

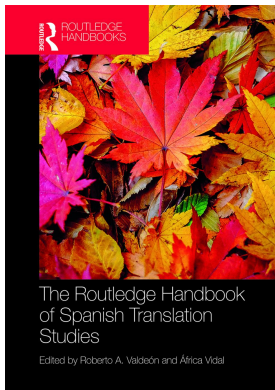
This article was downloaded by: 10.2.97.136

On: 08 Jun 2023

Access details: *subscription number*

Publisher: *Routledge*

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The Routledge Handbook of Spanish Translation Studies

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Technical and medical translation

Publication details

<https://test.routledgehandbooks.com/doi/10.4324/9781315520131-17>

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Published online on: 28 May 2019

How to cite :- Goretti Faya, Carmen Quijada. 28 May 2019, *Technical and medical translation from: The Routledge Handbook of Spanish Translation Studies* Routledge

Accessed on: 08 Jun 2023

<https://test.routledgehandbooks.com/doi/10.4324/9781315520131-17>

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TECHNICAL AND MEDICAL TRANSLATION

Goretti Faya and Carmen Quijada

Introduction

The development of science and technology in an increasingly interconnected world has had an important impact on the number of texts published in both fields. Scientific and technical texts are written mainly in English, with Spanish being the second most common language internationally (Moreno Fernández 2015, 10). Consequently, the number of translation assignments of scientific and technical texts has also increased (Lambert 2007). In fact, “technical translation already looms large in that it comprises more than 90% of the translation of the professional world output” (Kingscott 2002, 247).

This situation has caused a growing interest in the features and translation of scientific and technical texts. This circumstance has given a place to several research works with a mainly terminological or didactic approach. In the 1990s, the BITRA (*Bibliografía de Traducción e Interpretación*) bibliographic database provided 1,989 search results for studies on technical and scientific translation (Aixelá 2013, 41), whereas, nowadays, the same database gives 8,128 results.

To define ‘scientific and technical texts’, it is convenient to clarify certain concepts which are frequently mixed up in the literature, namely ‘languages for specific purposes (LSP)’, ‘specialised languages’, ‘specialised texts’ and ‘scientific and technical texts’.

Typically, LSP includes aspects of lexicology, terminology, translation and discourse analysis; however, traditionally it also has been related to teaching languages in specific fields. LSP is highly student-centred, and therefore mainly focused on learners’ professional linguistic needs as well as the production of teaching materials (Gálová 2007, 2). In fact, when referring to LSP, languages are usually thought of in terms of a user of that specific language; however, when dealing with the term ‘specialised language’, mediators and language specialists should also be taken into consideration.

Thus, LSP must not be mistaken for ‘specialised languages’, which are related mainly to the terminology of a communicative situation confined to a particular domain (Lavagnino 2012, 47), and can be considered an essential instrument for communication among specialists (Cabré Castellví 1999, 90). Specialized languages may include different varieties, such as legal, economic, administrative and medical (Aguado de Cea and Álvarez de Mon 2003, 2). However, not all texts using a specialized language can be considered to be ‘specialised



texts’ – while a very specific topic can result in a specialized text, it is not the only factor that determines whether a text is specialized or not (Cabré Castellví 1999, 24). It is thus necessary to also include some extratextual criteria related to the communicative situation: mainly the text function, the features of the interlocutors (Gamero Pérez 2001, 28), and even the skills required to translate these texts (Gamero Pérez and Hurtado Albir 1999; Alcina Caudet and Gamero Pérez 2002; Olohan 2016). Other features worth mentioning include the existence of an established discipline that acts as a communicative frame, an author who is a specialist in the matter, a rigid structure, a systemic thematic progression, a clear presence of specialized terminology, a trend towards a syntactic simplification and a clearly formal register (Franco Aixelá 2013, 39). On the other hand, it should be stressed that there is a clear permanent inter-relationship between a specialized language and a non-specialized one, i.e. they are not and cannot be independent (Loffler-Laurian 1984; Jacobi 1987; Gläser 1993; among others). In this vein, scientific and technical texts (those pertaining to the fields of science and technology) can be specialized or not – depending on their function and participants – and their features will be determined by the conventions agreed by the scientific community that produces them (Swales 1981, 1990).

The barriers between science and technology, however, are not always clear (Byrne 2012, 2); both disciplines deal with different kinds of knowledge, but at the same time they are related (Olohan 2016), though not consciously or immediately (Pinchuck 1977, 13). Scientific and technical disciplines present very varied natures (Sánchez Trigo 2005, 132), as the UNESCO Nomenclature for the fields of science and technology shows:

<i>Logic</i>	<i>Earth and Space Science</i>	<i>Economic Sciences</i>	<i>Political Science</i>
Mathematics	Agricultural Sciences	Geography	Psychology
Astronomy and Astrophysics	Medical Sciences	History	Sciences of Arts and Letters
Physics	Technological Sciences	Juridical Science and Law	Sociology
Chemistry	Anthropology	Linguistics	Ethics
Life Sciences	Demography	Pedagogy	Philosophy

In addition, some objects of study are covered simultaneously both by scientific (related to theoretical knowledge) and technical disciplines (related to the application of knowledge, for example to industrial exploitation [technological sciences] or floor exploitation [agricultural sciences]). There are even applied sciences, as is the case of medicine. The differences between science and technology will also determine different approaches and strategies in the translation of these texts:

[. . .] while a technical text is designed to *convey* information as clearly and effectively as possible, a scientific text will *discuss*, analyze and *synthesize* information with a view to *explaining* ideas, *proposing* new theories or *evaluating* methods. Due to these differing aims, the language used in each type of text, and consequently the strategies needed to translate them, may vary significantly.

(Byrne 2012, 2)

However, due to the close link between both disciplines, and since scientific research is gradually moving closer to technical applications, it seems appropriate to use the mixed label of 'scientific and technical texts' (Álvarez de Mon 2001, 41). On the other hand, it is convenient to clarify that, in Translation Studies, scientific and technical translation has been traditionally limited to pure and exact sciences (Valero Garcés, Tejedor Martínez, and Carmen Santamaría García 1997), that is to say, the disciplines related to notions of universalism and objectivism:

Translation studies has traditionally taken inspiration from traditional LSP (Language for Specific Purposes) research and terminology studies in analyzing intrinsic features of specialized discourse; those studies often perpetuated a view of science as consisting of absolute truths, involving objective and referential communication.

(Olohan and Salama-Carr 2011, 180)

In particular, the scientific and technical texts studied in Translation Studies tend to be related with the disciplines of health (medicine, biology, pharmacy, etc.), computing sciences, environmental sciences, engineering, physics and chemistry. Texts pertaining to any other discipline, however, have been studied in a completely independent way, as is the case of legal or economic sciences (see the chapter on LEGAL TRANSLATION). Translators must thus develop strategies to understand and deal with a wide variety of texts belonging to different specialized fields.

This chapter aims to survey the origins of scientific and technical translation and presents an overview of the major theoretical and practical works in the Spanish-speaking world. The overview of recent research in the field highlights the specific topics being studied and reflects the current tendencies in scientific and technical translation.

Historical perspective

Translating specialized languages is not new. In fact, both the advancement of our societies and the scientific, technical and social development of humankind are, to a large extent, due to the translation of scientific and technical texts (Olohan 2009, 246). Ranging from the Baghdad House of Wisdom and the Granada Tibbonids to the Toledo School of Translators, through to the alexandrine translations and the permanent knowledge transfer in the Mediterranean area, translation has always been a loyal and necessary ally of scientific and technical improvements (Montalt i Resurrecció 2005, 50–51; Gutiérrez Rodilla 2009, 230; Eckart 2009, 63–64, 72–76).

The Spanish language has not been alien to the great translation trends throughout history. Quite the contrary, the Iberian Peninsula was the centre of several medieval cultural institutions in which scientific knowledge was translated: first, from Arabic to Latin (and, to a lesser extent, from Hebrew [Santoyo 2009, 246–7]) in the monasteries of Vic and Ripoll, and in the medieval translation centres of Tarazona, León and Segovia, and later into the Spanish that was taking shape at that time. All these places were important precursors of the Toledo School of Translators (Gil 1985; Samsó 1996; Vegas González 1998; Santoyo 2004; García Yebra 1989, 323–36, 1994, 88–91; Santoyo 2009, 239–42, among others), which from the twelfth century, and through various stages and periods, accomplished the translation of different types of knowledge that had been gathered in the libraries of the Mediterranean area (Burnett 2007; Wright 2007; Valls 2007; Gutiérrez Rodilla 1998, 54; Eckart 2009, 74, among many others). However, this School of Translators never existed as such, but rather it was a group of

translators who did their work individually or in small groups under the supervision and guidance of a patron (Santoyo 2004, 3).

These scientific translations can be then considered the cornerstone of scientific and technical translation in Spanish. They are characterized by a lack of prefaces (Burnett 2007, 1232) and by almost methodical literalness (i.e. translators attempted to convey precisely the meaning of the source Arabic text, to the detriment of the classical Latin style), and the result was “a strict word for word agreement between source and target text” (Burnett 2007, 1235). The vast translating activity carried out in medieval Spain provided the Western world with a collection of scientific, philosophical and medical knowledge which changed European scientific thinking and gave a new impetus to the European science (Huot 2007, 1372).

The extraordinary advancement of science in the nineteenth and twentieth centuries should also be mentioned, as should the essential role played by translation both in spreading knowledge and information about new discoveries. In addition, the source languages used by the greatest scientists of that time were varied and, consequently, the translating activity was essential: for example, Max Planck, Albert Einstein and Sigmund Freud wrote in German; Robert Boyle and Alexander Fleming in English; Niels Bohr, in Danish; Louis Pasteur as well as Pierre and Marie Curie, in French; and Severo Ochoa and Santiago Ramón y Cajal published their works mainly in Spanish.

Another relevant milestone in the history of scientific and technical translation in Spanish is institutional translation, promoted by the international organizations created after the Second World War: the Spanish language is one of the five official languages of the United Nations and plays an important role in the directorate-general for translation of the European Union, since it is one of its twenty-four official languages (though it has recently been dropped as an official language of the European Patent Office (European Union 2012, see also Valdivieso 2014, 99–101) and is gradually becoming weaker (Fernández Vítóres 2012, 68; Pérez Vidal 2008 on the situation of the Spanish language in the Community institutions). In addition, in the community framework, the member states of the EU are required to have any kind of technical documents translated into the language of the country in which a product will be commercialized or sold, an activity will be carried out or a law will be implemented (European Union 1998, 2002), which involves a higher volume of scientific and technical translation projects (Byrne 2012).

In the twenty-first century, the profession of the translator is facing a moment of change as a result of technologization and commercial expansion, the globalization of all aspects of daily life, and also the specialized activities and unquestionable internationalization of scientific activity. These factors decisively influence the work volume of specialized translators (Montalt i Resurrecció 2005, 47–48). As Lambert (2007, 1689) points out, “globalization has become and actually is one of the external conditions for the strongest areas of the translation business”. In fact, the new needs for multilingual communication are reinforced and influenced by the proliferation of information and communications technology (Kingscott 2002; Lambert 2007; Olohan 2009). Moreover, virtually any product or service entails a translation order which in most cases will be scientific or technical (Byrne 2012, 5).

In addition, the position of English as a lingua franca also impacts scientific and technical translation (Ammon 2001; Aréchaga 2005, 2014; Gimeno Menéndez and Gimeno Menéndez 2003; Montgomery 2000, 2009; Navarro 1998, 2001a, 2001b, 2002; Olohan 2009, 2016, 138–39, among many others). This has a double implication: firstly, the well-known phrase ‘publish or perish’ (Garfield 1996) has settled so strongly on scientific and academic publications that one might think that the exponential increase in the volume of texts in English (Lambert 2007; Navarro 2001b) would involve a rise in the number of translation projects. However,

it is rather the opposite: in order to be able to publish, be visible and be cited, it is necessary to write in English (Angell 1986; Almirón Roig 2007; Montgomery 2009), and authors are frequently non-native speakers (Vandenbroucke 1989; Montgomery 2009). The second major effect of the use of English as a lingua franca is a consequence of the previous one: the higher the number of publications in English, the lower the need to translate texts (Timo-Iaria 1998; Pérez-Eid 1992), even though some researchers defend the opposite position and think that translation will become even more central (Montgomery 2009). The consequence of this on Spanish is, as Matías-Guiu, García Ramos and Porta-Etessam (2014, 36) highlight:

[. . .] en España se da la paradoja de que quienes más se resisten a entender que la calidad tiene poco que ver con el idioma y mucho con la investigación desarrollada son las administraciones públicas, que siguen promocionando lo de fuera y limitando lo de dentro, aunque sea de forma inconsciente.

The effects of the predominance of English in scientific research is also having an impact on the Spanish language, as stated by an increasing number of linguists and specialists (Matías-Guiu 1996; Aldrete 1999; Alberch 1996; Pérez-Eid 1992; Navarro 2001b; Alexandre-Benavent et al. 2007), and a direct impact on translation (Navarro 2001b), but the current situation could also be viewed optimistically: “[T]ranslation in varied form will more than ever be at the unacknowledged core of global scientific communication” (Montgomery 2009).

In Spanish-speaking countries, ranging from the Spain of Maimónides to the Argentina of Etcheverry (the translator of Freud into Spanish), scientific and technical translation into Spanish has always had a high demand (Montgomery 2009; Kelly 2012; see also Anguita Acero 2002, 369; Olohan 2016, 8). As regards research, however, scientific and technical translation has not received the same attention as in other disciplines (for example, there are several studies published covering legal translation in Spanish [see chapter on Legal Translation]) or the great impulse that this type of specialized translation has had in other languages (see also Maillot 1969, translated into Spanish in 1997, dealing with scientific and technical translation in French; Pinchuck 1977; Hann 1992; Wright and Wright 1993; Byrne 2006 about the English language; Jumpelt 1961; Kalverkämper and Weinrich 1986 about German). This may be due to the belief among translators that theory is not necessary or even useful (Sánchez Trigo 2005, 134). Another possible cause for the scarce interest that scholars have in scientific and technical texts is thought to be the limited creativity traditionally associated with these text types (Franco Aixelá 2013, 40). In this sense, Ortega y Gasset pointed out that the man of science has to begin by translating his own thoughts into the created language established by the ‘deliberate convention’ of the experts of a particular discipline. He also added that scientific translation might be understood as a partial exception to the essential untranslatability that he claims, since the scientist translates himself or herself from a language into a terminology (Ortega y Gasset 1937, 9).

This observation helps us to place the starting point of the meritorious efforts of those that have tried to establish a theoretical framework for scientific and technical translation in the Spanish context. The first works focused mainly on terminological aspects (González Pueyo 1988; Alpizar Castillo 1991a, 1991b, 1991c; Díaz Prieto 1995; Prado 1998, among others), while a high number of practical contributions were also published as a consequence of the exceptional development of Translation Studies at Spanish-speaking universities, as is the case of Congost Maestre (1994), Valero Garcés, Tejedor Martínez, and Santamaría García (1997) and Gamero Pérez and Hurtado Albir (1999). More recent publications regarding this type of translation and its teaching include the work by Montalt i Resurrecció (2002), Garrido Rodríguez

(2010), Sevilla Muñoz (2006, 2007), Jiménez Serrano (2007), Gómez and Gómez (2011) and Mayor Serrano (2002a, 2002b, 2003a, 2003b, 2005a, 2005b, 2007, 2010), among others).

On the other hand, guidelines and manuals are scarce. However, as will be shown later, a high number of papers and monographic works on specific aspects of scientific and technical translation or about specific disciplines have been published, as well as works of great merit describing scientific and technical Spanish (Gutiérrez Rodilla 1998, 2005; Vivanco Cervero 2006; Edo Marzá and Ordóñez López 2010, the fifth chapter of Martínez López 2011, and the most recent contributions of Sarmiento and Vilches 2016; Navarro 2015b, 2017b). Nevertheless, there is still no comprehensive publication dealing with both the essential elements and specific aspects of scientific translation (Gallardo San Salvador 2003, 161).

The situation described by Gallardo San Salvador more than ten years ago has not changed substantially. In order to assess the reasons for this stagnation or lack of interest, it would be convenient to reflect on two issues: (1) who is interested in the research in this field, and (2) who benefits from it.

As in any specialized language, there are two main agents in the translatorial act: the specialist and the translator (Byrne 2012, 18–24). A third group, which is a kind of hybrid of both, should be added: the academic researcher who produces a very high number of publications on Translation Studies (Rovira-Esteva, Orero, and Aixelá [2015] estimate that the number of annual publications on Translation Studies could be as high as 3,000). This third group is particularly important in the case of the Spanish language, as publications are an integral part of the Spanish university system.

Studies by specialists (i.e. any potential client of a scientific and technical translation, such as doctors, biologists, aeronautic or automobile technicians, etc.) and translators reflecting on this type of translation are scarce. Special attention must be paid to the medical field, which has always aroused interest among specialists, translators, researchers and scholars. An example can be found in the medical translation forum MedTrad (see Claros Díaz 2005) or *Panace@. Revista de Medicina, Lenguaje y Traducción*, a publication in which both doctors and translators, along with medical editors, journalists, specialists and scholars, share their research results. This journal has even published monographs which have partially filled the research gap on scientific translation in the Spanish language. In any case, they are isolated works which do not represent or involve a *continuum* in the research on scientific and technical translation.

Research issues

As previously mentioned, scientific and technical texts cover a vast and diverse range of fields and disciplines, which require the development of different translation strategies. Thus, researchers have adopted a wide variety of research approaches, ranging from linguistic and terminological issues to frequent translation difficulties and the application of these findings to the training of future translators.

This section is organized in five parts: (1) research monographs, (2) edited collections, (3) book chapters and articles in specialized journals, (4) lexicographical works and (5) doctoral theses.

Research monographs

As mentioned previously, despite the large number of works on specific thematic areas in other languages, mostly in English (e.g. Pinchuck 1977; Wright and Wright 1993; Byrne 2006, 2012; Montalt i Resurrecció and González Davies 2007; Varela Salinas and Meyer 2015; Olohan

2016, etc.), the number of monographs that deal with scientific and technical translation in Spanish is much smaller. In general, scientific and technical translation is tackled in books which study different approaches and different types of translation, and which devote one section to each of them (López Campos, Balbuena Torezano, and Jurado 2010). In this sense (see the following), contributions about scientific and technical translation are more frequently found in edited collections and articles in specialized journals.

In 1994, Congost Maestre published *Problemas de la traducción técnica*, the first noteworthy monograph in this line of research. The book, which studied the pair English-Spanish, aimed at combining two parameters of modern linguistic research: the analysis of technical translation and pragmatics, with particular reference to the study of medical language. In the theoretical part of the work, the author deals on the one hand with scientific and technical translation (e.g. relevance, specialized language, terminology, normalization and internationalization, the most common problems, etc.), and on the other with a pragmatic view of scientific and technical translation applied to medical language. The second, and more practical, part of the book includes a contrastive analysis in which the translations of three medical texts (namely, different sections of research papers) are compared with their matching source texts. Possible translation alternatives are also discussed.

In 2001, Silvia Gamero Pérez published *La traducción de textos técnicos*, a widely cited work with very positive reviews (Sager 2002). Although the author explores the pair German-Spanish, the theoretical part on technical translation and text genres is applicable to other language combinations, which makes it a useful tool for the students of technical translation. The book is structured in four parts: (1) a theoretical explanation of the nature of technical translation; (2) a detailed model of the analysis of the genre of user guides; (3) a comprehensive bibliography section of the literature on scientific and technical translation; and (4) a selection of text samples in both German and Spanish, which can also be suitable for other students working with Spanish as their target language.

On the other hand, the *Manual de traducció científicotècnica* (2005), by Vicent Montalt i Resurrecció, is worth mentioning. This wide-ranging book (which has been reviewed positively, e.g. Gutiérrez Rodilla 2006) deals with the different factors that determine specialized translation. The content is divided into eight chapters, which include both a theoretical approach and practical activities. The first three focus on scientific and technical communication, whereas the fourth and fifth deal with scientific and technical translation (i.e. its features, the process of translation and the difficulties they entail). The last three have a more practical focus, allowing students to practise their reading skills. The book also trains them to use different reference resources, shows how to carry out searches, as well as to write and revise the target text.

As previously mentioned, medical texts have received the greatest attention – most of the contributions being scientific papers and edited collections rather than monographs. *Traducción y Lenguaje en Medicina* (1997b), edited by Fernando Navarro, is worth mentioning. Although two chapters are co-authored, most of the text was written by Navarro himself. The author not only includes useful word lists of problematic medical and pharmaceutical terms, but also deals with morphosyntactic issues.

Other books deal with very specific medical topics, such as *La traducción de textos médicos especializados para el ámbito editorial (inglés-español)* (2011), by Ana Belén Martínez López, based on the author's doctoral thesis. It focuses on the translation of specialized texts (English-Spanish) for the publishing sector. Theoretical, methodological and practical aspects are also discussed. It offers a categorization of common problems which can be applied to the improvement of both the professional practice and university teaching. It should be pointed

out that, despite its title, it deals with scientific language in general and not medical texts in particular (Escribà Jordana 2012).

On the other hand, Claros Díaz's *Cómo traducir y redactar textos científicos en español* (2017) compiles a handful of useful strategies and norms to deal with scientific terminology (mainly from the chemical and pharmaceutical fields) in a didactic and informal style that might be helpful for scientific writers as well as professional and trainee translators. The book makes a call for 'correct scientific writing', i.e. the use of correct and precise specialized compound nouns, collocations, and mathematical symbols, as well as for the compliance with ISO norms, IS units, and basic orthographic and stylistic rules – aspects which are frequently ignored by scientists or scientific writers and/or translators.

Finally, it is not uncommon to find direct references to translation or even whole chapters devoted to the above in monographs dealing with specialized languages, for example, the fifth chapter of the book by Martínez López (2011) and the first section of the edited collection by Edo Marzá and Ordóñez López (2010, 13–194).

Edited collections

Although some edited collections are of a more general nature, such as *Aspects of specialised translation* (Balbuena Torezano and García Calderón 2016) and *Traducción científica y técnica (francés-español): Aspectos teóricos, metodológicos y profesionales* (Ortega Arjonilla and San Ginés Aguilar 2014), others delve into more specific topics. For instance, *Traducción e Interpretación en el ámbito biosanitario* (1998), edited by Leandro Félix Fernández and Emilio Ortega Arjonilla, describes the translating and interpreting activity in medical-pharmaceutical contexts. Structured in four sections, the topics discussed include the didactics of medical-pharmaceutical translation and conference interpreting in the health sector. The second and third chapters are especially worth mentioning, since they analyze the professional translation practice, first in institutions and companies, and then from the perspective of the freelance translator. This book, which was pioneering in dealing with the topic of medical and pharmaceutical translation in Spanish-speaking contexts, has been widely quoted (Corpas Pastor 2001; Ruiz Rosendo 2005, 2009; Díaz Galaz 2011, among others) and has been a reference work for years.

La traducción científico-técnica y la terminología en la sociedad de la información (2002), edited by María Amparo Alcina Caudet and Silvia Gamero Pérez and with an emphasis on terminological issues, is divided into five sections with contributions by some of the main researchers in this area, who discuss specialized multilingual communication, research about scientific and technical translation and terminology at Spanish universities, different professional profiles and useful tools for translators.

Manual de documentación y terminología para la traducción especializada (Gonzalo García and García Yebra 2004) also puts a strong emphasis on terminology. Although its title includes the words 'specialised translation', a considerable part of the book is devoted to scientific and technical translation. It offers a detailed and critical study of the documenting techniques applied to specialized translation. The theoretical fundamentals are discussed at the beginning of the book before delving into the documenting and terminological competences of the translator. It concludes with an analysis and assessment of the main software tools useful for specialized translation. The collection, which has been positively reviewed (Gallego Pelegrín 2004; Anguiano Pérez 2005; Sales Savador 2005, among others), may be a valuable resource for technical translators, terminologists, documentalists, philologists and lexicographers, but it may also be a basic reference for lecturers and researchers.

Finally, De Beni's *Ciencias y traducción en el mundo hispánico* (2016) is divided into five chapters, mainly dealing with the role of scientific translation throughout history. Therefore, it may be of great interest to historians and scholars focusing on the history of translation.

Book chapters and articles in specialized journals

In terms of content and topics, these can be grouped into the following categories:

Some publications are general studies of scientific and technical translation (Gallardo San Salvador 1992; Gamero Pérez 1999; Sánchez Trigo 2005; Castillo Bernal 2014; Franco Aixelá 2013, 2015), while other studies focus on their historical evolution (Franco Aixelá 2004; Olohan 2009; Acuña Partal 2015; Micó Romero 2016; Jiménez Domingo and Lépinette Lepers 2016; Sánchez González de Herrero 2016; Puche Lorenzo 2016; Muñoz Bello 2016). In addition, some discuss rigour and creativity in technical translation (Spang 1997; Bocorny Finatto 2010) as well as cultural aspects (Aguado de Cea and Álvarez de Mon 2003; Nakao, Goeuriot, and Daille 2010), or highlight and investigate the main translation difficulties (Tercedor Sánchez and López Rodríguez 2004; Fidalgo González 2014), with a focus on terminological issues (Prado 1990; Prieto Velasco 2007; Martínez Robledo 2009; Serra Pfennig 2016; among others). Some of them can be applied to any kind of scientific and technical text genre, such as Claros Díaz's (2006), or may more specific thematically speaking, i.e. they cover only a certain field, such as telecommunications (Navarrete Sirvent 2013), science and technology in the press (Del Pino Romero 2016), and the scientific translation of acupuncture (Jongyoung 2006). They study a particular text genre such as user guides (Vázquez y del Árbol 2008) or scientific documentaries (Ogea Pozo 2013); or they analyse a very specific topic, such as papers on cosmetic products (Vázquez y del Árbol 2007), the euphemistic value of technical terms (Echauri Galván 2013), the translation of highly specialized scientific titles (Soler 2015), or even metaphors in the fields of blindness, tiredness and spirituality (Vivanco Cervero 2016). Many of these publications have opened up new research lines.

The importance of the medical field is also reflected in the high volume of chapters and articles, as stated by Diego Amado and Gutiérrez Rodilla (2006). The use of translation in healthcare settings has been particularly productive (Navarro 1997a, 1997b, 2001a; Ortega Arjonilla et al. 1999; Gutiérrez Rodilla 1998, 2005, among others). Particularly noteworthy are the works by doctor and translator Fernando Navarro, who has written glossaries and explanations concerning confusing medical terms in different language combinations (for the English-Spanish pair, see Navarro 2007a, 2007b, 2008a, 2008d, 2009b, 2009c, 2010a, 2010b, 2012; for French-Spanish glossaries, see Navarro 2013b; for German-Spanish words, see Navarro 1996, 2003). Navarro has also published glossaries of abbreviations (2011a), lists of terms from very specific fields (2006b, 2006c, 2008b, 2008c, 2009a, 2011; see also Saladrigas et al. 2008a, 2008b), as well as linguistic-medical reflections (2013b, 2014, 2015a).

A number of specialists dealing with medical translation have focused on the mistakes and terminological difficulties linked to the field (Díaz Prieto 1995; Korning Zethsen 2004; Navarro 2006a; Jiménez Gutiérrez and Mañas Castro 2007; Martínez López 2007, 2010; Ruiz Rosendo 2008; Williams 2008; Texidor Pellón and Reyes Miranda 2009; Mayor Serrano 2010; Claros Díaz 2016). Cultural and textual approaches have also been productive (Marsh 1999; Jongyoung 2006; Olmo Cazevieille 2015), including several contrastive studies of the same text genre in different cultures (Mayor Serrano 2005b, 2006; Faya Ornia 2015b; Martínez Motos 2016; Jiménez Crespo 2017), and dealing with specific language pairs (Quijada Díez 2009, 2013; García-Esteban and Varela Salinas 2015; Martínez López 2015; Ortega Arjonilla 2015, among others).

Finally, several contributions have approached scientific and technical translation from a pedagogical perspective, as is the case of Gamero Pérez and Hurtado Albir (1999), Gamero Pérez (2010), Mayor Serrano (2002a, 2002b, 2003a, 2003b, 2005a, 2005b, 2007, 2010) and Montalt i Resurrecció (2002). Other key contributions include Vega Expósito (1999), Sevilla Muñoz (2006, 2007), González Davies, Scott-Tennent, and Torras (2001), Jiménez Serrano (2007), Clifford (2007), Garrido Rodríguez (2010), Gómez and Gómez (2011), Veiga Díaz (2011), Vázquez y del Árbol, Martínez Lillo, and Ortiz García (2012), Alcalde and Gregorio Cano (2013), Ruiz Mezcua (2014) or Sánchez Ramos (2017) among others.

Terminological and lexicographical works

As regards terminological and lexicographical issues, the *Diccionario Técnico español-inglés* (1983) by Guy Malgorn is one of the most widely used technical dictionaries. It focuses on vocabulary related to machinery, tools, combustion engines, metallurgy, public works, etc, while the *Diccionario politécnico de las lenguas española e inglesa* (1997), by Federico Beigbeder, includes also acronyms, abbreviations and the main measurement units.

In the field of medicine, the *Manual de traducción médica. Diccionario básico de Medicina (inglés-francés-español)* (1999) is an adaptation by Ortega Arjonilla and his collaborators of the source French book by Henri Van Hoof (1986). However, it is not a mere lexicographical text in the strict sense, since its first part deals with the process of translation, linguistic systems, translation procedures and the problems that usually arise when translating medical texts, while the second section of the book contains a basic glossary of medical terms (English-French-Spanish), as well as an annex of medical texts in French to be translated into Spanish. Although it has been criticized for a lack of coherence (Turrión 2000), it may be interesting for translation students working with these three languages since practical exercises are combined with solid theoretical foundations.

In this same field, it is worth mentioning the *List and Glossary of Medical Terms* developed by the GENTT research group (based at the Universitat Jaume I), who apply the concept of textual genre to the analysis of specialized translation, as well as the *Medical Spanish and English Dictionary* by Slonczewski and Ramírez, which may be useful for both students and professionals. It includes descriptions of diseases, pictures and medical interviews in audio support.

Especially relevant is the *Diccionario Crítico de Dudas inglés-español de Medicina* (3rd edition) (2000) by Fernando Navarro (popularly known as the *Red Book*), probably the most important reference work on medical translation. This exhaustive dictionary (with more than 48,000 entries) not only provides a Spanish equivalent for every English term, but also explains the reasons why other options are wrong, or even the suitability of certain alternatives depending on the context. Moreover, it warns of unnecessary calques and false friends, meticulously explains affixes to better understand the meaning of derivatives, compiles several polysemous words and deals with orthographic and stylistic issues. This dictionary, which is currently available only online in the Cosnautas portal (Navarro 2013a), is a reference work for the specialized translator, since it includes four relevant lexicographic works: (1) an updated version of the *Red Book*, (2) the *Diccionario inglés-español de alergología e inmunología clínica* by Igea Aznar (2016), (3) the *Repertorio de siglas, acrónimos, abreviaturas y símbolos utilizados en los textos médicos en español* (2017c), drafted by Navarro himself, and (4) a resource pack especially useful for translators of the medical field and related sciences: a collection of links which are permanently updated, the so-called *Árbol de Cos* (2013) by Laura Munoa.

In July 2017 this portal launched a German-Spanish medical dictionary with more than 200,000 entries: *Medizin. Gran diccionario médico alemán-español*, by Fernando Navarro. It fills a gap which had been only partially covered by previous works, such as Ruiz Torres (1960), Ruiz Torres and Ruiz Torres (2001) and Tamayo Delgado (1999) (see Navarro 2003 for further information on other German-Spanish medical dictionaries). Finally, other hard-copy bilingual medical dictionaries are worth mentioning: the *Stedman, Diccionario bilingüe de Ciencias Médicas (inglés-español, español-inglés)* (2001), the *Diccionario Médico Español-Inglés, Inglés-Español* (2005), and the Spanish monolingual *Diccionario de términos médicos* (2011), an important contribution to lexicography by the Spanish Royal Academy of Medicine.

To conclude this section, other notable lexicographical titles on very specific fields include the *Diccionario de Arquitectura, Construcción y Obras Públicas* (1987) (which not only provides explanations of each term but also includes engravings, pictures, drawings and equivalence tables for measuring units and other data of professional interest), the *Wörterbuch der Sportwissenschaft. Deutsch, Englisch, Spanisch. Dictionary of sport science. German, English, Spanish. Diccionario de las ciencias del deporte. Alemán, Inglés, Español* (1992), the *Mathematics dictionary and handbook: English-Spanish = Diccionario y manual de matemáticas: inglés-español* (1996) (concerning terms, formulas and mathematical expressions in conjunction with explanations and examples), and the *Spanish Computing Dictionary/Diccionario Bilingüe de Informática* (2004) (which provides over 50,000 computing and information technology terms).

Doctoral theses

In the last few years, several doctoral theses underscore the importance of both this research area and of translation as an academic discipline in the Spanish-speaking world.

Although the topics covered are varied, they can be classified in three groups. The first one includes theses dealing with the translation process of scientific and technical texts and related aspects (e.g. Gamero Pérez 1998; Camón Herrero 2002; Ojanguren Sánchez 2003; Veroz González 2014; Barba Redondo 2015). The second group contains theses on terminological and discursive issues (e.g. Gallardo San Salvador 1997; Fernández Polo 1998; Candel Mora 2003; Tijeras López 2008; Tsai 2011; Astorga Zambrana 2011; Pinilla Machado 2017), many of which are on the medical field (such as the theses by López Rodríguez 2000; Mayor Serrano 2002a; Quijada Diez 2007; Muñoz Torres 2011; Sánchez Ibáñez 2013; González Darriba 2014; Faya Ornia 2015a; Martínez Motos 2016). Finally, theses in the third group study the didactics of scientific and technical translation (e.g. Sevilla Muñoz 2002; Bolaños Medina 2008; Martínez López 2008; Contreras Blanco 2011).

Future directions

Many translators specialize in scientific and technical translation nowadays, as the field has broadened covering a wide range of disciplines (from engineering to applied sciences such as medicine). This interest can also be found in the growing number of higher education programmes, both in Latin America and Spain, including not only degrees in Translation Studies, but also in very specific areas of scientific and technical translation.

Research into this type of translation, as complex and diverse as it is, requires an interdisciplinary approach that sheds light not just on the translators' practice but also on the challenges for the practice of scientific and technical translation in the Spanish-speaking parts of the

world. The growing number of postgraduate and research degrees offered is a positive sign of the changing times, but there is still a long way to go as regards the production of qualitative and quantitative research involving the Spanish language and by Spanish-speaking language specialists. As previously stated, there is an evident lack of monographic works in this field, be it for the current status of English in academia or for the lack of professional language specialists willing to dedicate their time to this type of translation research. A possible reason for this lack of language researchers may be that specialized texts have been traditionally translated by field specialists with a knowledge of two languages rather than by professional translators; however, this practice also seems to be changing with the increasing professionalization of this sector. Notwithstanding this, more continuous and solid research is desirable, and other language combinations besides the English-Spanish pair should be taken into consideration, since their impact on the market should not be neglected (Claros Díaz 2017, 7–15). In this regard, the interest in medical texts, as highlighted by the articles, book chapters and edited collections published in the past, seems to continue.

The overall picture of scientific-technical translation drawn here shows that, despite the growing importance of this type of translation in recent years, more research into it is needed. Future research may cover, as Gallardo San Salvador (2003, 161) pointed out, aspects such as specialized language and writing, terminology, documentation, the main features of these types of text, as well as professional, didactic, and methodological issues.

Recommended reading

Gonzalo García, Consuelo, and Valentín García Yebra. 2004. *Manual de documentación y terminología para la traducción especializada*. Madrid: Arco/Libros.

This pioneering collection includes a wide variety of contributions recommended to gain an overall understanding of scientific and technical translation in the Spanish-speaking context.

Byrne, Jody. 2012. *Scientific and Technical Translation Explained. A Nuts and Bolts Guide for Beginners*. Manchester: St. Jerome Publishing.

Byrne's well-structured and comprehensive book is a handbook suited to both translator trainees and translator trainers. Although it does not cover Spanish, it will be of great help to newcomers, as it offers an overview of the field accompanied by a large number of texts, samples and exercises in English.

Olohan, Maeve. 2016. *Scientific and Technical Translation*. London: Routledge.

Olohan's work offers exercises and a reference list at the end of each chapter. Two chapters deal with theoretical aspects and five focus on specific text types. Its didactic approach makes it an interesting option for scholars, teachers, and (mainly postgraduate) students.

Claros Díaz, Manuel Gonzalo. 2017. *Cómo traducir y redactar textos científicos en español. Reglas, ideas y consejos*. Barcelona: Fundación Dr. Antonio Esteve.

One of the latest contributions to scientific translation focuses on the English-Spanish pair and aims mainly at establishing a clear, easy-to-find and quick style guide for nomenclatures, chemical, biochemical, and pharmaceutical compound nouns, and how to deal with them not just when translating from English but also when writing original scientific texts in Spanish. It is a well-documented book with abundant examples and very useful explanations for non-scientists on how to manage very specific terminology as well as basic orthographic and stylistic rules.

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