SCIENCE POPULARIZATION AS INTEREPISTEMIC TRANSLATION: AUGUSTO CÉSAR DE MIRANDA AZEVEDO'S POPULARIZATIONS OF DARWINISM IN 19TH CENTURY BRAZIL

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ABSTRACT: This paper aims to answer the call for a transdisciplinary approach in addressing science popularization (SP) by bridging Translation Studies, Science Communication, and the History of Science. Embracing the 'continuum model', it understands SP as an inseparable part of science communication, challenging the 'diffusionist model' that isolates scientists from the public. The study delves into the connections between SP and translation, advocating for a broader perspective, emphasizing the concepts of interepistemic translation and translationality. Using a case study on the dissemination of Darwinism in Brazil, the paper demonstrates the relevance of this approach by tracing the translational path from Charles Darwin through German intellectuals Heinrich Georg Bronn, Ernst Haeckel, and Ludwig Büchner to Brazilian popularizer Augusto César de Miranda Azevedo, emphasizing translation's pivotal role in the global circulation and transformation of scientific knowledge.
KEYWORDS: Augusto César de Miranda Azevedo; Heinrich Georg Bronn; Ernst Haeckel; Ludwig Büchner; Reception of Darwinism; Translationality; Interepistemic Translation.

1. Introduction

This paper aims to answer the call made by translation theorists Arduini and Nergaard (2011), Gentzler (2017), and Bassnett and Johnston (2019), amongst others, for translation to become as a research tool in a new transdisciplinary paradigm. By applying the concepts of 'translationality' and 'interepistemic translation' (which will be properly explained below), it hopes to launch a conversation about science popularization (SP)[1] involving the fields of Translation Studies, Science Communication, and History of Science.

The paper is divided into three sections. First, a brief literature review is presented to define SP and to establish its links to translation. It is shown that SP has been associated with translation both negatively and positively in metaphorical and non-metaphorical ways. More systematically, SP has been understood as intralingual translation by many authors. Thus, it is asked if this interpretation is enough to explain SP as a whole and what else could be fruitful for developing our understanding of it.

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[1] The terms to designate the act of communicating science ('science popularization', 'vulgarization', 'divulgation', 'journalism', 'communication', and so on) have their own histories and complexities both in English (Topham, 2009) and Portuguese (Vergara, 2008) and are not really standardized nowadays (see, for example, Bueno's (2010) definition of '*comunicação científica*' and '*divulgação científica*' and Sterk's and Goch's (2023) definition of 'science communication' and 'science journalism'). In fact, a quick search on *Google Scholar* results in more than 500.000 entries for 'science communication', over 10.000 for 'science popularization', and only a little over 2.000 for both terms together, suggesting that there is no consensus on which term should be used for what (queries conducted on 6 mar 2024). 'Science popularization' was chosen for the purposes of this paper because it encapsulates better the act of communicating science to the masses in the 19th century (see Lightman (2007), for example) while 'science communication', on the other hand, seems to relate more to the current academic field of research on this topic and to current practices of communicating science beyond just popularizing it.

To answer such a question, in the second section, the concepts of interepistemic translation and translationality are introduced. It is argued that they are fruitful avenues of research for understanding the movement of ideas across the world, taking into account the interepistemic translation that happens between different scientific cultures and the translational aspect of these movements including, of course, SP.

Lastly, a case study is presented: the translational path from Darwin's *On the Origin of Species*, passing through the German intellectuals Heinrich Georg Bronn, Ernst Haeckel, and Ludwig Büchner to the Brazilian Augusto César de Miranda Azevedo fifteen years later in a chain of interlingual and interepistemic translations including popularizations.

Thus, two arguments are put forward. First, post-translation studies (Arduini and Nergaard, 2011; Gentzler, 2017) are in fact a fruitful transdisciplinary avenue which can provide insightful perspectives for our case study in the History of Science. Second, it is advanced that the history of the reception of Darwinism in Brazil can be understood as a translationality chain that goes through multiple interepistemic translations from Darwin to German naturalism until finally arriving in Brazil. Such a perspective not only shows a new field of application for the concepts of Translation Studies but also answers the recent call from History of Science to understand science as a communicative process encompassing the circulation and transformation of knowledges around the world and through time.

2. Translation and Science Popularization

Before drawing a parallel between SP and translation, it will be helpful to properly define SP. The current understanding of SP was born in response to what is now known variously as the 'Metornian model' (Cloître and Shinn, 1985), '*paradigme de troisieme homme*' (Jacobi, 1985), 'canonical account' (Shapin, 1990), 'dominant view' (Hilgartner, 1990), 'diffusionist model' (Cooter and Pumfrey, 1994), 'deficit model' (Bensaude-Vincent, 2009), among others (Bucchi, 1998, p. 149), all of which hold that scientists and the general public occupy separate realms, and that knowledge produced by the former should be communicated unidirectionally to the latter. The argument is that, due to the high degree of specialization of scientific discourse (especially after the 19th century), a simplification is needed for the public to be able to access it, a transformation of form without tampering with the content. This results in a divide between a consumer/receiver public and a producer/sender science, that isolates scientists from any influence coming from the public, which, for its part, is supposed to receive an 'altered' version of the knowledge originally produced (Whitley, 1985; Meadows, 1986; Myers, 2003).

However, since the 1980s, this simple diffusionist model has fallen out of favour with historians and sociologists of science, discourse analysts, scientific communication scholars, and translation scholars (Whitley, 1985; Cloître and Shinn, 1985; Jacobi, 1985; Hilgartner, 1990; Cooter and Pumfrey, 1994; Wynne, 1995; Drouin and Bensaude-Vincent, 1996; Bucchi, 1998; Grundmann and Cavaillé, 2000; Myers, 2003; Secord, 2004; Topham, 2009; Daum, 2009; Wright, 2011; Gavroglu, 2012; Hochadel, 2020). Instead, many

continuist models have emerged, which approach SP as something inseparable from 'science proper' (Whitley, 1985; Cloître and Shinn, 1985; Jacobi, 1985; Hilgartner, 1990), until we at last arrived at Secord's (2004, pp. 661, 670) call for "eradicating the distinction between the making and the communicating of knowledge" and for the abandonment of "popular science" as a neutral descriptive term. This new model presents a dialectic view of science and the public where the latter is also an active agent in communication. More than that, the public is not necessarily lay, nor clear-cut since popularization also happens among specialists in the same field and among specialists from different fields. Thus, popularization is an integral part of science and performs rhetorical, discursive, ideological, and political roles both inside the scientific realm and outside of it (being consumed as entertainment in magazines or fictional literature for example). Moreover, SP is not a homogeneous category. It has changed over the centuries and nowadays encompasses texts as seemingly disparate as science fiction novels, grant proposals, and press releases, just to give a few examples.

Such a change in conception from an 'altered' text to be judged according to its fidelity to an 'original' to a two-way model that recognizes that the transformation of the text is a process that deserves to be studied in its own right will probably sound familiar to translation scholars. However, the similarities between scientific popularization and translation do not end here.

It is difficult to peruse the literature on SP without coming across the term 'translation' being used more or less rigidly or metaphorically[2]. Thus, the act of popularizing science has already been associated with different views regarding translation, ranging from those that see it as a potentially distorting process or as a mere search for equivalents to others that recognize it as a complex process encompassing not only linguistic phenomena but also social and philosophical issues.

For example, Authier (1982), still following a diffusionist model, states that science popularization[3] is a reformulation of a first discourse (D1) into a second discourse (D2), and thus can be found in a set of writings that includes conventional interlingual translations, abstracts, adaptations, rewritings, and so on, that each cater to a specific public. However, for Authier (1982, p. 35), SP cannot be called a translation, because translations "*se substituant au texte D1 comme équivalent. Son travail de reformulation peut demeurer implicite au point que l'on peut ignorer que D2 résulte d'une traduction*", while a second discourse resulting from SP presents itself as a heterogeneous and explicit reformulation that constantly refers back to its source text. Zamboni (1998) disagrees with Authier by taking SP not to be a reformulation at all, but rather the formulation of a new autonomous discourse. However, precisely because SP is no longer a reformulation, she also believes

[2] For example, a simply search for 'translat' (or 'tradu' in Portuguese) in the volumes edited by Shinn and Whitley (1985), Bucchi and Trench (2008), and Porto, Brotas and Bortoliero (2011) returns 41, 12, and 31 occurrences respectively.

[3] '*Vulgarisation scientifique*' in her words.

that it cannot be taken as translation.[4] Bucchi (1998, p. 3), for his part, states that considering the mediation of science for the public metaphorically as translation reduces it to a "mere matter of linguistic competence". Even Jacobi's (1985) and Myer's (2003, p. 266) critiques of the diffusionist model associate SP with translation as a process of altering, distorting, and simplifying the original scientific discourse. A passage by Peters (2008) exemplifies this understanding of translation concerning SP:

> Public communication of science cannot be understood as 'translation.' Translation would require structural equivalence of source and target language, and a shared reality serving as background for making sense of information. There is neither equivalence of scientific and everyday language, nor a shared reality. The worlds of modern science are esoteric and rather inaccessible to everyday reasoning (Peters, 2008, p. 138).[5]

By stating that SP is not translation, these authors reveal what they think translation is. In this negative space, we see translation as a reproductive activity resulting in a target text that hides the fact that it is a translation by being able to be read fluidly by the target reader as if it were an original. Equivalence is key in this process (Zamboni, 1998, p. 105; Bucchi, 1998, p. 3; Peters, 2008, p. 138) as it is the criteria for distinguishing between "reformulations" and effectively new writings. Needless to say, under this rather outdated view, SP cannot really be seen as translation. However, many other authors have remarked that, when translation is understood more generously as a creative, transformative process, then it is very productive for understanding the popularization of science, as will be discussed below.

Topham (2009), praising Secord's (2004) focus on understanding science as the circulation of knowledge, stresses the need for science to be taken as a communicative process. According to him, this not only reintegrates SP into science but allows for the use of resources developed by other disciplines, including translation studies, to enrich the historiography of science (Topham, 2009, pp. 19-20). For example, in her study about the history of the term '*vulgarização científica*' (science vulgarization), Vergara (2008, pp. 138-139) states that the idea of translation was present since its first definitions in the 19th century and shared with translation "*o limite na transmissão dos conteúdos; a preocupação de estar ao alcance de todos e assim conferir um efeito universal ao conhecimento; além de carregar consigo também a centelha do novo*." Vergara (2008, p. 144) argues that scientific discourse needs to be translated into everyday discourse in order to bring scientific community and the public together. She believes that it is wrong to understand translation as an inferior non-creative discourse and that untranslatability issues should not weigh on popularization efforts.

Amongst Translation Studies scholars, Wright (2011, p. 9) includes SP as a heterofunctional translation, meaning that the SP target text has a different purpose than

[4] See Zamboni (1998, pp. 76, 96). However, despite this, Zamboni keeps employing the term 'translation' metaphorically throughout the text.
[5] These words remain in Peters (2014, p. 78), the second edition of the work.

the original scientific source text. Esteves (2014), for her part, points out that the main goal of both processes (translation and SP) is the same, namely to make knowledge previously out of reach available to people who do not speak the language (including technical language), and brings up the question of interpretation and power; after all the translator is also a reader and the text he or she produces wields power to convince the final reader of anything. In that lies an ethical responsibility of producing an appropriate target text. Perhaps most interestingly, she discusses the problem of equivalence, making clear that a perfect 1:1 correspondence is impossible as it entails a copy of the source text, defeating the purpose of translation. This, however, also brings the SP and translation together in the sense that both need to discuss what will be 'lost' in the target text and the limit of what can be transmitted in any act of communication. According to Esteves (2014, p. 45), this limit of transmission appears as a paradox in SP because expertise is needed to render technical language into everyday language, so "*é para leigos, mas tem mais chances de ser traduzido corretamente se quem fizer a tradução for um não-leigo*". More recently, Bennett (2024, forthcoming) pointed out that Martin and Veel (1998, p. 31) and Fuller (1998, p. 35) understand SP as a translation (albeit in a metaphoric sense) from scientific language into common non-specialized language, thus enabling methods from descriptive translation studies (DTS) to be used to analyze popularizations.

Moreover, SP has often been understood as a kind of 'intralingual translation' or 'rewording', defined by Jakobson (1959, p. 233) as "an interpretation of verbal signs by means of other signs of the same language".[6] In fact, Machado (2014, p. 243) applied Jakobson taxonomy to scientific translation, aligning interlingual translation to the translation of science texts between different languages, intersemiotic translation to the production of concepts in science (going from abstract ideas to written or spoken words), and, of course, intralingual translation to SP and scientific literacy. In practical terms, popularization as intralingual translation has already been applied with the intent of improving communication at least in the fields of law (Rizzo, 2015), medicine (Wermuth and Verpaletse, 2018; Muñoz-Miquel, 2021), and economics (Bania and Faridy, 2020).

Thus, in contrast to the view espoused by the first authors cited above, the more recent authors associate SP and translation in a more positive way. By seeing SP as translation, they can draw concepts from translation studies to think or rethink SP concepts, enriching both fields. By understanding SP more specifically as intralingual translation, one gains access to a new approach to study has proven to be fruitful to the study and improvement of communicating science judging by the papers cited above.

However, one may go further and ask: is the intralingual translation perspective enough to explain SP as a whole? By going beyond translation as a metaphor, as put forward by the post-translation approach (Arduini and Nergaard, 2011, Gentzler, 2017), it

[6] See Zethsen (2009) and Zethsen and Hill-Madsen (2016) for more recent appraisals of intralingual translation and its situation in Translation Studies. It is important to note that 'expert-lay communication', in Zethsen's terms, is considered as intralingual translation from the get-go and there seems to be no reason to not include at least some types of SP under this category.

is possible to break free from text-based bias and apply Translation Studies methods and theories to the study of knowledge flows between different discourses and disciplines, between different epistemic systems (different ways of interpreting the world), in a process called 'interepistemic translation'.

3. Science Popularization as Interepistemic Translation

Within the context of what Nergaard and Arduini (2011) have called 'post-translation studies' (also termed as "outward turn" by Bassnett and Johnston (2019, p. 186)), authors like Blumczynski (2016), Cronin (2017), Robinson (2017), Gentzler (2017), Marais (2019), and Bennett (2024) worked on shifting the understanding of translation as a purely text-based phenomenon to a process (a 'how') that can be found anywhere. Translation, thus, is seen as a semiotic process and therefore ubiquitous in nature. Here lies translation's transdisciplinarity, which makes it helpful to understand virtually all fields of knowledge and their relations to each other.

Amidst these developments in translation theory arose the concept of 'interepistemic translation'. It was first employed by Robinson (2017, p. 200-202), somewhat tentatively, to designate translation between epistemic systems. It is described as:

> Similar to what medieval thinkers called the *translation studii*, the translation of learning, also known as the transfer or transmission of knowledge – which is never a 'cloning' of knowledge, of course, but always involves what I [Robinson] am calling translationality: adaptation, transformation (Robinson, 2017, p. 200).

Robinson's concept of 'translationality' emphasizes the transformations that every text goes through as it circulates in different cultures in space and time, ever-changing in unexpected ways in its new performances, rewritings, and rereadings. Translationality and interepistemic translation, thus, are intertwined concepts for a translational chain of transformations will go far beyond from just changing languages, it will go through changes of genre, media, areas of knowledge, and even perception. Robinson does not make explicit what he means by 'epistemic system', but judging from his list of interepistemic translations (Robinson, 2017, pp. 200-201), an epistemic system could be described as the overall context of communication ranging from the internalization of experience through perception to research practices and applications or entertainment presentations like literary and audiovisual works. Any movement between these contexts entails transformations in the form of writing, adaptation, reformulation, field application, and so on. Each of these transformations in the translationality chain presents an instance of interepistemic translation.

Recently, Bennett (2024, p. 2) and Neves launched the EPISTRAN project, an initiative to operationalize and refine interepistemic translation as a heuristic tool. It is defined as "using concepts, methods and theories from the field of Translation Studies to investigate the semiotic processes (verbal and nonverbal) involved in the transfer of information

between different 'epistemic systems'" focusing on the translation flows between the western science epistemic system and the epistemic systems of the Humanities, indigenous knowledges, and (more importantly for the purposes of this paper) popularizations.

Regarding SP, Bennett (2024, forthcoming) has developed a methodology for studying popularizations as interepistemic translations. Drawing on the work of linguists Halliday and Martins (1993) and Martin and Veel (1998), she argues that scientific discourse is itself a translation from the clausal mode of primary perception into a highly nominalized and impersonal style. Thus, by going the opposite way, scientific popularizations would be translations back into standard non-specialized discourse and, therefore, would also be eligible for the methods, tools and theories developed by Translation Studies. However, whereas Bennett advances a DTS approach in her case study of SP, in this paper, I would like to present a History of Translation approach similar to Robinson's (2017, pp. 47-128) account of the translationality present in the transmission of Galen's medical knowledge to Rhazes, Vesalius, Burton, Rabelais, Urquhart, Motteux, Ozell, Sterne until Portela through a series of translations, adaptations, and popularizations. Bennett (2023; 2024, p. 10) also advances this program by proposing that translation be understood as a vertical diachronic process that grounds the production of new knowledge in the various knowledges that have come before, stating that "all researchers are, to some extent, involved in charting translational processes that are constitutive of modern science (broadly defined) and in observing the changes that take place as scientific and philosophical texts and ideas circulate through time and place".

Thus, this paper focuses on highlighting the translational aspect of the circulation and reception of scientific ideas into different socio-historical contexts, crossing not only the epistemic divide between scientific discourse proper and SP discourse, but also between different scientific epistemic systems. The paper's interest, thus, lies not in the interepistemic translation that happens in popularization *per se*, but in the movement of knowledge across the world to which popularization is embedded. For such a goal, I present the long path traversed by the ideas contained in Charles Darwin's *Origin of Species* (1859, 1st ed.), going through Heinrich Georg Bronn's, Ernst Haeckel's and Ludwig Büchner's texts (both 'proper' interlingual translations and interepistemic translations)[7] until they were first publicly discussed more than fifteen years later in pre-Republican Brazil in the popularizations of Augusto César de Miranda Azevedo.

4. From England to Brazil (with Stops in Germany)

Augusto César de Miranda Azevedo was a Brazilian physician, popularizer of Darwinism, professor of medicine, and Republican politician. His life and works have received considerable attention from historians of science, especially due to his early dissemination

[7] As pointed out by Cid (2004, p. 65), French Positivism is also present in Miranda Azevedo's popularization but this aspect will not be covered in this paper due to space limitations. However, it must be remembered that multiple source texts (known as 'compilative translation') are a given for the EPISTRAN project, especially in SP (Bennett, 2024, pp. 8-9; 2024, forthcoming).

of Darwinism in Brazil; indeed, he was one of the first to discuss the subject in his M.D. dissertation, as well as in the series of public lectures, aimed at a broader audience, that followed (Miranda Azevedo, 1875; Miranda Azevedo, 1876).[8] Despite a number of studies into his life and work (Collichio, 1988; Cid, 2004; Carula, 2009; Waizbort, 2012), the translational aspects of his output remain unexplored.

Issues pertaining to interlingual translation are interwoven into Miranda Azevedo's life and work. A native speaker of Portuguese at a time when French, German and English dominated the scientific landscape (Gordin, 2015), and living in a country very influenced by Frenchism (Wyler, 2003, p. 60), the physician was part of a Republican group associated with popularization periodicals that featured various translations. This group believed that it was necessary to translate European repertories into Portuguese in order to disseminate them to a wider number of citizens in the hopes of eventually changing the country's political landscape (Alonso, 2002). Although he read mainly in French (Collichio, 1988, p. 34), the sources cited in his dissertation also cover English, Latin, and Italian, as well as Portuguese (Miranda Azevedo, 1875), and he displayed a clear awareness of the need for translation to export South American knowledge to Europe when he meant to translate his (never published) *Diccionario Biographico Ilustrado da América do Sul* into French.[9] He proofread Alberto Löfgren's translation from German into Portuguese of *O Estado de Direito entre os Autochtones do Brazil* authored by Carl F. P. Von Martius (1794-1868) (von Martius, 1906), and revealed his thoughts on translation in his public lectures at *Conferências da Glória*, where he lamented the unavailability of a Portuguese version of Darwin's *On the Origin of Species* (Miranda Azevedo, 1876, p. 55). He finally made his views on translation explicit in a preface for *Cartas Inéditas* by Priest José de Anchieta (1534-1597), translated from Latin by João Vieira de Almeida, favouring fidelity and equivalence between source and target texts over a more domesticated approach (Miranda Azevedo, 1900).

However, I contend that Miranda Azevedo also played a role as an interepistemic translator not only by translating scientific specialized knowledge to a broader audience but also by being at the end of a long chain of translationality of Darwin's ideas. Perhaps the best way to study this long and complex process is to start at the beginning: the publication of *On the Origin of Species* by Charles Darwin in 1859.

Darwin called the *Origin* an abstract of his 'big book', one that he had been writing since 1856 and which Stauffer (1975, p. 10) calculated would reach 750 pages if Darwin had not met with Alfred Wallace's independent discovery. Maybe it is too hasty to call the *Origin* a popularization of the 'big book' since the latter was never published, leaving the former to occupy the place of source text for future translations. Also, the *Origin* was

[8] Out of his seven lectures on Darwinism, only the first one was transcribed and published. Although accounts of the other lectures survived in newspapers of the time, an analysis focused on the first lecture is enough for the purposes of this paper.

[9] *A Opinião Nacional*, 1892, 3. p. 2. Available at: https://memoria.bn.br/DocReader/docreader.aspx?bib=378020&pasta=ano%20189&pesq=&pagfis=10 (Accessed: 6 mars 2024).

presented as a proper, even if somewhat unorthodox, scientific text (Secord, 2000, pp. 508-510). Despite that, some Darwin scholars have pointed out that the condensed nature of the book played a part in its reception (Johnson, 2007, p. 529; Horton, 2008, p. S77; Sloan, 2009, p. 78; Sloan, 2019) and even Darwin showed some concern regarding the 'popularity' of the book[10] which would suggest that our chain of translationality had its start in the very origin of the *Origin*. Nevertheless, the first major interepistemic translation in this chain happened alongside the book's first translation into German by the naturalist Heinrich Georg Bonn (Darwin, 1860).[11]

According to Gliboff (2008, p. 151-152), the misunderstandings and criticisms surrounding Bronn's translation (coming even from Darwin himself) resulted from a fundamental problem of terminological interpretation not only due to linguistic barriers but also to different ways of conceiving nature. After all, Bronn was an acting naturalist with his own theories, and translating the *Origin* into German was not a question of just changing English words to German equivalents, but of making sense of it in relation to the German scientific landscape.

Bronn was invested in advancing his studies as a *Wissenschaft*, that is, a scholarly pursuit with "a strong emphasis on the unity of all the life-phenomena and all the sciences as well as on the orderliness of nature and the rule of law in both the organic and inorganic realms" (Gliboff, 2008, pp. 30-31). He had developed his own theory of species change in which species went extinct as their adaptations no longer were of use in relation to their environment; however, he lacked well-defined laws to explain the origin of life and new species, and that was what he was looking for when he read Darwin's *Origin*. This was a vain pursuit, as Darwin did not provide explanations for how variations came about, but instead provided a theory to explain how individual characteristics could be retained and passed down through the generations, eventually giving rise to different species. Bronn's theory was also more holistic, and one of his main points of contention regarding Darwin was the lack of an origin for life itself, a subject Darwin consciously did not discuss. Although Bronn agreed with Darwin's 'struggle for life', selection and continuous adaptation, he did not want a mechanism, but general natural laws to explain the tendencies observed in species (Bronn, [1860] 1973; Gliboff, 2008; Richards, 2008, pp. 69-70; Johnson, 2020, p. 295). Furthermore, not having had so much contact with natural theology and animal and plant breeding in his German intellectual upbringing, the analogy between artificial and natural selection did not make much sense to him (Gliboff, 2008, pp. 132-133, 152-153). Thus, under such different intellectual perspectives, the situation was bound to present translation issues.

[10] See Letter 2441, from Darwin to John Murray, March 31, 1859. Available at: https://www.darwinproject.ac.uk/letter/?docId=letters/DCP-LETT-2441.xml (Accessed: 6 Mar 2024).

[11] Bronn's translation was based on the second edition of the *Origin*. A second German translation by Bronn was published in 1863 based on the *Origin*'s third edition, thus with some alterations on the text, but none in the translator's afterword (Gliboff, 2008, pp. 123-125).

First, there was not a translation for 'selection' that kept all the senses in which Darwin employed it. Bronn was not interested in the comparative aspect of 'natural' and 'artificial selection', but in presenting a general law of species change, thus arriving at the term '*Züchtung'* (meaning roughly 'stock breeding') for artificial selection, and a number of other terms for natural and sexual selection. According to Gliboff (2008, pp. 136-137), Bronn chose not to use terms that implied explicit agency or a "selector" ['*Wähler'*], but in doing so, Darwin's three types of selection (natural, artificial, and sexual) did not seem like the same process in the German translation (Gliboff, 2008a, pp. 136-138; Johnson, 2020, p. 294). Translating 'origin' was also problematic. Bronn chose '*Entstehung'* instead of '*Ursprung'*, close terms commonly used interchangeably until then; nonetheless, the choice was later criticized by the second German translator of the *Origin*, Victor Carus, who stated that '*Entstehung'* subtly meant origin as a continuous developmental process rather than a proper origin as a single event (Gliboff, 2008a, pp. 142-143). Finally, words like 'perfection', 'progress', 'improvement', and so on, used interchangeably in the *Origin*, prompted Bronn to translate them mainly as '*Vervollkommung'*. In the same way as Darwin had redefined such old teleological and morphological terminology to refer to the competitive capacities of life forms (see Darwin, 1859, pp. 336-337, for example), Bronn employed his term to draw Darwin's terminology closer to that of German morphologists. Having this in mind, Gliboff (2008, p. 142) states that it is unjust to label Bronn as a German transcendentalist without extending the label to Darwin as well.

The collective uneasiness that surrounded Bronn's translation eventually prompted a retranslation (or, more precisely, a revision) by Victor Carus (Darwin, 1867). Carus (like Haeckel and Büchner, who will be discussed below) represented a new generation of naturalists that hoped to break free from traditions and embrace the new Darwinist school, an intellectual reform that could not preclude translations. According to him, "because he [Bronn] was a 'natural philosopher' of the old German school ['*Naturphilosophie'*][12] or because he was too much of a describing Zoologist, he was too anxious to allow your [Darwin's] work to act freely upon the German public".[13] In light of that, Carus offered himself to retranslate the book and let Darwin free in Germany.

However, by the time Carus's translation was published, Bronn's text had already circulated widely giving access to Darwin's ideas to German thinkers that would greatly develop and disseminate Darwinism, such as Ernst Haeckel and Ludwig Büchner (Büchner, 1869, p. 27; Gliboff, 2008, p. 156; Richards, 2008, p. 68). Bearing in mind that Miranda Azevedo was accused of perhaps not even having read Darwin, but only Haeckel's account of Darwin (Waizbort, 2012, p. 348), it is important to give attention to that author's translational take on the subject.

[12] This is not a consensus nowadays. While Richards (2008, pp. 474-478) states that Bronn was close to '*Naturphilosophie'*, Gliboff (2008) presents him as an independent naturalist with many critics towards that school of thought.

[13] Letter 5269, from Victor Carus to Charles Darwin, 7 November 1866. Available at: https://www.darwinproject.ac.uk/letter/?docId=letters/DCP-LETT-5269.xml. (Accessed: 6 Mar 2024).

Ernst Heinrich Philipp August Haeckel read Bronn's translation almost as soon as it was published and shortly afterwards started applying Darwin's ideas to the invertebrates he had been studying in the last decades. He went on to give open lectures on the subject to a broad but learned audience, and in these first communications, Bronn's presence could still be felt strongly. At this time Haeckel agreed with Bronn in taking evolution as a necessary, determined but not predictable, process explained by different superimposed natural laws. In his notebook, Haeckel paraphrased laws of unity of type and conditions of existence elevated to '*Grundgesetzen'* [fundamental laws] by Bronn. Besides that, Haeckel's use of the term '*Mannigfaltigkeit'* [diversity, variety] also brought him closer to traditional German morphologists, suggesting that he might have been looking for solutions to old problems designated by old terms, but now under a Darwinian perspective (Gliboff, 2008, pp. 159, 164-166, 173, 176).

Nevertheless, it would be erroneous to state that Haeckel was just a tributary of Bronn. Already in these first lectures, although not completely satisfied with Darwin's explanation of variation, Haeckel diminished Bronn's complaints regarding the origin of life and showed the peculiarities that would distinguish his take on Darwinism: a strong opposition between traditional religion and science, and a direct employment of transformism[14] and progress to humankind (Gliboff, 2008, pp. 159, 170).

In the following years, Bronn's influence would wane as Haeckel developed his ideas (especially regarding 'Materialism' and 'Monism').[15] In his *Generelle Morphologie* (published in 1866), trying to answer Bronn's critics, Haeckel attributed the origin of life to physicochemical reactions and resolved the problem of varieties by tying variation to environmental variations kept in check by conservative inheritance. '*Anpassung'* [adaptation] remained as a Bronnian '*Grundgesetz'* but with the sense of contingent positive variations instead of the necessary elimination of the ill-adapted. In fact, it was characteristic of Haeckel to use Bronn's terms with new Darwinist meanings (he did the same with '*Entwicklung'* [development] disambiguating it into '*Phylogenie'* and '*Ontogenie'*)[16] (Gliboff, 2008, pp. 173-177). Haeckel's recapitulationism, usually exemplified by the phrase 'ontogeny recapitulates phylogeny', can also be interpreted as a rapprochement to Bronn, since it devised a way of reconstructing the evolutive history of organisms through their embryology, thus partially supplanting the need for fossil evidence to sustain Darwin's theory as a system of necessary laws as Bronn required (Gliboff, 2008, p. 180). Lastly, both shared the same understanding of progress as measured by the degree

[14] Transformism designates the set of ideas regarding the transformation of species. It includes but is not restricted to Darwin's ideas and its developments.

[15] Both Haeckel and Büchner, who will be addressed below, followed Materialism as a philosophy, that is, they defended and developed ideas against phenomena that could not be directly explained by physical processes. Monism, as defended by Haeckel, encompassed Materialism since it stood for a single explanation for reality in opposition to a dualist explanation. Body and soul, for example, would have to be explained by the same principles.

[16] Following Haeckel's (1874, pp. 9-10) definition, '*Phylogenie'* is the evolutionary history of a species while '*Ontogenie'* is the growth and development of a single organism.

of division of physiological labour and, consequently, morphological specialization (Gliboff, 2008, pp. 184-186; Richards, 2008, p. 147).

By 1867 Haeckel meant to translate his book into English. However, obstacles ranging from technical aspects to commercial failure prevented this from happening (Richards, 2008, p. 165) prompting Haeckel to produce a new book aimed at a broader audience. Between 1867 and 1868, Haeckel gave a series of twenty-four lectures derived from the *Generelle Morphologie*. These popular communications were then gathered to develop a new book, the *Natürliche Schöpfungsgeschichte* [*Natural History of Creation*] published in 1868. Here, Haeckel systematized biology according to Darwinian theory advancing new ideas where Darwin was lacking. Keeping the tendency of departing from Bronn, Haeckel mentioned him very few times throughout the book and did not list him as one of the first theorists on species change (Haeckel, 1874, pp. 245-246, 253, 283). This may be due to the new broad public now being addressed, which did not need to be convinced to abandon traditional morphological views. The book met with huge worldwide commercial success, eventually earning fame as the world's source on Darwinism (Richards, 2008, pp. 222; Hopwood, 2015, p. 66). This was read in Brazil by Miranda Azevedo, most likely through the French translation by sociologist and anthropologist Charles Jean Marie Letourneau[17] (Haeckel, 1874).

Bronn's ideas were also translated in Friedrich Karl Christian Ludwig Büchner's popularizations. Büchner was, like Haeckel, a well-known representative of the new German thinkers who heavily criticized, often in polemical ways, their traditionalist peers related to '*Naturphilosophie'*. He quickly incorporated Darwin's ideas into his own radical political-philosophical program, which identified with Materialism and non-Marxist Socialism and soon became one of the most influential German Darwinists both nationally and internationally (Montgomery, 1988; Weikart, 1998; Engels and Glick, 2008). In 1868, he published his *Sechs Vorlesugen über die Darwin'sche Theorie* [*Six Lectures on Darwinist Theory*] collecting the text of some of the open lectures he had given before, most likely read by Miranda Azevedo in Auguste Jacquot's French translation (Büchner, 1869). Haeckel and Büchner read and cited each other frequently (Büchner, 1869, p. 25; Haeckel, 1874, pp. 98, 571, 589), and Büchner was also a reader of Bronn's translation of the *Origin*.

Bronn is first cited in a criticism regarding his translation of 'selection' as '*Züchtung'* which Büchner found too teleological. He preferred '*Auswahl'* because, in his view, "*dans la pensée de Darwin, la nature n'amende pas (züchtet nicht) comme l'homme peut faire, simplement elle élimine, elle sélige (wahlt aus), mais sans parti ou dessein*" (Büchner, 1869, p. 27). Later, Büchner (1869, pp. 65-67) agrees with Bronn's criticism of Darwin for turning to a "miraculous" origin of the first type or types. This was a breach in Darwin's thinking for it opened the question: if a special act of creation was necessary for the first beings, why wouldn't it be the case for all other ones? Moreover, Büchner (1869, pp. 66-67) asks, why

[17] Letourneau's (an acting anthropologist) translation most likely added a new layer of translationality (and the same is probably true for Jacquot's translation of Büchner into French discussed ahead). However, a look into this episode of translation is outside the scope of this paper.

even bother to search for a natural explanation after a miracle? It was, then, paramount to extend Darwin's ideas to the origin of life like Bronn had said.

Thus, Büchner used Bronn's rapprochement of embryonic evolution and species evolution to discuss the origin of the first primitive unicellular organisms, which would resemble the germinative cells of ontological development. In other words, Büchner based his ideas on Haeckel's reply to Bronn's criticisms of Darwin (Gliboff, 2008, pp. 159, 170, 173-177; Haeckel, 1874, chapter XIII).

Until now, we have seen a chain of translationality going from Darwin to Bronn and then to Haeckel and Büchner in a variety of interepistemic translations. First, there is an interplay of interlingual and interepistemic translation in the case of Bronn's translation of the *Origin of Species*. The difference in Darwin's and Bronn's worldviews manifested itself not only in an overt criticism by the translator in various peritexts (independent review, translator's notes, and translator's preface) but also in the very terminology of the target text. Haeckel and Büchner received Darwin's ideas through Bronn's coloured lens which, as we have seen, influenced their own developments regarding Darwinism. Haeckel's and Büchner's texts were then popularized in a series of public lectures in another instance of interepistemic translation. Shortly after, these were compiled into new books: Haeckel's *Natürliche Schöpfungsgeschichte* and Büchner's *Sechs Vorlesugen* which were very successful and widespread worldwide.

All three authors were active participants in an ongoing dispute. On one side there was German transcendental morphology or *Naturphilosophie* and the old intellectual and social institutions to which it belonged, while on the other side, there was a new generation of naturalists wanting to break free from traditionalism and embrace Darwin's ideas regarding the natural world. Reaching and convincing as many people as possible was, thus, not only a scientific project but a political one as well. Therefore, translationality continued as Bronn's translation helped to fuel a new paradigm in German science that did not restrict itself to Darwin's original ideas but developed its own aspects of thinking. Haeckel was an acting naturalist while Büchner was an active philosopher, and both advanced their own ideas in their popularizations, putting forward notions such as a strong opposition between science and religion, a 'Lamarckian' emphasis on environmental effects, and a direct application of Darwin's theory to humankind. A few of their more particular ideas will be discussed as they find their way into Miranda Azevedo's Brazilian popularizations.

Both Haeckel's and Büchner's aspirations paid off, since their popularizations achieved market success, eventually overshadowing Darwin himself in transporting Darwinism across the world. Haeckel's writings were widespread in Brazil (Gualtieri, 2009) and Büchner's did not lag much behind. Both of them were read, most likely in French translation, by the young Augusto César de Miranda Azevedo before he graduated as a M.D. in 1874. His writings, echoing Darwin, Bronn, Haeckel, and Büchner, are the last link in the translationality chain to be presented in this paper.

Haeckel was extensively mentioned in Miranda Azevedo's M.D. dissertation, which was also structured using an order that resembles the one seen in the *Natürliche*

Schöpfungsgeschichte. His conclusion there, "*o aperfeiçoamento, pois, cada vez mais completo das espécies até o homem é uma verdade posta em evidência pelo Darwinismo*" (Miranda Azevedo, 1875, Proposições – Ciências acessórias, p. 3), also echoes Haeckel's understanding of human evolution.

In his popularizations, Miranda Azevedo quoted and paraphrased Haeckel extensively (Haeckel, 1874, pp. 2, 4; Miranda Azevedo, 1876, pp. 41, 43). Miranda Azevedo's historical account of the idea of evolution since Antiquity follows Haeckel's historical chapters and also presents a strong opposition between science and religion, anticipating critics by mentioning Haeckel's distinction of natural and moral materialism, a counterpoint to the moral decline thesis in a godless society advanced by religious groups (Haeckel, 1874, pp. 8-9, 34-35; Miranda Azevedo, 1876, p. 42). Even his definition of natural selection focusing on the struggle for life and elimination of the ill-adapted species seems to be calqued from Haeckel (Haeckel, 1874, pp. 119-120, 143; Miranda Azevedo, 1876, pp. 58-59). Miranda Azevedo also discussed "military selection" (the lack of suitable men for procreation due to war drafts), one of the social selection processes devised by Haeckel and which he believed had pernicious consequences for humankind, weakening its offspring rather than improving it (Haeckel, 1874, p. 153; Miranda Azevedo 1876, pp. 60-61).

Büchner, too, is nominally present in Miranda Azevedo's dissertation (Miranda Azevedo, 1875, Proposições – Ciências Acessórias, p. 1). In his 1875 lecture, the most flagrant mark that can be traced to Büchner is a didactic presentation of Darwinism in four main interconnected points: 1) the struggle for life; 2) variation; 3) inheritance; and 4) natural selection (Büchner, 1869, pp. 699-702). This straightforward explanation restricted to what Darwin presented in the *Origin*, rather than Haeckel's (1874, pp. 699-702) broad schematization in ten laws covering physiological and ecological aspects, was Miranda Azevedo's choice for a rhetorical structure both in his dissertation and in his popularization. In fact, while discussing the first point, the Brazilian physician went as far as to cite Büchner directly (Miranda Azevedo, 1875, Proposições – Ciências Acessórias, p. 3; 1876, pp. 43, 57).

As stated before, Haeckel and Büchner were contemporary scholars that, as intellectual reformers opposed to German romanticism, were broadly on the same side, and who discussed the same subject (Darwinism) having read the same source text (Bronn's translation of the *Origin*) while citing each other. Thus, it is no surprise to find elements in Miranda Azevedo that can be traced to both. His discussion, for example, of the stability of species opposing a teleological and a Darwinian school of thought culminating in the idea of "similar things producing similar things," meaning the nature of organisms of giving birth not to exact copies of themselves, but to slightly varied individuals, can be found in both (Büchner, 1869, p. 37; Haeckel, 1874, p. 141; Miranda Azevedo, 1876, pp. 57-58).

Now, bearing in mind the impact of Bronn on Haeckel and Büchner, it would be difficult for Miranda Azevedo to avoid echoing him. Thus, Bronn survives most noticeably in Miranda Azevedo through a reliance on "laws" of nature (Miranda Azevedo, 1876, p. 57-58), resembling the '*Wissenschaft*' approach Bronn followed, and also in the discussion of

the origin of life in his fifth lecture,[18] one of Bronn's major criticisms regarding the *Origin* now answered by Haeckel.

5. Concluding Remarks

The chain of translationality presented in this paper can be summarized in the following diagram:

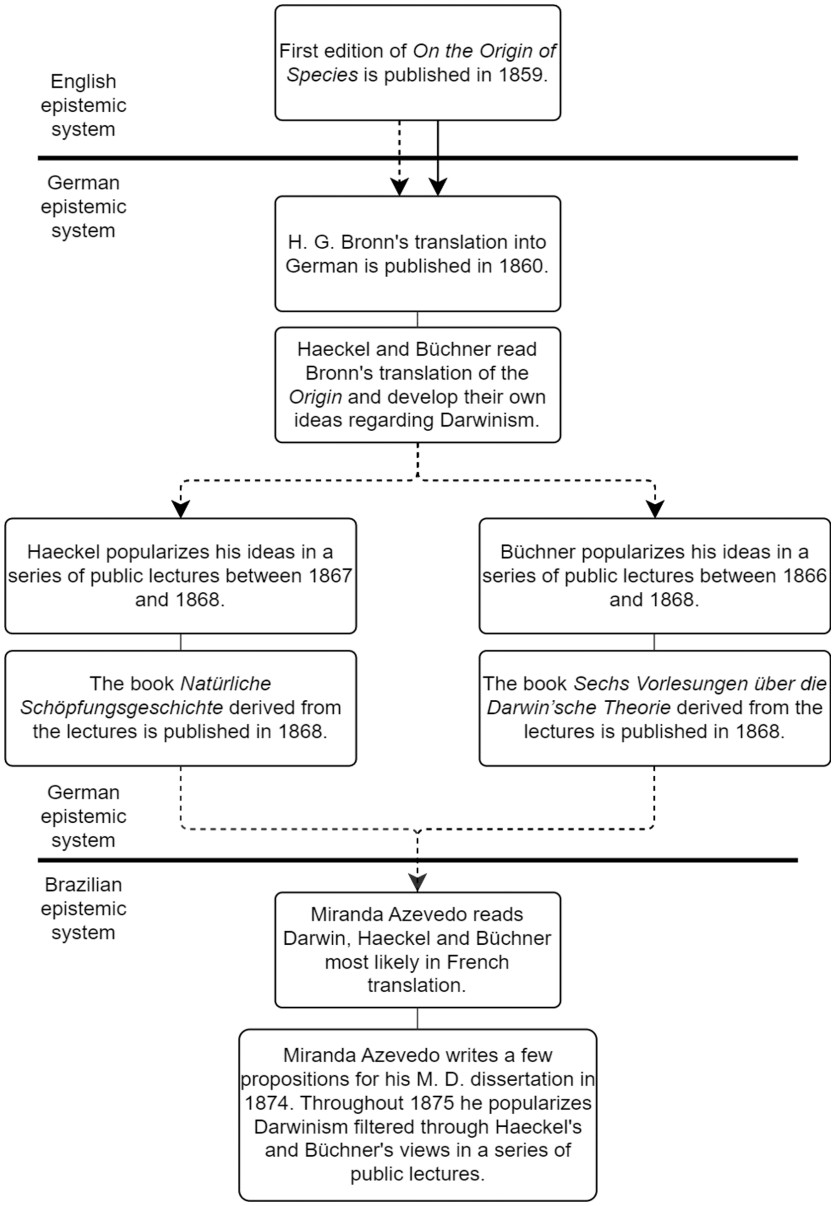

Figure 1. Flowchart of Darwin's reception in Brazil as a translational process. Dashed arrows represent cases of interepistemic translation while the continuous arrow represents a case of interlingual translation. The thick horizontal lines represent the "frontiers" of national epistemic systems.

[18] *Jornal do Commercio*, 18 May 1875, n. 137, p. 3. Available at: https://memoria.bn.br/DocReader/docreader.aspx?bib=364568_06&pasta=ano%20187&pesq=&pagfis=11073 (Accessed: 6 Mar 2024).

That is to say, in 1859, Darwin published the *Origin of Species* (itself an abstract of a larger unpublished work) which was then translated into German by Bronn in 1860 with comments and adaptations according to his particular view of science embedded in the German context (‘*Wissenschaft’*). In the first half of the 1860s Haeckel read Bronn’s translation and, as a practicing naturalist, advanced Darwinism scientifically by adding his own theorical contributions; he was also one of the most active participants in the sharply polarized debate between German intellectuals at the time (it must be remembered, then, that even inside the German epistemic system there were two different generational epistemic systems). Haeckel popularized his ideas orally in public lectures between 1867 and 1868 which were worked into a new book published in 1868. At roughly the same time, Büchner read Bronn’s translation and developed his own philosophical ideas regarding Darwinism, coopting it to his own philosophical-political purposes as a materialist and socialist. Between 1866 and 1868, Büchner popularized his ideas orally in public lectures, also publishing a book out of them in 1868. Both Haeckel and Büchner acquired national and international success, becoming almost synonymous with Darwin. In Brazil, Miranda Azevedo read Darwin (presumably), Haeckel, and Büchner most likely in French translation. First, he wrote a few propositions in his M. D. dissertation presented in 1874 based on these ideas. Finally, throughout the year of 1875, he popularized them orally in public lectures as part of political effort in educating the public for the new scientifically enlightened times in which they were living, surely hoping that it would fuel changes in Brazil’s socio-political make-up.

Thus, Darwin’s ideas suffered a series of transformations at each step until they reached the Brazilian public. First, they were thoroughly criticized by Bronn in his translation of the *Origin*, and his ideas regarding the very constitution of science directly informed his translation choices. Bronn followed his ideals of ‘*Wissenschaft’* pursuing a holistic, nomothetic, and inductive science which, according to him, Darwin did not always meet, thus, motivating his criticisms regarding the lack of an origin of life and his translations of Darwin’s terminology to cater to German naturalists. These points survived, as in Benjamin’s ([1923] 1997) afterlife [‘*Fortleben’*], although once again transformed, in Haeckel’s and Büchner’s works and popularizations. Moreover, Haeckel and Büchner were acting participants in a very heated debate against traditionalists, also motivating their engagement with Darwin’s ideas. These takes, in turn, survived in Miranda Azevedo’s popularization, transformed one more time according to Brazil’s socio-political situation on the eve of the proclamation of the Republic. Thus, Darwin’s ideas went through at least two major interepistemic translations (or perhaps an indirect interepistemic translation) in this case, first between the transportation from Darwin’s English views to the German epistemic context and then between it and the Brazilian epistemic context (notwithstanding, of course, the various reformulations and popularizations along the way).

Turning to the discussion regarding SP and its nature in a *continuum* of discourses of which ‘proper science’ is also a part of, we conclude that a translational aspect was present

in Miranda Azevedo's life and work, including, of course, his role as a Darwinism popularizer in Brazil. His role as popularizer was not that of a relay station that transmits an exact copy of a received message, a 'clone' to use Robinson's (2017) terms. He had agency in the choice of which ideas to keep in a short lecture, which sources to use, and also how to contextualize them for his public, which was also an active agent in this process, since Miranda Azevedo was trying to educate it to follow new repertories, to use Alonso's (2002) term.

In conclusion, this paper has argued that the concepts of translationality and interepistemic translation are useful tools for understanding how to follow knowledge that keeps changing over time. Beyond that, in line with Secord's (2004) call for understanding science as communication, these concepts may illuminate not only the act of science popularization but also the very history of science and the study of circulation and reception of ideas.

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