Pullum 1987) or extra-grammatical morphology (Dressler & Merlini Barbaresi 1994; Dressler 2000; Conti & Mattiello 2008; Mattiello forthcoming a), they are widely exploited in specialized discourse because of their (a) naming function, i.e. they assign concepts, phenomena and processes specific labels which can circulate internationally, and (b) economy (Zipf 1949; Martinet 1955), i.e. they avoid redundancy and favour textual efficiency.

This study investigates the terminology used in two scientific journals written in English – *Nature* and *Science* – and in two Italian translated versions of English journals – the American magazine *National Geographic* and the Australian magazine *Nexus New Times* – to show that scientific language often makes use of abbreviatory operations for various reasons. First, they help create social closeness, especially among in-group experts. Second, they help maintain textual cohesion, anaphorically referring to previously introduced concepts and ideas. Third, they catch the reader’s attention, especially when they are used cataphorically in news headlines. Cross-linguistically, this study will show that, in texts translated from English, Italian often leaves English abbreviations untranslated, because they refer to worldwide concepts, are amply recognized at an international level, and have acquired a status as words (Bat-El 2000; Kreidler 2000; Fradin 2003).

## 1. Introduction

Abbreviations are traditionally associated with informal style and familiar contexts. They often coincide with existing words or phrases, differing from their source only for their connotation or flavour (Kreidler 2000: 961). Although many abbrevia-

tions do not exhibit any semantic difference with respect to their base lexemes, representing mere allomorphic variants, the use of shortened words is often an index of social meaning or a marker of social identity. Clipping, for instance, is negatively defined by Bauer (1983: 233) as a process without any semantic consequences but with “a change of stylistic level”, and clipped words are assumed by Adams (1973: 135) to indicate an attitude of familiarity either towards the object denoted or towards the audience. Marchand (1969: 447) similarly claims that clippings do not belong to the standard vocabulary of a language in that they “originate as terms of a special group”, in a milieu where a hint is sufficient to indicate the full word. Plag (2003: 121) likewise observes that they acquire an “in-group flavor”, since they are generally used in smaller communities of speakers sharing a common social or professional jargon. This allows the standard English words *laboratory* and *hashish* and their colloquial variants *lab* and *hash* to co-exist, selecting different registers and users (Mattiello 2008).

Acronyms and initialisms, however, are not necessarily confined to colloquial language or slang. Most of them go back to the Second World War (Marchand 1969; Cannon 1989), but the progress of science and technology in the last two centuries also played a fundamental role in the development of their formation, and their use increased especially at the beginning of the twentieth century (Kreidler 2000: 959). According to Bat-El (2000: 63-64), acronym words are not synonymous with their full-length forms in that they refer to something “more specific” than their bases, and even change their “grammatical category”, e.g. from phrase to noun<sup>1</sup>. I disagree with Bat-El’s (2000) claim that acronyms change their grammatical class, because we cannot define a change from a noun phrase such as *North Atlantic Treaty Organization*, with a noun as its head, to the noun *NATO* as a proper syntactic or functional change (see Conti & Mattiello 2008: 568)<sup>2</sup>. Nevertheless, I acknowledge that acronymic words introduce some stylistic changes, becoming often part of a private, specialized or even secret lexis. Like clippings, acronyms and initialisms can be used by insiders either to exclude outsiders from understanding or to emphasize the cohesiveness of their group. For instance, *TBI* (← *traumatic brain injury*) is used by physicians in the presence of patients, and slang *LOL* (← *laughing out loud*) is used by young people to communicate with their peers.

Clippings and acronyms are also typically associated with oral communication, such as relaxed or unofficial conversation. However, the practice of shortening words or phrases is nowadays common not only in oral speech but also in written language, especially in “communication under shortage of time or space” (Ronneberger-Sibold 2008: 207). The mass media tend to favour rapid transmission of information, both through oral channels (television, radio), and through written ones (newspapers, magazines, periodicals). Furthermore, the Internet is revolutionizing all forms of communication, and contributing to the popularization of many specialized journals through their online circulation (Mattiello forthcoming b). This aspect

<sup>1</sup> See Fradin (2003: 249-250) for a related position.

<sup>2</sup> Counterexamples in English represent a minority of cases, mainly confined to slangy use: e.g. *job* (← *fresh off the boat*) used for ‘a recent immigrant’, and *dinkiel-y* (← *double/dual income no kids + -iel-y*) referring to ‘either partner of a working couple who have no children’.

is interesting for clipping, acronym formation and similar abbreviatory processes, which are now widespread and frequently used in the language of scientific journal websites. In scientific websites, new discoveries, viruses, illnesses, medicines, as well as novel organizations, associations, and research projects are given shortened names, not only because they are easier to pronounce, perceive and memorize with respect to their full forms, but also because they can straightforwardly circulate at national and international levels.

For these same reasons, blends are discussed in the literature in terms of their pertinence to formal contexts and specialized vocabulary, especially when coining new names for chemical substances and compounds. Marchand (1969: 453), for instance, mentions a series of relevant English examples belonging to the area of chemistry, such as *aldol* (← *aldehyde* + *alcohol*), *alkargen* (← *alkarsin* + *oxygen*), and *chloral* (← *chlorine* + *alcohol*). Some comparable Italian data (e.g. *liquigas* ← *liquido* 'liquid' + *gas* 'gas', *napalm* ← *acido naftenico* 'naphthenic acid' + *acido palmitico* 'palmitic acid') are reported in Thornton (1993: 151) who claims that, from the perspective of Natural Morphology (Dressler *et al.* 1987; Dressler 1999, 2005), blends are chiefly created for semantic reasons, especially "to reproduce a physical blending of substances in the blending of morphs" (Thornton 1993: 153). Within the same approach, Ronneberger-Sibold (2008: 206) has recently remarked that blends are amalgamated nouns which iconically reproduce "things or substances consisting of several amalgamated ingredients". Therefore, although the attractive potential of blends is often exploited in gossip magazines (e.g. *Brangelina* ← *Brad Pitt* and *Angelina Jolie*), as well as in advertising and product names (e.g. *Lipfinity* ← *lipstick* and *infinity*, 'Max Factor lipstick brand', *morbistenza* ← *morbidezza* 'softness' and *resistenza* 'strength' used in an Italian ad for a toilet paper), blends are heavily exploited also in specialized discourse, because of their vivid, condensed style, in spite of the negative consequences at the level of morphotactic transparency.

The present paper intends to show that abbreviatory morphological processes such as clipping, acronym formation and blending play a dominant role in specialized discourse. My focus will be, in particular, on scientific terminology used in journal websites<sup>3</sup>. The data collected for this paper are drawn both from well-known journals written in English and from Italian translations of English journals. However, in the paper I am not concerned with the lexical strategies intervening in the translation process, but rather on the distribution of abbreviations both in genuine scientific texts and in translated ones. Indeed, my assumption is that many English abbreviations are left unaltered when they are used in Italian contexts, especially if they are widespread, amply recognized, and belong to the universal terminology shared by the scientific community.

A corpus of 970 articles published in *Nature* (302 articles), *Science* (402), *National Geographic Italia* (132) and *Nexus* (134) have been explored to select a considerable amount of (contextualized) data for both morphological description and prag-

<sup>3</sup> The Internet certainly influences the lexical and stylistic choices of popularized forms of scientific discourse such as scientific journals on the Web. This aspect is studied in Mattiello (forthcoming b).

matic analysis<sup>4</sup>. Section 2 of this paper is a preliminary overview of abbreviations, including a description of their locus in relevant morphological theories and in scientific vocabulary. Section 3 is devoted to the scrutiny of the crucial socio-pragmatic functions of abbreviations in (translated) scientific discourse. Lastly, Section 4 offers a cross-linguistic analysis of data, with particular emphasis on borrowings and international abbreviations in Italian translated texts.

## 2. An overview of abbreviations

Since there is a lack of consistency in pertinent literature (e.g. Cannon 1989: 106; López Rúa 2002: 40; Plag 2003: 126-129) with respect to what counts as an abbreviation in general, in contrast with what should be regarded, for instance, as a proper clipping, an acronym, an initialism, or a similar shortened word, a preliminary terminological distinction is in order. In this paper “abbreviation” is used as an umbrella term comprising different morphological processes: namely, clipping (E. *dino* ← *dinosaur*, It. *flebo* ← *fleboclisi* ‘phleboclysis’), acronym formation (*NASA* ← *National Aeronautics and Space Administration*), initialism formation (E. *GMO* ← *Genetically Modified Organism*, It. *OGM* ← *Organismo Geneticamente Modificato*), and, less relevantly, blending (It. *sonofusione* ← *sonorità* ‘sound’ + *fusione* ‘fusion’) and back-formation (E. *to lase* ← *laser*).

The blending process is considered rather marginal within the broader category of abbreviations because (1) it also involves a fusion mechanism which is not typical of other abbreviations<sup>5</sup>, and (2) there are cases of overlapping blends which do not exhibit any truncation at all, as in *alcoholiday*, where the segment *hol* is shared by both constituents (*alcohol* + *holiday*), or Italian *Legambiente*, with an overlapping *a*. These latter cases will be therefore excluded from my analysis.

Back-formation of the type *laselaser* is likewise secondary with respect to other abbreviations<sup>6</sup>, because (1) the material it deletes is predictable on the basis of analogy with pre-existing pairs of words (e.g. *writelwriter*), and generally corresponds to affixes of word-formation (rarely inflection) rules, and (2) it involves a syntactic shift, although in the opposite direction (e.g. N → V). For the reasons just explained, my focus in this paper will be primarily on the phenomena of clipping and so-called alphabetisms, including acronyms and initialisms<sup>7</sup>, whereas blends and back-formations will be only marginally touched upon.

<sup>4</sup> The research conducted in this study is purely qualitative and meant to survey the primary abbreviatory patterns used in scientific terminology. Of course, a more systematic quantitative investigation would also be necessary for a thorough classification of these phenomena.

<sup>5</sup> Cf. Marchand (1969: 451-454), who discusses blends together with cases of word-manufacturing (i.e. letter- and syllable-words), and Bauer (1988: 39), who includes blends and acronyms under the same label, namely “alphabet-based formations”.

<sup>6</sup> In the literature, back-formation is often connected with an abbreviating mechanism and differently defined as zero-derivation with affix dropping (Marchand 1969), a kind of shortening (Kreidler 1979, 2000; Stockwell & Minkova 2001), a special case of clipping (Bauer 1983), or a combination of conversion and clipping (Nagano 2007).

<sup>7</sup> Initialisms are distinguished from acronyms on the basis of their pronunciation, which is letter by letter, as in *HIV* /eɪtʃ.əˈviː/, rather than orthoepic, as in *AIDS* /eɪdz/.

### 2.1. *Abbreviations in theories of word-formation*

In the literature on Generative Grammar, clippings, acronyms, blends, and back-formations are not assigned the status of word-formation rules. They are labelled “oddities” by Aronoff (1976: 20), and considered phenomena of minor importance by Scalise (1984), or even dismissed from any theoretical morphological discussion by Spencer (1991) and Haspelmath (2002).

Because of their lack of regularity and reduced transparency, abbreviations are confined to “expressive (vs. plain) morphology” by Zwicky & Pullum (1987), or to that part of morphology called “extra-grammatical” by Dressler & Merlini Barbaresi (1994), Doleschal & Thornton (2000) and Mattiello (2008, forthcoming a).

According to Dressler & Merlini Barbaresi (1994: 40), the operations forming abbreviations “do not form new words from the point of view of meaning (at least when they are coined)”, and for this reason they are excluded from morphological grammar.

Dressler (2000: 4) similarly claims that abbreviations such as acronyms and clippings “do not change meaning and thus violate a fundamental principle of MRs [Morphological Rules]”. When meaning change is involved, as with back-formations, this change is not additional as in rules.

Another principle that they violate is predictability of the output (Bauer 1983; Ronneberger-Sibold 2008; Mattiello forthcoming a), that is, unlike morphological rules, abbreviations do not manipulate forms in a regular way. We cannot, for instance, easily or totally predict the final form of an alphabetism from its input because:

- some words of the source phrase may not be graphically represented in the output, as in elliptic *CDC* (← *Centers for Disease Control and prevention*), which obscures both function (*for, and*) and content words (*prevention*).
- affixes may be considered as independent words, as in *NGO* (← *NonGovernmental Organization*), where both the prefix *non-* and the adjective *governmental* appear in the initialism (cf. *NAS* ← *Nuclei Antisofisticazioni e Sanità* ‘Fraud Squad’, where *antisofisticazioni* provides only one letter).
- not all compound members iconically correspond to a letter, as in *GPR* (← *green-absorbing proteorhodopsin*), where the *a* of *absorbing* is ellipted.
- more than one letter from the words in the source phrase can be retained to allow the acronym to arise, as in *HiRISE* (← *High Resolution Imaging Science Experiment*).
- spelling may vary and even admit an alternation between capital and lower-case letters, the latter often being in non-initial position (e.g. *AfDB* ← *African Development Bank*, *GeV* ← *Giga-electron Volts*, *PrEP* ← *Pre-Exposure Prophylaxis*, *TMAV* ← *Titi Monkey AdenoVirus*), but not necessarily (cf. *hESC* ← *human Embryonic Stem Cell*).
- furthermore, there may be borderline cases between acronyms and blends, e.g. the formation *CODATA* is spelt in capital letters and originates from a phrase (*Committee on Data for Science and Technology*), but it is a partial blend of two words (*Committee* + *Data*).

All the above-mentioned cases are non-prototypical alphabetisms, whereas non-elliptic acronyms (E. *CAT*, It. *TAC*) and initialisms (E. *GMO*, It. *OGM*) belong to the more transparent prototypical type.

Blends are equally difficult to predict. In particular, the operations forming blends are less regular than rules forming compounds, admitting, beside concatenation, also truncation and fusion (e.g. *dinofuzz* ← *dino(saur)* + *fuzz*), and even intercalation (see Kemmer's 2003 "intercalative blends"). Among them, the more transparent type, labelled "partial" by Thornton (1993: 148), abbreviates only one source word (called "splinter"<sup>8</sup>), leaving the other in its full form. The splinter, however, may be either the first or the second member, as respectively in *sono-luminescenza* (after the above-mentioned *sonofusione*) and *elephantiasis* (← *elephant* + *filariasis*)<sup>9</sup>. In blends, the prototypical pattern takes the first part of the first source word and the final part of the second source word, as in *sm(oke)* + *(f)og* → *smog* (López Rúa 2002: 43-44).

Similarly, clippings are not formed by a rule in any consistent and predictable way, since various, not necessarily more salient, parts can be retained. In English, for instance, the prototypical tendency towards back-clipping (*dino, lab*) (Jamet 2009: 18) is disconfirmed by counterexamples retaining the middle of a word (*flu* ← *influenza*), or, from complex bases<sup>10</sup>, two word beginnings (*Nat Geo* ← *National Geographic*, *slo-mo* ← *slow-motion*), or the beginning and the end, as in *breathalyser* (← *breath analyser*)<sup>11</sup>. In Italian, some regularities and preferences have been identified by Thornton (1996: 85-86), who claims that the output of prosodic morphological phenomena like *accorciamenti* (her label for "shortenings") is a "disyllabic trochaic foot ending in a vowel" (*gastro* ← *gastroscopia* 'gastroscopy', *polio* ← *poliomielite* 'poliomyelitis'). The minimal prosodic word template, however, is not applicable to all Italian clipped words: e.g. *etero* (← *eterosessuale* 'heterosexual') and *otorino* (← *otorinolaringoiatra* 'otolaryngologist') are not disyllabic, and *prof* (← *professionista* 'professional') does not end in a vowel. In my corpus, clippings such as *psi* or *multiverso* (← *multi-universo* 'multi-universe') are even less prototypical, in that they respectively retain the middle and the edges of a word.

Moreover, the input of abbreviations is not easily recognizable, their head is obscured by the shortening process, or even assigned to a letter, as in alphabetisms. These latter formations often exhibit some ambiguity, either with homophonous words (e.g. the acrostic *WISE* ← *Wide-field Infrared Survey Explorer*), or with other homophonous alphabetisms: for instance, the initialism *CI* corresponds to a variety of inputs in scientific terminology, including *Cardiac Index*, *Chemical Ionization*, *Chronic Illness*, *Conservation International*, *Cytoplasmic Incompatibility*. Clippings more rarely coincide with non-abbreviated English words, but exceptions exist: e.g. *pro* from *professional* (cf. Aronoff's 1976: 43 notion of "blocking").

Lastly, as Bat-El (2000: 64) observes, the input in extra-grammatical morphology is much more permissive than that in core morphology (see Zwicky & Pullum's

<sup>8</sup> Lehrer (1996: 361) defines splinters as "parts of words in blends which are intended to be recognized as belonging to a target word, but which are not independent formatives".

<sup>9</sup> The *OED* suggests that the etymology of this term is from the noun *elephant*, after Latin *elephantiasis*.

<sup>10</sup> See "clipping-compounds" in Marchand (1969: 445), "clipped forms" in Bauer (1983: 233), "shortened/abbreviated compounds" in Plag (2003: 122), "clipped compounds" in Mattiello (2008, forthcoming a).

<sup>11</sup> Cf. the back-formed verb *breathalyse* 'to subject (someone) to a test with a breathalyser' (*OED*).

1987: 336 “promiscuity with regard to input category”): for instance, it can be a list in acrostics like *REACH* (← *Registration, Evaluation, Authorization and restriction of CHEMicals*), or it can also be two semantically related words in blends like *ginormous* (← *gigantic + enormous*).

In spite of the irregularity and difficult predictability of abbreviations in both meaning and form change, and of the promiscuity and difficulty in recognizing their bases, some scholars (e.g. Bat-El 2000; Plag 2003) claim that truncations, acronyms and blends are highly systematic products of word-formation, and can be accommodated within grammatical morphology. According to Bat-El (2000: 64), acronyms as well as blends have regular syntactic functions, and they can even be the input of grammatical word-formation rules. In fact, clippings and initialisms can regularly obtain negative derived forms (e.g. *Saccharomyces cerevisiae* → *non-S. cerevisiae*, *poliomielite* → *anti-polio* ‘vaccine against poliomyelitis’, *United Kingdom* → *non-UK*), or even compounds (*Serratia marcescens* → *Serratia-free*, *Serratia-harboring*). Similarly, the lexicalized acronym *radar* (← *RADio DETECTION AND RANGING*) provides the base for the Italian neoclassical combination *georadar*. In addition, abbreviations can be regularly pluralized, in both English (*principal investigator* → *PIs*, *professional* → *pros*) and Italian (*la fleboclisi* → *le flebo*). However, these do not seem to be sufficient reasons to include abbreviations within grammatical morphology because, as we have seen, they are not transparently analysable into morphs (Bauer 1983), their bases are irregular and their outputs hardly predictable.

Plag (2003: 107) is even more precise in terms of regularities of what he calls “derivation without affixation”. He discusses the formal properties of truncations (including clippings) and blends, and shows that their formation is subject to strong restrictions on prosodic categories (Plag 2003: 116-126), whereas for acronyms he claims that a central role is played by orthography (*ibid.*: 126-129). For blends, Plag (*ibid.*: 123) even formulates a blending rule (AB + CD → AD), which is however disconfirmed by many counterexamples, e.g. *modem* (← *modulator + demodulator*) exhibits the structure AC. Thus, the tendencies or regularities that Plag (2003) identifies are not properly morphological, but lie in the interface with prosody, or, in any case, they cannot be generalized to all the aforementioned types and patterns of abbreviations.

The position I take in this paper is rather different. I agree with those who consider abbreviations as phenomena of extra-grammatical morphology, in that only prototypical and marginal types are identifiable, but no generative rules are universally applicable to their formation. However, I would reconsider these morphological phenomena on account of their frequency and enormous distribution, not only in informal contexts but also in specialized (i.e. more formal) discourse.

## 2.2. Abbreviations in scientific terminology

In pertinent literature, it is often claimed that abbreviations in scientific terminology are formally more complex than in prototypical examples (see 2.1 and Mattiello forthcoming a), and that they tend to acquire a more specific nuance, which makes them better labels among experts. The fact that these labels are addressed to a specialized audience, which is supposed to be familiar with scientific language, may be a plausible motivation for their reduced morphotactic transparency.

Bauer (1983: 233) interestingly notices that clipping in scientific language is often much more complex than in the usual back- or fore-clipping types. The words *parylene* (← *paraxylene*, also *p-Xylene*) and *prepreg* (← *preimpregnated*), for instance, retain discontinuous elements from the base words, and in *phorate* (← *phosphorodithioate*) the input is even more difficult to recognize.

We can also observe the existence of unusual acronyms where the letters are not properly initial letters in the words in a phrase or list. In *KREEP*, for instance, the *K* is the chemical symbol for ‘potassium’, whereas the other letters are the initials of *rare-earth elements (REE)* and *phosphorus (P)*.

Furthermore, some marginal scientific words are obtained from long technical phrases in a manner which is reminiscent of blending and acronym formation, but with a far less clear morphological motivation: e.g., in *picloram*, the groups of letters retained from the base *aminotrichloropicolinic* have been reversed in the final word.

The artificial scientific terms obtained by fusing the words which denote their constituent elements are equally far from prototypical blending. Marchand’s (1969: 453) example *amatol* (← *ammonium nitrate* + *trinitrotoluene*) well illustrates the complex structure and irregular patterns of blends in technical language.

Furthermore, scientific terminology typically abounds in hybrid cases, in-between different categories of abbreviations<sup>12</sup>. Some are borderline cases between acronyms and blends. The acronym *LUMCON*, for instance, tends to merge into a blend, because more than one letter is retained from the last word in the source phrase *Louisiana Universities Marine CONSortium*. Others are even obtained by welding part of a word with a previously existing acronym, as in *VegAnic*, an Italian blend from *vegetale* (‘vegetable’) and *Anic* (← *Alimentazione Naturale Integrale Consapevole*)<sup>13</sup>, or in *snoRNA*, from *small nucleolar* and lexicalized *RNA*.

Other borderline cases are midway between clipping and blending. The English formation *Fermilab* is shortened from the phrase *Fermi national accelerator laboratory*, as explained in an article of *Science* (22 July 2011), but it actually blends the personal name *Fermi* with a lexicalized clipping (*lab*).

Clippings merging into initialisms are also common in scientific language. Some scientific words are indeed orthographically represented by letters, but their source is not a multi-word sequence: e.g. *ADG* (← *adermatoglyphia*), *PDMS* (← *polydimethylsiloxane*), *UV* (← *ultraviolet*), etc.

As far as meaning is concerned, the labels obtained in acronym formation are often purposefully chosen for their reminiscence of existing names, especially female ones (e.g. *PAMELA* ← *Payload for Antimatter/Matter Exploration and Light-nuclei Astrophysics*), or may be connected with ancient mythology (e.g. *CALIPSO* ← *Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations*). As we will see in 3.1

<sup>12</sup> Cf. Bauer’s (1983: 239-240) “mixed formations”.

<sup>13</sup> This is the etymology given in an Italian translated text of *Nexus* (see 3.2 below). Yet some English websites (e.g. *Beginner’s Guide to Veganic Gardening*, <http://gentleworld.org/beginners-guide-to-veganic-gardening/>) give this word as a blend from *vegan* (from *veg* + *-an*) and *organic* (cf. the *OED*, where the adjective *veganic* is a derivative obtained from *vegan* + *-ic*, probably after *organic*).



below, the choice of acronyms in scientific language is not only suggested by the need for easy memorization, but also by the tendency towards prestige.

### 3. The main functions and effects of abbreviations in scientific discourse

The functions traditionally attributed to abbreviations are essentially three: lexical, naming, and textual or co-referential (Merlini Barbaresi 2007). For instance, many abbreviations used in English scientific texts are stable nominal lexemes with a wide international circulation (e.g. *laser*, *scuba*, *sonar*). Others have a naming function for worldwide organizations (*NATO*), institutions (*NASA*), and often substitute their bases completely, as in *Aids*, *DNA*. Still others have a shorter life, and are used within the same text as endophoric references, because they are more efficient than their source phrases but have no word status yet.

An investigation of the use of abbreviations in my corpus not only confirms that the above-mentioned socio-pragmatic functions are meant to be prominent in English scientific texts, but also that the same functions are served by loaned or translated abbreviations in Italian texts.

#### 3.1. Naming

In scientific discourse, many abbreviations, especially blends and acronyms, conform to the “Principle of Naming”. Researches, experiments, and new discoveries in the fields of science and technology are often named by using labels which are uncomplicated to pronounce, perceive and remember. This is the case with the Italian term *sonofusione*, adapted from English *sonofusion* and used in the following extract from the Italian version of *Nexus New Times*:

- (1) *Sonofusione*: la fusione nucleare in un bicchiere d’acqua  
 [...] È il caso della *sonofusione*, esperienza che vuole ricreare la fusione nucleare comprimendo bolle di vapore presenti in un liquido attraverso la pressione di onde sonore<sup>14</sup>.  
 (*Nexus*, “Sonofusione: la fusione nucleare in un bicchiere d’acqua”, 08 July 2011).

Interestingly, the choice of a blend to name such a scientific phenomenon is not accidental in that the blended noun *sonofusione* iconically reproduces the meaning of the phenomenon itself, contributing to conceptual clarity as well as to memorization.

However, according to Ronneberger-Sibold (2008: 206), the need that language users feel for a simple label is not only motivated by ease of perception and memorization, but also by “the iconic principle that one thing should be named by one word, instead of being described by several words”. Furthermore, abbreviations satisfy the quest for precision and exactitude of scientific discourse (Sabatini 1999), be-

<sup>14</sup> Translation: Sonofusion: nuclear fusion in a glass of water [...] It is the case of sonofusion, a process which aims to recreate nuclear fusion using sound wave pressure to compress vapour bubbles contained in liquids.

cause they become even more specific than their source words or phrases. This is the reason why acronyms and initialisms play a prominent role in scientific naming, both in English and in Italian translated texts, as respectively illustrated below:

(2) Levine and his colleagues designed a new gene that can be inserted into T cells to trick them into attacking cancerous B cells, the cause of chronic lymphocytic leukemia (*CLL*).

(*Science*, “Serial Killer’ Immune Cells Put Cancer in Remission”, 10 August 2011).

(3) Fortunatamente, i telescopi moderni sono in grado di studiare una sorta di immagine spettrale del nostro universo primordiale: la radiazione cosmica di fondo, o *CMB*<sup>15</sup>.

(*National Geographic Italia*, “Alla ricerca di altri universi”, 16 August 2011).

Whereas the English initialism *CLL* in (2) is an indigenous abbreviation, the initialism *CMB* in (3) is an English loanword (from *Cosmic Microwave Background radiation*). This signals that once they have acquired an independent status alphabeticisms can freely circulate across different countries, thus becoming especially suitable to scientific discourse (see 4.2 below).

Lastly, the use of acrostics also appears relevant to scientific terminology<sup>16</sup>, as shown by the following extract from *Nature*:

(4) [...] Now Maria Zuber, principal investigator for NASA’s Gravity Recovery and Interior Laboratory (*GRAIL*) mission, which is set to launch on 8 September, wants to reveal the Moon’s hidden history.

[...] The *GRAIL* mission consists of twin spacecraft that are near replicas of the Gravity Recovery and Climate Experiment (*GRACE*), a pair of satellites that have orbited Earth since 2002, mapping the planet’s gravity field so finely that they could see shifts in ground-water aquifers and ocean currents.

(*Nature*, “Twins to probe Moon’s heart”, 30 August 2011).

where the names *GRAIL* and *GRACE* are respectively used to label a mission and an experiment. First, their homophony with words which are already part of the English lexicon may help experts and non-experts to keep these names in their minds. Secondly, the meanings which these words have in English are evocative of a religious, holy and legendary sphere, which may be suggestive of the significance and value these names have in the scientific field.

### 3.2. *Economy (vs. redundancy)*

Another general principle governing lexical choices in scientific discourse is Martinet’s (1955) renowned “Principle of Linguistic Economy”, based on Zipf’s (1949) “Principle of Least Effort”, according to which shorter and simpler communication is

<sup>15</sup> Translation: Fortunately, modern telescopes can observe a sort of spectral image of our primordial universe: cosmic microwave background radiation, or *CMB*.

<sup>16</sup> For acrostics in political discourse, Plag (2003: 128) notices that “the participants consider it important to name a phenomenon in a particular way in order to win a particular argument”, as in *START* (← *STrategic Arms Reduction Talks*), referring to a disarmament treaty between the United States and the Soviet Union.

favoured over redundancy. This principle is especially germane to contexts where language users share a specialized jargon allowing one to abbreviate what is accessible to in-group members, because frequently used and easily recoverable. Such contexts favour, for instance, the use of lexical blends, which are more efficient and concise labels than the syntactic combination of their components (Thornton 1993: 153), as shown by the following excerpt:

(5) L'approccio *VegAnic* ci permette di imparare a riconoscere autonomamente, attraverso l'istinto, il cibo che ci fa bene e quello che ci danneggia, imparando a districarsi fra teorie, consigli dietetici, articoli di giornali e programmi tv...<sup>17</sup>.  
(*Nexus*, "Che cos'è l'alimentazione VegAnic?", 23 June 2011).

where *VegAnic* combines the Italian word *vegetale* with the acronym *Anic* (see 2.2).

As Gotti (2005: 41) observes, "Sometimes conciseness in specialized discourse relies on acronyms". Indeed, scientific contexts appear to favour the use of alphabetisms, especially as anaphoric referents to previously introduced concepts. For instance, in (6) below, *PDMS* immediately follows its full form, but is later re-used in the text to gain efficiency and avoid redundancy (see 3.4):

(6) So Cui's group used microfabrication techniques to first create a grid pattern mould out of silicon. Then a 100-micrometre-thick layer of polydimethylsiloxane (*PDMS*), a flexible, transparent polymer, was applied using a technique called electro-spinning. When the *PDMS* was removed from the silicon...  
(*Nature*, "Transparent battery powers the way to translucent devices", 25 July 2011).

In scientific domains, efficiency is also obtained through clippings, which are especially common in headlines, where there is an urgent need to condense information into short strings of words. Consider, for instance, the following English headlines, both from *Science*:

(7) *Lab Chimps* Extend a Helping Hand  
(*Science*, "Lab Chimps Extend a Helping Hand", 08 August 2011).

(8) Did a *Slo-Mo* Crash Create the Two-Sided Moon?  
(*Science*, "Did a Slo-Mo Crash Create the Two-Sided Moon?", 03 August 2011).

The clipped words *chimp(s)*, *lab* and *slo-mo* are institutionalized (i.e. accepted as neologisms by all of the speech community, including non-experts) and lexicalized (i.e. recognized as part of the lexicon) (Brinton & Traugott 2005: 45). This lexicalization process favours their choice in the place of longer forms.

### 3.3. Professional closeness

There are some contexts in which shortened word forms are highly frequent and universally understood. According to Ronneberger-Sibold (2008: 207), "Typical high

<sup>17</sup> Translation: VegAnic approach teaches us how to distinguish, autonomously and instinctively, between healthy and unhealthy food, and how to deal with theories, diet suggestions, newspaper articles and TV programmes...

frequency contexts abounding in shortenings are professional jargons". In professional jargons like scientific language, acronyms, initialisms and other abbreviatory mechanisms often obtain the effect of creating cohesiveness among insiders. Consider, for instance, the language used in (9) below:

(9) The structure of this complex could finally reveal how one of biology's most important signalling mechanisms, G-protein-coupled receptors (*GPCRs*), do their job. This structure, published online in *Nature* by a team led by Kobilka at Stanford University in California and Roger Sunahara at the University of Michigan in Ann Arbor, now reveals the complete three-dimensional atomic structure of an activated *GPCR* – the  $\beta_2$  adrenergic receptor ( $\beta_2AR$ ) – in a complex with its G protein. (*Nature*, "Cell signalling caught in the act", 19 July 2011).

In this extract, complex phrases (e.g. *G-protein-coupled receptor(s)*,  $\beta_2$  adrenergic receptor) are condensed into shorter forms – i.e. the initialisms *GPCRs* and  $\beta_2AR$  – which are immediately clear to professionals, but probably obscure to non-experts. This condensed specialized terminology contributes to establish professional closeness among the members of the scientific community, who recognize and share the same language.

The same effect of closeness may be obtained, both in English and in Italian translated texts, by the use of clippings, e.g.:

(10) The base sequences of the Spanish *flu*, smallpox and *polio* viruses are publicly available. So how should we in the press view the debate over whether or not *Nature* and *Science* should have been free to publish research on mutant *flu* viruses? (*Nature*, "Mutant flu – the view from the newsroom", 02 May 2012).

(11) La storia delle vaccinazioni contro il virus della *polio* nei paesi industrializzati e in via di sviluppo dimostra che distorcendo cifre e osservazioni i ricercatori hanno deliberatamente camuffato un evidente nesso causale fra vaccini somministrati e paralisi<sup>18</sup>. (*Nexus*, "I rischi nascosti delle vaccinazioni antipolio", 01 February 2010).

Back-clippings such as *polio* are commonly used among both English and Italian physicians to reinforce their in-group membership. However, the informality of the clipping process involved in (10)-(11) seems to produce more an effect of social closeness with the reading public than one of professional closeness among experts (Mattiello forthcoming b).

### 3.4. Textual cohesion

There are two strategies to create textual cohesion via abbreviated forms: anaphoric reference (see Gotti 2005: 103) and cataphoric reference. In anaphoric reference, the full form is introduced first, and the shortened form is used afterwards to allude back to it. In cataphoric (or anticipatory) reference, by contrast, the short-

<sup>18</sup> Translation: The history of vaccinations against polio virus in industrialized and developing countries shows that, by distorting figures and observations, researchers have deliberately disguised an evident causal link between given vaccines and paralysis.

ened word precedes its full-length referent, which is disambiguated only subsequently in the text. The first type of cohesive strategy is the most natural one. It is indeed commonly used to create a network of co-references within a text, and avoid excessive redundancy (see 3.2), as in (12) and (13):

(12) Previous studies have linked certain pollutants, in particular polycyclic aromatic hydrocarbons (*PAHs*), from sources such as indoor coal stoves, smoking and vehicle exhausts, to neural tube defects. [...]

With Ren, environmental scientist Tong Zhu, also at Peking University, investigated levels of *PAHs* [...]

In all those studied, the risk of a defect was 4.5 times greater where the levels of *PAHs* were above the average of 597 nano-grams per gram of lipid. As the amount of *PAHs* in the placenta rises, that risk rises also, to over 11 times the risk of a defect in the cases with the highest levels of *PAHs*.

(*Nature*, "Pollutants' role in birth defects becomes clearer", 18 July 2011).

(13) Negli scorsi giorni il Planetary Science Institute (*PSI*) e Xcor Aerospace hanno firmato l'accordo per portare il telescopio Atsa Suborbital Observatory del *PSI* – con esseri umani a bordo – sulla navetta Lynx, della Xcor. In alto, una rappresentazione artistica della navetta in orbita terrestre.

"Per decenni la Nasa ha fatto volare osservatori suborbitali su razzi senza equipaggio umano a bordo" ha detto Luke Sollitt, scienziato affiliato di *PSI* e co-inventore del telescopio Atsa<sup>19</sup>.

(*National Geographic Italia*, "Astronomi nello spazio e comete verso il Sole", 18 July 2011).

In both languages, an initialism (E. *PAHs*, It. *PSI*) is given in brackets after its full-form referent so as to facilitate the association also to non-connoisseurs, who may confuse, for instance in (13), the scientific label with the well-known political one (cf. *Partito Socialista Italiano* 'Italian Socialist Party').

On the other hand, the type of strategy called cataphora entails previous knowledge of the label employed, in that the abbreviated word is explained only after its mention in the text. This strategy is frequently used in headlines, as in:

(14) *NIH* cancer chief wants more with less

Harold Varmus, the high-profile director of the US National Institutes of Health (*NIH*) from 1993 to 1999, returned to the biomedical agency last July as director of the National Cancer Institute (NCI).

(*Nature*, "NIH cancer chief wants more with less", 06 July 2011).

Headings containing alphabetisms like *NIH* are not only efficient (cf. 3.2), but also effective, in that they attract the reader's attention and encourage him/her to

<sup>19</sup> Translation: In the last few days the Planetary Science Institute (PSI) and Xcor Aerospace have signed an agreement to bring PSI's Atsa Suborbital Observatory telescope – with humans on board – inside Xcor's Lynx shuttle. Above, an artistic photo of the shuttle in the Earth's orbit. Luke Sollitt, PSI Deputy Project Scientist and co-inventor of Atsa telescope, said: "For decades Nasa has made suborbital observatories fly on rockets without human crews on board".

proceed in reading. The cohesive function served by abbreviations at a textual level is therefore accompanied by an effect of prominence.

### 3.5. Prominence

As anticipated, another element motivating the use of abbreviations in scientific discourse is the prominence effect. While reading a scientific text, the reader's interest immediately falls on what escapes the norm, either graphically or formally. Acronyms and initialisms, for instance, are instantly noticed because of their unusual spelling in capital letters:

- (15) The culprit is an adenovirus, one of a class of viruses that cause a range of illnesses in humans, including pneumonia. But this particular strain has never been seen before. It has been dubbed *TMA*dV, or titi-monkey adenovirus.  
(*Nature*, "Respiratory virus jumps from monkeys to humans", 14 July 2011).

Blends, by contrast, are attention-grabbing because of their odd structure fusing two words into one:

- (16) '*Dinofuzz*' Found in Canadian Amber  
(*Science*, "Dinofuzz' Found in Canadian Amber", 15 September 2011)
- (17) *RoboCup*: dove si sfidano i Robot<sup>20</sup>  
(*National Geographic Italia*, "RoboCup: dove si sfidano i Robot", 01 August 2011)

so that at least one source word is abbreviated, i.e., *dino(saur) + fuzz* or *robo(t) + cup*.

Alternatively, prominence may be obtained through clippings, which are not necessarily non-transparent variants of existing words. For instance, in the following headlines, the clipped words *flu* and *lab*, alongside the initialism *24/7* (from *24 hours a day, 7 days a week*), are of immediate access to the reader. Yet they contribute to convey an informal tone, which may be captivating for the audience:

- (18) Work ethic: The *24/7 lab*  
(*Nature*, "Work ethic: The 24/7 lab", 31 August 2011)
- (19) Surprising Cells Rein In Killer *Flu*  
(*Science*, "Surprising Cells Rein In Killer Flu", 15 September 2011).

## 4. A cross-linguistic analysis: abbreviations in English scientific texts vs. Italian translated texts

Most abbreviations used in English scientific texts are indigenous, but have an international distribution and are easily understood because of their "monoreferen-

<sup>20</sup> Translation: RoboCup: Where Robots Defy Each Other.

tiality”<sup>21</sup>, especially within a specialized community of speakers and in relation to their context of use. For these same reasons, abbreviations used in Italian translated scientific texts tend to be borrowings from English, rather than calques or adaptations to Italian.

#### 4.1. *Abbreviations in Nature and Science*

In the two journals written in English that I have explored, abbreviations are for the most part native, so authors generally provide the full forms only for those that are not institutionalized or lexicalized. Although my small corpus does not allow for reliable quantitative results, we can identify the following general tendencies with respect to abbreviations:

- lexicalized abbreviations tend to exhibit no corresponding full forms in the text. This is valid both for alphabetisms (e.g. *AIDS*, *DNA*, *GDP*, *HIV*, *laser*, *NASA*, *PVC*), and for clippings (*flu*, *lab*), as well as for blends (*blog*, *elephantiasis*).
- however, some lexicalized clippings may act as cataphoric references to their full bases: e.g. *chimp* (chimpanzee), *dino* (dinosaur), *pro* (professional), and *slo-mo* (slow-motion).
- whereas some lexicalized initialisms may follow their full forms – especially when these latter are first mentions – becoming anaphoric referents to concepts previously introduced in the text: e.g. genetically modified (*GM*), giga-electron volts (*GeV*), global positioning system (*GPS*), three-dimensional (*3D*), ultraviolet (*UV*).
- the components of non-lexicalized blends are infrequently left inexplicit in the text, and even when they are, as in the blends *blogosphere* and *dinofuzz*, at least one of them is a shortened word accepted as part of the lexicon, e.g. a blend (*blog*) or a clipping (*dino*) (see above).
- denominations – either alphabetisms or clippings – generally follow their source phrases and are re-used in the text with a referential function: e.g. adermatoglyphia (*ADG*), Centers for Disease Control and Prevention (*CDC*), Cystic Fibrosis Foundation (*CFF*), El Niño-Southern Oscillation (*ENSO*), *Escherichia coli* (*E. coli*), European Union (*EU*), men who have sex with men (*MSM*), National Institutes of Health (*NIH*), *New England Journal of Medicine* (*NEJM*), polydimethylsiloxane (*PDMS*), traumatic brain injury (*TBI*), United Nations Educational, Scientific and Cultural Organization (*UNESCO*), World Health Organization (*WHO*).
- they infrequently anticipate their full forms in the text. Examples include the initialism *DM* (double-monoploid), and the acrostics *PAMELA* and *REACH*. In these latter cases, the base is made explicit either immediately, into brackets, or, more rarely, in the development of the text.
- foreign denominations are even rarer, and they generally follow an English translation of the original full forms, as in: International Cycling Union (*UCI*) (cf. Fr. *Union Cycliste Internationale*), National Centre for Scientific Research (*CNRS*) (cf. Fr. *Centre National de la Recherche Scientifique*), Institute of Photonic Sciences (*ICFO*) (cf. Sp. *Instituto de Ciencias Fotónicas*), and National Research Council (*CSIC*) (cf. Sp. *Consejo Superior de Investigaciones Científicas*).

<sup>21</sup> Gotti (2005: 33) defines monoreferentiality as the “semantic uniqueness” of terms, especially in a given context or specialized subject domain: “every term signals a concept and effectively condenses the semantic value contributed by the defining process which generated it”.

As mentioned, lexicalized abbreviations do not require explicit disambiguation in the text, because they are accessible either worldwide (e.g. *NASA*), or at least to the scientific community (e.g. *elephantiasis*). However, in spite of their international distribution and usage, some abbreviations (e.g. *GM*, *3D*) are made explicit in the English text. As a result, the text turns out to be clearer to a large audience, but of course redundant to expert readers.

With English denominations, the most frequent tendency is to offer the full form and the abbreviated one in succession. However, there may also be cases in which an English explanation like ‘International Cycling Union’ accompanies the original alphabetism: i.e. *UCI*, from French *Union Cycliste Internationale*. In these cases, although the semantics of the alphabetism is made clear by the English definition, its morphotactics is more obscure, in that there is no one-to-one correspondence between (the order of) the initials of the English phrase and the letters making up the foreign alphabetism.

#### 4.2. *Abbreviations in National Geographic Italia and Nexus*

The Italian translated scientific journals that I have explored exhibit a vast number of abbreviations which are for the most part English loanwords. The English source phrase is rarely left unexpressed, with the exception of institutionalized denominations which are internationally recognized, or which are not restricted to the scientific community. Sometimes the English abbreviation (*EU* ‘European Union’, *WHO* ‘World Health Organization’) has a corresponding Italian abbreviation (*UE*, *OMS*) with an equal status, which works not only for Italian, but also for French and other Romance languages. The most common choices with respect to abbreviations in Italian translated texts are reported here below:

- international abbreviations borrowed from English tend to appear in Italian translated texts without their corresponding full forms. Some of them are indeed lexicalized also in Italian (e.g. *AIDS*, *HIV*, *NASA/Nasa*), whereas others are at least familiar to the scientific community (e.g. *Add*, *CMB*, *ISDE*, *Ocd*, *Pms*).
- some Italian abbreviations, such as the initialism *OGM*, or the above-mentioned *OMS* and *UE*, do not require corresponding clarifications in the Italian translated texts, in that they have entered the Italian lexicon.
- other adaptations are instead non-institutionalized in Italian – e.g. the blends *sonofusione* and *sono-luminescenza* – and therefore require disambiguation.
- rare counterexamples to the above tendency exist. For instance, the technical clipping *multiverso*, a calque on English *multiverse* shortened from *multi-universe*, is not expressed in its full form in the Italian translated text.
- international denominations of English origin may be preceded by an Italian translation of the original full form, as in *Unione Astronomica Internazionale (IAU)* (cf. *E. International Astronomical Union*), and in *Stazione Spaziale Internazionale (ISS)* (cf. *E. International Space Station*).
- other foreign denominations (generally from English) tend to follow their source phrases. For instance, the alphabetisms *MIT*, *PAA*, *WISE*, and *WMAP* are anaphoric textual referents for ‘Massachusetts Institute of Technology’, ‘Public Affairs Awards’, ‘Wide-field Infrared Survey Explorer’, and ‘Wilkinson Microwave Anisotropy Probe’.
- the reverse (cataphoric) function of foreign denominations is atypical in Italian trans-



lated texts, although there may be exceptions such as the abbreviated English loanword *HARPS* followed by its original source phrase ‘High Accuracy Radial Velocity Planet Searcher’.

- in some articles of *Nexus* which integrate the translated edition of *Nexus New Times* with an Italian section, Italian native abbreviations are followed by their descriptions, e.g. the acronym *G.I.A.* (Gratitudine Incondizionata Anticipata), the initialism *INFN* (Istituto Nazionale di Fisica Nucleare), and the blend *VegAnic* (cf. *E. veganic*, *OED*). This signals that, along with borrowed abbreviations with an international circulation, native abbreviations are increasing as well in Italian scientific language<sup>22</sup>.

Whereas in English scientific texts native shortenings (especially alphabetisms) prevail over abbreviated loanwords or adaptations, in Italian translated scientific texts a considerable proportion of international shortenings are borrowed from English. Some English lexicalized abbreviations that are widespread and accessible to the whole community are left in their original forms, and/or adapted to the Italian phonetics: e.g. in Italian, the English acronym *AIDS* is generally read letter by letter, rather than as a word. Also abbreviations belonging to technical terminology are borrowed and used with no formal changes in Italian translated texts. For instance, the alphabetisms *Add*, *ISDE* and *Ocd*, respectively from ‘Attention Deficit hyperactivity Disorder’, ‘International Society of Doctors for the Environment’, and ‘Obsessive-Compulsive Disorder’, are accessible only to a restricted minority of speakers, namely physicians. Yet they appear in Italian translated scientific texts with no extra information about the original source phrases, as a symptom of their independence and acquired status as words.

## 5. Conclusions

Although the examination of the corpus selected for this study does not allow for a quantitative analysis of the phenomena under consideration, the following generalizations may be made:

- contrary to what most word-formation theorists claim, clippings are not necessarily associated with an informal style or with oral speech. They are widely used both in scientific journals written in English and in Italian translated journals, especially those conceived for a vast audience, including also non-experts. Alphabet-based abbreviations such as acronyms and initialisms are even more suitable to specialized discourse, because of their efficiency and effectiveness.
- the pragmatic functions that abbreviations serve and the effects they produce range from lexical to textual, and even to socio-pragmatic. At a lexical level, they have a predominant naming function, labelling new scientific concepts and allowing for their international diffusion. At a textual level, abbreviations serve the economy of the

<sup>22</sup> This assumption, which should be corroborated by a more specific investigation of abbreviations in Italian non-translated scientific discourse, represents an interesting area for future research.

text, but also facilitate lexical cohesion, creating a network of anaphoric (or cataphoric) co-references throughout the text. In addition, they give prominence to concepts, especially when they are used in headlines, to catch the reader's attention. Lastly, at a social level, they contribute to the cohesiveness of the group of insiders, whose specific language becomes more cryptic to outsiders if words are made less recognizable through an abbreviation process. Yet also social closeness with the reading public seems enhanced by the use of some abbreviations, especially those obtained by clipping.

- English texts tend to use indigenous abbreviations, ranging from institutionalized or lexicalized acronyms to labels created instantly for the purposes of the text. Italian translated texts, by contrast, make a larger use of abbreviations of foreign (especially English) origin, which are neither translated nor adapted, because they can circulate internationally with no extra explanations. As a consequence, Italian scientific terminology used in translated journals appears as a hybrid language, which borrows from scientific English more than English does from Romance languages.

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