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THE ORIGIN OF TERMS. TERMINOLOGY AS AN INSTRUMENT OF
KNOWLEDGE IN THE 19TH CENTURY

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Abstract

This thesis describes the role of terminology, intended as the practice of naming, classifying, and defining specialised concepts, within the scientific progress in Europe during the first half of the 19th century (1800–1850). This is done through the analysis of terminological processes i.e., practices and reflections on term formation on the part of experts – which occurred in 19th-century primary sources such as journal articles and volumes, and later conceptualised by terminology theory of the 20th and 21st centuries. The examples illustrate processes from multiple fields of study, such as meteorology, mineralogy, and architecture, and cover a variety of languages i.e., English, French, German, and Latin. Specifically, this thesis describes the reflections of the experts on the importance of terminology, to assess how the analysis of these historical sources can contribute to a more detailed description of these processes in the contemporary discipline of terminology.

In four terminological processes, I describe the role of terminology within the 19th-century scientific progress through relevant case studies. These processes are multilingualism-influenced term formation, variation, and standardisation to classify cloud formations (Howard 1803a), as well as term translation in naming colours (Syme 1814). Discussions among experts on the naming of electrochemical entities highlight the social aspect of the exchange of ideas among experts (Faraday 1834a), illustrating a practice which – presumably both in the past and the present – played a pivotal role in term formation. Lastly, the primary sources show how naming guidelines in mineralogy addressed a necessity for standardisation and shared indications to classify discoveries (Mohs 1820).

A combination of different qualitative methods provides the methodological framework for this thesis. A case study approach is adopted to select terminological processes from the primary sources. Historical and archival methods are then combined to describe the context of the episodes and the connections among them. Eventually, text analysis research strategies are used to present the case studies.

On a more theoretical front, this thesis aims to contribute to the development of diachronic studies in terminology and specifically to the description of the historical context and contextual factors involved in term formation. This study also reveals promising intersections between terminology and the history of science, which provide insights into the study of terminological processes in context and in their development over time. Lastly, this thesis aims to foster the diffusion of historical and archival methods for analysing primary sources and describing terminological processes.

The results of the thesis suggest that the reflections of 19th-century scholars show interesting similarities with the ones codified in the contemporary terminology theory. This includes the fact that the terminological activity – back then as nowadays – is not confined to the development of a single

field of study but much more applies to the progress of specialised knowledge in general. Further results pertain to the multilingual perspective of naming in the 19th century and the parallel use of semiotic systems in term translation to clarify concepts and enhance communication. The analysis of these translations illustrates how term variants emerged due to contextual needs. This underscores the social aspect of term formation, highlighting the importance of describing processes in communicative situations. In this case, experts standardised their language to ensure effective communication and dissemination of knowledge.

Ultimately, this study describes the 19th-century scholars as terminologists *ante litteram*, and precursors of modern-day scholars in terminology. Through the analysis of previously unexplored primary sources, historical and archival studies are encouraged as a rather underexplored area of research in Terminology. This opens an array of possibilities for the description of terminological processes, which have not been investigated to date.

Abstract

Deze dissertatie beschrijft de rol van terminologie, bedoeld als de praktijk van het benoemen, classificeren en definiëren van gespecialiseerde concepten, binnen de wetenschappelijke vooruitgang in Europa tijdens de eerste helft van de 19e eeuw (1800-1850). Dit gebeurt aan de hand van een analyse van terminologische processen - d.w.z. praktijken en reflecties van experts op het gebied van termvorming - die werden herkend in 19e-eeuwse primaire bronnen zoals tijdschriftartikelen en boekdelen, en later werden geconceptualiseerd in de terminologietheorie van de 20e en 21e eeuw. De voorbeelden illustreren processen uit verschillende vakgebieden, zoals meteorologie, mineralogie en architectuur, maar ook talen als Engels, Frans, Duits en Latijn. Specifiek beschrijft dit proefschrift de reflecties van de experts over het belang van terminologie, om toegang te krijgen tot hoe de analyse van deze historische bronnen kan bijdragen aan een meer gedetailleerde beschrijving van deze processen in de hedendaagse terminologiediscipline.

Vier terminologische processen beschrijven de rol van terminologie binnen de 19e-eeuwse wetenschappelijke vooruitgang aan de hand van relevante casestudies. Deze processen variëren van termvorming, -variatie en -standaardisatie onder invloed van meertaligheid om wolkenformaties te classificeren (Howard 1803a) tot termvertaling bij het benoemen van kleuren (Syme 1814). Discussies tussen experts over de naamgeving van elektrochemische entiteiten benadrukken het sociale aspect van de uitwisseling van ideeën tussen experts (Faraday 1834a), en illustreren een praktijk die - vermoedelijk zowel vroeger als nu – een cruciale rol speelde in de vorming van termen. Tot slot tonen de primaire bronnen aan dat richtlijnen voor naamgeving in de mineralogie tegemoetkwamen aan een behoefte aan standaardisatie en gemeenschappelijke benamingen voor het classificeren van ontdekkingen (Mohs 1820).

Een combinatie van kwalitatieve methoden vormt het methodologische kader voor dit proefschrift. Er is gekozen voor een casestudy-benadering om terminologische processen uit de primaire bronnen te selecteren. Historische en archivalische methoden worden vervolgens gecombineerd om de context van de episodes en hun onderlinge verbanden te beschrijven. Uiteindelijk bieden strategieën voor tekstanalyse inzicht in de casestudies.

Op een meer theoretisch vlak wil dit proefschrift een bijdrage leveren aan de ontwikkeling van diachrone terminologiestudies en in het bijzonder aan de beschrijving van de historische context en contextuele factoren die een rol spelen bij de vorming van termen. Deze analyse brengt ook veelbelovende raakvlakken tussen terminologie en wetenschapsgeschiedenis aan het licht, die inzichten bieden in de studie van terminologische processen binnen hun context en hun evolutie door

de tijd heen. Ten slotte bevordert dit proefschrift de verspreiding van historische en archivalische methoden voor de analyse van primaire bronnen en de beschrijving van terminologische processen.

De resultaten van het proefschrift suggereren dat de beschouwingen van de 19e-eeuwse experts interessante overeenkomsten vertonen met die van de hedendaagse terminologietheorie. Dit omvat het feit dat de terminologische activiteit – zowel vroeger als nu – niet beperkt is tot de ontwikkeling van een enkel vakgebied, maar veel meer een rol speelt in de vooruitgang van gespecialiseerde kennis in het algemeen. Verdere resultaten hebben betrekking op het meertalige perspectief van naamgeving in de 19e eeuw en op het parallelle gebruik van semiotische systemen bij het vertalen van termen om concepten te verduidelijken en de communicatie te verbeteren. De analyse van deze vertalingen illustreert hoe termvarianten ontstonden door contextuele behoeften. Dit benadrukt het sociale aspect van termvorming en onderstreept het belang van het beschrijven van processen in communicatieve situaties. In dit geval hebben experts hun taal gestandaardiseerd om effectieve communicatie en kennisverspreiding te garanderen.

Uiteindelijk beschrijft deze studie de 19e-eeuwse terminologen als terminologen *ante litteram* en voorlopers van de hedendaagse terminologen. De analyse van tot nu toe niet eerder onderzochte primaire bronnen stimuleert het gebruik van historische en archivalische studies als een relatief onontgonnen onderzoeksgebied binnen de Terminologie. Dit opent een scala aan mogelijkheden voor de beschrijving van terminologische processen, die tot op heden nog niet onderzocht zijn.

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1. Introduction

This thesis describes the role of terminology, intended as the practice of naming, classifying, and defining specialised concepts, within the scientific progress in Europe during the first half of the 19th century (1800-1850), also known as "the age of classification" (Yeo 1991: 26). This study illustrates the reflections and awareness of the experts on the importance of terminology and terminological processes and highlights how the analysis of these historical sources can contribute to contemporary terminology theory. This is done by analysing terminological processes, as codified in the modern terminology theory, in primary sources from the 19th century such as journal articles and volumes. In the context of this study, terminological processes are interpreted as practices and reflections of the experts to name and classify concepts pertaining to a specific domain.

Also known as the period of the "professionalisation of science" (Ellis 2014: 777), the historical context of this study was a time of particular interest in naming and classification (Daunton 2005), when modern science was formed, as we know it today (Lightman and Zon 2014). Influenced by pioneering studies on naming and classification in botany and zoology during the 18th century and inspired by Carl Linnaeus' (1735) work, multiple fields of study organised their knowledge into shared nomenclatures and classifications, trying to gain recognition within the scientific community and form structures which could support international communication and knowledge exchange (Yanni 2014). This age saw an effort to name and classify specialised concepts of every field which had not been systematised before. This is reflected in an intense discussion on naming and classification.

The present thesis analyses these naming and classification efforts starting from experts who discussed the formation of scientific disciplines in England, due to a particularly lively context of research which was present there in the 19th century (Yanni 2014). The development of knowledge is considered in this study as an international process, in which the main European languages of scientific discourse were involved, i.e., English, French, German, and Latin (Melosik 2023). Case studies from both the humanities and the hard sciences are illustrated, to provide a multidisciplinary perspective on the processes and a spectrum of applications as broad as possible. Relating to this, a comparative method is applied to comment on the case studies and across nomenclatures and conceptual classifications, as the meaning and potential of terminological processes can only be fully grasped in comparison, and by looking at them in a broader context.

This thesis adopts a multilinguistic and multidisciplinary approach to the analysis of the primary sources which show a specific terminological process. A terminological process is defined in this study as a practice or reflection of the experts which could 1) be named and conceptualised according to the theories and principles codified in the modern and contemporary theory of terminology and 2) be recognised in the primary sources as similar – and with an analogous development – to the modern

and contemporary practice of terminology. Further criteria for the definition of the terminological processes include 3) their application in more than one field of study, and 4) their development in more than one language considered in this study. Based on this definition, four terminological processes were identified in the primary sources, to each of which a chapter of this thesis is dedicated.

During this first half of the 19th century, also identified as the era of the "invention of science" (Cunningham 1988: 385), naming and defining scientific concepts appeared to be fundamental steps in the organisation of knowledge into shared structures, some of which last until today. Specifically, this study illustrates how the analysis of terminological processes from a historical perspective highlights less investigated contextual factors and only a comprehensive view could lead to a meaningful reconstruction of the process. Among others, some of these factors are naming attempts, terminological variants in multiple languages, and discussions among experts, who evaluated terms and concepts, thereby contributing to the progress of knowledge.

With a focus on the activity of scholars in various fields, this study argues that – when examined from the perspective of terminology theory – the discursive practices of these scholars represent actual terminological activity *ante litteram* i.e., before the origin of the modern schools of terminology in Europe at the beginning of the 20th century (Wüster 1931). This study also aims to foster the intersection between terminology theory and the history of science in the description of terminological processes, as an unexplored direction in research to date. The analysis of existing studies (Witteveen 2018; 2020) reveals that the description of naming and classification processes from the perspective of the history of science would constitute an interesting contribution to terminology theory. Specifically, research in the history of science would foster the definition of terminological processes in history, through the analysis of real instances of their application in historical sources.

The main sources considered are journal articles, dedicated volumes, and pamphlets, as well as minutes of conferences and reports of meetings among experts published in the first half of the 19th century. These primary sources are commented on through a framework of secondary sources mainly in terminology theory, but also in history and the history of science. The relation of these terminological processes to the modern and contemporary theory of terminology is analysed to see 1) to what extent these processes conform to the modern and contemporary theories and principles and 2) in which ways the modern and contemporary terminology theory relate to the practice of experts before the origin of the discipline at the beginning of the 20th century. Lastly, the study argues that 3) the analysis of these terminological processes can contribute to the current knowledge of the theories and principles of terminology.

The analysis in the present thesis focuses on processes which occurred in multiple disciplines and languages, albeit in various declinations depending on the context. The comparison among terminological processes in different contexts was fundamental to identifying a process across

disciplines and languages. A process became important for the purposes of this study when it was recognised as recurrent, across languages and disciplines, and common features were identified across the specific contexts of application. This thesis shall thus argue that a terminological process was not proper of a single discipline but pertained instead to the process of naming and to the formation of scientific knowledge.

A composition of qualitative research approaches provides the methodological framework of this study, which is formed of historical and archival research methods, a text analysis method – specifically the narrative analysis of data – and a case study approach. Archival research and text analysis constitute the first phase of research and the search for terminological processes in online and physical archives. At a successive stage, a case study approach is adopted to describe the meta-reflection of experts on the formation and development of terms and concepts through the analysis of interesting practices. This case-study approach is combined with the use of a comparative method, to analyse practices and processes in comparison to one another. This comparison aims to highlight common features of the processes, applied in different contexts and languages. The aim of the analysis is to reconstruct a broader and more general reflection on terminological processes and the meta-reflection of experts on naming and classification, through a comparison of applications of them in real contexts and communicative situations. The methodological approach of this study can be defined as theory-based, aiming to discuss theories of terminology through the analysis of historical data. The method is inductive and qualitative, adopting text analysis strategies for the examination of the primary sources. Intertextual analysis is applied to examine texts not as isolated items, but in comparison to similar sources (Belsey 2013) with a comparative approach (Sunderland 2010). Finally, this thesis represents one of the first studies in terminology theory to make an extensive use of archival methods applied to online and physical archives and wishes to encourage the diffusion of this research method in terminology to a broader extent than what has been the case so far.

The theoretical framework of this thesis encompasses studies in terminology theory, with a focus on the aspects to which the present analysis wishes to contribute. In the last few decades, research in terminology theory – traditionally devoted to the study of terms as synchronic entities – has shown an emerging interest in the historical perspective in the study of terms and of the processes through which they are formed (Humbley and Warburton, forthcoming). Within the discussion of the traditional principles of the *General Theory of Terminology* (Wüster 1979), term formation and its development in a diachronic perspective appear to have been less investigated in the most recent theories of terminology, in comparison to other principles of terminology (Myking 2020). This study wishes to contribute to the diachronic description of this process, by analysing previously unexplored 19th-century primary sources. At a time when it appears that a reflection is needed on the past theories of Terminology, as Faber and L’Homme (2022) state:

Our main objective is to provide readers with an opportunity to familiarize themselves with many different approaches to Terminology from Wüster to more recent initiatives. We also think that the time has come to **take a step back** and look at what these approaches have taught us. The time has also come to see how they address different issues and suggest **new solutions** to further a **better understanding** of the complex phenomena that terminologists must handle. (Faber and L'Homme 2022: 3)

The descriptive theories of terminology – first formulated between the 1990s and the early 2000s – appear to feel the need to reflect on their principles, more than twenty years on (Faber and L'Homme 2022). In this context, this thesis wishes to propose the diachronic perspective – through archival studies and the analysis of historical sources – as a contribution to research. While historical studies are present in the literature on the topic (Temmerman 1995; Van Campenhout 1998), they appear to be limited to the historical reconstruction of the creation of single nomenclatures or of the specialised language of a single field (Becker 2005; Pitkänen 2008). This perspective would primarily aim to gain insights into these terminological processes through the analysis of previously unexplored primary sources from a relatively undiscovered age, at least from the perspective of terminology theory.

The remainder of the thesis is structured as follows. Chapter 2 reviews the existing literature on terminology theory, with a focus on the diachronic approach to the study of terms and term formation. This theoretical framework addresses less investigated aspects in the existing literature in terminology theory, such as the description of the process of term formation from a diachronic perspective. Chapter 3 describes the main factors of the historical context of the first half of the 19th century in which this study is set, such as the diffusion of print and periodicals, and the organisation of knowledge into dictionaries and encyclopaedias. Following this general introduction, chapter 4 sets out the methodology of the present thesis, and the main research approaches adopted in this study. The four chapters of analysis present the terminological processes analysed in this thesis (see Chapters 5 to 8). Based on a case study approach, these chapters are constructed to analyse each terminological process independently. Nevertheless, the connection among them is based on the common aim to describe the process of term formation and to provide insight into the processes through which terms and concepts were formed, developed, and evolved over time, as well as how and why they became obsolete and were substituted with alternatives.

Regarding their contents, each chapter of analysis focuses on different aspects of term formation. Chapter 5 introduces multilingualism as a common factor to three different terminological processes i.e., term formation, variation, and standardisation, through the example of the classification of cloud formations. Chapter 6 then presents term translation as a form of denominative variation across languages and semiotic systems and illustrates the point with reference to the classification of colours. The social dimension of term formation is the subject of chapter 7, which addresses discussions among scholars on the formation of the scientific language in electrochemistry and

astronomy. In conclusion, chapter 8 describes the practice of writing guidelines for the formation of terms, which the experts adopted, among others, in crystallography and zoology. In the chapter, this practice is compared to an attempt at standardisation, not only of terms but also of the process of codifying them and of their connection to the concepts they represented. Finally, chapter 9 addresses the main outcomes of this thesis and comments on its limitations. Following these, directions for future research are proposed as the subject of further studies. Among them, the most interesting research perspectives involve historical studies in terminology and the application of a diachronic perspective for the further analysis of the processes of term formation in history.

2. Theoretical framework

2.1. Introduction

This chapter is dedicated to the theoretical framework of this study in terminology theory, and it has three purposes. First, the chapter introduces the main theoretical aspects for understanding the content of the following analysis. Second, it aims to examine some less investigated aspects of Terminology in the existing literature to date, which this study would help to investigate. Lastly, this chapter situates the present thesis in the contemporary state of the art in terminology theory. In doing this, it does not aim to provide a complete overview of the literature in terminology theory to date: only aspects that are considered relevant for the purposes of this study are addressed.

As a premise to the construction of this theoretical framework, it should be noted how fewer theoretical studies have been published on terminology theory in the last twenty years. Many recent articles from these years refer, indeed, to the earlier studies from the 1990s and 2000s. This demonstrates how theory may have a stable foundation that more recent studies rely on.

As L'Homme (2020: 3) observes, "the topic has not been the centre of interest as it once was". If compared to the discussion on major principles of the field in the 1990s and early 2000s (*ibid.*), terminology theory seems to have become less interesting for the scientific community as "new approaches are applied to specific problems" (*ibid.*).

L'Homme's (2020) affirmation seems to be confirmed by the fact that many articles published in the *Terminology* journal over the last twenty years refer to principles formulated in those which can be defined the *founding* texts of the discipline that were published between the early 1990s and the early 2000s (see Sager 1990; Gaudin 1993b; Cabré 1999; Temmerman 2000a), which represent their main reference and where the main theories of Terminology are defined.

In this regard, the strategy of this chapter is twofold. While the main principles of Terminology are addressed, with reference to the purposes of the present thesis, this overview aims to shed light on the most recent advancements in terminology theory, as well as on less investigated aspects and subjects of the discipline. Concurrently, I also address the lack of research I recognised in certain directions, towards which future studies could be oriented.

The collective volume on theories of Terminology by Faber and L'Homme (2022) elaborates on the main principles of the discipline and could constitute an introduction to this theoretical framework. Faber and L'Homme's (2022: 3) introduction to the volume is significant, insofar as the authors claim that the time has come to look back at theories of Terminology since its foundation, and for a reconsideration of the principles of the discipline (see Ch. 1). All these positions seem to express the necessity to reflect on the existing principles in terminology theory, to find new interpretations. This seems to align with the intention of this thesis. Indeed, the appearance in the last years of the

collaborative volume on theories of Terminology by Faber and L’Homme (2022), the introductory article on an evaluation of the last twenty years of research on Terminology by L’Homme (2020), and Myking’s (2020) study concerned with an overview of the state of the art in term formation to date all seem to suggest a common direction: a time appears to have come for the discipline in which authors need to reflect on what has been done so far. Starting from this premise, as Faber and L’Homme (2022) suggest, a different understanding of terminological phenomena should be fostered.

This also provides the opportunity to put this study in context and find its motivations within the present situation of the discipline. The present time i.e., twenty years after the last main principles were first introduced, appears to be a stage of reflection in the discipline, in which its main principles are discussed. This thesis should thus be set within this stage of reflection and among the attempts at re-evaluation of these principles.

Starting from the recognition of a decreasing interest in terminology theory in the last twenty years examined in this section (see L’Homme 2020), section 2.2. presents an overview of theories of Terminology and points out various approaches in the existing literature, which are significant for the analysis in the next chapters. As an introduction to the diachronic perspective in terminology, section 2.3. describes the historical origin of terminology and the main texts which anticipated the first schools of Terminology before the 20th century. Section 2.4 introduces the diachronic perspective in terminology theory, which received increasing attention over the last few years. Sections 2.5. addresses the necessity of a more detailed description of the process of term formation, both in its constituting phases, and in the definition of its actors and factors. Following this, section 2.6. describes the missing connection between terminology theory and in the history of science regarding the processes of naming and classification, making a case for greater integration of the disciplines. Finally, section 2.7. introduces different perspectives on the process of term formation and its development in time. These aspects are analysed in this thesis through the examples in the historical sources and proposed as possible directions to expand the description of term formation, as well as its phases and actors, in the existing literature in terminology theory. Lastly, section 2.8. briefly summarises the contents of the chapter.

2.2.A brief overview of the defining theories of terminology

This section presents an overview of the theories of terminology since the origin of the discipline at the beginning of the 20th century and with a focus on the theories from the 1990s onwards.

While terminology has always existed if we conceive of it as the practice of naming and classifying concepts (Rey 1995), the *discipline* of Terminology originated at the beginning of the 20th century. Its putative founder was the Austrian engineer Eugen Wüster, who proposed a *General Theory of Terminology* (GTT), which he first introduced in his PhD Thesis entitled *Internationale*

*Sprachnormung in der Technik, besonders in der Elektrotechnik*¹ (Wüster 1931). The theory based on the so-called univocity ideal i.e., a univocal correspondence between concept and term, where synonymy was allowed in the case of regional variation, with synonyms having the same meaning. Moreover, Wüster's view was synchronic, and onomasiological i.e., based on a superiority of concepts over terms. Wüster's PhD Thesis on terminology in engineering, with the founding principles of the discipline and characterised by a synchronic and prescriptive approach (Wüster 1979 [1991]). The main works by Felber (1984) and Rondeau (1984) belong to these texts presenting a synchronic approach to Terminology, which characterises other prescriptive theories in the following decades.

As Faber and L'Homme (2022) state, the literature on Terminology sees a separation between the texts written before and after the 1990, as in this year new descriptive approaches to the study of terms are introduced, as compared to the prescriptive theories of the previous decades:

[...] This **watershed moment** was at the beginning of the 1990s. The period before 1990 is strongly associated with the **General Theory of Terminology** (GTT) whereas the period after 1990 witnessed a host of **new approaches** to Terminology. Some of these approaches evolved around the GTT and adapted to changing methods and tools, whereas other approaches differed considerably from the GTT, which certain scholars had begun to refer to as traditional terminology². (Faber and L'Homme 2022: 1-2)

The descriptive theories of Terminology belong to this period, which expand the univocal and monosemic view of terms and concepts that Wüster (1979) proposed. Several works published between the 1990s and the mid-2000s can be considered as setting a new foundation of the discipline. Among the theories of this period are Gaudin's (1993a; 1993b) *Socioterminologie*, Cabré's (1999) Communicative Theory of Terminology, Temmerman's (1997; 2000a) Sociocognitive Theory of Terminology, and Faber's (2009; 2012) Frame-based Terminology.

New and opposing theories started to appear in the 1990s (see Faber and L'Homme 2022). After Wüster's founding theory, two main approaches to Terminology were identified in literature: a prescriptive and a descriptive one (see Faber 2009): the former aimed to define prescriptive principles to which the discipline should adhere, with a closer proximity to Wüster's original conception of terminology; the latter was characterised by a particular attention to the real and social context of use of terms and concepts. Pamela Faber (2009: 107) also defines the moment between these two approaches as the "cognitive shift" in terminology, where the focus of the discipline changes "from a prescriptive to a descriptive approach" (ibid.).

¹ Wüster, Eugen. (1931). *Internationale Sprachnormung in der Technik, besonders in der Elektrotechnik. Die nationale Sprachnormung und ihre Verallgemeinerung*. [International Language standardization in technology, particularly in electrical engineering. The national language standardization and generalization]. Berlin: VDJ Verlag.

² Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

Maria Teresa Cabré's (1999) *Communicative Theory of Terminology*, which postulates the central role of terms in context, belongs to the descriptive theories of Terminology. Among the defining elements of her theory, the author presents her *Theory of Doors*, as a model of terminological units (Cabré 2003). In this model, a terminological unit is described as a polyhedron, characterised by three main aspects: communicative, linguistic, and cognitive.

Juan Sager's (1990; 1997) approach to the study of terms belongs to these descriptive theories of Terminology, and it is central in this thesis. Key concepts of Sager's theory are the process of "terminologisation" (Sager 1990: 60) i.e., the progressive definition of concepts through successive stages of naming, and the distinction between a primary and a secondary stage in term formation (Sager 1997). While the former identifies the naming process for newly coined concepts, the latter refers to naming a concept that was already named before. In addition to these principles, Sager's (1990) work highlights the central role of human agency and motivation in term formation and a possible connection between Terminology and the history of human knowledge. Sager's (1990; 1997) contribution to the discipline has a particular significance for this study. While being precedent to the other texts of the decade, his main volume, published in 1990, provides a major contribution to the development of the discipline, as well as to the advancement of research on two main issues I address in this study i.e., the process of term formation, and the diachronic perspective of evolution of terms and concepts in time. In his volume, Sager (1990) describes the formation of terms from a diachronic perspective, considering terms and concepts as the continuously evolving product of this process. In Sager's view, terms and concepts are not stable, but evolving based on a continuous process of knowledge development (Sager 1990: 60).

In the same years as Sager, Francois Gaudin's (1993a; 1993b) theory called *Socioterminologie* reflects on the sociological aspects of terms, such as the ways in which terms are created in real contexts, how they evolve and circulate across society and are perceived by users (see Gaudin 2005; 2007). After that, terminology theory progressively grows towards an approach characterised by greater attention to the real context of term formation and use, as well as to the multiple motivations and conditions influencing the formation of terms and the definition of concepts.

Pamela Faber's (2009) *Frame-based Theory* belong to these approaches to Terminology. Faber's theory originates from Charles Fillmore's (1985) theory of semantic frames and focuses on the importance of frames, or contexts in which terms and concepts are used. This theory is based on frame-like representations in the form of conceptual templates underlying the knowledge encoded in specialised texts. Reflecting on this approach, which emphasised the social and situational aspects of terms in specialised language, referring to Pihkala (2001, in Faber 2012) as a *socioterminologist*, Faber (2012: 14) discusses the standardisation of terms and concepts in Socioterminology as impossible to reach in real communication:

Pihkala (2001) points out that the socioterminological approach focuses on the **social** and **situational** aspects of specialized language communication, which may affect **expert communication** and give rise to term variation. According to socioterminologists, **standardization** is a **chimera** since language is in constant change. (Faber 2012: 14)

Faber thus distances her theory even more from the traditional prescriptive approach of the discipline. Indeed, the acknowledgement of the difference between Wüster's univocity ideal and the multiplicity of terms and concepts lead to the formulation of two significant principles of the contemporary theory of terminology: multidimensionality and denominative variation.

Multidimensionality describes the possibility of concepts of being categorised differently, according to the context in which they are employed, where some of their features become more relevant than others (Bowker 1997; 1998; 2022). This implies that different terms can describe alternative aspects of the same concept, which goes in against Wüster's traditional univocity ideal.

The second principle is denominative variation and describes the possibility of multiple terms to identify the same concept in different contexts (Freixa 2006; 2022). In her studies of the topic, Freixa (2006; 2022) proposes a categorisation of the causes of denominative variation. According to Freixa (2022) this variation can be due to, for instance, interlinguistic causes, and be characterised by the presence of term variants in more than one language. Among others, there can be cognitive causes, which relate to a different conceptualisation of the same concepts among the authors of terms (Freixa 2022: 405). Earlier works on the motivations in the choice of terms were Rondeau (1984) and Kocourek (1991), whose models underline the importance of speakers and their intentions in term formation.

Rita Temmerman's (1997; 2000a; 2022) contribution to the evolution of Terminology is known as Sociocognitive Theory of Terminology and highlights the social and communicative dimension of the terminological units, which, in this theory, are used to refer to "units of understanding" (Temmerman 2008: 116). In these units, the multidimensionality of concepts becomes central, as each unit is characterised by multiple aspects, highlighted by different terms in a specific context. According to Temmerman, there is no strict categorisation of concepts into conceptual systems. Instead, conceptual structures change, according to the context in which they appear.

The difference between the study of terms in a synchronic and in a diachronic perspective should also be addressed, with reference to these theories of Terminology. In the context of Terminology, a synchronic approach would involve analysing terms and concepts in the present, whereas a diachronic approach would study the historical development of terms and concepts over time. Temmerman (2000a; 2000b) highlights the importance of analysing Terminology in a diachronic perspective, as she recognises that concepts and their designations evolve over time and are influenced by the contexts in which they occur. Indeed, in another defining text of the discipline, Temmerman and

Van Campenhoudt (2014: 3) assert that the progress of cognitive models contributes to the evolution of ideas, and knowledge.

Kyo Kageura's (2002; 2022) theory of Terminology and term formation should also be part of this overview. The author describes terminology as a unique phenomenon, governed by two forces: the need for standardisation of terms, and the necessity to precisely express the meaning of each concept in every context (Kageura 2002: 7). Emphasising the importance of context in the study of terms, the author asserts that, according to his view, synonymy does not exist in terminology, since every term is chosen to represent a specific aspect of a concept in a determined context. Moreover, Kageura's (2002) definition of term formation is interesting, as the author defines the process as "the specification of concepts within a conceptual class, as represented by the nucleus, by means of modifications represented by the determinants" (Kageura 2002: 59). In this, he seems to believe that term formation is influenced by other terms in the same conceptual system.

Most importantly for this thesis, the importance of the real social and historical context of term creation and development seems to have become increasingly significant in the theories of Terminology. The multidimensionality of concepts and the principle of denominative variation appear to be central in a theory of Terminology where the context in which a term is formed and the causes which lead to the formation of a nomenclature, as well as the motivations of the speaker in the choice of a term and the categorisation of a concept become important.

As L'Homme (2020) points out, while it seems appropriate to affirm that the main principles of the discipline are defined in the years between the 1990s and the 2000s, the following studies represent further definitions of these principles. Indeed, the most recent works on Terminology theory still refer to the principles elaborated in the previous decades. As Dury and Picton (2009) observe, the theories of Terminology of the 1990s focus on discussing and innovating Wüster's (1979) traditional view and its principles. As the authors note (Dury and Picton 2009), the synchronic approach was among the few traditional aspects which were not discussed in those innovative theories.

As Myking (2020) and Condamines (Condamines et al. 2021) state, most recent studies in Terminology aim to give relevance to aspects of theory which were excluded from the re-elaboration of Wüster's (1931) *General Theory of Terminology*. These are some of the aspects on which this thesis focuses. Among them are the processes of term formation (Humbley 2018a; 2018b), the human factor involved in the process and its motivations (Myking 2020), as well as the diachronic approach to the study of terms (Condamines et al. 2021). The most recent texts in literature of the last twenty years seem to focus on neglected or less investigated aspects of Terminology in the literature produced in previous research. Examples of these are Dury (2022) and Picton (2011) studies on the diachronic perspective in Terminology, as well as Myking (2020) state of the art in term formation and focus on the human agency within the process.

Following L'Homme (2020), texts of the last twenty years seem to all start from the premise that everything has been already said in the discipline, and that all principles have already been defined. What seems to be left to do for authors, is to discuss existing principles, or to find new applications of them. In this, a further-looking perspective on future developments of the discipline seems to be missing, which goes beyond a re-evaluation of existing theories. These developments could include, as suggested in the present thesis, the exploration of unknown historical periods, to see to what extent and in which ways terminology, as a practice, existed there and how it was conceptualised. While, as L'Homme (2020: 3) confirms, "the topic has not been the centre of interest as it once was", in the most recent years, studies appear to be characterised by a development of principles introduced between the end of the 20th and the beginning of the 21st century, twenty years on. This is the case of Liu and Wei (2023: 133) theory of a "revolving door". Inspired by Cabré's (2003) *Theory of doors*, this re-elaboration proposes a modified version of the model of a terminological unit, with a different relation of its defining aspects. At the same time, the fact that authors propose in 2023 revisions of theories dating back to twenty years before, seems worth underlining as it presumably mirrors the general theoretical evolution of the discipline, or lack thereof.

Lastly, all the theories listed in this overview tend to see concepts and terms not as abstract entities to standardise, but as concrete objects in a real context, and as such influenced by many contextual factors. In this scenario, this thesis would like to contribute to this descriptive approach to terms, by evidencing the importance of analysing the context in which terms are created. While this overview was not supposed to be exhaustive, its purpose was to introduce some aspects of the existing theories of Terminology, which should be useful for understanding the positions expressed in the following sections.

2.3. The historical origins of terminology before the 20th century

2.3.1. A century of naming classifying

This section presents a brief introduction to the 19th-century process of naming and classifying. This process of systematisation of knowledge was said to begin in the 17th century and lasted until the early 20th century. Defined by Yeo (1991: 26) as the "age of classification", this era saw, among other developments, the formation of scientific disciplines, which organised their specialised knowledge into nomenclatures and classifications, some of which are still in use today (Schiebinger 2004; Dauntou 2005 inter alia). As Kuhn points out (1976: 27), in the 19th century numerous disciplines became "professions with their own institutional forms". Among these forms, nomenclatures and conceptual classifications featured prominently.

Influenced by pioneering 18th- century studies on naming and classifying in botany and zoology and inspired by Carl Linnaeus' (1735) work on nomenclature, scholars in numerous fields of study that

were previously considered to be unofficial areas of research began discussing their structure, and therefore, their nomenclature and conceptual classifications (Yanni 1997). This reflection involved both humanities and natural sciences. Apart from Linnaeus (1735), the work on scientific language was inspired by Diderot's and D'Alembert (1751-1765) *Encyclopédie* and Guyton De Morveau et al. (1787) *Méthode de nomenclature chimique*, as well as by his *Traité élémentaire de chimie* (Lavoisier 1789), and by numerous other dictionaries and encyclopaedias (Yeo 1991; Lefèvre 2018). As Yeo (2003) argues, this systematisation of knowledge was directly connected to the organisation of the language necessary to communicate new theories and discoveries to the scientific community.

The emergence of specialised journals and institutions with an international nature dedicated to various fields of knowledge was another significant factor in the systematisation of knowledge (Schaffer 1986; Yeo 1991) and in the process of "professionalisation of science" (Ellis 2014: 777).

Research on the nomenclature of the human body was conducted in the field of medicine, while names for newly discovered physical entities and phenomena of the mind were being explored (Crichton 1798). In specialised journals, experts discussed the nomenclatures of the arts, and classifications for the different historical periods of architecture (De Caumont 1825). At the same time, experts in mineralogy were coining terms to assert independence from chemistry (Mohs 1825). In meteorology, which until then had not been recognised as a legitimate field of study, the study of clouds, winds and tides also led to the creation of terms.

These attempts at knowledge organisation are reflected in the works of numerous experts in the 19th century, who took an interest in scientific language and technical terms (Bentham 1817; Whewell 1840a, Mill 1895 inter alia). More recently, scholars of the history of science have revisited and examined 19th-century practices of naming and classification that were popular with experts of the scientific disciplines at the time (Daston 2015: 2016; Witteveen 2020) both from a general point of view, and from the perspective of specific disciplines (Case 2015; McOuat 1996; Skipton-Long 2018).

2.3.2. The historical origins of terminology

Literature in terminology theory entails several works addressing the historical origins of terminology before the 20th century and some decisive texts contributing to the contemporary practice of terminology. Even if in a necessarily limited selection, these texts deserve to be mentioned as precursors of the contemporary terminology.

Alain Rey (1995: 11) addresses the "Origins and Development of Terminology" in history and, with reference to the Western World dates it back to Plato's *Cratylus*, which, according to Rey, can be considered as "the first basic text in terminology" (Ibid.). The following stages in the evolution of terminology are connected by Rey (1995: 13) to the necessity of a "separate" and specific language for specialised fields of studies i.e., the ones which will be recognised as scientific in the 19th century.

Rey's (1995) chapter lists some fundamental historical events in the development of terminology in history. This starts as a separate field of knowledge on naming after the Renaissance, with the introduction of the term *nomenclature* in the 16th century. In the 17th century, a necessity to describe specialised language began to appear, specifically in the French scientific community, as Rey (1995: 12) asserts: "There was not only a need to identify specialised discourse, but it was also considered necessary to provide descriptions for its items". The *Dictionnaire Universel* of Antoine Furetière (1690, in Rey 1995) and the work by Thomas Corneille for the Académie Française (1694) addressed this need. This necessity increased, in the 18th century, with the contemporary development in France of the *Encyclopedie* by Diderot and d'Alembert (1751-1765) in France, and Chambers (1728, in Rey 1995) *Cyclopaedia* and Johnson's (1755, in Rey 1995) *Dictionary of the English Language* in England. As Rey (1995) states, the 18th century saw a development of specialised language and terminology in the natural sciences. In his work on the classification of plants, Linnaeus (1735) was the first to recognise the necessity of "a separate language" and Latin descriptive labels (Rey 1995: 13). However, numerous other authors were working on the specialised language of natural sciences. Among them, Buffon (1749, in Rey 1995) recognised the informative value of the linguistic sign, and Duhamel du Montceau (1758, in Rey 1995) defined a nomenclature as "the art of classifying the objects of a science and naming them" (ibid.). Guyton de Morveau (1780, in Rey 1995) *System of Chemical Nomenclature* deserves to be mentioned among the most decisive classification and naming efforts in the natural sciences. As Rey (1995: 14) underlines, these works developed because of "a complete unity between knowledge and the language used for its classification". Further important developments are Locke's (1690) *Essay on Human Understanding*, which is considered a fundamental work on the definition of concept, term, and naming, and William Whewell's (1837) work on the scientific meaning of terms and the definition of scientific knowledge, which Sager's (2000) *Essays on Definitions* mention extensively. Sager's volume is a collection of contributions to the concept of definition by different authors, such as Plato, Aristotle, and Locke and it is interesting as an historical perspective in terminology.

Whewell's role in the history of terminology is underlined in Rey's (1995) *Essays on terminology*. Rey (1995:15) reports that the meaning of the word *term*, seemingly originated in Whewell's writings. Rey refers here to Whewell's 1837 *History of the Inductive Sciences*, where the author describes the meaning of the words he employs in his volume:

It must be recollected that I designate as **Terminology**, the system of **terms** employed in the description of objects of natural history; while by **Nomenclature**, I mean the collection of the **names** of species. (Whewell 1837: 307, in Rey 1995:15)

As Rey (1995:15) notes, the use in the same sentence of words like "system, object, and science", gave *term* the scientific connotation it has today. The 19th century also saw the origin and development of linguistics as a discipline, in which also specialised languages were studied.

Cabré (1999: 1) mentions Rey (1995) with reference to the origins of terminology in history to address knowledge development necessities, before being codified as a discipline in the 20th century. Cabré (1999) describes the process of the industrial revolution and the necessity of standardisation of technical language which interested the period, while still recognising the origins of the practice of terminology in the 18th century:

In the **18th century** research in **chemistry** [...] or in **botany** and **zoology** [...] exemplify the interest that the naming of **scientific concepts** has always had for the real protagonists the specialists. Due to the growing **internationalization** of science in the 19th century the need for scientists to have at their disposal a set of **rules** for formulating **terms** [...] became apparent. [...] In the 18th and 19th centuries scientists were the leaders in terminology; in the 20th century engineers and technicians have become involved. The rapid progress and development of technology required not only the naming of new concepts, but also agreement on the terms used. (Cabré 1999: 1)

Notably, Cabré (1999) focuses on the evolution of necessities in technical language in history. If the activity of the experts in the 18th and 19th centuries was centred on naming newly discovered entities, the creation of a shared language for science and industry was the main concern of technicians and engineers in the late 19th and at the beginning of the 20th century:

In the **18th- and 19th-century**, scholars were alarmed by the proliferation of terms and were most worried about the **diversity** of forms and the relationships between forms and concepts. They were not concerned with the nature of concepts nor the foundations for creating new terms. **Theoretical concerns** about the nature of terms arose later when terminological work began to be organized in some special fields because of practice. (Cabré 1999: 7)

As an example of the concept reported in the previous quote, Cabré (1999: 7) cites the work of Wüster (1968, in Cabré 1999: 7). The founder of the *General Theory of Terminology* was, indeed, first concerned with term standardisation, and focused then on the "theory of terms" (ibid.).

In the *Handbook of Terminology* (Kockaert and Steurs 2015), Depecker (2015) underlines how the origins of terminology as a practice lied in the 17th and 18th centuries scientists research activity, referring to the example of Ferchault de Réaumur (1734, in Depecker 2015), and the way he described concepts through their characteristics in the classification of insects:

Ferchault de Réaumur (1734: 318), one of the main researchers of the **18th century** on insects, writes: "*D'être aile, ou de n'avoir point d'ailes, sont assurément des caracteres qui sembleroient les meilleurs pour distinguer des classes*" ("to have wings, or not to have, are surely characteristics (*caracteres*) which would

appear as the best to distinguish classes"). "*Caractere*" as part of a concept, for example in **classification** of beings, as in the extract from Ferchault de Reaumur or in other scientific works of the **17th and 18th centuries**, is still used nowadays. Also still in use is the verb "to characterize". A biologist can "characterize" a virus, i.e. enumerate the characteristics of the virus. (Depecker 2015: 41)

As Cabré (1999) states, while the origin of Terminology lies in the research of scientists, the practice of standardisation originated in the activity of engineers following the necessities of the industrial revolution. Humbley (2009: 14) presents the formation of a specific term in law in the mid-19th century. This proves once again how terminology theory appears to be aware of its origins in the scientific discourse of experts and scientists in the centuries before the formation of a discipline of terminology, and of the terminological practice this thesis tries to describe. At the same time, Grimaldi (2020b: 96) reconstructs the history of the botanical language, referring to Tournefort (1694, in Grimaldi 2020b) and his first "nomenclature rationnelle" [rational nomenclature] of species. The work of Augustin De Candolle's (1813, in Grimaldi 2020b), in his *Théorie élémentaire de botanique* [Elementary Theory of Botany]³ is also interesting, since the author notably introduced rules for term creation.

In a recent issue of the *Terminology* journal (Pilke et al. 2021), the authors analyse the evolution of terms in different historical contexts, such as the French Law (Curti-Contessoto et al. 2021) or the language of the EU Institutions (Mariani 2021). For instance, Curti-Contessoto (ibid.) examines how the term *marriage civil* has changed in French Law since its introduction in 1791, because of the concept change and the evolution of the society. Moreover, the historical origins of lexicography are reconstructed by Grimaldi (2021) in an article in which the relation between lexicography and terminology is addressed. Specifically, the historical practice of writing dictionaries and the difference to encyclopaedias in history are described, as part of an overall activity of knowledge codification.

The recently published volume on the theories of terminology (Faber and L'Homme 2022) starts chronologically from Wüster's (1931) *General Theory of Terminology* at the beginning of the 20th century, though mentioning the first necessities of organisation of specialised languages from the end of the 18th century:

At the end of the **18th century**, naming rules became necessary for domains such as **Botany, Zoology, Chemistry, and Medicine** because this was the only way to increase the accuracy of linguistic designations. (Candel 2022:40, in Faber and L'Homme 2022)

The historical origins of terminology will also be the subject of a forthcoming volume published by John Benjamins and edited by John Humbley and Kara Warburton (forthcoming), in which the practice of terminology is examined in various historical periods, well before the creation of Terminology as a discipline and which is going to fill the gap in terminology theory.

³ Unless otherwise specified, translations are provided by the author of this thesis.

2.4. The diachronic perspective in terminological studies

Due to the traditional synchronic nature of the discipline (Wüster 1979 [1991]), the diachronic perspective was always less present in terminology theory. Wüster's synchronic view of terms and concepts appears to be motivated by his intention to systematise terminology in a specialised domain: starting from his own field of expertise, i.e. electrotechnics, Wüster is interested in establishing a univocal correspondence between terms and concepts. Naturally, introducing a diachronic perspective and acknowledging the evolution of terms and concepts in time (see e.g. Temmerman 2000b) would have rendered this correspondence unstable, or temporary, as future theories of Terminology would argue. Due to this reason, a diachronic perspective in the study of terms and concepts was never interesting for the traditional theories of Terminology.

The possibility of considering different approaches from Wüster's (1979 [1991]) synchronic one has appeared in the last decades. Indeed, what Faber's (2009: 107) defines as "cognitive shift", paved the way for alternative approaches to Terminology. These approaches question the features of Wüster's (1931) traditional view of Terminology, and among them, its synchronic nature (Temmerman 2022). In reference to this, this thesis proposes a diachronic perspective for studying the evolution of nomenclatures and classifications in terminology theory. Condamines (Condamines et al. 2021) observes that there was no explicit meta reflection on the synchronic nature of Terminology as a discipline until the second half of the 1990s (Møller 1994; 1998). From then on, more recent studies apply this approach to term and concepts, evaluating it both within the theory of the discipline, and as applied to specialised fields of research, such as physics and biology (Picton and Dury 2017; Humbley 2018b). However, this thesis argues that few historical studies exist on naming from a terminological perspective, as they are limited to the analysis of nomenclatures or single terms (Temmerman 1995; 2013; 2014; Becker 2005; Pitkänen 2008). In reference to this, I suggest that first, the diachronic studies in Terminology are few and there should be more; and second, that the existing studies are limited in scope, and future ones could focus on more terms and disciplines, as has been done so far.

From the early 1990s, few pioneering studies on the possibility of historical studies in Terminology, and their connection to research on naming in the history of science started to appear in the publications in the discipline. In an early study, Humbley (1994) addresses diachrony in Terminology and the possibility of analysing the history of terms and the context in which terms are coined involving experts in the history of science. The definition of terms as inseparable from their historical context, and thus from the specific knowledge only specialists possess, is a principle introduced in the descriptive theories of Terminology of the 1990s, and is relevant in this study⁴:

⁴ Unless otherwise specified, translations are provided by the author of this thesis.

[...] Il s'agit tout simplement de suggérer des **outils** plus appropriés à l'analyse de la langue de spécialité dans sa **dimension historique** [...], il serait nécessaire, comme en terminologie contemporaine, de confier une partie importante de ces travaux aux spécialistes aux mêmes, en l'occurrence, les **historiens des sciences et techniques**⁵. (Humbley 1994: 710)

A few other studies suggest the adoption of a diachronic approach in Terminology. Temmerman's (1995: 107) diachronic reconstruction on the history of the term "splicing" represents one of the few studies to focus on term formation in a diachronic perspective. More in detail, Temmerman (ibid.) describes term formation in biology, and is thus significant for this thesis, since it focuses on the formation of language in a specific discipline. A few years later, Van Campenhoudt (1998) addresses the evolution of use of the French terms *maille* and *maillon* in 19th and 20th century dictionaries. The approach of this work, which illustrates the use of terms in dictionaries, recalls the one adopted in several publications in historical lexicography. Most of these studies base the reconstruction of the history of the appearance of a term in specialised dictionaries and constitute an already quite developed research direction in lexicography (Lonati 2011; 2013; 2019).

On the same lines as Temmerman's (1995) and Van Campenhoudt's (1998) works, in two articles published in 1994 and 1998, Møller (1998: 426) stresses the necessity of defining the evolution of terms and terminologies, which he terms "terminochronie" since "discussions of diachronic approaches in terminology are scarce or not to the point" (ibid.). In the 1990s i.e., before a new interest in the diachronic dimension of terminology emerged in literature, these articles could be said to constitute the only attempts to address such a perspective in the discipline. While the approach was less applied in terminology in the past, an emerging interest on the diachronic perspective seems to have appeared in the last years, starting with the work of Dury (1999) and Picton (2009).

One of the aims of this thesis is to argue that a diachronic perspective in the study of terms could contribute to a more encompassing theory of Terminology. This perspective can provide insights into the historical evolution of terms and concepts in specialised domains. Besides this, the diachronic perspective can help us to understand how and why terms and concepts emerged, evolved, or became obsolete and were substituted over time. At the same time, this perspective could shed light on how these developments of terms and concepts are interconnected with broader changes in the field of knowledge to which they pertained.

⁵ English Translation: [...] It is simply a question of suggesting tools more appropriate to the analysis of the language of specialisation in its historical dimension [...], it would be necessary, as in contemporary terminology, to entrust a significant part of this work to the specialists themselves, in this case historians of science and technology.

2.4.1. The emerging interest in the diachronic perspective

The lack of diachronic and historical studies in Terminology in the past has been partially amended by an emerging interest on the topic in the last decades, though still limited, in comparison to the synchronic perspective. The publications of the last few years denote how the perspective was missing from most of the studies on the subject, and thus constitutes an almost unexplored and promising research direction. A tendency which could be recognised in the literature on terminology theory in the most recent years is the analysis of the lexicon of a specialised field of research from a diachronic perspective: this happens for instance in Peruzzo's (2018) article on a diachronic approach to legal terminology. More recently, the issue 118 of the *Cahiers de Lexicologie* (Zanola 2021a) was devoted to diachronic studies in Terminology. The issue, entitled *Terminologie diachronique: méthodologies et études de cas* [Diachronic terminology: methodologies and case studies] and edited by Maria Teresa Zanola (2021a), provides a comprehensive view of the most recent applications of this perspective in terminological studies.

This issue highlights particularly relevant concepts for this thesis. Zanola (2021b) introduces the diachronic perspective and the study of the history of terms and underlines how the "métaterminologie" (ibid.: 14) – identified as the ensemble of reflections and theories of experts in science before the 20th century – is worth investigating through the diachronic perspective and how its historical context plays a significant role in its understanding. Connected to this, and most importantly for this thesis, Zanola also underlines how the context is most significant to understand the development of terms and concepts and their "implications culturelles" [cultural implications] which cannot be neglected (ibid.: 15).

In a following article, Piselli (2021) reflects on the evolution of colour terms in the art of silk dyeing between 1750 and 1850. Piselli identifies in the historical sources two types of neologies: a "néologie référentielle" [referential neology] (Cabré 1998: 256, in Piselli 2021: 120), where multiple terms are created to name a newly coined concept, and a "néologie de (sous-) domaine" [(sub)domain neology] (Humbley 1994: 707, in Piselli 2021: 120) for terms which came from other domains or subdomains and were employed to name colours. In the domain of jewellery, Altmanova (2021) confronts the historical evolution of the specialised terminology of a domain from the 19th century onwards. In the article, the author introduces the topic of normalisation in terminology, particularly with reference to the development of the industrialisation and the consequent necessity to normalise the language of the domain. Finally, the topic of "determinologisation" (Meyer and Mackintosh 2000: 11) is addressed by Picton, Condamines and Humbert-Droz (2021) in the context of short-term diachrony and in the domain of particle physics. More specifically, the article proposes different degrees of integration of terms into the general language, thus extending the original concept, as does Dury (2012) in a precedent article. In this article, Dury (ibid.) addresses a progressive "dilution du sens"

[dilution of meaning] (ibid.: 66) of terms from specialised to general language and across disciplines. Always Dury (2021) describes the diachronic evolution of acronyms and abbreviations in short-term diachrony and in a corpus on the medical domain. In an historical introduction to the article, Dury also mentions the process of language normalisation during the industrial revolution (see Cabré 1999). Dury's (2012b; 2021) work on diachrony in terminology deserves further mention. In another article, Dury (2012b: 81) addresses a specific form of neology, which she terms "néologie d'adaptation" [adaptation neology], described as the neology created to substitute a term with a pejorative connotation. In the article, as a significant trait for this thesis, Dury addresses the necessity of the scientific community to substitute terms with a pejorative connotation in their domain, reflecting also on the translational consequences of that.

As Dury (2022) observes, an imminent interest in diachrony in Terminology is testified by the inclusion of a chapter on it in a collective volume on the theoretical approaches to terminology (Faber and L'Homme 2022), which, as Dury (2022) confirms, would have been irrelevant some decades ago. As Dury states, quoting Candel (2004: 24, in Dury 2022: 423), while Wüster acknowledges the existence of the diachronic dimension in the study of terms, he did not consider it to be of interest for the discipline. As Candel (ibid.) argues, a synchronic perspective in the study of terms was – in the context of Wüster's work at the beginning of the 20th century, quite innovative, as historical studies, also on language, were more common than they are today. Candel's observation confirms, indeed, the importance of seeing theories in their own historical context.

In a recent article appeared in the *Terminology* journal, Dong (Dong et al. 2023) presents a diachronic study of Chinese translated terms. While the contribution refers to the literature on the diachronic approach to terminology (Dury and Picton 2009; Humbley 2018b), the attention seems to be on the data, and not on the theory of the discipline. However, the appearance in the very last years of these studies seems to reveal a new attention for the diachronic perspective.

The historical context of term creation is central in further studies on the diachronic perspective in terminology. Becker's (2005) PhD thesis examines the semantic and lexical aspects of mathematics' specialised language in the 19th century, while Pitkänen (2008) addresses the evolution of the Finnish language in botany. The same author later describes term formation as applied to how words define scientific concepts (Pitkänen-Heikkilä 2015). Finally, the study conducted by Banks (2017, in Dury 2022) is significant for the purposes of this thesis. It examines grammatical structures in the *Journal des Sçavans* and *Philosophical Transactions of the Royal Society* between 1665 and 1700. Angela Campo's (2012) PhD thesis on Wüster's terminological work and the successive development of the discipline of Terminology is also worth mentioning (see Felber 1973). While the theses mentioned in the previous paragraph and the present one all apply a diachronic approach to the study of terms, Campo's (2012) thesis shows the same interest in terminology theory and its evolution. Lastly,

and always in a diachronic perspective, Grimaldi (2023) reconstruct the evolution of the concept of *participation* in terminological and terminographic research. Starting from the origin of the first schools of terminology at the beginning of the 20th century (see Wüster 1931), Grimaldi (ibid.) reflects on the importance of users' collaboration in constructing terminological resources.

2.4.2. The interest in the diachronic approach by French scholars

The French school of Terminology seems to have developed a particular interest for the study of diachrony (see Guilbert 1973; Guespin 1995). Not only the diachronic approach in the study of Terminology belongs to this tradition, but also a focus on the formation of scientific language since the 18th century. Possibly influenced by the theory of Socioterminology (Gaudin 1993a: 1993b), the description of terms in the articles of the time is defined as taking place in a *socio-historical* context, where the nature of terms was different from the one of general language words, mainly as being governed by specific rules for the formation and organisation of terms. These articles, published mostly in French, with some English exceptions, analyse mainly French primary sources from the 18th century on the formation of encyclopaedias and dictionaries. In this context, the diachronic approach to the study of terms is discussed in numerous articles (see Humbley 1994; Condamines and Rebeyrolle 1997). With this premises, it seems fair to state that at least the articles published only in French would be precluded to anyone not familiar with this language. Concurrently, most of these articles were not, to the best of my knowledge, translated into English, and were thus excluded from what is nowadays considered the main debate on the topic.

In a recent contribution, Dury (2022) offers an overview of the main studies on diachrony since the 1990s. The first work on the topic appears to be the conference on diachronic Terminology held in Brussels in 1988 (De Schaetzen 1989). A re-edition of the same conference took place in 2023 in Lyon, and it focused on the state of the art of diachronic studies in Terminology. After that first discussion on the diachronic approach in 1988, Candel and Gaudin (2006) publish a collection of works describing diachronic perspectives on specialised language. In the volume, the editors remark a continuing lack of interest for diachrony in Terminology, hoping that the collection would raise the interest of researchers in the field. Interestingly, a possible explanation of this lack of interest could be the instability of concepts and terms that a diachronic approach inevitably reveals, as also Dury (2022: 425) observes, referring to Gaudin (2003) and his work on Socioterminology.

The interest of the French school of Terminology for the diachronic approach appears to begin in the mid-1990s. Early studies include two articles by Bernt Møller (1994; 1998) in which the author acts as a forerunner of the evolution of French technical terminology, affirming how this could be studied by applying a diachronic and quantitative method. At the same time, John Humbley (1994) examines aspects of the dating process of technical terms, as compared to general language words.

Specifically, the article addresses the possibility of studying the evolution of terms through their historical context, and how naming methods evolved in time.

Some years later, Condamines' studies (Condamines and Rebeyrolle 1997; Condamines et al. 2004) are most important for developing the diachronic perspective. Among them, Condamines describes the process of "determinologisation" (Meyer and Mackintosh 2000: 11) in the domain of physics (Condamines et al. 2004, 2021). In the same years, several studies by Pascaline Dury (1997; 1999) appear on diachronic terminology. These apply a diachronic approach to case studies from various disciplines, while affirming the usefulness of the diachronic perspective in the study of terms. In one of these studies, Dury (1999: 485), in the English abstract of an article written in French, affirms that "translators and terminologists would highly benefit from a more regular use of the historical information gathered on concepts and terms", exemplifying her point with a comparative and diachronic study of the concept of "ecosystem". Remarking on the importance for translators to investigate the evolution of terms and concepts, and thus establishing a connection between the activity of translators and terminologists and diachronic studies in Terminology, Dury (1999: 485) underlines how, in 1999, diachronic studies in Terminology were still rare and the approach appeared to be an "activité marginale" [marginal activity] in the discipline.

Aurélié Picton's (2009; 2011) work on diachronic terminology seems decisive for the further development of the approach. Picton's (2009) PhD thesis focuses on developing a diachronic method for studying the evolution of knowledge in a corpus from the domain of spatial engineering. The thesis is only the beginning of a series of articles dedicated to diachrony and terminology (Dury and Picton 2009; Picton 2018). In a following study, Picton (2011) notably addresses the lack of diachronic studies in the existing literature:

The **diachronic** dimension has **long** been **ignored** in terminology, a point deplored by many researchers (among them Dury 1997; Guespin 1995; Humbley 1994; Møller 1998; Sager 1990 or Van Campenhoudt 1998). However, some authors, such as Rey (1992), observed that experts have to be aware of the recent evolutions in their domain, a need that implies "mastering new terms, new concepts and the change of denominations assigned to concepts that **evolve more rapidly** than them" (ibid.: 58). (Picton 2011: 134)

The article describes short-term diachronic phenomena, such as neology and necrology, in corpora of specialised texts. As Picton (ibid.) observes, the "lack of interest in the diachronic perspective" could have different causes, both theoretical and technical, some of which are addressed by Dury and Picton (2009) in a central contribution for the further development of diachronic studies. Among them, theoretical and historical causes due to Wüster's synchronic setting of the discipline are mentioned, as well as pragmatic and psychological causes. Under the latter, the instability of concepts and terms that would appear in a diachronic perspective is fascinating.

Picton (2014) presents a methodology, based on the construction of a corpus to monitor the evolution of terminology in short-term diachrony; while Delavigne et al. (2022) underline the role of experts in the creation of terminology and of the scientific community in their evolution (see Bertaccini and Matteucci 2005; Picton and Dury 2017, in Delavigne et al. 2022). Always in a diachronic perspective, Ledouble (2019) observes the phenomenon of denominative variation in popular science discourse, commenting on how term proliferation can create both terminological and conceptual confusion among the users.

At the same time, quoting Temmerman (2000a), to understand the nature of concepts and terms, it appears necessary to examine them in an historical perspective, since they both evolve in time and according to their context:

Afin de comprendre la catégorisation et la dénomination, une **analyse historique** des unités de compréhension est indispensable. Nous avons pu constater que dans le langage des sciences de la vie, le choix d'une dénomination est rarement **arbitraire** et que la **catégorisation** est un processus, i.e. qu'elle se caractérise par des **propriétés temporelles**⁶. (Temmerman 2000a: 61, in Dury and Picton 2009: 35)

Valérie Delavigne (2006) connects in her PhD thesis the evolution of the concept of scientific popularisation and the linguistic analysis of it in a socioterminological perspective. Recalling Temmerman (2000b: 15), as "concepts evolve over time, as well as their designations", Delavigne (2006) underlines how terms cannot be separated from their context i.e., from the historical and social situation in which they emerge and evolve:

[...] les **événements** terminologiques sont **indissociables** des conditions dans lesquelles ils émergent et le **contexte** sociohistorique n'est pas sans effet sur la constitution et **l'évolution** du vocabulaire [...].⁷ (Delavigne 2006 : 90, in Dury 2022 : 432)

Dury and Picton's (2009) concluding reflection on the terms employed for the description of diachronic phenomena seems to signal the lack of research on the topic. The authors wish for a harmonisation among terms such as variations, cycles, instabilities, movements etc. to describe the dynamics revealed by the historical study of terms and concepts. Indeed, the authors argue that a diachronic study of terms would help to understand the reasons behind the choice of a specific denomination, which is described as rarely arbitrary. As Freixa (2006) observes, the causes for the choice of a term to describe a concept in a specific situation can be multiple. At the same time, if arbitrariness is possible in

⁶ English Translation: To understand categorisation and naming, a historical analysis of the units of understanding is essential. We have seen that in the language of the life sciences, the choice of a name is rarely arbitrary, and that categorisation is a process, i.e., it is characterised by temporal properties.

⁷ English Translation: [...] Terminological events are inseparable from the conditions in which they emerge, and the socio-historical context is not without effect on the constitution and evolution of vocabulary [...].

terminology to some extent (Fernández-Silva, Freixa and Cabré 2011: 49), it does not mirror the speaker's perception (Freixa 2006: 54):

The arbitrariness of the linguistic sign is accepted by linguists but, as Guilbert observes (1981: 202–203), it does not correspond to **speakers' intuition**. The specialist has a particular relation with the real world he names, and his feeling of non-arbitrariness is more important than that of other speakers. The principle of the **arbitrariness** of the linguistic sign does not, however, deny the existence of other principles affecting denominations. Terminological units are often motivated units, in the sense that they reproduce characteristics of what is named in the denominative form. (Freixa 2006: 54)

As Dury (2022) states, one of the consequences of this instability is the connection of diachronic studies to term variation and the evolution of knowledge. As Dury (ibid.) also observes, these are further aspects of the study of terms which could draw the attention of experts if a diachronic perspective is adopted in Terminology. Another most recent PhD thesis (Humbert-Droz 2021) describes the process of "determinologisation" (Meyer and Mackintosh 2000: 11) and its application in the domain of particle physics. Specifically, the thesis analyses the progressive integration of terms into general language, and after they *leave* the specialised domain in which they were previously used. The "determinologisation" process is defined as the opposite to Sager's (1990: 60) "terminologisation", or the process of formation of terms and concepts through successive naming attempts.

2.4.3. The diachronic approach between terminology and lexicography

This declination of the diachronic approach to the study of terms is different from the others since it appears to combine methods of terminology and lexicography, adopting an onomasiological and semasiological approach at the same time and with a interest for very specific historical contexts and their influence on the development of terms. These studies, conducted mainly by Maria Teresa Zanola (2014; 2021) and her colleagues, focus on the historical dimension of terminology creation and development in the 18th century and in the arts and crafts, analysing the specific terminology of single technical domains, such as ceramic or leather work. Particular attention is devoted in these research works to the historical and social context of evolution of terms, and to the examination of the motivations which lead to the introduction and modification of terms. Examples of this declination of diachronic terminology are the projects called *Term Diachro*⁸ and *Mastri and Maestri* project⁹ of the University Milan. Numerous interesting publications on the specialised language of specific disciplines and sectors belong to the projects.

⁸ Term Diachro Project. Università Cattolica del Sacro Cuore (Milan): <https://centridiricerca.unicatt.it/otpl-progetti-term-diachro> [accessed May 5, 2024].

⁹Mastri e Maestri. Saperi e Mestieri: l'arte antica dell'innovazione. Università Cattolica del Sacro Cuore (Milan): <http://www.mastriemaestri.it/> [accessed May 5, 2024].

The *Term Diachro* project analyses the terminology of the arts and crafts and of science in a diachronic perspective. Starting from Zanola's (2014; 2018a; 2018b) work, it has developed several specialisations (see Dankova 2023a; 2023b; Grimaldi 2017; 2020a; 2021; 2022; Piselli 2019; 2021; Zollo 2020). The *Mastri e Maestri* project focuses instead on the 18th- century creation of specialised lexica in different disciplines and various fields of knowledge. Both projects belong to the *Osservatorio di Terminologie e Politiche Linguistiche* [Observatory of Terminologies and Language Policies] (OTPS) of the University of Milan "La Cattolica del Sacro Cuore", which comprehends various terminological and lexicographical projects¹⁰. In the projects (Zanola 2018a), the diachronic analysis of the technical and scientific knowledge of the arts and crafts examines the tradition and innovation through the origin and development of their specialised terminology and represents a most valuable study both in a terminological and in an historical perspective. In these works, the analysis of terms becomes a valuable tool through which the social context is analysed, with a specific attention for the factors and actors who influenced the formation and evolution of terms.

Zanola (2014; 2018a; 2018b) presents various studies dedicated to the historical evolution of the French terminology of the arts and crafts in the 18th century, giving relevance to the historical context of the time and the connection of terms and concepts with the context in which they appeared. Other articles are dedicated to the analysis of the specific terminology of single fields of specialisation. Zanola (2023) examines the topics of diachrony and variation in ancient mathematics, remarking the importance of analysing terminological "realia" (ibid.: 51), which inform about the conceptual history and contents of a specialised domain.

The participants to these projects express a particular interest for the formation of the language of science (see Grimaldi 2020a). So does for instance Grimaldi (2020a) in an analysis dedicated to the formation of scientific language in the Académie Royale des Science between 17th and 18th century (see Nappi 2021; Grimaldi 2020a). Grimaldi (2020b) also explores the botanic classifications in history and the creation of the vocabulary of the discipline. The article is important for this thesis since it addresses the origin of botany as a scientific discipline, as related to the formation of its specialised language. The article connects classification and naming to the formation of a modern scientific method from the 17th century onwards.

Piselli (2019) analyses the language of dyeing silk in the 18th century in the work of Pierre Joseph Macquer and with specific attention for the terminology of colours, as in a similar diachronic perspective Dankova (2023b) examines the terminology of textile fibres in France from the 18th to the 21st century. All these studies attribute a great relevance to the description of the historical context in

¹⁰ Osservatorio di Terminologie e Politiche Linguistiche. Università Cattolica del Sacro Cuore (Milan): <https://centridiricerca.unicatt.it/otpl> [accessed May 5, 2024].

which terms are formed and developed, as well as a particular attention to a very specific domain of knowledge to which the terms belong.

The approach of these research works can be defined as terminological and lexicographical at the same time. It presents a strong historical component, since, as stated by the authors, terms and classifications are used in these contributions to investigate the historical and social context of knowledge development in the arts and crafts (see Zanola 2014). Indeed, the processes of term formation and variation, as well as the changes in categorisation of specialised concepts and their adoption as standards in the disciplines are evidenced to represent historical changes in the development of the technical and scientific evolution of the domains, which are mirrored in their language. An example from this research direction is Zanola (2014) main work on the diachronic analysis of the language of the 18th-century arts and crafts. On the same lines, Grimaldi (2017) analyses the evolution of scientific language in the French scientific press between 1699 and 1740 within the formation of the disciplines of botany and chemistry. In this volume, Grimaldi (*ibid.*) argues that the terminological necessities of the discipline to systematise and discuss their specialised language at the time, coincided with the origin of the textual genre of the periodical print in France.

This research area is particularly important for this thesis. Indeed, the present thesis and this research direction share the interest for a diachronic analysis of terms where the historical and social context in which terms are formed and developed plays a decisive role. Additionally, these works also share the interest for the 18th and 19th century as period of formation of the modern scientific disciplines and knowledge. Lastly, all these contributions aim to demonstrate the importance of terminology and terminological practices in the context of the necessity of systematisation of scientific language for the development of knowledge.

2.5. The necessity for further research and a better definition of the process of term formation

In this study, I argue that term formation has been less investigated in the literature on Terminology theory (Myking 2020), due to the predominantly applied and synchronic perspective of the discipline. Even though studies on the etymology of terms exist, they are limited to the history of single terms or the lexicon of a specific domain, with the dynamics of evolution of concepts, or the history of the precedent forms of the term (Temmerman 1995: 107).

Studies on term formation and on the process of describing and defining concepts seem to be limited to Sager's (1990; 1998-99) definition of primary and secondary term formation, or to his description of the process of "terminologisation" (Sager 1990: 60) i.e., the formation of terms through different stages of naming. Apart from these counterexamples, as it appears from the analysis of the literature, existing studies do not focus on term formation, examining, for instance, the multiple factors and actors which contribute and influence the process. Terminology theory seems indeed to almost

devote attention solely to terms, hindering research on other processes and dynamics. If the centre of attention was shifted to, for instance, term formation and the different actors involved, some interesting research directions could be discovered, which this thesis aims to encourage.

While the missing interest in the description of term formation as a process relates to the absence of diachronic studies (cfr. Sec. 2.4.), this also appears to denote a lack of interest for the description of terminological processes. This could be argued to be due to Wüster's traditional setting of terminology, where concepts represented the central object of study. As Terminology theory seems indeed to have shifted a lot since its origin, and to have abandoned some tenets of Wüster's (1931) theory, the synchronic approach appears to be still predominant in the discipline, as the study of terminological processes over time seems a less interesting topic. Among the existing studies, Sager's (1990: 60) definition of "terminologisation", and the theories that derived from it, appear to be the ones describing term formation more in detail. In the description of term formation, the relevance that Sager attributes to human activities is significant, as it directly addresses the central role of experts in communication:

Term formation [...] is a **conscious** human activity and differs from the **arbitrariness** of general word formation processes by its greater awareness of pre-existing patterns and models and of its **social responsibility** for facilitating communication and the transmission of knowledge. (Sager 1997: 25)

In a following article, Sager (1998-99) describes "terminologisation" (ibid. 1990: 60) more in detail, as he discusses the foundations of Terminology. Specifically, he defines the process in a diachronic perspective:

The first step in the series of **attempts** made throughout history to control the free scope of language by various restrictions which have led to the invention of professional jargon and secret languages and eventually the creation of artificial languages for the systematic **fixation of knowledge** as for example Botanical Latin and mathematical formula. (Sager 1998-99: 47)

Sager (1990: 60) defines "terminologisation" as opposed to lexicalisation, where a language unit can become lexicalised, and thus denote a certain variety of objects or, alternatively, restrict its meaning or usage and become terminologised. In the same article, Sager (1998-99) refers to term formation as composed of two stages: the formation of a representation, and following this, the formation of a concept. In this, Sager (ibid.) refers to two texts about the theory of logic from the beginning of the 20th century i.e., Sigwart (1911) and Rickert (1929), as the origin of this theory. After Sager's (1990) definition, the concept of terminologisation is developed in numerous studies. Ten years later, Meyer and Mackintosh (2000: 11) define as "determinologisation" the process in which terms in expert language "move into everyday life" i.e., to general language. Dury and Drouin (2011) provide a similar

interpretation of the process which they call "necrology" i.e., the phase in which terms disappear, while the necessity of defining the evolution of terms in time brings Møller (1998: 426) to propose a "terminochronie", or the reconstruction of the history of terms (cfr. Sec. 2.4.).

Kageura (1998-99) suggests that it is possible to establish a descriptive framework for the study of term formation. This framework is composed of three steps for the description of "conceptual patterns in term formation" (ibid.: 37). The conclusion of his article seems significant for this study, as it addresses the relation between terminologists and experts in the knowledge domains investigated in Terminology, and sees in this relationship a direction for future development of the discipline:

[...] little effort has been devoted to the possibility of establishing a theory of terminology based on a **concrete** analysis of terms. It is time to face this challenge, as otherwise the study of terminology will end up being something **more properly carried out** by those who have trained in **the related domains** claimed to be relevant by those who do research in terminology (Kageura 1998-99: 37).

Kageura's study seems to refer to the context of use of terms, which is central to the present thesis. As Kageura observes, the relation of Terminology and the domains in which research is conducted is significant. Indeed, what I would also like to point out is the crucial role of experts in shaping the terminology of their own discipline. This, among other factors, appears to be a less discussed component of the process, which this thesis would like to shed light on.

In addition to the previous studies, Valeontis and Mantzari (2006) distinguish three methods for term creation: formation of new terms, use of existing ones with a new meaning, and translingual borrowing. Term formation and neology are also the subject of several studies conducted by John Humbley (2009; 2018b), who presents an overview of term formation models in the existing literature:

The first, going back to Halliday's work on grammatical metaphor, is that new terms are formed not just in specialised discourse but as a result of discursive strategy. The second, represented in Temmerman's work, is that new terms are essentially metaphors, new ways of approaching specialist knowledge. The third, which Kageura put forward explicitly as a theory of the dynamics of term formation, implies that new terms are constructed based on existing terms. The fourth is that term formation is an essentially diachronic function and should be studied from a historical point of view but using all the resources of linguistic analysis. (Humbley 2009: 5)

Addressing Humbley's (2009: 5) overview, the first and the last models are particularly noteworthy for this thesis. Indeed, terms are considered also in this study as the "result of discursive strategies" (ibid.) and in a diachronic perspective, in which the evolution of terms and concepts over time can be analysed. In a most recent article, Johan Myking (2020) also questions the state of the art of research on term formation. Myking argues that the process is not developed in detail as other concepts of

terminology theory. More specifically, the author observes how the role of human agency in term formation was, among the other factors, less interesting for researchers in the field.

2.5.1. The relevance of the human agency in term formation

Recalling Myking's (2020) most recent evaluation of the state of the art in term formation, the present thesis attempts to shed light on the role of human agency within term formation as a less investigated aspect of the process. More specifically, the lack of a detailed description of term formation implies a concurrent lack of studies on the factors and actors involved in the process, as well as on their multiple forms of contribution to the development of terms and concepts. This thesis would thus try and focus on the actors and contextual factors involved in the process of term formation, as a central aspect of the primary sources which will be examined in the following chapters.

Through the analysis of terminological processes in which the reflections of the experts on naming were central, this thesis emphasises the central role played by experts in the formation and variation of terms. This aspect was indeed less studied in past research in Terminology, presumably as connected to the dynamics of term formation, and thus to a diachronic description of term creation.

Sager (1990) addresses the communicative aspect of terms as related to the intentions of the speakers to convey a message, and to calibrate it according to the level of expertise of the interlocutor. Among more recent studies, Candel (2005) describes the role of experts as central in the formation of scientific language and knowledge in an article in which she addresses the relation between science and Terminology. As Candel (*ibid.*) observes, the relation between the development of Terminology and the scientific fields to which it is applied has always been very close. Along the same lines, Freixa (2006; 2022) presents term variation as connected to the intentionality of the speaker in the choice of a term in a specific situation, against the apparent arbitrariness, which does not exist in term choice.

The investigation of terminological processes should be more closely tied to the context in which these processes occur to fulfil the purpose of this study. Regardless of the historical era, the social factors, as well as the experts who worked together to discuss ideas and create terminology, belong in this framework. As Humbley (1994) proposes in an article mentioned in Section 2.4., terms should be studied in connection to the evolution of the context in which they are created, to understand the reasons why concepts and denominations evolve in time. Along these lines, a closer connection of terminological studies to the ones in the history of science on the development of scientific knowledge should be encouraged, as I suggest in the following section.

In reference to this, Humbley (1994) suggests looking at the context of terms, while the present thesis tries to establish a connection between two disciplines in the study of terms i.e., terminology theory and the history of science. Some years later, Humbley (2022) reflects on Wüster's (1979) *General Theory of Terminology*. According to Humbley, Wüster's theory should be considered in its own

historical context, to fully grasp its innovative character. Indeed, the *General Theory of Terminology* could only be described as innovative, if compared to the context of research at the time. Similarly, the next section shall encourage a connection between the historical reconstruction of naming episodes in the history of science, and the literature in Terminology theory.

2.6. The missing connection between the history of science and terminology theory

The connection of terminological practices and the history of science seems to be less studied in the literature of both disciplines. Besides describing the less explored historical perspective in studies in Terminology, this thesis shall focus on the connection of these two disciplines i.e., Terminology and the history of science, in the study of terminological processes.

The missing connection between Terminology theory and the history of science seems to be confirmed in the numerous articles and volumes which examine the terminological processes I address in this thesis, from the perspective of the history of science (see Daston and Galison 2010; Snyder 2011). I would therefore encourage an intersection between the disciplines, to better describe these processes. This thesis further draws attention to the role of terminological practices in constructing scientific knowledge (Witteveen 2018; 2020). Specifically, it describes how the 19th- century naming practices can be studied in both disciplines, and how terminology theory and the history of science could be connected to one another.

The present thesis argues how few historical studies exist on naming and classification from a terminological perspective. Moreover, the existing ones are limited to the study of specific terms (Temmerman 1995; Becker 2005; Pitkänen 2008). Most studies on 19th- century nomenclatures are conducted on single terms and almost exclusively from the point of view of the history of science (McOuat 1996; Bret 2018). In these studies, the linguistic perspective is almost completely missing, in favour of an exclusively historical account of events. My study will thus try and draw attention to this. While there surely are exceptions to this in both fields of study, mostly published in the last two decades, the topic appears to require further investigation. The lack of interest in the connection of terminology theory and the history of science can be possibly due to Wüster's (1979) view of Terminology. This theory considers terms as independent entities from their context, and thus from the development of the discipline to which they belong.

In a pioneering article published in the first issue of *Terminology*, Juan Sager (1994) addresses Terminology in connection to cognitive sciences and linguistics, arguing which role terms have in knowledge acquisition, representation, and transfer through language. There, terms are defined as "custodian of knowledge and means of knowledge transfer" (ibid.: 7). A study by Leech (2002) can also be mentioned as pioneering in describing the "genealogy to the study of terminology" (Leech 2002: 2) and its relation to the history of science. Specifically, Leech argues that the origin of Terminology could

be – at least partially – traced back to the work of John Locke and his *Essays concerning Human Understanding* (1690). There, terms are described as the means of fixing concepts and their meaning, and thus as a constituent part of human knowledge:

The **process** by which complex ideas are formed, according to Locke, is three-fold: "first (the mind) choses a certain Number. Secondly, it gives them connection, and makes them into one Idea. Thirdly, it ties them together by a Name (III, 4). **Terminology**, then, is part of the active construction of **human knowledge**, the term being seen as a functional element, in the construction and preservation of a certain concept. The term, in other words, acts as a sort of "pro-memoria", a signpost to a complex idea, and is necessarily precisely because these concepts, not pre-existing in nature, and composed of different simple ideas, are manmade and thus to a certain extent fragile [...]. (Locke 1690, in Leech 2002: 5)

As Leech (ibid.) points out, Rey's (1995) *Essays on Terminology* constitute a crucial work in the description of the origin of the discipline and its connection to the history of science. Specifically, Rey (1995) devotes a whole chapter to the origin of terminology in history and Sager (2000) mentions the origin of Terminology in history, with reference to the 19th century, and describing the experts' activity as the one of terminologists *ante litteram* (cfr. Sec. 2.3.2.). Further studies address the didactic aspect of Terminology, as connected to the process of learning in science (see Antia and Kamai 2016). There, term variation is observed as a helpful tool in relation to learning processes.

On the same topic, aside from being one of the first diachronic studies in Terminology, Condamines, Rebeyrolle and Soubeille (Condamines et al. 2004: 547) describe the connection between terminological variation and the evolution of knowledge. As in many other studies, the authors confirm that research at the crossroads between the two disciplines was missing at the time:

[...] l'idée que les changements qui affectent le monde (évolution des connaissances, découvertes scientifiques, [...]) se répercutent dans les **discours** sous la forme de **changements** de sens [...]. Selon le point de vue théorique que l'on adopte, on expliquera ces changements sémantiques de diverses manières : d'un point de vue onomasiologique, on s'appuie sur le principe unificateur de l'analogie pour expliquer les changements qui affectent l'organisation sémantique du lexique (Ulmann, 1969, Blank, 1999), d'un point de vue sémasiologique, on explique le changement de sens par un changement de désignation réalisable par différents processus lexicaux, tels que les formations de mots, les phraséologismes, etc¹¹. (Koch 2000, in Condamines, Rebeyrolle and Soubeille 2004: 547).

¹¹ English Translation: [...] the idea that the changes that affect the world (evolution of knowledge, scientific discoveries) [...] are reflected in discourse in the form of changes in meaning [...]. Depending on the theoretical point of view adopted, these semantic changes are explained in various ways: from an onomasiological point of view, the unifying principle of analogy is used to explain the changes affecting the semantic organisation of the lexicon (Ulmann, 1969, Blank, 1999); from a semasiological point of view, the change in meaning is explained by a change in designation achieved by various lexical processes, such as word formations, phraseologisms, etc.

The authors address a topic close to the concerns of this thesis: namely, the development of scientific discourse as connected to the advancement of knowledge. As seen in the previous paragraphs, studies on the relation of terminological processes to the history of science have appeared, though sporadically, since the 1990s. Among them, Condamines and Rebeyrolle (1997) article on the points of view in specialised language underlines the presence not only of various perspectives in the construction of specialised language, but also of multiple discourses. In the article, the multiple discourses are justified by the presence of numerous interlocutors i.e., the experts, and various communicative situations.

The connection between terminological processes and the development of scientific knowledge is the subject of a few studies in terminology theory. Among these, Pecman's (2012: 2014; 2018) research has a central role. Specifically, Pecman (2012: 27) emphasises the role of "tentativeness in term formation" as a strategy employed by scientists to shed light on different aspects of a concept, or to give relevance to a specific facet of an idea. In particular, the article highlights the use of term variation as a strategic tool in scientific discourse used by scholars to influence the development of science. This interpretation of term variation is relevant for the purposes of this thesis since it proposes an active role of scholars in the formation of terms and focuses on the importance of language and linguistic strategies in scientific discourse. Pecman (2014: 1) then describes term variation as a "cognitive device", addressing possible methods in which scholars contribute to the progress of knowledge through term formation. These articles seem to represent some of the few studies in terminology theory which directly address the relation between term formation and scientific discourse. Referring to Halliday's (1985; 2004) grammatical metaphor, Pecman remarks the importance of language in the formation of scientific knowledge and its central role in shaping ideas, which is among the purposes of this study. Finally, a further volume (Pecman 2018) addresses the relation of language and knowledge formation.

The perspective of the history of science on the processes of naming and classification is also interesting. Indeed, from the texts I read on term formation in the 19th century in the history of science, some topics appear in the literature in both disciplines i.e., Terminology and the history of science, albeit from different perspectives. In the next section, I thus provide a brief overview of some texts from the contemporary history of science, which I found particularly useful for the description of the terminological processes I address in the present study. A reflection on possible connections of the two perspectives is thus encouraged. The connection of terminological practices and the history of science seems to be less studied in the literature of both disciplines and this is what this thesis aims to foreground in the analysis of the primary sources presented in the following chapters, besides the aim to contribute to the relatively less investigated historical perspective in terminology theory.

2.6.1. The description of terminological processes in the history of science

This section addresses the descriptions of the practices of naming and classification in the existing literature in the history of science and underlines the parallel interest of terminology theory and the history of science on the same processes. The historical reconstruction of the terminological processes presented in this thesis is based on studies in the history of science, focusing on the history of naming and classification episodes in various disciplines. The analysis of these episodes from a terminological perspective would not have been possible without the chronological reconstruction of the events provided in studies from the history of science (see Ch. 5 to 8).

This section argues that while these articles describe terminological processes of naming and classifying scientific concepts, they do not refer to terminology theory, and most of them do not display an interest in linguistic phenomena broadly conceived. Most studies on 19th- century nomenclatures and classifications in the history of science are conducted on single terms (McOuat 1996; Bret and Chappey 2018; Bret 2019). In these articles, the linguistic perspective is almost completely missing, in favour of an exclusively historical account of the facts. Among these, McOuat's (1996; 2001a; 2001b) reconstructs debates among English experts in zoology on the formation of guidelines for their nomenclature and compares the official nomenclature to *trivial* terms and naming traditions, which continue to exist. Bret (2014; 2019) focuses on the history of discussions on scientific language formation and term translation in the context of the French *Bureau de Traduction* with the *Academie des Sciences, Arts et Belles-Lettres* de Dijon [Dijon Academy of Sciences, Arts and Belles Lettres], founded by Guyton de Morveau and specialised in chemical terminology. The work of Claudine Picardet is examined there, as she is described as one of the most experienced translators of French at the time; she also specialised on texts in chemistry and mineralogy, and specifically on the translation of colour terms (Bret 2014: 2019).

Joeri Witteveen (2015; 2016; 2018; 2020) extensive production on language and the history of science is also significant for this thesis. In his articles, the historian of science analyses both Carl Linnaeus and William Whewell's work on scientific language from various perspectives, addressing crucial topics in the formation of scientific language, with which this thesis is also concerned. Lorraine Daston and Peter Galison (Daston and Galison 1992; 2010; Daston 2015; 2016) describe the formation of knowledge and some main logic principles, which can be found also in the literature on terminology theory. Additionally, Steffen Ducheyne (2009; 2010; 2014) analyses Whewell's work in the philosophy of science, as does Laura Snyder (2006; 2011), who focuses on discussions among experts on the formation of scientific language in the 19th century and on the importance of debates among scholars for the progress of science. Specifically, in *The Philosophical Breakfast Club*, Snyder (2011) observes how the 19th-century debates among experts had a decisive role in the formation not only of

nomenclatures but also of the first scientists in England and of the profession overall, in which the discussion and the exchange of ideas were central.

An interest in diachronic terminology and the specialised language of scientific disciplines in the past is shown in recent publications in the history of science. An example of that is the volume edited by the historian of science Marcus Asper (2024), which examines ancient terminologies in disciplines such as botany, medicine, and astronomy. While the volume adopts an historical perspective in the description of terms, a connection with the interests of the present thesis and the diachronic dimension in terminology seems evident. Even if the main perspective is historical, some principles of terminology theory are mentioned, as well as some fundamental works on the subject (see Felber and Budin 1989; Temmerman 2000a). One of the main suggestions of this study would be, in the perspective of future research, to establish a connection between these studies and the theories of terminology.

This brief overview argues that a closer collaboration between Terminology and the history of science could lead to fruitful results for both fields of research. Indeed, from the analysis of some contributions in the literature of the disciplines, it appears that they could both profit of the respective findings, which could complement each other towards a better description of the evolution of terms and concepts in their socio-historical context, as well as of the terminological processes overall.

2.7. Theoretical framework of the case studies

This section introduces the main perspectives on the process of term formation adopted to analyse the case studies in the following chapters (see Ch. 5 to 8), with reference to the existing literature in terminology theory. Specifically, this section claims that term formation was less studied in the existing literature in terminology theory, and it states that a diachronic perspective could help to describe the process more in detail, and through less investigated aspects so far in terminology theory. The following sections propose thus different points of view on the process of term formation, highlighting various factors of and providing the necessary information for a better understanding of the following analysis.

More in detail, section 2.7.1. is dedicated to the role of multilingualism in term formation, variation, and standardisation, while section 2.7.2. examines term translation as a form of term variation and its influences on naming across languages. Section 2.7.3. presents the social dimension of term formation, also known as human agency, illustrated in the discussions among experts on the ideal features of terms. Finally, section 2.7.4. addresses standardisation, or the practice to write guidelines for the formation of nomenclatures and conceptual classifications, as a process which is described as both precedent and part of the overall process of term formation.

2.7.1. Multilingualism-influenced terminological processes

This section explores multilingualism in three different terminological processes i.e., term formation, variation, and standardisation. Multilingualism is addressed from various perspectives in terminology

theory. Rizzo (2023: 8) defines the concept in the context of the European Commission as "the sphere of competences and abilities of societies, groups of people, individuals and institutions to engage on a regular basis with more than one language in everyday life". Various aspects of multilingual communication are addressed in terminology theory in multiple contexts (see Temmerman and Van Campenhoudt 2014). This definition highlights how the diversity generated by the presence of multiple languages contrast with the concepts of uniformity and standardisation traditionally employed in terminology management, particularly at the origin of the first schools of terminology (Budin and Wright 1997). Specifically, Budin and Wright (ibid.) stress the difficulties of language systematisation in a multilingual context. Multilingualism is described in an historical perspective, addressing language diversity as a "natural human impulse"(ibid. 1997: 246). Montiel Ponsoda (2011) deals with multilingualism in ontologies and the systematisation of concepts in different languages, as specialised concepts cannot be translated. They need, instead, an adjustment to a different cultural system. The formation of ontologies is, according to the author, a process in which concepts are systematised as part of a context. Therefore, once the context changes, the conceptual organisation should be adjusted, too. Multilingualism is defined also in opposition to plurilingualism. While multilingualism identifies the use of languages by either one speaker, or a group of speakers, plurilingualism defines a speaker's ability to use more languages in a communicative situation. At the same time, Temmerman (2011b: 164) addresses the intercultural reality of Europe as "functional multilingualism".

Multilingualism is analysed with reference to the context in which it takes place, and in which terms and concepts are formed. As Léon Araúz and Faber (2014) observe, the analysis of the context of terms and concepts is important both in monolingual and in multilingual resources. According to the authors (ibid.) a series of pragmatic factors relates to the context, such as the specialised domain, the culture, and the communicative situation.

2.7.1.1. Term formation and Neology Term formation is defined as the codification of denominations to identify specialised concepts (Myking 2020). The state of the art in term formation is discussed by Myking (2020), who questions how the notion evolves over time, affirming that its study should become more "empirical" and less "normative" (ibid.: 8). Term formation is also described by the processes it involves. Rondeau (1984) distinguishes two types of neologies, defined as *néologie Primaire et Secondaire* [primary and secondary neology], and Sager (1997) conceptualises primary and secondary term formation. Both authors underline the difference between a first process of naming of previously unnamed concepts, and a successive one of naming variation for already named and classified concepts. According to these authors, while the first process is related to the formation of terms and concepts, or neologisms, secondary term formation deals with the naming of already existing concepts and can thus be considered a form of variation.

The formation of terms for newly discovered or defined concepts is referred to as neology (Cabré et al. 2012; Humbley and García Palacios 2012; Humbley 2018b). As a variant of term formation, neology is identified as the formation of terms for newly defined concepts (Cabré et al. 2012; Humbley García Palacios 2012; Humbley 2018b). Described by Rey (1988, in Cabré 1999: 209) as a "dynamic field" which needs to be continuously updated in line with the evolution of knowledge, neology has always been a primary concern of Terminology (Picht and Daskau 1985; Sager 1990). Humbley (2018a; 2018b) investigates the evolution of theories on neology, while Kageura (2002; 2022) questions the features of the formation of terms as part of a detailed attempt to describe rules and patterns of systematicity in the dynamics of term formation. As for its definition, Cabré (1999: 203) describes neology as the creation of a term, which coincides with the appearance of a new concept. The difference between the definitions of term and concept is also worth mentioning. As Myking (2020: 11) states, quoting the ISO Standard 704 (2002: 34): "A term is a designation consisting of one or more words representing a general concept in a special language in a specific subject field" (ISO 704, 2002: 34). The definition of a term is compared in literature to the one of a visual illustration, as both help to describe the concept they identify (Cabré 1999; Faber 2009).

Finally, Sager (1997: 25) underlines an author's intentions and motivations, as well as the "social responsibility for facilitating communication and the transfer of knowledge" in term formation. The role of human agency in term formation, as well as the motivations (Myking 2009), and the role of experts as a social responsibility in forming terms for communication are important aspects in the examination of nomenclatures in the following sections.

2.7.1.2. Term variation and the alternative naming proposals Two aspects of term variation are addressed in the following examples from the historical sources. First, alternative denominations of the originally defined concepts, proposed by other scholars, are illustrated. While further refining the concepts, these alternatives terms represent an advancement of knowledge on the subject. Second, term translation is described as a form of variation. While undergoing a translation into another culture and language, the suitability of terms to denote concepts and allow communication at an international level is proved.

Term variation was not always considered as a relevant process in terminology. As León Araúz and Cabezas-García (2020) recall, the univocal correspondence of term and concept was an essential feature of terminology for Wüster (1979) and of the Vienna School's prescriptive theory of terminology. Only later did successive theorists come to recognise term variation as a relevant phenomenon which could not be disregarded in specialised language. Indeed, in the existing literature in terminology, denominative variation began to gain importance in descriptive and sociolinguistic theories of terminology, as a "greater degree of variability" was accepted (Bowker and Hawkings 2006: 100).

Quoting Pihkala (2001), Faber (2012: 14) describes how the focus of socioterminology on the social and situational use of terms prepared the way for the notion of term variation in terminology theory (Freixa 2022), as term translation in specialised language is investigated as a form of term variation (Léon Araúz and Cabezas Garcia 2020; Fernandez Silva et al. 2011).

Other aspects of terminological variation investigated in the literature include its causes (Bowker and Hawkins 2006; Freixa 2022), as well as its role in the formation of knowledge (Pecman 2012, 2014, 2018). Pecman (2014: 1) describes the connection between term variation and knowledge formation, defining variation as a "cognitive device" for the construction of knowledge, and Humbley and Picton (2017: 2) reflect on the connections between field-specific knowledge and terminological activity. Specifically, the authors underline how experts could "fall back onto domain specific knowledge" when forming terms, owing to their knowledge of the specialised domain. The same relation between domain-specific knowledge and terminology is examined by Sager (1994: 7), who defines terms as "means of knowledge transfer" while addressing term variation as a form of secondary term formation. According to the descriptive theories of terminology of the last decades (Sager 1990; 1997), terms are always used in context. Each context involves multiple factors which motivate the choice of a specific variant. By seeing terms in their context, the monosemic relation of concept and term prescribed by traditional terminology theory (Wüster 1979) should probably be reconsidered as influenced by the context in which this relation is established. At the same time, the arbitrary use of term variants, presumably motivated by contextual factors, should be re-evaluated (Bowker and Hawkins 2006; Rogers 2004).

2.7.1.3. The standardisation process Defined by Wüster (1931) as the aim of his *General Theory of Terminology* (GTT), standardisation was initially a main concern of terminology theory (Wüster 1979; Rondeau 1984; Strehlow and Wright 1993 inter alia), as well as a fundamental process behind efficient communication and the advancement of knowledge according to several authors (Felber 1984; Wüster 2003). However, in recent decades, the prescriptive Wüsterian interpretation of standardisation as requiring a fixed and monosemic relation between the concept and the term (Wüster 1979) has lost strength, with the discipline embracing a more descriptive view of the relationship between concepts and terms, more connected to the reality of language use. This view entails interpretation of language planning as more akin to harmonisation (Gilreath 1992), or *normaison* to quote Gaudin (2003) in Socioterminology, rather than strict standardisation. Recent theories of terminology also re-evaluated the role of speakers in determining the forms of language, seeing standardisation as an agreement on meanings shared by a community of users (Gilreath 1992). Similarly, Faber (2012: 14) defines standardisation as a "chimera" which is impossible to achieve, since language changes constantly.

There are two main aspects of the role of standardisation in the formation of a nomenclature: how the nomenclature relates to the traditional knowledge of a community of users, who collaborate in the creation of standards (Galinski and Weissinger 2010; Van Campenhoudt 2017) and the role of standard terms as "references" (Leonardi 2009: 41) in the codification of knowledge and language.

As Johnson and Sager state (1980: 87), terms can be said to belong to a "structured system of knowledge" possessed by a community of users, who then ratify this knowledge in the form of standards. This shared knowledge is described in the literature as objective (Wüster 2003: 287) as opposed to the subjective view of each member of the community. As Cabré (1999: 194) observes, as ambiguous terminology led to communication issues, 19th and early 20th century experts started to regulate terminology in their respective areas and to become directly involved in the process:

Ambiguous terminology based on polysemy, synonymy and homonymy obviously presents obstacles to communication among specialists and inevitably frustrates efforts to order thought. For this reason, as early as the **19th century**, scientists and, at the beginning of the 20th century, technicians, felt it was necessary to **regularize terminology** in their respective areas and thus became directly involved in the **standardization** process¹². (Cabré 1999: 194)

As the first practices of standardisation appeared in the 17th century (Cabré 1999: 195), the role of regulatory bodies in the creation of standards became increasingly important in the 19th century and with the industrial revolution, as terms were referred to as "the correction of a sociolinguistic situation and the choosing of a specific term as a reference form" (Cabré 1999: 195). Sager (1994: 1) also addresses the role of experts in the codification of terms. Defined as "custodians" of the collective knowledge, these experts agree on a "social norm", or common knowledge of a community, which should be organised into publicly available standards (Johnson and Sager 1980: 84).

After being defined, the standard terms are used as references in the formulation of possible variants, which accompanied the development of knowledge in the field (Leonardi 2009). Following the standardisation process, they become the main reference in the discussion among experts. These references are then used in the creation of terms, or terminological variants, which, to be understood and constructed, need to be described by the scientific community using standardised concepts and terms already known to all. The appearance of term variants seems to naturally follow the standardisation, as standard terms are needed for communication among experts and for the further development of knowledge. The standardisation process and the derived standard terms constituted the basis for the discussion and exchange of ideas among experts, which needed to start from shared concepts and terms. From these communicative situations derived also further naming alternatives for the same concepts, which mirrored the progress of knowledge.

¹² Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

2.7.2. Term translation as a form of term variation

This section is dedicated to term translation across languages and semiotic systems, interpreted as a form of term variation (Freixa 2006; 2022). Both case studies analysed in the historical sources (see Sec. 6.2.) illustrate the translation of designations across semiotic systems i.e., from lexical terms to symbols, letters, and drawings or other forms of representation. In this analysis, two principles are addressed. First, translation of terms not only among languages but also among semiotic systems. Second, term translation is addressed as a form of term variation. A first classification of the forms of translation is proposed by Roman Jakobson (1959), who distinguishes among three forms of translation: intralingual, interlingual, and Intersemiotic:

These three kinds of translation are to be differently labelled: 1) **Intralingual** translation or rewording is an interpretation of verbal signs by means of other signs of the same language. 2) **Interlingual** translation or translation proper is an interpretation of verbal signs by means of some other language. 3) **Intersemiotic** translation or transmutation is an interpretation of verbal signs by means of signs of nonverbal sign systems. (Jakobson 1959: 261)

As Dusi (2015) reports, Eco (2000, in Dusi 2015) proposes a more detailed classification of the forms of translation, adding the further category of intrasystemic translation, in which "the interpretants belong to the same semiotic system as the interpreted expression" (Eco 2001b: 100–101, in Dusi 2015: 183). Different approaches to translation remark the importance of cultural and contextual factors which influence this process (see Bassnett 1980; Hermans 1985; Lefevere 1992, in Dusi 2015: 189). Studies on semiotic profited of the reflection of Charles Peirce, who believed in translation as a process of continuous growth of meaning, starting from the source text (Dusi 2015: 202).

Multiple perspectives are adopted to describe term translation in the existing literature. Among them, Rogers (2015) and Thelen (2015) present an historical perspective on the relation between terminology and specialised translation, L'Homme (L'Homme et al. 2022) examines the use of terms by translation students in the context of Frame Semantics, while Cabezas-García (2021) underlines the importance of context in the translation of multi-word terms. Interestingly, Cabezas-García (2023: 368) refers to the concept of translation equivalence, as defined by Felber (1984), regarding it as impossible in its entirety, and having instead three possible levels of realisation:

[...] total equivalence is often a chimera. For this reason, Felber (1984) identifies different degrees of equivalence: (i) full equivalence (all conceptual features coincide); (ii) intersection (most conceptual features coincide); (iii) inclusion (the concept in the target language is broader and includes the concept in the source language); and (iv) non-equivalence (the concept does not exist in the target language). (Cabezas-García 2023: 368)

Regarding term variation, a similar classification is applied to the use of terminological variants, which are distinguished into intralingual variants i.e., the use of variants within the source language, and interlingual variants i.e., different translation of term variants into other languages (Kerremans 2014).

In the present analysis of term translation as a form of variation, two further principles of terminology are addressed. First, the cognitive dimension of terms as instruments for the advancement of knowledge and the description of concepts or, as Pecman (2014: 1) terms them, "cognitive devices". Second, the sematic differences which are present in term translation across languages, as Temmerman (2008: 11) argues. The practice of describing concepts is addressed in terminology theory by multiple authors. While it is common knowledge that concepts and their definitions are not static (Faber 2012: 14), according to Antia (2000: 113), the definition "fixes the concept" as an independent entity within a conceptual structure, defining its nature and linking it to other concepts. Because of that, instability is a well-accepted feature of conceptual systems and nomenclatures, definitions and concepts descriptions are needed to fix the meaning of concepts. The description of concepts is examined in this thesis (see Ch. 6) through multiple semiotic systems for communication and knowledge advancement.

The mutual influence and contribution of successive nomenclatures in the definition of the official terms are described as contributing factors, to both the formation of specialised language and the knowledge advancement. In this perspective, relevance is given to all proposed nomenclatures, which are considered as equally valuable in their contribution to the history of formation of the scientific language. In addition to this, the practice of describing specialised concepts without naming them with a lexical term - as defined in contemporary terminology theory (Sager 1990; Cabré 1999) – is described as a terminological practice. Indeed, as this chapter argues, this seems to be a preliminary process to the formation of terms.

Lastly, all these parallel designations¹³ i.e., numbers, symbols, lexical terms, and descriptions appear to be involved in the definition of scientific concepts. Therefore, they are presented in this study as possible factors in Sager's (1990: 60) described process of "terminologisation", or the progressive definition of concepts through naming attempts.

2.7.3. The social dimension in term formation

The social aspects of term formation have been mainly addressed in studies on Socioterminology. Among these, Balliu (2005) observes how the language of medicine was influenced by its successive users and was particularly instable over time. The necessity of a multidisciplinary approach to terminology and the study of the context of term formation are central in Socioterminology, as Gaudin (1993a) affirms. Indeed, the theory focuses on the multiple factors which influence term formation,

¹³ See ISO Standard 1087 (2019): <https://www.iso.org/obp/ui/#iso:std:iso:1087:ed-2:v1:en> [accessed January 5, 2024].

such as the social and historical context in which they are created and their users (see Gaudin 1993b; 2005), which are common features to the analysis presented in this chapter. This study shares with Socioterminology the interpretation of terms as part of a dynamic context (Gaudin 2005) in which terms are formed through interactions among their users. In this vision, terms are also constantly updated as part of the human experience of reality and of the creation of knowledge.

There seems to be no study at present focusing explicitly on debates among experts as a process within the formation of scientific language and its description in a diachronic perspective. There are, however, contributions which describe aspects of it, such as the role of experts in term formation, (Rondeau 1984; Kocourek 1991; Myking 2020), its communicative and social dimension (Balliu 2009; Gaudin 1993b; 2005; 2007), and the relation of the processes of naming and classifying and the formation of scientific knowledge (Pecman 2014). Concerning this, Sager's (1997) definition of terms connects term formation and the process of knowledge construction by experts of a discipline:

Terms are the linguistic representation of concepts, the result of the development of **cognitive processes** and **communication** among **experts** of a special language community (Sager 1997: 25)

Sager's (ibid.) description of terms as the result of "cognitive processes and communication among experts" seems to hint at the importance of examining the communication of experts. Fernández-Silva (Fernández-Silva et al. 2011: 49) reports the same quote and defines terms as "the reflection of how knowledge is structured in the expert's mind". Back then as nowadays, scholars discussed the terms to choose, the concepts these should identify, and on how to define terms, based on their meaning. Therefore, the debates are analysed in this study as part of the formation of scientific knowledge.

In terminology theory, the role of terminological practices in scientific discourse is addressed from multiple perspectives (Daille et al. 1996). Among others, Pecman (2014) examines the relation of term variation and knowledge advancement, as she describes terms and term variants as "cognitive devices" (2014: 1) used by experts to form knowledge by explaining concepts and promoting a specific interpretation of them. At the same time, neology in scientific discourse is defined as a rhetorical device, employed by experts to emphasise new aspects of their thought (Pecman 2012).

The relation of language and knowledge is also analysed by Sager (1990: 14), who describes concepts as "elements of the structure of knowledge". The communication of these concepts happens through language, by means of which these are transformed into information. Quoting Nedobity (1989: 169, in Zarnikhi 2005: 294), Zarnikhi claims that language and its content are equally important for the progress of knowledge, and should therefore develop in parallel:

[...] suppose that a scientist is working towards a specific area of science and then a concept takes shape in his mind, what does he need to express his idea? **Language** is like a **container** and **science** is the **content**. (Nedobity 1989: 169, in Zarnikhi 2005: 294)

Zarnikhi (2005) observes that term formation could perform a twofold function for the scientific community: it constructs concepts in the experts' minds, and it collaborates to disseminate scientific concepts within the community.

The present analysis wishes to illustrate the communicative dimension of terminology, which Sager (1990) describes as related to real contexts of use of terms and to communication among experts. In a chapter dedicated to the communicative dimension of terminology, Sager (1990: 99) also illustrates the use of terms in a model of specialist communication. According to Sager, a successful communication among specialists is dependent on three choices of the sender in formulating the message: the choice of intention, the selection of knowledge, and the choice of language (Sager 1990: 102). First, the choice of intention of the sender must be commensurate with the recipient's expectation. Normally, as Sager (*ibid.*) states, in a specialist communication, the intention of the sender is to inform the recipient by "augmenting, confirming or modifying his current state of knowledge". Second, the selection of knowledge within a specific subject field is described as a choice made by the sender to provide the recipient with new information. According to Sager (*ibid.*), indeed, the choice of knowledge in an informative communication presupposes both a more specific knowledge by the sender, and the fact that the same is recognised with an authority to inform. The choice of knowledge is situation-dependent (Sager 1990: 103), and that to be able to make this choice, the sender must be aware of the state of knowledge of the recipient. Lastly, the sender chooses a language which the recipient can understand. At this point, Sager refers to standardised terms in a specialised language which the sender can use to make sure that they refer to the knowledge he shares with the recipient.

In discussing the communicative dimension of terminology, Sager (1990) highlights the role of experts in term formation i.e., human agency in these processes (see Humbley 2018b; Myking 2020). As Fernández-Silva et al. (2011) address the role of the scientific community in term formation:

Terms, the linguistic representations of concepts, are created by a particular **language community** which needs to communicate the knowledge it has produced. [...] terms are also the final step in concept formation and contribute to the development of cognitive processes. (Fernández-Silva et al. 2011: 51)

The vision of terms as results of the process of discussion is fundamental for this study. Indeed, the previous quote remarks the importance of connecting terms and knowledge formation, through the cognitive and communicative activity of experts who create language and knowledge simultaneously (Fernández-Silva et al. 2011: 51). Literature to date seems to entail either studies which focus merely on terms, without the cognitive and social processes through which they are formed; or on the reconstruction of the history of single terms (Temmerman 1995; Van Campenhout 1998). An attempt to describe term formation in a diachronic perspective and as the definition of concepts through naming attempts is due to Sager's (1990: 60) process of "terminologisation". This definition is detailed

in further works, which examine successive stages of this process, such as the "de-terminologisation" (Meyer and Mackintosh 2000: 11), also referred to as "necrology" (Dury and Drouin 2011: 19) i.e., the phase in which terms ceased to be used.

Parallel to terminology theory, the formation of scientific language and of systems of organisation of knowledge have been investigated in the history of science. Regarding the debates among experts, numerous studies deal with the chronological reconstruction of famous discussions in different disciplines. Among others, examples of these are McOuat (1996; 2001a; 2001b) reconstruction of the debate regarding Strickland's (1837a) *Rules for Zoological Nomenclature*, or Bret's (2019; Bret and Chappey 2018) studies on discussions among experts on the nomenclature of colours and its translation. All these studies represent historical reconstructions of the events, and they thus constitute a chronological basis for the terminological analysis proposed in this thesis (cfr. Ch.7).

2.7.4. The practice of writing rules for naming

This section focuses on the description of a necessity of standardisation, as part of the process of "professionalisation of science" (Ellis 2014: 777), or "the invention of science" (Cunningham 1988: 385). Specifically, this section describes the process of writing rules for nomenclature, as a prescriptive stance, to regulate the lexicon of a discipline. This section explains what the rules of term formation are within the theory of terminology, and it illustrates what has been written about this in literature to date, to use these texts as a framework for the analysis of the historical sources.

Rules for term formation are proposed by Wüster (1931) as part of the *General Theory of Terminology* and the creation of rules for naming are part of the activity of the International Standardisation Organisation, founded by Wüster in 1951. Specifically, the ISO Standard 704 entitled *Terminology Work: Principles and Methods* (1987: 38) describes the nature and principles of term formation. These principles are listed as: transparency, consistency, appropriateness, linguistic economy, derivability and compoundability, linguistic correctness and preference for native language. As Cabré (1999) recalls, in 1968, also the ISO Standard R860 was approved by the ISO TC 37, as *Principles for Naming* which "sets forth principles that new units should adhere to and recommends favouring term formation processes that unify terminology in different languages" (Cabré 1999: 212). The Standard prescribes that "the literal sense of a term should reflect the characteristics of the concept it names", or that "Complex terms can be considered to be abbreviated definitions" (ibid.).

Quoting Cabré (1999), the ISO Standard R870 (1968) shows interesting similarities to the rules for naming that the experts discussed in the 19th century. The ISO Standard (1968) evolved in the current version as the ISO 704 (2022) but entails the same principles to regulate naming methods. Besides this, other contributions to terminology theory discuss the definition of terms and their distinctive features when compared to general language words (Sager 1990; 1998-99). As Candel (2022)

remarks, standardisation, and the creation of rules for naming are fundamental parts of Wüster's *General Theory of Terminology* (Wüster 1931):

He strove to harmonize international terminology while working together with other countries to establish **international norms**. He claimed that **standardizing** individual denominations needed unified and cross-linguistic guidelines from the *Allgemeine Terminologielehre* or terminology in general. Thanks to this type of action, many basic ISO standards in Terminology and Lexicography were developed in the space of twenty years by 43 countries and 35 organizations, including the UNESCO¹⁴. (Candel 2022: 49)

The topic is thus framed in this section between the prescriptions of Wüster's (1979 [1991]) *General Theory of Terminology*, and the process of standardisation (Cabré 1999). More in detail, this study does not aim to explain the choice of terms by the scholars, and it focuses instead on some principles of term formation and on the description of the main features of terms, according to the 19th-century scholars. These features are then compared to the ones described in literature in terminology theory.

In terminology theory of the 20th and 21st centuries, starting with the *General Theory of Terminology* up to the modern prescriptive views, terms are created through a process governed by precise principles, in which the expert community defines their distinguishing features as part of a specialised language, and which distinguishes term formation from the creation of general language words (Cabré 1999; Faber and López Rodríguez 2012). As Sager (1997) states, a lack of arbitrariness characterises term formation, which is instead governed by principles defined by the scientific community and shared by all its members. As Sager (1997) observes, in term formation, experts need models, or patterns to rely on, which also distinguish terms from words:

Term formation [...] is a **conscious human activity** and differs from the **arbitrariness** of general word formation processes by its greater awareness of pre-existing patterns and models and of its social responsibility for facilitating **communication** and the **transmission of knowledge** (Sager 1997: 25).

The intentionality of term formation differentiates it from the creation of general language words (Sager 1997). Besides this, existing patterns inspired the experts in term formation, as they are responsible for coining terms to foster communication and allow knowledge transmission.

The definition of the nature of terms and their distinguishing features when compared to general language words has always been a main concern in terminology, as well as their relation to the corresponding concepts (Sager 1998-99). In connection to this, Rondeau (1984, in Humbley 2018b: 442) distinguishes term formation from the creation of words:

For Rondeau, the distinction [...] between **word** and **term** was reflected directly in the way the two were formed. For the latter, Rondeau postulated three major characteristics: that neonyms, as he called them, are

¹⁴Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

characterised by **collective awareness** of a **group** of **enlightened speakers** (i.e., the **specialists**), usage which can largely be accessed through the literature, and dating the new terms in the latest reference works, mainly specialised dictionaries. (Humbley 2018b: 442)

Rondeau's reference to the role of "enlightened speakers" and their "collective awareness" (ibid.) in shaping terms underlines the importance of elaborating collective guidelines for term formation, towards the future development of the discipline. In this, not only the central role of experts is highlighted, but also the collective character of the practice. Shared features should be formulated and acknowledged by all members of the community, so that individual initiatives and self-established habits can be avoided. The formation of terms is also connected to the organisation of the specialised concepts they refer to, in a form which could be unequivocally shared throughout the scientific community. Addressing this relation, Sager (1997: 26) specifies how the knowledge structure of a subject field should be *mirrored* in a system of conceptual relations and therefore in its nomenclature:

[...] the inherent **knowledge structure** of a subject field can suggest through its internal relations the preferred patterns for combining linguistic elements into terms. In an ideal situation, term formation obeys **strict rules** that **mirror** conceptual relations as far as the linguistic rule system permits. (Sager 1997: 26)

By addressing language planning and knowledge management in a discipline, Antia and Ianna (2016) also refer to scientific language as the means to expand the existing language of a domain to subjects for which no term existed before:

Terminology development refers to a process of functionally extending, especially, the lexical semantics of a language into new domains. The purpose is often to facilitate **communication** of specialised knowledge units or knowledge structures that were either previously non-existent in the conceptual universe of **speakers** of a certain language, or unattested in a form considered adequate for new demands of communication (Antia 2000, 33 in Antia and Ianna 2016: 61).

According to this definition, terminology not only designates the existing concepts through terms, but it also expands knowledge by creating terms for newly formulated concepts. In relation to this, Zarnikhi (2005) suggests three criteria to measure the evolution of specialised language. Among them, standardisation is described as the attempt to reduce loan words and concepts, and therefore refine the conceptual structure and language of a domain.

Standardisation has been attended to in different manners in literature, as one of the main aims of terminological work (Meyer 2022). In opposition to Wüster's (1931) *General Theory of Terminology*, with univocity and uniformity as its defining features, the sociocognitive and frame-based theories of terminology did not regard it as an achievable aim, describing it as a "chimera" (Faber 2012: 14) which could not be reached, as real language changed constantly. Temmerman (2000a) shares the same position, confirming that terms and their meaning change continuously over time. To the contrary

of that, Cabré (1999: 195) discusses standardisation as the process of "correcting" the sociolinguistic situation of language and designating a term as a reference form for a concept. Cabré (1999) underlines how standardisation aims at efficient communication, since its earliest forms which, according to the author, can be traced back to the 17th century. Cabré (1999) also states how the standardisation process relies on shared rules, formulated by regulatory bodies. In reference to standardisation, also the uniformity and coherence of terms in a nomenclature could be recalled from contemporary terminology theory (Van Campenhoudt 2017; Faber and Montero Martinez 2019), as part of an attempt at standardising the terms in a discipline (Johnson and Sager 1980).

To conclude, it is necessary to emphasise that when 19th- century scholars discussed the desired terminology for specific concepts, this should indeed be interpreted within the context of standardisation or, an agreement regarding the use of terms. In this light, principles of term formation, as presented in the *General Theory of Terminology* (Wüster 1931), can effectively serve as a framework for analysing and describing the various cases.

2.8. Summary of the contents

In this chapter, I presented a state of the art in literature in terminology theory, as far as the principles and theories relevant for this study are concerned. The chapter attempted to shed light on less investigated topics in the literature in Terminology, such as the diachronic perspective in the study of terms and their evolution, and the process of term formation, as this study would like to contribute to their further description. At the same time, the chapter presented the aspects of term formation and variation which are discussed more in detail in the following analysis and through the case studies selected in the historical sources (see Ch. 5-8). While this theoretical framework did not aim to provide a complete overview of the existing literature in Terminology, it highlighted important texts on these subjects from the literature to date. Concurrently, this chapter aimed to describe the theoretical framework in which this study is set, to help its contextualisation and the comprehension of the topics analysed in the following chapters.

Lastly, this framework wished to position this thesis within contemporary research in terminology theory, since the time seems to have come to look back at the most important theories of Terminology of the last decades, and to find new and possibly better interpretations of them.

3. Historical context

3.1. Introduction

This chapter presents the historical context of this thesis i.e., the first half of the 19th century in Europe. It highlights some of the factors which influenced naming and classification processes, as well as the organisation of knowledge into scientific disciplines as we know them today. The aim is to provide the reader with the necessary information to contextualise the case studies, in the chapters that follow.

After a general introduction, the chapter is divided into three main sections: section 3.2. focused on some premises of the 18th-century practices of naming and classification, and specifically on the work of Carl Linnaeus. Section 3.3. introduces general factors, such as the work of the scientific societies, the impact of the concept of evolution of the species in the 19th century, the diffusion of prints and periodicals, the organisation of knowledge into dictionaries and encyclopaedias, and the formation of scientific disciplines and method, as they are considered relevant for the development of the terminological processes, which this thesis aims to describe. Finally, section 3.4. focuses on the specific contexts of formation of the disciplines from which the main case studies of analysis are presented i.e., meteorology, mineralogy, and physics, while the context of the other examples is touched upon. To conclude, while section 3.5. underlines the importance of interdisciplinarity in the activity of 19th-century scholars, as disciplines were being defined, and the interests of experts in the formation of scientific language, extended much further than the single research fields, section 3.6. summarises the contents of the chapter.

3.2. The premises for the development of scientific language

This study is set in the first half of the 19th century (1800 – 1850), which has been identified as the age of codification of scientific disciplines, through the systematisation of knowledge into terms and nomenclatures, and thus also termed the "age of classification" (Yeo 1991: 26). As for its geographical context, while the primary sources used are mainly located in the United Kingdom, the study covers the circulation of knowledge among experts throughout Europe and in a number of languages.

As Lightman and Zon (2014) observe, while in Victorian England the culture of science and the humanism were complementary to one another, each field of research appeared to be experiencing the need to structure its own knowledge into official and shared systems, such as nomenclatures and classifications. In this context, shared terms were fundamental for efficient communication and knowledge exchange, both at a national and at an international level (Willis 1844).

In the 19th century, fields of expertise that had been considered the preserve of amateurs, such as mineralogy and meteorology, organised their knowledge into shared nomenclatures and classifications, to be recognised as independent disciplines (Lightman 2011; Lightman and Zon 2014), and these systems of classification are still in use today, as the historians of science confirm (Daunton

2005). Regarding this, Lightman and Zon (2014) underline science and culture influenced each other, with literary production influencing science as well.

The origin of the formation of scientific language lies in the interest shown by experts in Europe in the late 17th and 18th centuries for naming and classification, starting first and foremost with the work of Carl Linnaeus (1735) in Sweden in the fields of biology and zoology. Linnaeus was a pioneer of naming and classifying (Skipton-Long 2018) and was known in Britain as "the father of natural history" (Yanni 1997: 211), for his work on botanical species, while he also played an essential role in the discussion on the nomenclature of zoology in the mid-19th century (McOuat 1996). Linnaeus was also known as "the father of modern taxonomy" (Calisher 2007: 268), thanks to the diffusion of his binominal nomenclature of botanical species which, even if already used by experts, was made popular through his volumes. Consequently, the field of botany set an example for other disciplines thanks to Linnaeus' taxonomy and binominal nomenclature.

As a further innovation from the 18th century, both Jean-Baptiste Lamarck in France, a naturalist, biologist and academic, and Carl Linnaeus in Sweden used pictorial comparative taxonomies to describe their objects of study in all their variants (Skipton-Long 2018). These variants were opposed to the "static nature of previous terminology" and classes, which did not involve an inherent evolution (ibid.:177). Eventually, the foundations of these works lay according to Skipton-Long (2018) and Yanni (2014), in Aristotle's concept of living beings on a "climbing scale", also known as "The Great Chain of Being" (Skipton-Long 2018:177), in which life is a constant progress towards a better form.

Another crucial event in the formation of scientific language in the 18th century was the revision of chemical nomenclature by the French Chemist Louis-Bernard Guyton De Morveau in his book *Méthode de Nomenclature Chimique* [Method of Chemical Nomenclature], who was thus credited with Berthollet, de Fourcroy and Lavoisier with the first method for chemical nomenclature (Guyton De Morveau et al. 1787). Guyton De Morveau's nomenclature was translated into German by Jons Jakob Berzelius and adapted to the German language. Over the years, the French school of chemistry, continued the discussion in the *Académie des Sciences, Arts et belles Lettres de Dijon* [Dijon Academy of Sciences, Arts and Belles Lettres], which was originally founded in 1725 by Hector-Bernard Pouffier (see Bret 2014; 2019). Numerous volumes on chemistry and mineralogy were translated at the Académie, such as Abraham Werner's (1774) works on the classification of minerals, which shaped scientific nomenclatures across the European languages (Bret and Chappay 2018).

In combination with other achievements, these events of the second half of the 18th century could be considered as the premises to naming and classifying in the first half of the 19th century, as well as the motivation behind the development of an interest in these processes. The 18th century also saw the development of practices of knowledge organisation such as the writing of dictionaries and encyclopaedias (see Sec. 3.3.4.). The structuring of knowledge related to the classification of concepts,

which needed to be named. Besides this, these observations were connected to the development of a scientific and observational method in different disciplines. Indeed, the application of a scientific method and the discussion of founding principles contributed to the scientisation of disciplines, in which experts wished "to make their work methodical [...]" (Yanni 1997: 207).

3.2.1. The beginning of scientific naming

The research on naming and the classification of knowledge began much earlier than the 19th century (Leech 2002). Naming and classifying were originally inspired by the work of Carl Linnaeus (1735) in botany and zoology and Diderot and D'Alembert's (1751-1765) concerns in the *Encyclopédie* about the "standardisation of the artisan world" (Leech 2022: 1). As Winston (2018) observes, these works seemed to have influenced the development of classifications in all research fields and were considered as the beginnings of scientific naming:

Linnaeus **standardized** the system almost accidentally by beginning to print a nomen trivale, a unique two-word combination for every species [...]. He used this system consistently for plants in the 1753 edition of his *Species Plantarum*, and for animals in 1758 in the 10th edition of his *Systema Naturae*. These two dates are still taken as **the beginnings of scientific naming**. (Winston 2018: 1123)¹⁵

Numerous achievements in other disciplines of the 17th and 18th century could be considered as premises of the development of scientific language in the 19th century (Leech 2002). Among these, as Leech (2002) observes, many principles later developed in the contemporary discipline of terminology were already present in the reflections of John Locke (1690) at the end of the 17th century, in his *Essay on Human Understanding*. Addressing the origin of 19th-century naming, Ohl (2019: VII) describes it as "part of our perception of nature", categorising it as part of the process of scientific discovery. In this process, and in all natural sciences, Ohl states how an object was first described through known features, and consequently classified and named:

Each one has a name, which is usually provided in the form of a **label**. It is through its name that the individual is bestowed with **meaning**, and it is through its **naming** that it becomes part of our perception of nature. **Names** perform the function of **verbal tags** that can apply to any imaginable biological entity. Species, which serve as the most important unit of generalization in the natural sciences [...]. The standardised and distinct **linguistic designation** of species follows right on the heels of scientific discovery: one can only **name** what has been discovered and recognised. (Ohl 2019: VII)

According to Ohl, names were "labels" with meaning, which connected the natural object, or concept, to existing knowledge. Naming, and therefore also the classification of the object, followed its discovery. Only through naming, could the object be recognised within a system.

¹⁵ Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

Linnaeus decided to focus on nomenclature using Latin. Latin had been the *lingua franca* and main vehicular language for scientific communication for centuries and continued to be used in the 18th and early 19th centuries as the main language of term creation. However, in the first half of the 19th century, nationalistic currents started to emerge, in which the possibility of employing national languages for scientific naming such as English and French were discussed. In time, an increasing number of nomenclatures and classifications were proposed in national vernacular and without Latin equivalent terms or translations (see Forster 1816).

3.3. The context of naming in the 19th century

This section introduces some historical factors which contributed to the practices of naming and classification in the historical context of the case studies analysed in this thesis i.e., the first half of the 19th century (1800 – 1850). While a general illustration of the historical context of the 19th century is not the aim of this chapter, some factors are mentioned, as they are considered relevant to understanding the progress of the practices of naming and classifying at the time. This aims to provide the reader with an overview of the historical situation in which the case studies were situated. With this purpose, the factors presented in this chapter are supposed to be integrated with the introduction to the analysis chapters of the thesis (see Ch. 5-8).

3.3.1. The scientific societies and the definition of "social network analysis" in history

The work of the scientific societies and associations across Europe was fundamental for the discussion of nomenclature and classification proposals during the 18th and 19th centuries, as was the one of the guilds i.e., the associations of artisans and merchants. Each society or association usually had its own publications, which made a significant contribution to the diffusion of naming proposals, as well as to the promotion and discussion of newly published volumes in the own country and abroad:

Scientific societies have always been closely associated with Western science; the foundation, in the 17th century, of the Accademia del Cimento, the Royal Society of London, and the Academie des Sciences is usually cited as one proof of the emergence of modern science in that era. (Bastalla 1967: 618)

These associations were extremely significant in the development of the terminological processes described in this thesis. Among them, the *British Association for the Advancement of Science* (BAAS) was responsible for the formation of the Committee for the Revision of the Nomenclature of the Stars (see Herschel, Whewell, and Baily 1844), while the *Académie des sciences, arts et belles-lettres de Dijon* [Dijon Academy of Sciences, Arts and Belles Lettres] played a crucial role in the translation and diffusion of the new nomenclature of mineralogy from Germany to France and then to the rest of Europe (see Werner 1790). These associations were often responsible for important publications and periodicals. Indeed, an efficient communication among experts at a national and at an international level was early

recognised as fundamental for the development of knowledge (Bastalla 1967) and scientific publications were identified as one of the most efficient "channels" for the diffusion of scientific knowledge:

Channels must be opened to **facilitate** formal **national** and **international scientific communication**. This can be accomplished by founding appropriate **scientific journals** and then gaining their widespread recognition. (Bastalla 1967: 618)

The scientific societies and their publications were fundamental for the dissemination of the scientific discussion, as this was naturally connected with the diffusion of print media at the time. Through the possibility to print a great deal of volumes and journals the diffusion of scientific theories and discoveries in the European scientific community became easier during the 19th century.

In this regard, the definition of a "social network analysis" proposed by Sigrist and Widmer (2011: 347) should be mentioned as a method to describe the network of connections among scholars from the 18th century, which seemed to represent an important factor in the development of the terminological processes this thesis aims to describe:

The use of **social network analysis** to develop a better understanding of research practices is now fully acknowledged in natural history (Spary, 2008). In the specific field of botany as in others, the introduction of a network perspective implies the acceptance of a conception of science as being a matter of **interactions between scholars** as well as a succession of theoretical paradigms. The obvious consequence is to shift the focus of historiography from the traditional investigations into ideas, theories, and discoveries to the analysis of the **social organization of research**. [...] this means that epistolary exchanges, transfers of specimens and other **social intercourses** have suddenly come to the forefront (Dauser & al., 2008, in Sigrist and Widmer 2011:347).

The network defines the connections among experts from different disciplines, which were fundamental for the development of knowledge. As will become clear in the analysis of the primary sources, discussions among scholars with experience on different aspects, as well as the exchange of knowledge which followed their interactions, was crucial for the definition of terms and concepts. As Sigrist and Widmer (2011) observe, this aspect, specifically in its interdisciplinary declination, might have been long overlooked in historical studies and not properly valued as a declination of human agency in terminological research.

3.3.2. The concept of evolution in Victorian Britain

Another important factor to understand the development of scientific knowledge is the theory of evolution, and how this was addressed in Britain during the 19th century.

Lightman and Zon (2014) provide an overview of the interrelation of the concept of evolution and the cultural context of 19th-century Victorian Britain. The cultural situation in Victorian Britain was

characterised by a fervent debate on life and evolution. There, the scientific method was being developed, based on the observation and description of reality, which was in constant change. Concurrently, other disciplines, such as history of art and architecture, were rethinking their principles and adopting an observational method, aiming to be recognised as scientific and gain authority in the scientific community (Lightman and Zon 2014).

To achieve this, principles, theories, and methods of the discipline needed to be updated and remodelled on the example of authoritative natural sciences such as biology and chemistry. This phase was characterised by the discussion of the concept of evolution in each area of knowledge, derived from a closer observation of reality (Yanni 2014: 227). As Yanni (2014) describes, evolution was of paramount importance in the Victorian culture as, starting from Charles Darwin's theory (1861), it was taken up in all disciplines. Darwin's theory – first defined by Herbert Spencer (1864: 444) as the principle of the "survival of the fittest" – was not the only evolutionary theory at the time. Instead, scholars of various disciplines reflected on evolution and progress in life. This resulted in an array of evolutionary theories in the first half of the 19th century, which emphasised contrasting aspects of evolution (Lightman and Zon 2014). In Yanni's (2014) view, Victorian culture tended not to sympathise with Darwin's theory of natural selection, which was seen as too materialistic. His non-deterministic vision of the development of life with no purpose, merely determined by natural factors and by the living beings' capacity to adapt to the environment was not well received. However, since the concept of progress towards a final purpose was firmly part of the British culture, alternative theories trying to explain the evolution of living beings emerged.

As Lightman and Zon argue (2014), in the Britain of the industrial revolution, the main aspect of these theories was the development of life towards a better future: evolution was accepted only when it could be seen as an improvement. This interpretation was strongly influenced by Christianity and its theological view of a final salvation, which had a most significant place in culture at the time. Through a final purpose, these theories implicitly allowed the presence of a pre-determined project of God for all living beings to evolve towards a better future.

It is important to observe, how theology was of paramount importance in the culture of the time. In universities, theology was studied, and other aspects of culture were implicitly connected to it (Lightman and Zon 2014). Victorian culture was not only deterministic, as it searched for a cause of every event and did not believe in causality, but also teleological. This teleological view depended on the presence of God as the main force involved in the progress of evolution (Yanni 2014). In other words, science was accepted if it did not deny God's existence.

In 1844, Robert Chambers' (1844) *Vestiges of the Natural History of Creation* became a huge best-seller (Yanni 2014: 235), mirroring its contemporary cultural situation. The volume based on the conception of a series of advancing phases of development of the living being, culminating in a state

of perfection. As Yanni (2014) underlines, Chambers' theory of evolution became the most popular in Victorian Britain as it seemed to give progress a purpose. To Darwin's (1861) atheist theory of survival, Victorian culture preferred a deterministic theory of evolution, such as the one expressed in Spencer's *Principles of Biology* (1864). It was indeed preferable to believe that nature tended towards a better future, instead of sharing Darwin's view of a brutal evolution and elimination of the unfit due to practical reasons (Lightman and Zon 2014).

In line with this, Lightman and Zon (2014) address the issue of lexicon in Victorian Britain. The evolutionary perspective pervaded all disciplines at the time. Consequently, a new vocabulary was needed to express these ideas. Therefore, parallel to the theoretical discussion, a linguistic debate emerged in almost all disciplines about the new lexicon to adopt:

Many writers in the second half of the century came to believe that **evolution** constituted the law of things as they are, and this belief transformed their view of human nature [...] Darwinian theory raised questions for both novelists and scientists about the **suitability** of the **current lexicon** to capture the dynamic reality now revealed by evolution. (Lightman and Zon 2014: 9)

As Yanni (2014) argues, this discussion involved all scholars in different ways, mutually influencing one another. A positivist, and deterministic view of evolution was preferred in all cultural circles, starting the process of "scientisation" of disciplines (Yanni 1997: 207).

3.3.3. The diffusion of print and periodicals and the importance of discussion

According to Karl Popper "criticism was essential for the development of knowledge" (Cantor and Shuttleworth 2004: 9). The diffusion of print and periodicals in the 19th century contributed decisively to the debate among experts on naming, of which criticism was a fundamental component. The possibility to publish scientific theories, as well as nomenclature and classification proposals, thus seemed to contribute to the development of knowledge (Dawson and Topham 2020a).

As Dawson and Topham (2020b: 35) observe, "Nineteenth-century Britain witnessed a sizable expansion in the number and variety of science and medicine periodicals", and they list some of the causes of this, such as the cheaper printing costs and the expansion of the reading audience. It was in fact, only at the end of the 19th century that periodicals started to target primarily scholarly readers in universities. All the processes described in this thesis seem to be part of a general discussion across disciplines and languages on the terminological processes involved in the construction of scientific language. Cantor and Shuttleworth (2004) provide a useful overview of the role of periodicals and discussions among experts for the development of knowledge, and therefore also of the terminological processes this thesis focuses on:

The nineteenth century witnessed [...] the substantial growth and differentiation of the **general periodical press**, [...] profound changes in the nature and practice of all aspects of science. It is tempting to concentrate

on such major innovations in scientific theory as Darwin's theory of evolution and the conservation of energy; however, by so doing we are likely to overlook the crucial changes that were occurring in **conceptions of science** and in the way science was constructed for non-expert readerships. One indicator of this process was William **Whewell's** coining of the word "scientist" in the mid-1830s to identify an increasingly self-conscious group who studied the natural world but sought to distance themselves from the outmoded term "natural philosopher", with its connotations of dilettantism. (Cantor and Shuttleworth 2004: 2)

As Cantor and Shuttleworth (2004) observe, the historical context of these developments was not only characterised by Darwin's work or the great scientific discoveries, but also by a new conception of science, which was formed in the 19th century. Therefore, numerous factors need to be considered, to illustrate a context in which the scientific method was not just communicated, but also "given definition, to a greater or lesser degree, in the pages of the periodical press" (Ibid.: 4). As the same authors point out (ibid.), periodicals had a crucial role in fostering the discussions among experts and thus through naming and advancement proposals, in the formation of concepts:

Periodicals [...] can register changing **cultural conversations** more clearly than books. They also operate according to different temporal patterns and in response to a different range of external pressures. Editors must fill each issue, publish it on time, keep the periodical financially profitable, publish material that will attract readers, and yet be careful not to offend them too much by disseminating unacceptable opinions. A hard-fought **controversy** on a prominent issue could only boost sales. (Cantor and Shuttleworth 2004: 8).

The periodicals analysed in this thesis provide evidence of multiple popular controversies among experts of various disciplines. These were, indeed, fundamental for the reconstruction of the development of naming and classification proposals.

3.3.4. The organisation of knowledge into dictionaries and encyclopaedias

The organisation of knowledge in the 18th and 19th centuries was not carried out exclusively through the formation of scientific disciplines, but also through the creation of dictionaries and encyclopaedias.

The experts' attitude towards the organisation of knowledge changed from the late 18th to the early 19th century (Yeo 1991). Diderot and D'Alembert (1751-1765) *Encyclopédie* and others were mainly concerned with the creation of a universal knowledge, which would, among other aims, reduce the number of volumes and publications. On the contrary, experts in the early 19th century started to be more interested in the categorisation of knowledge both into structures and volume, and into scientific disciplines and communities. The two opposite tendencies were present, according to Yanni (1997) in the years between the two centuries throughout the European scientific community. As Yeo (1991) reports, the encyclopaedias of the 18th and 19th centuries were characterised both by their ability to organise knowledge and by their interdisciplinarity, which the volumes shared with the scientific discussions among experts:

[...] in most eighteenth-century encyclopaedias, [...] although there was cross-referencing, [...], terms were not exclusively owned by particular subjects; rather, the emphasis [...] was on multiple cross-connections. The combination of the larger systems with the practice of **cross-referencing** [...] significantly contributed to the profile of major subjects or **disciplines**. Indeed, the third edition had drawn the distinction between these systems and the "**various detached parts of knowledge**," [...]. (Yeo 1991: 41-42)

As will become clear in the analysis of the primary sources, the interdisciplinarity of scientific activity appears to have been a constant in the 19th century. As Yeo (1991) states, in the 19th century, disciplines were delimited, and experts recognised for their role in specific fields:

From the early nineteenth century [...] the notable feature of major British encyclopedias [...] was the presentation of detailed entries on scientific disciplines by expert contributors [...]. This **emphasis on discrete** areas of expertise was apparent as early as the *Encyclopedie Methodique*, the successor to the work of Diderot and D'Alembert, which commenced in 1782. [...] "the modern world, in which certified experts rule over carefully demarcated territories." It is significant that this form of presentation occurred in the period that is now seen as the point of transition from eighteenth-century natural philosophy to the emergence of modern **scientific disciplines**, perhaps marking a second scientific revolution. (Yeo 1991: 43)

This is significant for the organisation of knowledge at the time. Not only were the fields of study first defined, but also the professional role of experts was shaped, as they were identified as "certified" personalities with experience in the field. This happened when a more general natural philosophy was substituted with the modern discrete scientific disciplines, identified as the "Second Scientific Revolution" (Ibid.). Although already introduced at the beginning of the 20th century, the concept of Scientific Revolution was popularised in the work of Thomas Kuhn (1970) in the mid-20th century (Baracca 2018). Among the numerous innovations to scientific language Whewell introduced, the history of the two terms, as the ones of many at that time, reflected the necessity to name and employ a concept in discourse, which was not there before.

3.3.5. The construction of scientific disciplines

As Roberts (2021) reports, the historian of science Robert Kohler provides a definition of scientific discipline, while describing the origin of Biochemistry:

[...] **Disciplines** are political institutions that demarcate areas of academic territory, allocate the privileges and responsibilities of expertise, and structure claims on resources. They are the **infrastructure of science**, embodied in university departments, professional societies, and informal market relationships between the producers and consumers of knowledge. (Roberts 2021: 45)

To this definition, Roberts (ibid.) opposes Michael Foucault's (2005) idea of "disciplines as mechanisms of power". Roberts (2021) expands the definition with the difference between discipline and field, as well as pointing attention to the cooperation among actors and visions in a specific area of knowledge:

[...] a definitional distinction between "discipline" and "field", [...] separated out questions of epistemological and methodological development as relevant to the study of scientific fields and pointed the study of disciplines toward two historiographical principles. First, physics (and other disciplines) should be understood "as constituted by a multitude of actors" versions [...]. Second, "discipline" should "refer to a particular pattern of **socio-institutional knowledge** and **production** that involved specialist periodicals, societies, institutions, positions, qualifications, and pedagogies". (Roberts 2021: 45)

Referring to Yanni's (1997: 207) definition of "scientisation", the organisation of such disciplines according to a scientific method of research was a main factor in the 19th-century context. To properly describe this process, however, a first distinction should be made between traditional, or already existing, disciplines in the 19th century, and the newly established or emerging ones. While the traditional disciplines questioned their organisation and method, through an analysis of their language and conceptual organisation; emerging ones tried to establish their independence through the formation of an independent nomenclature and conceptual classification, as happened in the case of crystallography and mineralogy, through the work of Friedrich Mohs (1820).

As Dubois (2016) recalls, the definition of discipline as we intend it nowadays dates back to 18th-century Europe, and specifically Germany. In the 19th century, science was conceptualised as a "cognitive dynamic" as well as a "delimited institutional space" devoted to scholars sharing the same professional values (ibid. 2016: 2). The fact that most scientists in the 19th century did not do research as their main occupation should also be remembered. This is another major factor to be considered in the present analysis, and the reason why, many experts involved in the discussions on names were working on many topics at the same time:

At that time, not only was **scientific research** still practiced on a limited demographical scale, but science was not the main occupation of early practitioners of science. Historians of science have described the German origin of this transformation (McLeeland 1991) but also questioned the illusory simplicity of the notion of "professionalization" commonly used to describe this transformation (MacLeod 1972; Porter 1978; Goldstein 1984; Broman 1995; Golinski 1998; Barton 2003). (Dubois 2016: 3)

The notion of discipline referred at the time to a "specific area of specialized knowledge associated with a specific form of collective control over its production and diffusion", which can also be associated with the contemporary definition of discipline (Dubois 2016: 4). But other scholars, saw discipline as a "key unit of internal differentiation in science", i.e., a delimited set of individuals working

as researchers but also as teachers within a specific cognitive perimeter (Ibid.: 5). In the same article, Dubois recalls the origin of the division of knowledge into disciplines, in the 18th-century Germany:

The disciplinary **differentiation of science** is based on the organizational growth and the organizational pluralization of science. In Germany, the first country to witness disciplinary differentiation, organizational growth appears to have been the more relevant causal condition. In the 18th century, the University of Göttingen was the first instance in which considerable growth in the provision of organizational roles, in particular in the philosophy faculty, was accompanied by a readiness to accept increasingly specialized **descriptions of professorial chairs**. (Stichweh 1992: 9, in Dubois 2016: 5)

To introduce the sources analysed in the following chapters, it is worth noticing that the differentiation of science and disciplines which started in the 18th century, appears not to reflect the scientific activity of experts, such as William Whewell and John Herschel. In fact, as the primary sources show, the activity of these experts ranged across fields of study, in which they were interested beyond their main occupation. Particularly regarding the formation of scientific language, a certain interdisciplinarity seemed to characterise the experts' activity and to have a positive influence in the formation of terms and concepts. As for instance Whewell (1840a) seems to confirm in his *Aphorisms on the Language of Science*, term formation took inspiration from all fields of study, as scientific language developed as an interdisciplinary entity, first formed, and then applied to different specialised contexts.

3.4. The historical context of the case studies

This section introduces the historical context of the disciplines presented in the analysis of the primary sources and should provide some general indications, which are then specified in the single chapters. The section is supposed to show how, while some general features were present in all fields of study, each field presented its context of development.

3.4.1. The context of research in meteorology: the classification of clouds

The development of meteorology between the 18th and 19th centuries was addressed from multiple perspectives, in relation to its history in England, France, and Germany in particular. Neves et al. (2017) provide an overview of the history of the field, starting from Aristotle's *Meteorologica*, which, was written around 340 BC, and is said to be the oldest treatise on the subject, up to the division of the field in the 18th century between a purely theoretical branch, and one focusing on weather forecasting practices. The authors remark the fundamental role of scientific academies in the development of the discipline from the 18th century on, as well as the works of the main experts, such as John Herschel's (1861) *Meteorology* or Heinrich Dove's (1862) *Laws of Storms*, in which the scholar described storms as meetings of "airs with different properties" (Neves et al. 2017: 8). Naylor (2006) presents a

recollection of the history of meteorology in Britain, and describes the necessity to classify and standardise concepts as part of the process defined as the Second Scientific Revolution (Kuhn 1970):

This so-called Second Scientific Revolution of the **early nineteenth century** promoted the **standardization** of information, where inspection and tabulation became symbols of scientific control and associated with sober evaluation and moral purity. [...] The early years of the nineteenth century were witness to frenetic attempts **to standardize information** about both the natural and social worlds – the so-called Second Scientific Revolution. [...] acts and inspectorates were established through the 1820s, 1830s and 1840s that required the quantification and standardization of data, for instance the Weights and Measures Act of 1824, the Statistical Department of the Board of Trade (1832), the Factory Inspectorate (1833), the Registrar-General (1837), the Observatory of the British Association of the Advancement of Science (hereafter BAAS) at Kew (1842) [...]. This impulse was just as relevant to the development of **meteorology**. [...] the early nineteenth century marked a shift away from the provincial meteoric tradition with its descriptive and idiosyncratic reports of extraordinary atmospheric events, and towards a collecting endeavour based on standardization, quantification, and synchronization. (Naylor 2006: 409-12)

This description of the necessity for standardisation during the first decades of the 19th century is important for the purposes of this study. Naylor (2006) describes the 19th century as the beginning of a standardised and institutionalised meteorological science, which was before characterised by the activity of non-professionals. In doing this, Naylor underlines the importance of institutions and associations which decisively contributed to the formation of the discipline. Examples of these are the *Scottish Meteorological Office*, the *British Association*, and the *British Meteorological Society* which placed great relevance on "instrumentation, precision, and rigorous numerical analysis" (ibid.: 414). Schaffer (1997) also confirms how standardisation, and the use of a rigorous method were at the basis of the formation of science in Victorian Britain:

Schaffer has noted that systems of **standardization**, distribution of instructions, division of labour and rigid hierarchical management seemed to offer the key to **Victorian scientific progress**. So, it was for mid-nineteenth-century **meteorology**. The quantification of the weather redefined a moral and methodological landscape for meteorological science. [...] This new science of the weather demanded new meteorological subjects and objects [...]. Instruments were to be free from local interference, observers to be unaffected by the demands of their daily lives, their measurements to be tabulated and presented according to standardized principles. (Naylor 2006: 416)

Richter (2020) provides a similar overview of the development of meteorology in German speaking countries, as he underlines two factors which influenced the condition of the science between 1750 and 1850. First, a German nation did not exist yet, and therefore science was not governed by the State or by the power of the academic communities. Science was not "state-sanctioned" (ibid.: 2), but open and diversified, with a flexible relationship between the fields. Secondly, the emergence of a so-called

"semiotics of science" (Ibid.), derived from a Christian view of the world as governed by God. This view, described as teleological, conceptualised the events as related to one another, towards a final improvement. This connection justified that the prediction of the future from the present, and therefore the interest in the field for meteorological forecasts. This thesis considers the situation of meteorology at the beginning of this stage of professionalisation, as the discipline was still considered an "amateur" and emerging field (Hamblyn 2002: 1), trying to establish itself as a discipline.

In this context, Jean-Batiste Lamarck (1802) and Luke Howard (1803a) proposed a nomenclature of cloud formations almost simultaneously. Apart from presenting different forms of terms in two languages, their classifications had opposing fortunes: Lamarck's is said to have been discarded by Napoleon himself, while Howard's own was praised by experts all over Europe, including Goethe who, like many others at the time, was a passionate meteorologist (Pinna 2007).

Within the same research field, the definition of the scale of the wind force had a different development (Huler 2004). A classification of the wind force was needed not only in meteorology, but also in engineering, where the wind was connected to the motion of machines, and thus started to be discussed in the 18th century. While Daniel Defoe addressed the topic in *The Storm* (1704), in which he described the devastating effects of the Great Storm in England in November 1703, a first classification of wind strength for engineering was proposed by John Smeaton (1759) in the *Philosophical Transactions of the Royal Society of London*. Following various attempts, the English Admiral Francis Beaufort codified the classification of wind strength which became international, as he was looking for symbols to register the wind force in his logbooks. Regarding this, in a recollection of the history of the Beaufort Scale, Huler (2004) provides a beautiful description of scientific language at the time:

Derham's little attempt at classification shows that it was more than just mariners who needed to be able to describe the wind. That attempt brought to mind one of the subtexts that make the Beaufort scale so attractive. These words do *work*. These words have a *job* – to make you understand [...] *exactly* how the wind is blowing, in comparison with other winds. They express perfectly a fundamental thing about language: Language is technology. It's a tool to accomplish a task. [...] technology, on the other hand, comprised things we create to solve problems, to do work. And the first piece of technology [...] created millions of years ago when a stone tool was – quite literally – the cutting edge, was language. **Language** is, at bottom, a tool, a **technology for communication**. And irrespective of its beauty, the Beaufort scale, in its clarity and specificity, is a spectacularly sharp tool." (Huler 2004:91).

Though referred specifically to the Beaufort Scale, if read in a broader perspective, the quote illustrates the importance of terms and scientific language being created for the development of knowledge and for international communication in all fields of research.

3.4.2. Werner's nomenclature of colours and Mohs' classification of crystals in mineralogy

In the 18th and 19th centuries, research in mineralogy and crystallography was closely connected to chemistry, the traditional discipline from which they both originated. As crystallography tried to become independent from mineralogy, both fields were influenced by developments in chemistry, specifically at the end of the 18th century.

Term formation in mineralogy was popular at the time. Several features of minerals were classified, and numerous experts were involved in the discussion. For this reason, this introduction to the historical context of Mohs' rules for nomenclature in crystallography can be combined with Abraham Werner's (1774) classification of colours in mineralogy. All the examples cooccur to the description of an exceptionally lively historical context, in which the development of knowledge seemed to be reflected in the creation of naming systems and conceptual classifications.

As with all terminological processes discussed in this study, the formulation of rules for crystallography was connected to a specific stage of development of the discipline. Through his *Treatise on Mineralogy* (1825), Mohs (1820) tried to make the discipline of crystallography independent from mineralogy and to update its traditional nomenclature. He played an important role in the discussion on nomenclature in crystallography, developing a new classification of crystal forms into systems, which were independent from the traditional system by Christian Samuel Weiss in his *Über die natürlichen Abtheilungen der Crystallisations Systeme* (1813) , published in English as *On the methodical and natural distribution of the different systems of crystallisation* (Weiss 1823), aside from being responsible for the creation of the scale of mineral hardness (Mohs 1812).

Mineralogy originated between the end of the 18th and the beginning of the 19th century mainly in Germany. German was therefore one of the main languages in the debate on the subject, and the principal one used in term formation. Abraham Werner's (1774) *Von den äußerlichen Kennzeichen der Fossilien*, translated into English by Thomas Weaver (1805) as *Treatise on the external characters of fossils*, was considered a founding milestone of the discipline, just as Werner's school in Freiberg was a reference for students all over Europe, which Mohs himself joined in 1798. Werner's classification of minerals was also discussed in England by experts, such as William Whewell and Richard Kirwan. The article published in *The Philosophical Magazine* by Kirwan (1800) entitled "On the chemical and mineralogical nomenclature" examined the rules for chemical nomenclature proposed by the French school of Guyton De Morveau (Guyton De Morveau et al. 1791) in his *Method of Chemical Nomenclature*, as opposed to Werner's German traditional rules for nomenclature:

The **first principle** laid down by M. Morveau is that **phrases** are not a **name**, that substances and chemical products should be denoted by **names** fit to indicate them in every occasion, without having recourse to circumstances. To this principle I give my entire assent. [...] Another **rule** [...] is that in choosing

denominations we should prefer those which have their roots in the **dead languages** more generally known, in order that **the sense** should suggest the name, and **the name the sense**. (Kirwan 1800: 56)

Only five of Guyton De Morveau's (Guyton De Morveau et al. 1791) rules for chemical nomenclature were commented by Kirwan (1800). However, the importance of the *French school* in reforming the chemical nomenclature was well known and the practice of writing rules for nomenclature appeared to come from chemistry.

The outcome of the article is interesting, as Kirwan and Whewell's responses shaped the discussion taking place on mineralogical nomenclature at the beginning of the 19th century. Within this debate, the contrasting interests of the fields were present: chemistry, as an already established discipline, was facing the challenge of the French School and Guyton De Morveau's (1791) newly proposed naming method, and the discussion which followed. Mineralogy, at the same time, was trying to become independent from chemistry through the works of its founders between the 18th and the 19th century, among which both Werner (1774) and Mohs (1822; 1824) can be counted.

The experts' attitude towards the creation of terms seems different, according to the stage of development of the discipline they were discussing. In this perspective, Mohs's guidelines for mineralogical nomenclature, appear to have been a statement of intention towards the existing nomenclature and its future development. Mohs did not propose a nomenclature for mineralogy, but he positioned his guidelines against the previous naming tradition in the field, lamenting the absence of a systematic nomenclature as the main cause of a missing development of the discipline and the lack of interest by experts in other fields, such as zoology and botany. The tradition of the French school (Kirwan 1800) is compared in this chapter with the German and Swedish tradition of research and nomenclature in mineralogy (Bret 2019). In the comparison among disciplines, the research tradition on chemical nomenclature is opposed to the emerging disciplines of mineralogy and crystallography, which took inspiration from established field of study to define their own nomenclatures.

3.4.3. Faraday's work on electrodynamics and the formation of physics as a discipline

The context in which physics originated was the one of the definition of disciplines from the concept of Natural Philosophy, or *Naturphilosophie*, of the 18th century (Nier 1975). This process of specialisation was not proper of physics alone, but of many other natural sciences at the time. Physics was first recognised as a "socially organised category of knowledge" (Nier 1975: 1), as it emerged as an independent research field at the beginning of the 19th century.

Many contributions address the origin of physics as a discipline. Among these, Silliman (1974) focuses on how the field was recognised as independent as it defined its object of study and delimit its interest compared to other fields. The same confirms Baracca (2018), who describes the emergence of physics as the result of many changes in the field in a context of "deep social, cultural, and economic

changes" (ibid.: 1). Introducing the early 19th- century *revolution*, Baracca (2018) addresses the social component of Kuhn's (1970) definition of scientific revolution, as particular relevance is attributed to the social context of production of science in the early 19th century:

Production of science is a **social activity**, deeply intertwined with the whole social environment, its contradictions, cultural currents and traditions, the specific role of scientists and the organization of scientific activity (with national peculiarities), up to the hard economic and technological demands, choices, and transformations, including the advancements in experimental techniques. (Baracca 2018: 3)

This perspective on the development of disciplines at the time seems relevant for the description of the terminological processes in this thesis. In the article, Baracca (2018) mentions the similarities between physics and chemistry in the context of the Second Industrial Revolution in the last decades of the 19th century (Landes 1965, in Baracca 2018), as the process, started in Germany, led to the foundation of chemical industries. A product of the division of the field of Natural Philosophy, physics was recognised as a profession in the 19th century, as happened to many other fields (Silliman 1974). This occurred in connection to the definition of a scientific community of experts, who recognised themselves as a unitary group with the same interests, as well as to the improvement of the employment opportunities for physicists in European Universities and the appearance of specialised publication in the field (ibid.). Before that, at the end of the 18th century, physics was described as a not precisely defined field, divided into two research branches:

At the end of the eighteenth-century **physics** was still an **immature**, undisciplined pursuit with indefinite limits and little cohesiveness among its various concerns. The main source of disunity was the unequal development of its two chief divisions: **general physics**, equivalent to mechanics, and **particular physics**, embracing the study of heat, light, electricity, magnetism, and other special properties of matter. Whereas the former was a coherent, exacting, quantitative science, the latter [...], was essentially a miscellany of empirical findings joined to a loose array of speculative theories. Physics emerged as a discipline when these two components came into closer accord [...]. (Silliman 1974: 138)

Silliman (1974) also connects the origin of the discipline to the formation of the term *physics*:

In its origins "physics" meant simply the **knowledge of natural things** [...] associated with Aristotle's treatise of that name, the term retained its broad meaning through the seventeenth century Scientific Revolution; and as late as the middle of the eighteenth century the narrowing of its scope had hardly begun. A brief entry in the first edition of the Encyclopaedia Britannica in 1771 read: "Physics, a denomination sometimes given to natural philosophy". (ibid.: 139-140)

Initially concerned with the properties of natural bodies, the discipline was originally divided into the subdisciplines of general and particular physics, as the definition of "physical sciences" applied to chemistry, mineralogy, anatomy, and zoology (ibid.: 141):

Throughout **the eighteenth-century** experimental physics had its dedicated practitioners and enthusiastic public following. In France the vogue of experimental physics began early in the century when a [...] native tradition in experimental science was reinforced by influences from England and Holland. [...] interest grew rapidly. Popular surveys, **dictionaries**, and **manuals** were published in great numbers; chairs were established in **colleges** and **universities**, and informal lecture series were available to the public. (Silliman 1974: 142)

Positions were diverse, in the European countries, as they mutually influenced one another. Beyond these differences, however, the common trait of all orientations seems to have been the scientific method of analysis:

In the eighteenth century the universally acknowledged ideal of scientific practice was the **method of analysis**. Knowledge of the physical world was to be built up from **experience**; beginning with observations or experiments the investigator decomposed complex appearances into their simplest elements and from these proceeded inductively to a general principle [...]. (ibid.: 150)

Pearce Williams (1962) provides an interesting viewpoint on the development of physics in the first half of the 19th century. He points out how the prevalence of the inductive method in all countries of scientific production in Europe was addressed through the conviction that theories must arise from facts. Because of that, theories which arose from intuitions and were then proven by facts and therefore discovered through deduction, instead of induction, were not so frequently published in the most popular publications. With reference to this, Pearce Williams (1962) makes a noteworthy remark on the use of primary sources and the published material: almost exclusively theories based on inductive methods were published in the main periodicals and volumes at the time. To be able to find out less popular and deductive theories, a more private category of sources needed to be investigated, such as the correspondence between Whewell and Faraday. This should be remarked as a distinction among the primary sources for this thesis.

The case study examined in this thesis is the correspondence between Michael Faraday and William Whewell on the naming of newly discovered entities in electrochemistry. The analysis is based on the reconstruction by Sydney Ross (1961) and by the historians Ralph Oesper and Max Speter (1937) on William Whewell's original correspondence which is preserved at the Christopher Wren Library of the Trinity College, Cambridge. The correspondence of Michael Faraday was collected and commented at the end of the 19th century by Dr Bence Jones (1870) in two volumes entitled *The Life and Letters of Michael Faraday*, while Pearce Williams (1971) published another selection of Faraday's correspondence.

Faraday was an English scientist who contributed to major discoveries in electrochemistry and electromagnetism. As a chemist, he was responsible for the discovery of benzene, among other chemical compounds and later became Professor of Chemistry at the Royal Institution of Great Britain

(Oesper and Speter 1937). Meanwhile, in 1834 i.e., at the time of the correspondence, William Whewell was Professor of Mineralogy at Trinity College, Cambridge and had already proven himself an expert in scientific naming, which was the main reason for the correspondence. Whewell does not appear to have known much about electrochemical entities, while he was well aware of the naming conventions in other fields. In his reconstruction of this episode, Ross (1961) introduces the other scholar that Faraday consulted and Dr Whitlock Nicholl i.e., Faraday's friend and personal physician. As Ross (1961) recounts, terms such as anode, cathode, electrode, and ion were coined in their correspondence, with the aim of naming entities for the newly theorised process of electrolysis. Apparently, Faraday needed to describe the entities in a paper, which he then published as part of the series on *Experimental Researches in Electricity* in the *Philosophical Transactions* (Faraday 1834a).

Pearce Williams (1962) also addresses the discussion between Michael Faraday and the French physicist André-Marie Ampère (1816) on the origin of electrodynamics. The rivalry between the two emerges clearly from their correspondence and can be seen in the main periodicals in natural history at the time: *Les Annales de Physique, de Chimie et d'Histoire Naturelle in France*, which alongside their German counterpart i.e., *Die Annalen der Physik*, reported on most of the international disputes among scholars at the time, and therefore also on the most discussions on the origin of scientific disciplines.

3.5.A remark on interdisciplinarity activity in the 19th century

To properly understand the episodes described in the following chapters, it seems important to highlight that, since a clear distinction among disciplines was being developed at the time, the activity of the experts could be defined as interdisciplinary. According to this principle, all experts were working contemporarily on multiple subjects, and most of them were educated in various fields. While many worked in one field, for many of them this was not their main occupation.

In the primary sources, multiple examples were thus present of Professors of Chemistry or Mineralogy involved in research on other topics. Equally interesting, it will also come as no surprise that personalities of literature and poetry, such as Johann Wolfgang von Goethe and Samuel Taylor Coleridge contributed to naming in meteorology and chemistry (Coleridge 1821; Goethe 1834).

At the end of the 19th century, Bence Jones (1870) confirmed the interdisciplinarity of Faraday's research, while commenting on one of his letters. The same does Weinberger (2013) as he describes Faraday's extensive publications in the *Philosophical Magazine*. Among them, as Weinberger (2013: 1456) mentions, the series of *Experimental Researches in electricity* lasted for thirteen years and included numerous exchanges on naming of physical entities with the French physicist André-Marie Ampère. They discussed the invention of the electromagnetic induction in the *Annales de Physique et de Chimie* in 1832, as Weinberger (2013) reports:

I BEG to address to you the following pages upon the subject of electro-magnetism and request the favour of their insertion in the **Annales de Chimie et de Physique**. They may, I fear, provoke a **controversy** that I would willingly avoid; but under the existing circumstances I feel compelled to adopt the present course of proceeding, for **silence**, [...] would be regarded as **an admission of error**, not only in a philosophical, but also in a moral point of view from which I believe myself wholly exempt [...]. (Weinberger 2013: 1461)

The exchange confirms the crucial role of discussions among experts at the time, as well as the relevance of periodicals in allowing the diffusion of these debates, at a national and international level.

William Whewell's research is an example of this interdisciplinarity: Professor of Mineralogy, he became an expert in scientific language and coined terms in mineralogy, chemistry, architecture, and astronomy. Michael Faraday was a British chemist and physicist who worked in different fields, such as electrochemistry and electromagnetism, besides being the inventor of the Faraday's cage, which bears his name. John Herschel was a British astronomer and natural philosopher. Born as the son of William Herschel, an astronomer, he was known for his research in astronomy, but was also as the inventor of the blueprint, and for his contributions in botany and the philosophy of science, mainly in the volume entitled *A Preliminary Discourse on the Study of Natural Philosophy* (Herschel 1830). With Whewell and John Baily, he was a member of the Committee for the Revision of the Nomenclature of the Stars, and equally noteworthy was his role in the dispute on the Naming of Uranus (Case 2015; 2020). The dispute, which involved the French astronomer Urbain Le Verrier was described as one of the most lively in the field:

It was the autumn of 1846, and John Herschel (1792-1871), the British astronomer and natural philosopher [...] had just put his foot into the century's **most acrimonious astronomical dispute**, and now he was being abused by those on both sides of the matter-his British colleagues on the one hand, and French astronomers and their **European** allies on the other [...]. (Case 2020: 170)

To conclude, it is important to underline how the scholars' interdisciplinarity of interests should be remembered as a crucial factor, while analysing their reflections in naming. It often happened, indeed, that scholars were defined amateurs, or experts in a specific field, while they were contemporarily working on other subjects. While this is understandably different from the division of competences in science today, it appeared to be quite widespread in the 19th century, as disciplines were being defined in their modern structure, and experts followed their research interests in multiple fields.

3.6. Summary of the contents

This introduction to the historical context of the terminological processes described in the primary sources underlined the collective character of the scientific discussion in the 19th century, as well as of the practices of naming and classifying. While a general overview of the historical situation in the first half of the 19th century was not in the interest of this study, some relevant factors were presented,

which seem to have more decisively contributed to the development of the practices of naming and classification in the examined period, and even more specifically, to the terminological processes, which this thesis aims to describe and bring forward in the 19th century primary sources.

Despite the focus on single research fields, section 3.5. remarked the importance of the interdisciplinarity of the experts' work at the time, and its relevance for a complete understanding of the examined sources. Indeed, this seemed to be connected to the common and general feature of scientific language and knowledge, described as property of the experts' community, and built through common efforts (Kuhn 1970).

4. Methodology

4.1. Introduction

This chapter presents the methodology applied in the construction of the present thesis. This study combines multiple methods for the search and analysis of the data. First, historical approaches are employed in retrieving and selecting primary sources in online and physical archives (Lundy 2008). Second, a qualitative and case study approach is employed in selecting the data, preferring examples that illustrated the terminological processes observed in the primary sources. A dedicated section of this chapter provides a definition of terminological process, as intended in this thesis (see Sec. 4.2.). Narrative analysis is employed to reconstruct "the history behind the data" (Gimenez 2010: 200). This approach, which is qualitative in nature, too, helps to describe the process of term formation as diachronic. As part of the same approach, terms and concepts are defined as entities evolving with the contextual conditions, as Temmerman (2000b) confirms.

The general methodological approach of this study can be defined as theory-based, aiming to discuss theories of terminology through the analysis of historical data. The method is inductive and qualitative, adopting historical and archival research methods, a case study approach, and text analysis strategies for the examination of the primary sources. A comparative approach is at the basis of this study (Sunderland 2010). The correlation of the terminological processes described in the primary sources among each other and in relation to the theories of terminology is fundamental for this thesis. The thesis indeed intends to describe terminological processes identified in the 19th- century primary sources from the perspective of the contemporary terminology theory.

The rest of the chapter is structured as follows. Section 4.2. introduces a working definition of the concept of terminological process, and the criteria taken into consideration for its formulation and the selection of the processes to include in this study. Section 4.3. repeats the research questions and sub-questions of this thesis, as presented in the introduction (see Ch.1), while section 4.4. presents the types of sources included in the study i.e., primary, and secondary sources. Section 4.5. focuses on the search of the primary and secondary sources. Section 4.6. illustrates the selection criteria for the primary sources, while section 4.7. describes the selection of the case studies. Finally, section 4.8. positions this study within the relevant research methodologies in the existing literature, and section 4.9. summarises the contents of the chapter. A table with all retrieved case studies from the primary sources is included in the thesis as an annex (see Annex C).

4.2. A definition of terminological process

This study addresses the role of terminology, intended as the practice of naming, classifying, and defining concepts in a specialised field, within the progress of science in the first half of the 19th century (1800–1850). To do so, an interlinguistic and multidisciplinary approach is adopted. This is done

through the analysis of original 19th-century primary sources which showed a specific terminological process. In relation to this, in this thesis, a terminological process is defined as a practice which could 1) be named and conceptualised according to the present theories and principles codified in the modern and contemporary theory of terminology and 2) be recognised in the primary sources as similar – and with an analogous development – to the modern and contemporary practice of terminology. Further criteria for the definition of the terminological processes included in this study were then 3) their application in more than one field of study, and 4) their development involving more than one language, considered in this study. Based on this definition, four terminological processes were identified in the primary sources, to each of which a chapter of the present thesis is dedicated.

4.3. Research questions

This study aims to describe how terminological practices contributed to the formation of 19th-century scientific knowledge and to illustrate terminological processes before the origin of terminology as a discipline at the beginning of the 20th century, which is identified in Europe with the work of Eugen Wüster and the Vienna School of Terminology (Wüster 1931). This study describes how these processes occurred as part of the scientific activity of experts of both humanities and hard sciences, which were not terminologists, while investigating possible similarities and differences between these 19th-century practices with the principles of the 20th and 21st century theory of terminology.

The research questions originate in the interest in a terminological activity before the beginning of the official schools of terminology at the beginning of the 20th century. This interest was initially motivated by the lack of descriptive studies, and specifically historical studies, on terminological practices before the 20th century and focuses on the methods in which terminology was discussed among experts of other disciplines before the 20th century. While historical studies are present in literature on the topic (Temmerman 1995; Van Campenhout 1998), they are limited to the reconstruction of the creation of single terms or nomenclatures. Against this background, this study focuses on terminological processes in multiple domains and several European languages. Specifically, this thesis addresses the following research questions.

First, this thesis investigates the role of terminology within the 19th-century progress of scientific knowledge. More in detail, it describes how these terminological processes, as theorised in modern terminology theory of the 20th and 21st century, were involved in the construction of scientific disciplines and language during the first half of the 19th century. Once these processes are named and conceptualised in the primary sources, this thesis describes how they are applied in different fields of studies and languages, and how these processes contributed to the formation of scientific language and the construction of scientific disciplines.

Second, the present thesis illustrates how the 19th-century terminological practices in various disciplines relate to the theory and principles of modern and contemporary terminology of the 20th and 21st century. Specifically, it investigates to what extent these practices conform, or not, to modern principles of terminology.

Third, and last, this thesis addresses the extent to which a more detailed knowledge of these historical processes can contribute to current research on term formation in terminology theory and how the modern discipline would benefit from a more detailed description of these processes based on historical sources and past practices. Moreover, the thesis questions the application of a diachronic perspective for the description of terminological processes, and how this can add to the current debate in the discipline on these processes and to enlarge the perspective on terms and their creation.

Each question assumes a different methodological approach and they are therefore differently addressed in the present thesis. While the first one is more descriptive in nature, the second and third ones are more theoretical, addressing a meta-reflection on the processes. To describe terminological processes, a multidisciplinary and interlinguistic approach to the description of the processes is adopted.

4.4. The selection of the primary sources

The approach to the selection of primary sources was qualitative and descriptive and is described in detail in the following sections. The sources were selected since they described processes of formation of nomenclatures and conceptual classifications in different disciplines and languages. More specifically, the selection of the sources was meant to highlight processes involved in term formation, as defined in terminology theory (Sager 1990; 1997).

A relevant selection principle was the diachronic evolution of a terminological process in time. For the purposes of this thesis, it was essential to be able to reconstruct, even within a limited time frame, the evolution of a case study. Indeed, the need for terminology theory to study the development of terms in time is one of the theoretical premises of this study (see Ch.2). However, with reference to the case study approach adopted in the analysis of the data, a quantitative principle was part of the method. Indeed, the quantity of collected material per single case study was included as a criterion, as this was considered an indicator of the relevance of the terminological process. Following the cross-referencing of the sources, the amount of journal articles and publications referring or dedicated to a nomenclature proposal was assumed as an indication of the attention attributed to the subject.

This study examines primary and secondary sources which are used in the construction of the case studies. A definition of primary sources in historical studies is provided by Lundy (2008):

Primary sources are first-person accounts that involve the oral or written testimony of eyewitnesses, and these may include documents, letters, observational notes, photographs, recordings, diaries, journals, life

histories, drawings, mementos, and other relics (Berg 2001; Lundy; 2008). Salkind (1996 as cited in Berg 2001) stated that primary sources are usually original artefacts, documents and items related to the direct outcomes of an event or an experience. (Lundy 2008: 395).

The primary sources analysed in this study pertain to the following categories. An example from the collection of sources is presented for each type:

- Specialised journals: journals specialised in a specific topic or field of studies:
 - The Asylum, Journal of Mental Science. First published as The Asylum Journal in 1853.
- Journals on general subjects: journal of general interest, where more fields of studies and general topics were discussed:
 - The Philosophical Magazine comprehending the various branches of science, the liberal and fine arts, agriculture, manufactures, and commerce. By Alexander Tilloch, Member of the London Philosophical Society.
- Volumes on dedicated subjects:
 - Howard, Luke. (1818). *The Climate of London*. Deduced from meteorological observations, made at different places in the neighbourhood of the metropolis. In two volumes. First edition. London: Phillips and Yard.
- Pamphlets
 - Willis, Robert. (1844). *Architectural Nomenclature of the Middle Ages*. With three plates. Cambridge: printed at the University Press.
- Minutes of Meetings and Reports:
 - Herschel, John F.W. (1845). "Report of a Committee consisting of Sir John Herschel, Mr Whewell, and Mr Baily (deceased), appointed by the British Association in 1840 for revising the Nomenclature of the Stars". In: *Report of the 14th Meeting of the British Association for the Advancement of Science*. Held at York in September 1844. London: John Murray.

The definition of the main types of sources included in this study follows the one by Ornes (2009):

Books¹⁶. In agreement with UNESCO (1964) by the name *book* is meant that publication which has more than 49 pages and *pamphlet* that which has from five to 48 pages. According to types of usage, books are classified: general type, writings in elemental form, and textbook for the study of a discipline; specialized for the professionals and researchers. Monographs are documents in which a topic is treated exhaustively. [...] **Journals (Magazines)**. Are documents of recent information, generally specialized publications. [...] **Technical Information**. In this type of information are included **minutes of conferences**, the news of congresses, meetings, and others. They are important due to the fact that the information generally deals with current topics which affect a particular community or an interest group. [...] **Diaries and newspapers**. Are source of information in so far as they contain facts occurring in space and time, past and present. (Ornes 2009: 67-68)

¹⁶ Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

As Ornes specifies, different types of sources are included in this study. While different kinds of sources are present among the primary ones collected for this study, the source type is also related to the type of discussion, or process being described.

4.5. The secondary sources

The selection of secondary sources is important for the construction of the theoretical framework of the thesis. A dedicated chapter analyses this framework more in detail (see Ch. 2). Secondary sources are defined in this study as:

A **secondary source** is something written after the events it describes, usually after the author has read and interpreted primary sources. Published books, such as those kept in libraries, tend to be secondary sources [...]¹⁷. (King's College Cambridge Glossary online 2024)

The secondary sources included in the study pertain mainly to terminology theory, but also to history and the history of science (see Ch. 2). In reference to this, the secondary sources used in this study can be divided into two categories. The secondary sources pertaining to terminology theory of the 20th and 21st centuries are used to build the theoretical framework of this study, as well as to name and conceptualise the terminological processes analysed in the primary sources. The secondary sources pertaining to history and the history of science are instead employed to reconstruct the historical context in which the terminological processes occurred in the 19th century.

As occurred for the primary sources, various categories of secondary sources are included in the study. They were mainly journal articles, from specialised journals in terminology theory, as well as linguistics and translation theory. Additionally, the secondary sources include relevant chapters of specialised volumes, and conference proceedings. These secondary sources on history are particularly important for the chronological reconstruction of the case studies since they provide the historical and chronological background for the analysis of the primary sources. It was not, indeed, the aim of this thesis to reconstruct the chronological and historical development of the processes it describes. Instead, the thesis relies on secondary sources from the history and history of science to do that. The main aim of the thesis is to comment on the historical processes from the perspective of terminology theory. Thanks to these historical sources, it is possible to connect the primary sources to one another, and to focus only on the terminological processes. However, these processes need to be contextualised, at the same time, as part of a broader historical context in which they occurred. The historical secondary sources help in the reconstruction of this historical context. For the purposes of this study, the secondary sources are catalogued into two categories:

¹⁷ Online glossary of the King's College Cambridge (UK). URL: <https://www.kings.cam.ac.uk/archive-centre/introduction-to-archives/glossary#secondary-source> [accessed January 7, 2024].

- **General sources:** pertaining to the construction of the theoretical framework of the study. These sources are also used to name and conceptualise the terminological processes being discussed in the case studies.
- **Specific sources:** describing the single case-studies and their historical context.

While both categories are fundamental for this study, they are catalogued separately. As previously mentioned, secondary sources are employed in this study, which pertained mainly to terminology theory. These secondary sources are used to name and conceptualise the terminological processes then described in the case studies. This use of the secondary sources in terminology theory is particularly important in this thesis, since it allows these processes to be identified in the primary sources.

4.6. The phases of search for primary and secondary sources

The following sections present the phases of research for the collection of the primary sources. The process was carried out in a circular and iterative way i.e., it was repeated multiple times throughout the development of this thesis. A parallel process of retrieval and analysis of secondary sources was conducted contemporarily to the search for primary sources. Therefore, secondary sources are also considered in the process.

4.6.1. Introduction

This section is dedicated to the description of the procedure followed in the search for primary sources. All search phases included downloading and classifying the primary sources according to the following criteria:

- Name of the main author
- Year of publication
- Name of the journal or volume title
- Number of the volume and issue of the journal
- Page number

The collection of metadata on the primary sources was fundamental to allow the classification of the primary sources and the retrieval at later stages. These metadata were used to catalogue the primary sources into dedicated folders. In the cataloguing system, each folder corresponded to a discipline, in which the formation of terms, a nomenclature, or a conceptual system was involved. Each folder was divided into sub-folders, dedicated to the single case studies pertaining to the same discipline. Each subfolder was consequently named according to:

- Discipline: The discipline they belonged to

- Sub-discipline or field of study: differently from the previous point, in this categorisation, sub-disciplines are considered as internal subdivision of a single discipline. An example of that would be within the discipline of meteorology, the sub-divisions of the classification of cloud forms, the classification of the wind strength, and the classification of tides.
- Name of the Author: The work of a specific author or group of authors
- Subject of the Debate: The debate or case study they refer to.

These criteria were applied to the classification of primary sources throughout all phases of research, as well as to secondary sources.

4.6.2. The search for primary sources in online archives

The first phase of research for primary sources was conducted exclusively on online archives. A complete list of all employed archives is included as an annex to this thesis (see Annex A). This search was conducted online, as most primary sources from the first half of the 19th century were scanned by public or private museums, libraries, or research institutions throughout the world and are freely available online. Particularly regarding the first half of the 19th century (1800 – 1850), almost all issues of the most widely known and influential scientific periodicals and journals are freely available online.

The first research phase was concerned exclusively with specialised and general journals from the first half of the 19th century. This phase was devoted to the search for discussions on nomenclatures, or conceptual classifications in most famous journals at the time. With this purpose, a list of the main scientific journals at the time was compiled, and all their issues between 1800 and 1850 were consulted online. The full list of the journals included in the project is attached to this work as an annex (see Annex B). Some titles are reported here as examples:

- *The Philosophical Transactions of the Royal Society of London*
- *Die Annalen der Physik*
- *Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts*

The relevant sources were retrieved using search engines provided in the online archives and through relevant keywords (see Table 1). In this phase, the online archive used for most publications was the Hathi Trust Digital Library¹⁸. The site is a portal for primary sources, mostly publicly available. The online archive provides a search engine, through which documents can be searched using keywords or exact phrases. On the website, the relevant journals and time frame were selected to restrict the search. Inside each issue, a search was performed using keywords. The search engine provided a link to the full issues, where the keyword was found. The keywords were:

¹⁸ Hathi Trust Digital Library, founded in 2008. URL: <https://www.hathitrust.org/> [accessed December 29, 2023].

- Nomenclature
- Classification
- Terminology
- Naming
- Definition

The keywords were selected according to their relevance for the research questions of this study. In the selection process, other potentially relevant keywords were excluded, since they might have been not specific enough, and might have led to the selection of texts which did not pertain to the interests of this research project (e.g. name, names, to name, system, systems).

The search through keywords was performed first in English, and then equivalents in German and French respectively were used as query terms. Equivalents were selected by the author of this thesis: in some cases, the search was performed using alternative equivalents or spellings. As an example, at the time, different spellings of some keywords were used. This was the case of the German term "Nomenklatur" which could also be found spelled as "Nomenclatur". The same search was thus repeated using the different forms and the plural form of the keywords. Table 1 summarises the English, German, and French keywords used for the search for primary sources in online archives:

English Keywords	German Keywords	French Keywords
Nomenclature, nomenclatures	Nomenclatur, Nomenclaturen,	Nomenclature, nomenclatures
Classification, classifications	Nomenklatur, Nomenklaturen	Classification, classifications
Terminology, terminologies, terminological	Classifikation, Klassifikation, Classifikationen, Klassifikationen	Terminologie, terminologies terminologique
Naming	Terminologie, Terminologien,	Nomenclature
Definition, definitions	terminologisch	Définition, définitions
Denomination, denominations	Nennen	Dénomination, dénominations
Designation, designations	Definition, Definitionen	Désignation, désignations
Description, descriptions	Denomination; Denominationen	Description, descriptions
To define, define	Designation, Designationen	Définir, définir
To describe, describe	Beschreibung, Beschreibungen. Definieren, definierend Beschreiben, beschreibend	Décrire, décrire

Table 1: Keywords used in this study for the search in online archives, with spelling variants.

After the search, the relevant pages of the journals were downloaded from the archives in pdf format. The articles were then recomposed through the union of the single pages using an online available tool for the creation of pdf files. The articles were then catalogued according to the discipline and the topic into folders and subfolders (see Sec. 4.6.1.).

An example of this first phase is provided by the search for the keyword "Nomenclature" in the specialised journal *The Asylum. Journal for Mental Science* (see Rollin 2003). In this journal, a discussion

on a new classification of mental illnesses was found through the search for that keyword. The first article found through this method was entitled "On the Nomenclature of the various forms of Insanity" (Monro 1855) by Dr Henry Monro in England. In the article, the author discussed the existing nomenclature of mental illnesses and its possible update, as proposed in the same years by Dr Daniel Noble (1853).

As Dury (2022: 431-32) states, one of the main difficulties in the study of historical texts is their analysis. Most of the times texts are available only in electronic format, as pdf, and need thus to be manually transcribed. This was a difficulty I encountered in this study, both for texts available in electronic format, and for texts collected from physical archives, which also needed to be transcribed.

4.6.3. The search for relevant secondary sources on the case studies

This section presents the search for secondary sources. These secondary sources belong mainly to the discipline of terminology, and specifically to terminology theory. These sources are mainly used to name and conceptualise the terminological processes being illustrated in the case studies analysed in this thesis. Secondly, these sources compose the theoretical framework of this study (see Ch. 2).

Additional sources are included from the discipline of history and history of science. These latter categories of secondary sources describe the historical context of the processes defined in the primary sources. The search for secondary sources happened mainly through online archives, and continued throughout the whole project, parallel to the search for primary sources. While a full list of consulted archives for secondary sources is provided as an annex to this study (see Annex A), some of the most relevant are reported in what follows as examples:

- Sistema Bibliotecario di Ateneo dell'Università di Bologna
- The online archives of the University of Manchester
- JSTOR.org digital library
- Nilde.cnr – Network for Interlibrary Document Exchange

While this thesis focuses on the analysis of primary sources, secondary sources in the history of science have a prominent role in the construction of the context and argument. Contemporarily, secondary sources in terminology theory are used to define the terminological processes, which are then illustrated in the case studies. As the secondary sources are used to describe the context of the case studies, they often provided evidence of the existence of further relevant primary sources. When this was the case, the mentioned primary sources were searched for in online archives. Indeed, a great deal of references to primary sources were found in the secondary literature, as described in greater detail in the following section.

An example of this phase is represented by the reconstruction of the history of the classification of wind strength, as part of the development of the discipline of meteorology in Europe (Huler 2004).

In this case study, the historical secondary sources were particularly helpful for reconstruction of the context of the episode, for two reasons. First, because the secondary sources were used to reconstruct the chronological development of the episode. Second, since the secondary sources mentioned primary sources on the topic, which were then used in the analysis. Knowing that the evolution of the classification of the wind strength had already been reconstructed in an historical perspective (Huler 2004), provided a useful reference for the description of the historical context of the episode. Starting from this historical context, the present thesis could then concentrate only on the elements of the episode, which were relevant for the terminological analysis.

For instance, Huler (2004) mentions several primary sources which I at first was not able to find during the first phase of research. An example of that was the volume by James Capper (1801) entitled *Observations on the Winds and Monsoons*. After reading the historical reconstruction of the classification of the wind strength by Huler (2004), since the author describes Capper's volume as an example of an alternative proposal of classification of wind force, I searched for that in the online archives I was using for the primary sources. The volume, which I then found in an online archive, was indeed relevant in the reconstruction of the history of the classification of the wind strength, as a direct precedent of Admiral Beaufort's (1817) main classification.

4.6.4. Cross-referencing from other journals

This section describes the phase of expansion of the search for primary sources. This was conducted through a process of cross-referencing from the general and specialised journals I consulted (see Sec. 4.4.). This expansion happened in two forms contemporarily:

- **Within the same language:** When a reference was made to an article or relevant source in another journal in the same language.
- **Across languages:** When a reference was made to an article or relevant source in another journal and in another language.

This phase illustrates the expansion of the search across languages within the same case study. Indeed, while the search for primary sources started with keywords in English, French and German respectively, the selection of the primary sources was limited to one of these languages at a time. Within the same case study, also sources in other languages, among the selected ones for this study, were included in the selection. This process of cross-referencing across journals and languages had two aims. First, it should reconstruct the history of the terminological processes in a multilingual context. Second, it aimed to assess the interest in the discussion on the topic, both within the same country and language, and across linguistic communities of experts in Europe.

At this stage, references to other articles were found, which were not part of the initial selection of journals for the project (see Sec. 4.6.2.). If considered relevant, articles from other journals

were included in the collection of primary sources. In the classification of cloud formations (Lamarck 1802: Howard 1803a) e.g., this phase of search through cross-references across languages was essential to reconstruct the debate on a subject.

As in most other cases, a debate on a subject was composed at the time of numerous minor discussions in different languages and journals such as *The Philosophical Magazine* in England and *Die Annalen der Physik* [The Annals of Physics]¹⁹ in Germany. Therefore, as a principle, the reconstruction of a single debate was never regarded as sufficient to understand the whole dynamic. In the specific case of the classification of cloud formation, Howard (1803a) referred to Lamarck's (1802) classification, which was contemporary to his own. Through this reference, additional relevant primary sources were searched for and retrieved online.

In most cases, a terminological process could be best described through the reconstruction of several discussions happening at the same time in multiple languages and publications. Indeed, in almost all articles in which a nomenclature was discussed, reference was made to other journals entailing the same or related topics, as well as to volumes dedicated to a nomenclature proposal. Most of the times, these references were attached to the text as footnotes in which the title and author of another journal article were reported. As an example, the first German translation of Howard's (1803a) nomenclature of cloud formation in the *Annalen der Physik*, reports in a footnote:

Aus Tilloch Philosoph. Magaz. No. 62 übertragen in die Bibl. Britann. Sc. et Arts Vol. 27 p. 185 f. Herr Pictet, der Herausgeber, bemerkt er habe auf seiner letzten Reise nach England das Vergnügen gehabt, der Verfasser dieses Aufsatzes persönlich kennen zu lernen [...]²⁰. (Pictet 1805: 137)

The footnote is interesting, since the editor of the *Annalen der Physik*, Karl Pictet, considered to be the first to have translated Howard's (1803a) nomenclature of cloud formations into German, noted that he also had the pleasure to meet Howard in London (cfr. Sec. 5.3.2.).

In other cases, simply the name of the journal, with year of publication and page were mentioned as a reference. Reconstructing this net of references across publications was the main strategy used to recreate the overall discussion among experts on a specific topic. At the beginning of the 19th century, as a debate on a subject arose, editors also seemed to be responsible for informing the readers about parallel debates taking place in other countries. Cross-references of this sort could be found in numerous journals, mostly across England, France, and Germany, as happened, for instance, for the classification of cloud forms. This process differs to what normally happens nowadays

¹⁹ Unless otherwise specified: translations are provided by the author of this thesis.

²⁰ English Translation: From Tilloch Philosoph. Magaz. No. 62 transferred to the Bibl. Britann. Sc. et Arts Vol. 27 p. 185 f. Mr Pictet, the editor, remarks that on his last journey to England he had the pleasure of personally meeting the author of this essay [...].

in specialised journals, as these are mostly international publications, not representing any specific country.

4.6.5. The inclusion of other types of primary sources

This research phase focused on other types of primary sources beyond the general and specialised journals, with which the first three phases were concerned. Some examples of these are reported in what follows:

- Volumes or volume chapters dedicated to single nomenclatures and classifications.
 - Capper, James. (1801). *Observations on the Winds and Monsoons*. Illustrated with a chart and accompanied with notes, geographical and meteorological. London: Whittingham.
- Pamphlets dedicated to the proposal of alternative nomenclatures.
 - Syme, Patrick. (1814). *Werner's nomenclature of colours*. With addition, arranged so as to render it highly useful. Edinburgh: James Ballantine & Co.
- Minutes and proceedings of meetings among experts and conferences.
 - Herschel, John, F. W. (1842). "On the Advantages to be attained by a Revision and Re-arrangement of the Constellations, with especial reference to those of the Southern Hemisphere, and on the Principles upon which such Re-arrangement ought to be conducted". Read June 11, 1841. In: *Memoirs of the Royal Astronomical Association*. Volume XII. With six copper plates. London, published by the Society: 201-224.
- Written versions of speeches and lessons by experts on relevant subjects.
 - Müller, Max. F. (1864). *Lectures on the Science of Language delivered at the Royal Institution of Great Britain in April, May, and June 1861*. Fourth Edition. London: Longman, Green, Longman, Roberts, and Green.

During this phase, other online archives were employed, where mainly complete volumes were accessible for online consultation or download. A full list of all archives consulted for this study is attached at the end of this thesis (see Annex A). Some archives are reported as examples:

- The Internet Archive.com
- Google Books
- The Biodiversity Digital Library
- The Smithsonian Institution Archives
- Gallica – The BnF (Bibliothèque nationale de France) digital Library

These archives mainly feature whole volumes in downloadable pdf format or available for online consultation exclusively. The different sources added at this stage were retrieved through cross-references from previously consulted ones. While in the first three phases only relevant articles concerned with the object of research were downloaded, two main options were considered:

- **Entire volumes:** Whole volumes dedicated to a nomenclature proposal were read and downloaded. These volumes were mostly published by the authors to present a nomenclature or classification proposal.
- **Single chapters or sections:** Only chapters or sections of volumes related to a nomenclature proposal were read and downloaded. In these volumes, the nomenclature proposal was illustrated in a dedicated chapter, but it did not constitute the main subject of the volume.

As previously happened for journals, it often occurred that the search for a volume in an online archive led to the discovery of other relevant publications that were also downloaded and catalogued. This process is typical of the search in physical archives and happens with the same dynamics on online archives, too.

An example of this process is the reconstruction of the nomenclature proposal for crystallography by Friedrich Mohs (1820; 1821). The presentation of his "New system of crystallography" in the *Edinburgh Philosophical Journal* (Mohs 1820; 1821) was connected to the publication of his *Treatise on Mineralogy* (Mohs 1825). Originally written in German and entitled *Grundriss der Mineralogie* [Outline of Mineralogy] (Mohs 1822; 1824), the volume was translated into English some years later (Mohs 1825). Mohs' proposed nomenclature was originally found through the search for relevant keywords in the *Edinburgh Philosophical Journal* (Mohs 1820). Specifically, the keyword used for the search was "Nomenclature" in English. There, the article on the presentation of his proposal was downloaded. As the article referred to Mohs' original volume in German (Mohs 1822; 1824) and its English translation (Mohs 1825), both volumes were searched for and downloaded from the Internet Archive.com, in their original version in German and English respectively. In both volumes, the chapters dedicated to the nomenclature proposal were saved as separate documents and examined more in detail.

4.6.6. The search for primary sources in physical archives

This research phase was performed in physical archives to collect primary sources. This phase was prepared by an online search for relevant sources, through the online catalogues of the archives. Only archives in the United Kingdom were consulted, such as the archives of The University of Manchester and the archives of the Christopher Wren Library at the Trinity College in Cambridge. The above-mentioned archives were selected since they provided access to a significant number of primary sources from the timeframe considered in this thesis i.e., 1800–1850. While planning the visits, the online catalogues of the archives were examined, and the consultation of the most relevant primary sources was arranged with the management. As often happens in the regular practice of both on- and offline archival search, while at the archive, further relevant primary sources were consulted. Some of them were included in the collection of primary sources for this thesis.

The choice of the United Kingdom was motivated by the fact that most primary sources from the 19th century are available there mostly in their first edition, mainly due the intensity of research in the country at the time. A significant number of scientific associations were present, such as the BAAS i.e., *The British Association for the Advancement of Science*, as well as a substantial number of important publishers. Moreover, strong connections with scientists abroad were maintained by English experts at the time. Most of these experts, particularly during the first half of the 19th century, lectured in major English Universities. For this reason, many volumes from the time are in conservation at Universities libraries and archives, as well as the professors' correspondences with other experts in England and abroad. For example, at the Christopher Wren Library of the Trinity College in Cambridge the original correspondence between Michael Faraday and William Whewell on the names for newly discovered entities in electrodynamics was consulted (Whewell and Faraday 1834–1860). The correspondence is part of the archive at Trinity College since Whewell was professor of mineralogy there, serving also as Master of the College. Sidney Ross (1961) partially transcribed the correspondence in an article on the subject and most letters were scanned by the library and available on their website²¹. While there, other volumes and letters by Whewell were consulted. While reference to these sources is present in this thesis, they are not described as main primary sources.

4.7. The selection criteria for primary sources

This section describes the elaboration of the selection criteria of the primary sources. This phase concerns the delimitations applied to the selection of the primary sources. After their definition, the selection criteria are described in the following sections. As part of this definition, original examples from the primary sources are provided.

The definition of the selection criteria has two purposes. First, it describes the features of the primary sources selected for this study and illustrates their diversity. Second, it constitutes a preliminary analysis of the collected sources. A first reflection on the primary sources seemed necessary to decide which ones to include in the collection of data. Indeed, due to space constraints, primary sources were excluded from the analysis conducted in this thesis. However, they possibly represent valuable material for future research.

²¹ Faraday, Michael and Whewell, William. (1834–1860). Correspondence between Michael Faraday and William Whewell. From the James Catalogue of Western Manuscripts, Trinity College Library, Cambridge (UK). Reference: O.15.49. <https://mss-cat.trin.cam.ac.uk/Manuscript/O.15.49> [accessed January 2, 2024].

The complete Faraday-Whewell correspondence quoted in this chapter is available at the Christopher Wren Library of the Trinity College, Cambridge (UK). Reference to the correspondence at the following link: <https://archives.trin.cam.ac.uk/index.php/correspondence-between-william-whewell-and-michael-faraday> [accessed January 2, 2024].

4.7.1. The timeframe: the first half of the 19th century

The timeframe for the selection of the primary sources was the 19th century, specifically the first half of it i.e., the period between 1800 and 1850. Described by Yeo (1991: 26) as the "age of classification", the 19th century saw the construction of scientific knowledge both at a national and international level. The initial timeframe of this study was the long 19th century, defined as the period between the end of the 18th and the beginning of the 20th century, which is considered as the age of formation of scientific disciplines (Lightman and Zon 2014). Through a preliminary study of the sources, it was acknowledged that some of them dated back to the end of the 18th century, if not earlier. The reconstruction of specific terminological processes also led to the acknowledgment that they extended also beyond the end of the 19th century and up to the beginning of the 20th century. However, most of the primary sources included in the study dated between 1800 and 1850. For these reasons, while reference is made in the thesis to terminological processes throughout the long 19th century (1770–1920), the focus of this study will be on the first half of the 19th century.

4.7.2. The languages

The languages included in the study represent a further principle of selection. The selected languages of the primary sources are:

- Latin
- English
- French
- German

These were selected as the main languages of scientific discussion at the time (Melosik 2023). Sources in other European languages, such as Italian (Melloni 1833), Spanish or Polish, are briefly mentioned in the study, to show how the discussion on nomenclatures spread at the time across all Europe. However, they were excluded from the main selection, as they were less employed at the time in the European scientific discussion (*ibid.*). Not all languages were present in all selected case studies. Depending on the evolution of a debate, indeed, each episode included at least two languages, but not necessarily all of them. Moreover, as the author of this study, the selection was made with reference to the languages I can read and speak.

Potentially interesting case studies were discarded if no evidence was found of the presence in their evolution of at least two languages. While the discarded episodes were not included as main examples in the thesis, they may be mentioned anyway to illustrate the variety of the debate on terminological topics at the time.

Multilingualism represents an important factor in this study, since the thesis aims to prove how the described terminological processes occurred contemporarily in multiple languages, scientific

communities, and disciplines. Moreover, multilingualism, as the presence of multiple languages in terminological processes concerned with naming and defining concepts, is intended in this work as an indication of the international character of these processes.

4.7.3. The disciplines

This study aims to include the widest possible range of fields of research in the analysis. This should help to prove that comparable terminological processes occurred in the first half of the 19th century in presumably all fields of research. Both hard and social sciences were considered. However, this distinction was not present when this study was, as the definition of *classificatory sciences* could be applied to most disciplines (Bud 2018).

The comparison among disciplines, languages and terminological processes is at the basis of the structure of this thesis. As specified in the introduction to the methodology of this study (see Sec. 4.2.), the focus of the thesis is on terminological processes happening at the same time in different fields of study and languages. As a consequence of that, the multiple applications of the same process are studied in comparison to one another.

This principle of multidisciplinary describes the presence of the same terminological process in multiple disciplines. Indeed, one of the aims of this study is to demonstrate how terminological processes were common to more than one field of research and therefore were not part of a discipline's exclusive method (Lightman and Zon 2014). In the collection of primary sources, two complementary levels of multidisciplinary were observed:

- **External multidisciplinary** occurred when similar or comparable terminological processes were present in different disciplines.
- **Internal multidisciplinary** occurred when similar or comparable processes within the same discipline were present, but in different fields of research or applications.

4.7.4. The quantitative principle: the relevance of a debate in a discipline

The quantity of collected primary sources on a specific debate or episode constituted a parameter to assess the relevance of a discussion, or of a nomenclature, within the development of a discipline. Therefore, debates were selected for this study also with reference to the quantity of primary sources, which were found during the phases of search.

As specified in section 4.4., the quantity of primary sources was related to the diffusion of the debate within the scientific community. The fact, for instance, that a nomenclature or classification proposal were discussed in several specialised journals was considered as an indication of their prominence in the discipline. The presence among the primary sources of a great deal of volumes and pamphlets dedicated to a nomenclature could be considered as an indication of its relevance for the

discipline. At this stage, it seems worth underlining how this study does not aim to entirely reconstruct historical episodes or debates among experts on nomenclatures, as this would be beyond the possibilities of this thesis. Instead, this thesis illustrates the widest possible range of terminological processes taking place in a limited frame of time, and to compare them to one another. Specifically, with reference to the concepts of breadth and depth of the research, in the construction of this study, I favoured the former over the latter.

Every time a debate on an attempt at classification was detected, the most significant primary sources on the topic were searched for in online archives. These were, in most cases, journal articles in which the debate occurred, relevant volumes dedicated to the presentation of a nomenclature, as well as translations of volumes or parts thereof. This principle is connected to the process of cross referencing across primary and secondary sources, through which the important primary sources for each debate were detected (see Sec. 4.6.4.).

The availability of a primary source could depend on multiple factors, such as the importance of the volume at the time or its diffusion among the experts. Normally, throughout the search, frequently mentioned, and therefore particularly central primary sources could be found in the consulted online archives. While these sources were not always in their original version or first edition, the second or third edition of all volumes was available online.

4.7.5. Fields excluded from the selection

Debates on nomenclatures in biology and chemistry, all taking place at the time, were excluded, as main examples of the terminological processes this study is set to describe. The decision was made as it was acknowledged that these major processes had already been described from a linguistic perspective (see Crosland 1962; Schiebinger 2004). It was preferred to centre the study on less known case-studies on nomenclatures at the time. This was done with the intention to show that, aside from the main discussions on naming in botany and chemistry, the same interest for naming was present in other fields of research, in which naming, and classification of concepts were also connected to the constitution of the fields of research as scientific disciplines (see Lightman and Zon 2014).

The application of terminological dynamics and the discussion on nomenclatures and classifications of concepts was extended to linguistic disciplines at the time.

In this study, the choice was made to exclude linguistic disciplines per se as possible examples of the dynamics. This was motivated by the nature of the discipline and of the experts discussing it. While in other fields of study the protagonists were experts of other disciplines discussing terminological processes, in the case of linguistics the same experts were linguists discussing terminological processes. This principle is significant for the purposes of this study. Indeed, the study aims to show how a terminological discussion took place as part of the development of knowledge in

other disciplines. To this purpose, the exclusion of terminological reflections by experts of linguistic disciplines is of primary importance.

However, reference to these debates will be made at various stages of this thesis, to show how, the general discussion at the time also involved these disciplines. An example of that is the discussion of Max Müller's *Lectures on the Science of Language* and the lecture entitled *On Thought and Language* (Müller 1866). The lecture, published in the journal *The Monist*, investigated the relation of concepts and words. During the period considered in this study, linguists' reflections on scientific language also involved psychological implications on the way of thinking of the human mind, and the connections of our thoughts and words. In this perspective, the discussion entitled *Thoughts without words* (Romanes 1887: 172) is interesting. Taking place among experts of psychology in *Nature*, the exchange defined words as the "scaffolding" of our thoughts. While these discussions are particularly interesting from the terminological perspective, they were not considered significant for the research questions of this project. However, they will be part of describing the historical background of the presented case studied, aiming to remark the multitude of disciplines involved at the time in terminological reflections.

4.7.6. The identification and description of a terminological process

The search for primary sources aimed to identify terminological processes, or aspects of term formation within the primary sources, in the scientific activity of experts of other disciplines, and with a sufficient number of primary sources to describe them. A separate section is dedicated to the definition of terminological process (see Sec. 4.2.), as identified in this thesis, and with reference to modern and contemporary terminology theory (see Temmerman and Van Campenhout 2014).

The search aimed to collect enough primary sources to describe a terminological process and demonstrate that it was present as part of the experts' scientific activity. All these processes extended diachronically far beyond the limits of this study. At the same time, a more in-depth description of each process considered in this thesis, could theoretically constitute the subject of a separate study in the future. In this, each case study was not relevant on its own, but as part of the broader picture illustrating the terminological activity of 19th-century experts and as an example of their terminological practices. In this vision, the selected fields of research are only examples of the application of these processes to various objects. The following table presents an overview of the selection criteria for the primary sources:

Timeframe	Focus on 1800 - 1850
Languages	Latin English French German
Disciplines	Hard sciences Social sciences

Additional quantitative principle	Relevance of the episode for the discipline
Multilingualism in the selection of the case studies	At least two languages involved.
Multidisciplinarity in the selection of the case studies	At least two disciplines involved.
Multiple declinations of the same dynamic in different case studies	Presence of at least two examples for each terminological process.
For each terminological process	A main example - explained more in detail. A side example - with reference to other similar processes

Table 2: Selection criteria for the primary sources.

4.7.7. The selection of the case studies according to the described selection criteria

An example of the case studies selected from the primary sources is presented in this section. The complete table with all identified case studies is attached to this study in Annex C. In the following example, the main features of case study are provided.

<p>Periodisation of English, French and German architecture</p> <ul style="list-style-type: none"> - Main timeframe: 1808 - 1842 - Discipline: Architecture - Languages: English, French, German - Objects of classification: windows - Main works on the subject <ul style="list-style-type: none"> - De Caumont, Arcisse. (1825). <i>Essay sur l'architecture religieuse du moyen age. Principalement en Normandie</i>. Caen : Chalopin fils. - Rickman, Thomas. (1817). <i>An Attempt to discriminate the Styles of English Architecture, from the Conquest to the Reformation; with notices of Eight Hundred English Buildings: Preceded by A Sketch of the Grecian and Roman</i>. London: Longman, Hurst, Rees, Orme, and Brown. Second Edition. - Sharpe, Edmund. (1851). <i>The Seven Periods of English Architecture</i>. Defined and illustrated. London: George Bell. - Main journals involved: The Builder, The Ecclesiologist. - Terminological dynamics involved: term formation, variation, translation. - Other forms of representation or semiotic systems: architectural drawings

Table 3: An example of the identified case studies in the primary sources and their main features.

These features were compared across case studies, to select the ones which were examined as the most interesting, according to the criteria analysed in the previous sections.

4.8. An overview of the existing paradigms on research methodology

4.8.1. Introduction

A combination of different qualitative and comparative research approaches provides the methodological framework for this multidisciplinary study. Historical research approaches are employed in the collection of primary sources on which this study bases. After the collection, a descriptive analysis is conducted on the sources. Finally, a case study approach is applied, selecting representative examples from the primary sources for the description of terminological processes. Moreover, a combination of inductive and deductive approaches is employed in the analysis: research prevalently started from theories on terminological processes and tries to prove them through the data analysis. Concurrently, a bottom-up approach is employed, with the aim to formulate theoretical statements and to specify the initial assumptions from which the study started.

As reported by Kothari (2004: 2), the research methodology of this study can be defined as exploratory and descriptive i.e., with the aim to "portray in an accurate manner the characteristics of a subject, individual or event" and "to gain familiarity with a phenomenon or to achieve new insights into it". Regarding the research methods defined by Kothari (2004), the study can be defined as both applied and fundamental. While discussing single case studies through an applied approach, the study can also be described as fundamental, since it aims to discuss, after the analysis of the case-studies, general principles on terminology theory.

The following sections describe the main research methods applied in this study. First, the historical and archival approach, then the approach pertaining to text analysis, defined as "narrative analysis" (Gimenez 2010: 200); third the case-study approach employed to analyse the data; and lastly, the qualitative and comparative approaches to research.

4.8.2. Historical research method

The methodology of this study can be defined as historical and qualitative. According to Sager and Rosser (2015), historical research is concerned with the systematic account of past events, with the aim of explanation and description. In reference to this, the approach adopted in this study is historical, and based on the reconstruction of selected 19th- century events.

Tan (2015: 1) describes the main aim of historical studies as the one to "verify and explain" an event. However, the motivations to conduct historical research could be diverse. The most important of them, seemed to be that "people can learn from the past", as Moore, Monaghan, and Hartman (1997) state. This is important for this thesis: the construction of links between episodes, as well as across past experts and the modern theorists of terminology, are examined with the intention to learn from them.

As I specify the conclusions of this thesis (see Ch.9), what we can learn from past experts and practices seem to be new insights into real and context-dependant processes of naming and classification. These new insights describe the ways in which terms and nomenclatures were formed through social processes of discussion among scholars and definition of shared guidelines to be adopted. More in detail, the analysis of the sources confirms the importance of considering multiple contextual factors, as well as actors in the description of term formation.

Regarding terminology theory, the aim of historical research as a process which helps to construct "links between the present and the past" is important, as mentioned by Monaghan & Hartman (2000, in Tan 2015: 1). According to the same study, the multidisciplinary perspective is important. Multidisciplinarity is indeed encouraged in historical research, where events are not considered as single elements, but within a broader context, in which they are all connected.

Two approaches to historical research proposed by Monaghan and Hartman (2000, in Tan 2015: 2) are applied to this study. The first, defined as qualitative, or "history by quotation", refers to the method in which primary sources are examined, to reconstruct a historical event; and the quantitative approach, where, among the historical sources, quantitative evidence is searched for, to answer the initial hypothesis of the study. Indeed, as happened in this study, the quantitative approach to history has the aim of generalisability, while being based on the initial assumption that broader statements can be made, starting from the analysis of quantifiable sources. Beyond encouraging multidisciplinary, a feature of the historical method, mirrored in this study, is the significance attributed to comparison, as mentioned in the following quote:

Historical methods of research is a scientific method in which **comparison** is used to reveal the general and the particular in historical phenomena and to gain an understanding of the various historical stages of development of one and the same phenomenon or of two different but **contemporaneous phenomena**. (Kumar 2014: 2)

The reference in historical research across past, present, and future events is noteworthy. As mentioned by the author, historical research aims not just to describe the evolution of events in a systematic manner, but to explain present events, while formulating possible solutions to future ones. Indeed, the value of historical research, as categorised by Hill and Kerber (2001, in Kumar 2014) is to find solutions to past and present problems, and to re-evaluate data on theories based on the description of past events.

In conclusion, the extensive use of archival methods in this thesis should be mentioned, as the present study seems to represent of the first instances of this in terminology theory. To the best of my knowledge, if archival studies exist in literature in terminology theory, they appear to be always limited to the history of single terms or nomenclatures within a specific discipline and language (see for instance Becker 2005; Pitkänen 2008; Pitkänen-Heikkilä 2015).

4.8.3. Text and narrative analysis

The project combines a microanalytical approach for the study of the details of the primary sources to a macro analytical approach which considered the broader social and historical processes of the context in which the study is set.

The main research strategy applied in this study pertains to the field of text analysis, as an approach referring to the broader field of discourse analysis (Baxter 2010). As stated by Heller (2001, in Baxter 2010: 117) text analysis, combines macro- and microanalytical approaches i.e., bottom-up and top-down approaches (ibid. 2010: 119). In this, the method works both on linguistic details of the text, and on the "broader social processes", expresses through language.

Regarding text analysis, the methodology of this study is mirrored in the approach described in literature as narrative analysis (Bauer et al. 2014). This method defined by Gimenez (2010: 200) is set to describe "the history behind the data" and to be applied to episodes among which "discursive connections" can be established, to describe patterns and regularities among them. From the concept of narrative also derives the definition of "narrative network", always pertaining to the field of critical discourse analysis, as Gimenez illustrates:

The term "narrative network" was first used by Bearman and his colleagues (Bearman et al., 1999; Bearman and Stovel, 2000) to describe how the structural elements in a narrative create an internal network of meanings which supports the holistic interpretation of a story. From an epistemological perspective, **narrative networks** can be placed within Critical Discourse Analysis. (Gimenez 2010: 206)

A similar definition of network exists in historical studies (Sigrist and Widmer 2011). Neuman (2014) and Adedoyin (2020) describe narrative analysis as one of the strategies to examine qualitative data:

Narrative analysis is a **qualitative** content analysis strategy where data are dissected for the provision of logical explanations, and this can come from several means such as analytic narrative, narrative explanation, narrative structural analysis, or sequence analysis. (Adedoyin 2020: 83)

Baxters' (2010: 119) definition of discourse as "social and ideological practice" seems to apply also to the discourse in written form with which this study is concerned:

The term "discourse" is itself a contested term [...] its definition [...] is that of "language above the sentence" (Cameron 2001). [...] This definition seems to cohere with Fairclough's (1992: 3) description of discourse as the "situational context of language use" [...] linguists [...] are also likely to understand discourse in the plural – as discourses. Such a usage reflects the influence of cultural historian, Michel Foucault, who famously defined discourses as "practices that systematically form the objects of which they speak" (Foucault 1972: 42). In simpler terms, discourses are more than just linguistic: they are social and ideological practices which can govern the ways in which people think, speak, interact, write, and behave. (Baxter 2010: 119)

Discourse analysis is important in this study, since it focuses on written reports of debates among experts. As Baxter (2010) reports, indeed, discourse analysis originated in the sociology of scientific knowledge:

[...] Social scientists [...] were investigating the **sociology of scientific knowledge** following a dispute in the field of biochemistry. Their analytical goal was to discover the systematic features of **scientists' discourse**, but they came across strongly conflicting descriptions of experience. [...] (Baxter 2010: 124-25)

This study employs discourse-historical methods, which aim to "integrate systematically all available background information in the analysis and interpretation of the many layers of a written or spoken text" (Fairclough and Wodak 1997: 266, in Baxter 2010: 127).

4.8.4. Case study approach

This thesis adopts a case study and comparative approach to the structuring of the data analysis. The approach was selected as essentially qualitative (Susam-Saraeva 2014). Referring to social sciences, Susam-Saraeva (2014) reports a definition of a case which can be applied to this thesis:

In the social sciences a case is defined as "a unit of human activity embedded in the real world; which can only be studied or understood in **context**; which exists in the here and now; that merges in with its context so that precise boundaries are difficult to draw" (Gillham 2000: 1; in Susam-Saraeva 2014: 38).

Starting from this definition, other relevant features of the case study approach can be encountered in this study. The importance of context is described as a main feature of this approach, as it focuses on the description of a whole episode within its context, in the most detailed manner. Following this, the unit is considered as an example from a broader reality, in which, starting from the selected case, generalisations are possible. All relevant details of the case are described, to which then the interpretation of the case follows. Ultimately, as Susam-Saraeva (2014: 44) states, case studies can be "revelatory" in the observation of a phenomenon which had not been described before and can either confirm or invalidate a theory. Regarding this study, the selected cases are meant to discuss terminological processes, instead of proving or disproving a theory i.e., to find new insights into these processes, through the analysis of case studies which were never described before.

The case study approach is described also by Priya (2021: 94) as a main strategy of qualitative research. Parallel to that, Yin (2009: 18) defines case study as "an empirical inquiry which investigates a phenomenon in its real-life context". Concurrently, the case study is defined as a strategy for research design, in which data are structured in a specific way (see Yin 2009, in Priya 2020). Creswell (2014) provides a comprehensive definition of case study strategy:

Case Studies are a qualitative design in which the researcher explores in depth a program, event, activity, **process**, or one or more individuals. The case(s) are bound by time and activity, and researchers collect

detailed information using a variety of data collection procedures over a sustained **period of time**. (Creswell 2014: 241)

According to Priya (2021: 96), case studies can be classified with reference to their purpose. Regarding her proposed definitions, the case studies presented in this thesis can be defined as both descriptive and explanatory. They are descriptive since they aim to "describe a phenomenon in a real-world context", while they are also explanatory, as they are constructed "to explain a particular phenomenon" (ibid.) and its causes, within a specific context. Indeed, while describing the selected examples, new application of the terminological processes could potentially be identified. These new applications could, at the same time, constitute the subject of future and more in-depth studies.

4.8.5. The qualitative and comparative approach

The method for the analysis of data can be defined as qualitative, descriptive, and comparative. A feature of the qualitative approach is the iterative process of analysis it involves, as Adedoyin (2020) describes:

Successive approximation refers to a qualitative data analysis strategy that involves **iteration process** by moving forward and backward between abstract concepts, theories, or models and observed data with persistent polishing of data gathered. (Adedoyin 2020: 83)

The same iterative process of data analysis is applied in this study. There, as previously specified in this chapter (see Sec. 4.6.) primary sources and case studies were selected through an iterative application of the selection criteria. The connection among primary and secondary sources was also typical of this study. Indeed, the qualitative analysis is also described as a "constant comparative analysis" (Thorne 2000: 69) among data and theories. This feature can also be found in this study.

As Swainson (1971, in Adedoyin 2020) observes, comparative research is a perspective, which allows the researcher to test the research method and to become aware of problems in the method to answer the research questions, and to expose "similarities and differences between units" (Holt and Turner 1970, in Adedoyin 2020). Moreover, the comparative method is a qualitative strategy used to expose similarities and differences across the data, as Freiburger (2018) underlines:

A comparative study whose primary goal is description aims at a better understanding of a particular historical-empirical item by means of **comparison**. Comparing that item with other items can serve a heuristic purpose by identifying aspects and facets that would otherwise be missed or neglected. (Freiburger 2018: 4)

The case study approach and the qualitative method are often used in combination with comparison, since they all imply an in-depth knowledge of the data being studied, as well as of their historical and social context. Naturally, as Mojtaba Miri (2019) argues, as in the present study, these approaches are

best applied to a limited number of studies. The focus on a reduced number of examples allows to describe these examples in detail:

Comparative methods, then, may be used for both theory development and hypothesis testing. With a moderate number of cases (usually around 5–50), it becomes possible to examine **cross-case patterns** while still attending to the **details** of each case. In comparative research, theory development and hypothesis testing interact in two ways. First, comparative methods may be used to develop, test, and revise a particular theory. Second, comparative methods may be used to adjudicate between competing theories (Ragin and Rubinson 2009, in Mojtaba Miri 2019: 6)

Comparisons are defined as descriptive in nature, since they aim to describe the occurrences of certain phenomena, among the examined cases and how differently they apply to various phenomena. As Mojtaba Miri (2019: 8) specifies, another important feature of the comparative process is the iteration of the processes it involves, which is a feature on which also this study is based, among selection, description, juxtaposition, and redescription of the data, after being compared to other data.

4.9. Summary of the contents

This chapter presented the main elements of the methodology employed in the construction of this thesis. After an introduction to the contents of the chapter, the following sections focused on the phases of research, which were applied in an iterative process for the retrieval of the primary and secondary sources. Section 4.6. and 4.7. explained the selection criteria for the inclusion of primary and secondary sources, as well as the case studies, on which this thesis is based. Lastly, section 4.8. was devoted to a brief positioning of this study within the literature on the main research paradigms mentioned in the construction of this thesis. As specified in section 4.6., the research phases were applied repeatedly throughout the construction of the study as part of a circular process, in the selection of the sources and case studies. Comparison was the main principle on which the structure of the thesis was organised, as multiple case studies from the primary sources were compared, with reference to their applications of the terminological processes being investigated.

5. Multilingualism-influenced terminological processes

5.1. Introduction

The chapter addresses the role of multilingualism in term formation as the influence of multiple languages to the term formation process. Specifically, this chapter presents languages as one of the aspects involved in 19th- century term formation and it aims to see how multilingualism influenced the development of three terminological processes.

The present analysis applies insights from these studies to case studies from the primary data. The role of multilingualism is examined as it applies to three stages of the formation of the nomenclature of cloud formation. First, the creation of terms for unnamed concepts, defined by Sager (1997) as primary term formation; second, the proposal of alternative terms for already named concepts, which could be defined as secondary term formation (Sager 1997). Lastly, multilingualism is described as involved in term standardisation (see Johnson and Sager 1980; sec. 2.7.1.). Moreover, the chapter highlights the relevance of the differences across languages in the formation of terms and in the definition of concepts, which are identified through these terms. In addition to this, the different use and relevance of languages in the international scientific community of Europe are addressed. A further example presents multilingualism in an attempt at standardisation of the architectural nomenclature.

Different aspects of the relation of multilingualism and terminology are described in the literature to date. From Budin and Wright (1997) examination of language planning and standardisation in a multilingual context, to Temmerman and Van Campenhoudt (2014) and Faber and L'Homme (2022) collective volumes, various approaches to multilingualism are addressed in specialised communication as applied to various domains, such as legal terminology or medicine (see Maryns 2012; Derlén 2014).

While term formation is examined through the process in which it has been divided in the existing literature in terminology (see Rondeau 1984; Sager 1990), two main aspects of term variation are exemplified through the analysis of the historical sources. First the connection of term variation and the advancement of knowledge, second, term translation as a form of term variation. Lastly, multilingualism is analysed in standardisation of the specialised language both in relation to the traditional knowledge in the domain (Galinski and Weissinger 2010; Van Campenhoudt 2017), and within the role of standard terms as "references" (Leonardi 2009: 41) for the development of knowledge. Finally, this chapter – as the whole thesis – highlights the role of experts in the formulation of standard terms and in their role of evaluating them as "the correction of a sociolinguistic situation and the choosing of a specific term as a reference form" (Cabré 1999: 195).

The rest of the chapter is structured as follows. Sections 5.2. and 5.3. present the classification of cloud formations. This process originated in England and developed across Europe, involving experts

from Germany and France. In section 5.4., another example describes the use of languages in the formation of scientific language in architecture and how the classification of architectural elements can contribute to the periodisation of medieval architecture. This example shows how terms in different languages are compared in an attempt at standardisation, in a pamphlet entitled *Architectural Nomenclature of the Middle Ages* (Willis 1844). Section 5.5. reflects on multilingualism in the described terminological processes, while section 5.6. comments on the processes from the perspective of terminology theory. Finally, section 5.7. sums up the contents of the chapter.

5.2. The classification of cloud formations

Taking the nomenclature of cloud formations as an example, the role of multilingualism is described within three terminological processes. The history of such nomenclature is presented as a succession of attempts at naming clouds in three languages i.e., French, Latin, and English (Lamarck 1802; Howard 1803a), starting with the first attempts at the beginning of the 19th century, and up to the official nomenclature published in the *International Cloud Atlas* (Hildebrandsson et al. 1890) in English, French, and German. The diachronic perspective adopted in the description of the events underlines how research on the naming of clouds extended before and after the 19th century. Considered in a broader historical context, the classification of clouds is one of many attempts to categorise natural phenomena and newly discovered entities (Schiebinger 2004) during an era of intense interest in the organisation of knowledge at an international level (Yeo 1991; Daunton 2005 inter alia).

The focus is set on the formation of terms in various languages as a collaborative practice, composed of multiple processes and in which numerous actors were involved. This collaborative practice is addressed both a national and an international perspective. Since there is – to the best of my knowledge – no evidence in literature of a collaboration among experts across Europe on the naming of cloud formations (Gedzelman 1989), the collaborative practice is described within the single language communities. In the analysis of the sources, however, the presence of an international and European scientific community is mentioned, as part of the context in which these episodes occurred.

The first terms were proposed at the beginning of the 19th century (Lamarck 1802; Howard 1803a). Through the discussion among experts in multiple European countries, terms and concepts were debated. At that stage the use of a specific language for the international and official nomenclature was discussed. As a reference to the importance of languages in the scientific discussion and in the creation of the official nomenclature of cloud formations, at the end of the century, the three main European languages of scientific debate were included in the standardisation of the nomenclature. Notably, the official terms included in the *International Cloud Atlas* (Hildebrandsson et al. 1890), published in 1890, were inspired by the ones proposed at the beginning of the century (Howard 1803a).

The reconstruction of the history of the nomenclatures of cloud formations is based on a collection of historical and secondary sources. Hamblyn (2002) describes the evolution of Howard's classification of clouds (1803a)²², from his first proposal to the codification of the official nomenclature in the aforementioned *International Cloud Atlas*. Vasak (2014) examines the value of Howard's classification in the history of science, while Thornes (1984) recognises the influence of Howard's classification on 19th- century painting and landscape representations, as does Stephens (2003), who goes on to highlight the significance of cloud classification to the formation of systematic cultural and scientific knowledge. In addition to this, the literary value of Howard's and Goethe's work on the nomenclature of clouds is described by Pinna (2007).

From a historic perspective, the classification of clouds was critically important to the discipline of meteorology, proven in studies by the *Royal Meteorological Society* (Pedgley 2003). Clearly, the development of cloud terminology was a model for the development of terminologies in other fields. However, it has not yet been examined from the perspective of terminology theory.

5.2.1. An overview of cloud classifications in the 19th Century

Attempts to classify cloud formations were made throughout the 19th century, following a few early naming proposals in the 18th century. As Hamblyn (2002) reports, the first classification of cloud formations was presented in 1802, when the French biologist Jean-Baptiste Lamarck published an article entitled "Sur la forme des nuages" [On the shape of clouds] in his own journal on meteorology: the *Annuaire Météorologique* [Meteorological Yearbook]. That same year, the English meteorologist Luke Howard presented a classification at a meeting of the Askesian Society of London which was published in the *Philosophical Magazine* in the following year (Howard 1803a; 1803b; 1803c).

As Hamblyn (2002) notes, while Lamarck's classification was immediately discarded, Howard's nomenclature led to an animated discussion among experts in various European countries, such as England, France, and Germany. The debate continued in numerous journals, as the *Philosophical Magazine*, and *The Gentleman's Magazine* in England, as well as the German *Annalen der Physik* [Annals of Physics] and the French *Journal de physique, de Chimie, d'Histoire Naturelle et des Arts* [Journal of Physics, Chemistry, Natural History, and the Arts]. Parallel to that debate, alternative nomenclatures were proposed in all the languages involved (Forster 1816; Hildebrandsson 1890; Ley 1884). Howard's terms even caught the attention of German poet and writer Johann Wolfgang von Goethe, a passionate meteorologist. A correspondence between the two experts has been documented, as well as some letters of appraisal by Goethe for Howard's useful terms, published as part of his *Werke* [Works] (Goethe 1834). Despite various attempts to replace Howard's Latin

²² Henceforth referred to as Howard's classification or Howard's nomenclature.

nomenclature throughout the century, it became the most well-established terminology in the discipline.

The last decades of the 19th century saw an increasing necessity for a standardised and international nomenclature of clouds among experts in Europe (Abercromby 1887; Hildebrandsson 1887). This necessity inspired the formation of a so-called *Cloud Commission*, a committee of experts of the *International Meteorological Organisation*, which sought to codify the nomenclature of clouds. As a result of their joint efforts, the standardised nomenclature was published in the aforementioned *International Cloud Atlas* in English, French and German (Hildebrandsson et al. 1890). Ten terms were declared standard, four of which were part of Howard’s original nomenclature.

The evolution of the nomenclature continued after the publication of the *Atlas*, as new subvarieties of the standard ten classes were described. Clayden’s (1905) proposal for an extension of the official nomenclature was just one of many attempts to update the official terms. Inspired by precedent classifications, such as those of Hildebrandsson (1890) and Ley (1894), Clayden (1905: 34) defined subvarieties, or exceptions, to the official terms, which could "hardly be bettered".

In this chapter, the analysis of naming during this century will be limited to three processes i.e., term formation, variation, and standardisation, each discussed from the perspective of modern terminology theory. The history of the classification of cloud formations in the 19th century is inspired by Hamlyn’s (2002) reconstructions.

5.3. Cloud Terms at the beginning of the 19th century

5.3.1. The first cloud nomenclatures in French, Latin and English

The first phase of naming cloud formations occurred at the beginning of the 19th century beginning with Lamarck’s (1802) nomenclature of five classes of clouds, entitled "Sur la forme des Nuages" [On the shape of Clouds]. Howard’s contribution, entitled "On the modifications of clouds, and on the principles of their Production, Suspension and Destruction" (1803a) was published in the *Philosophical Magazine* the following year. Table 1 compares these classifications.²³ However, terms and concepts are not matched, since a relation among the concepts and terms presented in the classifications could not be established, to the best of my knowledge. As Gedzelman (1989: 381) confirms, the classifications were developed "independently", and concepts are listed in the following table in the sequence in which they were presented in their first publications respectively (Lamarck 1802; Howard 1803a):

Lamarck	Howard
Celle des <i>nuages</i> en voile	Cirrus – Def. Nubes cirrata, tenuissima, quae undique crescat.

²³ Gedzelman (1989: 381) states that the two classifications were developed "independently". I found no evidence of a connection between Howard and Lamarck, or that they were aware of one another’s activity.

<p>[That of the clouds in voile]²⁴</p>	<p>"Paralle, flexuos or diverging fibres, extendible in any or in all directions".</p>
<p>Celle des nuages attroupés [That of the clustered clouds]</p>	<p>Cumulus – Def. Nubes cumulata, densa, sursum crescens.</p>
<p>Celle des nuages pommelés [That of the dappled clouds]</p>	<p>"Convex or conical heaps, increasing upwards from a horizontal base".</p>
<p>Celle de nuages en balayures [That of the clouds in sweeps]</p>	<p>Stratus – Def. Nubes strata, aquae modo expansa, deorsum crescens.</p>
<p>Celle de nuages groupés [That of the clouds in groups]</p>	<p>"A widely extended, continuous, horizontal sheet, increasing from below".</p>
	<p>Cirro-cumulus – Def. Nubeculae densiores subro tundae et quasi in agmine appositae.</p>
	<p>"Small, well defined roundish masses, in close horizontal arrangement".</p>
	<p>Cirro-stratus – Def. Nubes extenuata sub-concava vel undulata. Nubeculae hujus modi appositae.</p>
	<p>"Horizontal or slightly inclined masses, attenuated towards a part or the whole of their circumference, bent downward, or undulated, separate, or in groups consisting of small clouds having these characters".</p>
	<p>Cumulo-stratus – Def. Nubes densa, basim planam undique supercrescens, vel cujus moles longinqua videtur partim cumulata.</p>
	<p>"The cirro-stratus blended with the cumulus, and either appearing intermixed with the heaps of the latter or superadding a wide-spread structure to its base".</p>
	<p>Cumulo-cirro-stratus vel Nimbus – Def. Nubes vel nubium congeries pluviam effundes.</p>
	<p>"The rain cloud. A cloud or system of clouds from which rain is falling. It is a horizontal sheet, above which the cirrus spreads, while the cumulus enters it literally and from beneath".</p>

Table 4: Lamarck's and Howard's classifications of cloud forms.

Despite being published at virtually the same time and on the same subject, Lamarck's (1802) and Howard's (1803a) nomenclatures were significantly different. With reference to Sager's (1997: 25)

²⁴ Unless otherwise specified, translations are provided by the author of this thesis.

"intentionality" in term formation, communication and knowledge transfer at an international level were Howard's main concerns in forming his terms, leading him to choose Latin and English. Lamarck, in contrast, thought that French was international enough for an official nomenclature, and that providing Latin or English equivalents of his terms was not necessary. The language appeared to be fundamental for the success of Howard's nomenclature. The choice of Latin, and thus the possibility for the nomenclature to be employed by the whole scientific community in Europe, presumably represented an advantage for Howard's nomenclature to become official. The use of equivalents of the Latin terms in another language, in this case English, represented another successful strategy adopted by Howard. This way, Latin terms remained stable throughout the debate in all European journals and contributions by foreign experts, and the equivalent terms in English were translated into other languages, together with their definitions. The choice of translating only term equivalents and definitions were probably made by the experts to maintain the Latin and international nomenclature, while coining terms in their national language, and thus foster the discussion on them within the national community of experts.

Aside from the choice of language, the main difference between the classifications was the linguistic form of the terms. Howard's denominations were nouns coined for the purpose of classification and then combined with one another (e.g. Cumulo-cirro-stratus). Lamarck's terms were more similar to descriptions, composed of the substantive *nuage* [cloud], associated with different adjectives (e.g. Celle de nuages groupés). Furthermore, Howard also associated symbols with his terms. This was to facilitate annotation in notes on the states of clouds (Vasak 2014). Howard's proposed symbols for the various classes of clouds are represented in the Figure 1.

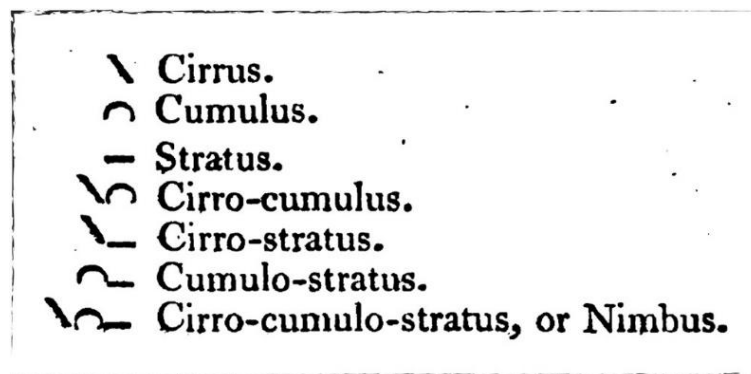


Figure 1: Howard's (1803a) proposed symbols for the various classes of clouds in his classification.

Lamarck's (1802) and Howard's (1803a) classifications denoted a clear interest in naming clouds. Although the classifications were different from one another, the nomenclatures represented contemporary attempts at naming entities which were not named at the time. The discussion on the naming of cloud formations seemed to spread all over Europe at the time, as the involvement of

experts from other countries, such as Cotte (1804), Brandes (1810) in France, and Goethe (1834) in Germany testified.

Unlike Howard's classification, Lamarck's attempt did not gain international recognition. The exclusively French character of the classification, and the absence of defined terms, substituted with adjectives and descriptions of the classes of clouds, might have been the reason for this, even though there seems to be no reference to this in literature. Nevertheless, Lamarck's attempt is significant for this study, since it testified the widespread interest in the description and classification of unnamed concepts, as in this case cloud formations, at the beginning of the 19th century. The attempt is important since it attested the presence at the time of a widespread effort to construct terms and definitions. Given that these terminological entities were not officially defined by the discipline of terminology at the time, all the described cases were remarkable, for having attempted to propose something which was not officially codified yet.

Lastly, as Clayden (1905) suggested, a key feature of Howard's proposal was that it was composed of four basic cloud forms, which, in combination with one another, could describe all other classes of clouds that had been observed by that time. As Hamblyn (2002) reports, as Lamarck's nomenclature was discarded, Howard's terms gained popularity and were discussed internationally throughout the 19th century (Forster 1811; Müller 1817; Poey 1863). Howard continued to publish and explain the nomenclature in further works (e.g., 1818; 1843; 1865). As knowledge about cloud formations developed, there was a need to extend Howard's initial nomenclature, but Howard's original terms were retained as the core ones.

Overall, Howard's nomenclature seemed to be more appropriate to respond to the necessities of the field at the time. Indeed, as becomes clear in the following sections, the field of studies needed terms as a codified system of symbols to identify the concepts being studied i.e., the forms of clouds. In this case, the language in which the terms were coined seemed to be a primary factor in the success of the nomenclature. As the proposal of alternative nomenclatures in different languages (see Sec. 5.3.2.) shows, Howard's choice of Latin appeared to have allowed his terms to become international.

Howard's decision to add visual representations and symbols to identify the concepts appeared to follow the strategy of a univocal representation of the classified concepts. However, even if these drawings and symbols were thought to be univocal, so that these symbols and the identified concepts could not be mistaken to others in other languages, other drawings and symbols could potentially be proposed for the same or other concepts also in other languages. Contemporarily, Latin terms could be understood by experts in other European countries. In a dedicated volume, Howard (1865) proposed drawings of all classes of cloud formations entailed in his nomenclature. An example is presented in what follows, and illustrates the class of clouds called *Cumulostratus*:

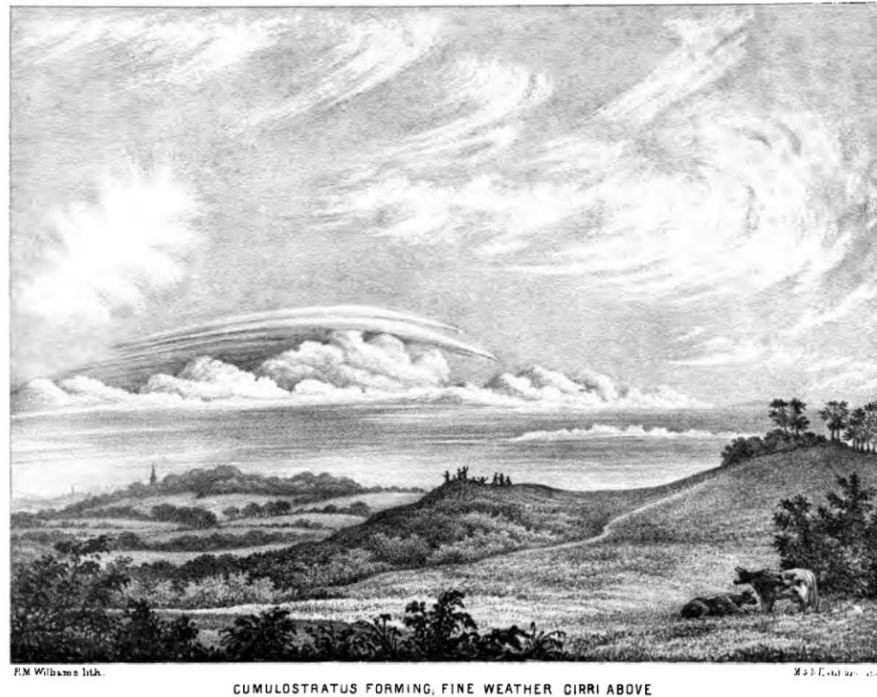


Figure 2: Cumulostratus forming, fine weather Cirri above (Howard 1865)

Lamarck (1805b) then presented a more detailed classification of clouds grouped into twelve categories in 1805, accompanied by specific definitions. Published in his own journal (Lamarck 1805b), the article was preceded by a classification of the states of the sky (Lamarck 1805a). In this work, Lamarck underlined the importance for emerging sciences of defining terms as linguistic expressions of their principles:

In every **emerging science**, one is forced to **create terms**, or compound words, to express by abbreviation a series of inter-related **ideas** or **facts** that would otherwise only be expressible that by means of **description**.

It is clear that such **descriptions** would not serve well to document **observations**²⁵. (Lamarck 1805a: 101)

The quote seems interesting for the definition of terms it provides. Indeed, Lamarck defined terms as abbreviations of facts, ideas, or series thereof, which could not be expressed by descriptions. Equally noteworthy is Lamarck's statement of the purpose of terms, which should serve "to document observation" (ibid.).

5.3.2. Alternative nomenclatures and translations into English, French, and German

The nomenclature of clouds began to undergo term variation for several reasons. First, variants to Howard's (1803a) terms were proposed by other experts as part of the discussion that followed his proposal in 1803. Second, as the debate extended into other languages, variants were created by way of translation.

²⁵ Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

The discussion of Howard's nomenclature started the same night as it was proposed (Hamblyn 2002). Indeed, scholars immediately noticed the revolutionary nature of Howard's terms as he presented the principles governing the combination of the four classes of clouds. The choice of Latin terms and the usefulness of the nomenclature were perceived as necessary for the development of research in the field of cloud studies. In following years, the experts commented on the proposal in various journals such as *The Annual Review* (Bostock 1804), the *Journal of Natural Philosophy, Chemistry, and the Arts* (Bostock 1810) and *The Gentleman's Magazine* (Forster 1811).

However, Howard's terms were destined to much wider success than within the scientific community in London, and the discussion expanded in specialised journals in other languages. Howard's nomenclature was immediately translated into German and French, and the discussion continued in the *Annalen der Physik* [Annals of Physics] (Howard 1805). One of the editors of the journal, Karl Pictet (1805), appeared to have translated the first version of Howard's (1803a) terms into German in an article. There, Howard's Latin terms were maintained, while their English equivalents and definitions were translated. Some years later, the discussion on Howard's nomenclature continued in the same journal, where articles with further reflections appeared (Forster 1815b; Müller 1817).

Other experts published on the subject in French, including Cotte (1804) and Brandes (1810). Cotte (1804: 279) defined the nomenclature of clouds as a "science des mots", separate from a "science des faits" (ibid.) to which it should lead. Indeed, Cotte distinguished clearly between the evolution of scientific language at the time, and the development of the knowledge it was connected to. In his article, Brandes (1810) criticised Howard's proposed term *Cirros*, for the specific form of cloud, but he agreed with Howard on the fact that clouds changed their forms when rain was approaching (Brandes 1810: 350). In 1815, in the *Annals of Philosophy*, the discussion of the nomenclature of cloud formations became particularly intense, as Howard himself provided explanations, or definitions, of his own terms (Howard 1815). Shortly after, in 1817, Christopher Johnson proposed two additional classes of clouds to be added to Howard's nomenclature (Johnson 1817).

The value of Howard's nomenclature appeared to be the use of Latin for the official terms. While Latin terms were provided with an equivalent term in English in the proposed nomenclature, the main form of each term was in Latin. The presence of both languages allowed the use of Latin terms in the international communication, also giving the experts the possibility to recognise them across publications and discussions in various countries. At the same time, experts within the national scientific communities could benefit from the translation of terms in their local language, as confrontation on term variants to identify the same concepts was fostered.

The choice of the language for official terms was addressed also in the proposal of an alternative nomenclature of clouds in English by Thomas Forster (1816) in *The Gentleman's Magazine*, based on the English version of Howard's terms, proposed in his nomenclature (Howard 1803a).

Indeed, English equivalents of the Latin terms were proposed by Howard (1803a) himself in the original version of his nomenclature. In his proposal of an alternative nomenclature of cloud formations in English, Forster questioned the use of Latin for terms, as this might hinder the diffusion of knowledge among non-experts:

The habit of the English writers of borrowing from other tongues the greatest part of their technical words, especially those which are used for the Sciences, is one of the causes why Natural History is not so much known to the generality of the people [...]. They told me that they could never remember the technical terms, which were made up of **Latin or Greek words**, which they did not understand; and wished that names could be given to Meteorological Phenomena, which are formed out of **our own tongue**. (Forster 1816: 131)

Goethe's contribution to the success of Howard's nomenclature is noteworthy (Hamblyn 2002; Pinna 2007). The German author presumably became acquainted with Howard's nomenclature through a translation that appeared in the *Annalen der Physik* (Pictet 1805). The article, which reported Howard as its author, was supposed to introduce Howard's nomenclature to the German scientific community.

As Pinna (2007) reports, Goethe complimented the English meteorologist in an epistolary exchange for a much-needed classification of clouds, as stated in his collected *Werke* (1834: 196): "Ich ergriff die Howardische Terminologie mit Freude, weil sie mir einen Faden darreichte, den ich bisher vermisst hatte"²⁶. In his work, Goethe (1834) dedicated a chapter to Howard's terminology:

Howards Terminologie

[...] Howards Terminologie wird hier aufgestellt, in die Ordnung wie die verschiedenen Wolkenformen Bezug auf die Erde, oder auf die [...] Regionen haben mögen²⁷.

Stratus

Hierunter werden alle diejenigen Wolken begriffen, welche sich Streifen oder schichtenweise zunächst auf die Erde beziehen. Von dem Nebelstreif an²⁸, [...]

Strato-cumulus

Heißt diese Erscheinung wie sie hier beschrieben worden: wenn nämlich beide Wolkenbestimmungen, der schon abgehandelte **Stratus** und der folgende **Cumulus**, noch zusammenhängen und keine Absonderung zwischen Ihnen stattfindet²⁹. (Goethe 1834: 198)

²⁶ English Translation: I grasped the Howardian terminology with joy because it presented me with a thread, I had been missing.

²⁷ English Translation: [...] Howard's terminology is set up here, in the order in which the various cloud forms may have reference to the earth, or to the [...] regions.

²⁸ English Translation: This is the term used to describe all clouds that first cover the earth in stripes or layers. From the streak of fog, [...]

²⁹ English Translation: This phenomenon is called as it has been described here: namely, when both cloud determinations, the stratus already dealt with and the following cumulus, still hang together and no separation takes place between them.

Goethe adopted Howard's terminology, translating then the original definitions of the terms into German. While Goethe mentioned the translations of Howard's terms appeared in the *Annalen der Physik* (Pictet 1805), he did not attempt to provide alternative translations of the terms. Instead, he defined the Latin terms in his own words, stating that he would adopt Howard's Latin nomenclature in his observations. Goethe also made an honorary tribute to Howard in a poem dedicated to his effort in naming. In Pinna's words (2007: 39), the poem represented a sort of "literary translation in verses of Howard's doctrine", which exemplified Goethe's interests for meteorology and poetry.

These authors' comments and proposal of expansion of Howard's (1803a) nomenclature testify its popularity and the diffusion it profited from at the beginning of the 19th century. As an apparently previously unnamed entity in meteorology, cloud formations appeared to be at the basis of a discussion among experts, which evidently involved also fundamental principles of term formation and classification.

5.3.3. The *International Cloud Atlas*

A significant milestone in the formation of the nomenclature of clouds is the standardisation of terms in the *International Cloud Atlas* (Hildebrandsson et al. 1890)³⁰. Led by a group of experts known as the Cloud Commission of the International Meteorological Committee, this publication standardised the nomenclature of clouds by presenting ten official terms in three languages i.e., English, French, and German (Hamblyn 2002). The official nomenclature was based on Howard's classification from 1803. When these terms became standardised in the Atlas, they had already been part of the traditional language of the discipline for almost a century. Interestingly, the publication of the Atlas was preceded and followed by articles and volumes dedicated to variants and expansions of Howard's nomenclature (Abercromby 1887; Clayden 1905). This might be seen as a signal that term standardisation was part of a process of language development, which seamlessly accompanied the evolution of the discipline. Moreover, the choice of coining the official nomenclature in multiple languages showed the importance of the discussion across the whole European community of experts.

The Atlas resulted from an intense process of standardisation at an international level. Even though most terms were already in use, a shared international nomenclature was not available. To the best of my knowledge, the question remains, indeed, as to why the Atlas was published only at the end of the century. While a general interest in standardisation of the specialised language of multiple fields appears to be present at the end of the 19th century, in fact, some terms appeared to be already in use among experts before. Presumably the presence of multiple term variants could have caused this necessity for standardisation among experts.

³⁰ Henceforth referred to as the Atlas.

This standardisation process was influenced by attempts at expanding Howard's nomenclature, such as Hildebrandsson (1890), which featured a nomenclature in English, French and German, and Ley's (1894) volume *Cloudland*, which proposed a nomenclature of clouds in Latin and English. As the languages were the same as the ones proposed by Howard (1803a), the nomenclature was different. Specifically in a chapter entitled *Classification, Nomenclature and Description of Clouds*, Ley proposed a nomenclature of clouds based on Howard's terms. In doing so, he notably stressed the importance of traditional terms, which, derived from Howard's (1803a) proposal, more than a century after their introduction, were still fundamental to knowledge development in the discipline and communication among experts.

In the discussion among experts leading to the publication of the Atlas, some noteworthy considerations on the nature of terms and the usefulness of an international nomenclature were put forward. Several papers presented at the meetings of the Cloud Commission were published in the *Quarterly Journal of the Royal Meteorological Society*. There, two contributors to the codification of the official nomenclature, Ralph Abercromby and Hugo Hildebrandsson, from Britain and Sweden respectively, shared their concerns about the nomenclature and the criteria adopted therein for the classification of clouds. As an example, Abercromby underlined the importance of both standardisation and tradition in terminology:

My primary idea – on which Prof. Hildebrandsson entirely concurred – is that the name of a cloud is of far less importance than that **the same name** should be applied to the same cloud by all observers; and also that **the existing names** should be retained, only that the form they are applied to should be more precisely defined. (Abercromby 1887: 155)

Abercromby's position on the diffusion of the same terms among all observers seems important, within the process of standardisation, as appears to be also the reflection on the use of existing names. This position, shared by Hildebrandsson, appears to be descriptive of the opinion of the scholars towards the creation of a standardised nomenclature at the time.

The publication of the Atlas did not end the discussion. Further attempts at specification and expansion of the official nomenclature were published in the following years, such as Clayden (1905). In a chapter of the volume entitled *Cloud Nomenclature*, Clayden proposed an expansion of the official nomenclature from the Atlas into 16 classes of clouds, in which subvariants of the official terms were specified. In a noteworthy foreword to his newly proposed classes of clouds, Clayden observed that if new forms of clouds were discovered, the nomenclature could be further extended:

During our survey of these groups, we have found that some of them include **clouds of many shapes**, which must be due to the very diverse **conditions**. [...] if observations are to be made on the **occurrence** of these special kinds, with a view to arriving at a thorough understanding of the circumstances to which they owe their **forms**, it becomes necessary to devise a **code of names and symbols** whereby **an interchange of ideas**

and records may be rendered possible. **Specific names** have been proposed as each form was considered, and it only remains to sum them up concisely. Subsequent observation, particularly in other climates, may show that further **additions** should be made; but if **the principle of specific names** be once admitted, it will be easy to fill any omission. (Clayden 1905: 155)

The exchange of ideas and the communication among observers appear to be the aim of Clayden's proposal. The observation on the addition of further specific names is noteworthy. First, as it refers to a "principle of specific names" (ibid.), as a model, to which future specific names should be adapted. Second, because it also seems to recall Abercromby's (1887: 155) previous comment on "existing names". According to Abercromby, traditional names should be retained – as far as possible – and new terms should specify them. Clayden (1905: 155) appeared to share the same position, as he stated that further specific names should "fill the omission" of already existing terms. Clayden declared that the time had come for a detailed nomenclature of clouds to match the progress of knowledge. He also encouraged the introduction of additional categories of clouds not as a substitution, but as an extension of Howard's original nomenclature. Clayden's (1905) work represents the beginning of further discussions on the nomenclature. The terminological history recalled herein is part of a much longer history, that of the formation and development of knowledge about clouds.

5.4. Multilingualism in an architectural nomenclature

A further example of multilingualism regards architecture, a topic that was discussed at length by experts in the first half of the 19th century. The debate extended from the codification of an official nomenclature of architectural elements in various European languages, to the terms referring to the periods of medieval architecture in different countries.

Compared to other discussions included in this study (see Sec. 7.2.), the debate on architecture is peculiar, since the experts addressed two aspects of term formation which are related to multilingualism. First, the experts acknowledged the connection among terms, concepts, and their cultural context. Due to the specificity of each country's architectural production, of which the experts were aware, English terms referred exclusively to English architecture and its periodisation, as the same happened in France and Germany. This interdependence of terms, concepts and a specific context did not leave much possibility for translations, as terms which identified both periods and architectural elements were strongly related to their country of production. Consequently, within the international exchange on architecture, experts were looking for possible equivalences among concepts, not for translational or linguistic equivalences. Secondly, the experts acknowledged the relation between language and audience, or type of users, as part of the reflection on term formation. Various experts recognised that terms written in Latin, the main vehicular language of scientific communication at the

time, had a different audience and ideal users, than terms in national languages, even ones as widely used as English or French.

In the example of architecture, multilingualism was involved in two terminological processes. First, in the definition of the terms to name the periods of medieval architecture in various European countries. From a terminological perspective, this process could be defined as an example of primary and secondary term formation (Sager 1997; Temmerman 2013). Secondly, multilingualism was involved in an attempt at standardisation (Johnson and Sager 1980) of the existing nomenclature in multiple European languages by the English architect and architecture historian Robert Willis, in a volume entitled *Architectural Nomenclature of the Middle Ages* (Willis 1844).

Given the local character of both the classified architectural elements and the periods, and differently from other cases examined in this thesis, possible translations of terms into other languages were not proposed by the authors. Instead, the terms already in use in the different languages were compared, to show how the same classifications were conceptualised in various countries. Architecture experts aimed at maintaining the linguistic diversity of the terms, which was presumably connected to the local and unique character of the concepts they represented. As two examples of periodisation of medieval architecture in England and France, the nomenclatures by Thomas Rickman (1817) and Arcisse De Caumont (1825) are compared in what follows:

Thomas Rickman (1817) – *An attempt to discriminate the styles of English architecture*

Norman – to 1189 A.D.

Early English – 1189 – 1307 A.D.

Decorated English – 1307 – 1377 A.D.

Perpendicular English – 1377 – 1630/1640 A.D

Arcisse De Caumont (1825) - *Essai sur l'Architecture du Moyen Age*

Roman Primordial – depuis l'expulsion des Romains de la Gaule jusqu'au Xème siècle.

Roman Secondaire – Fin du Xème et XIème siècle.

Transition – Fin du XIème et première moitié du XIIème siècle.

Gothique Primordial – Fin du XIIème siècle et première moitié du XIIIème siècle.

Gothique Secondaire – Fin du XIIIème siècle et XIVème siècle.

Gothique Tertiaire – XVème et XVIème siècle.

1st Epoch		2nd Epoch			1st Epoch		2nd Epoch				
Secondary Gothic or Gothique Rayonnant					Tertiary Gothic or Gothique Flamboyant						
1270	1286	Louis X	1350	1364	1380	1422	1461	1483	1498	1515	1547
IX... + P III + Phil.		IV... + Ph. V + Ph. VI			John + Chs. V + ... Charles VI... + Charles VII		... + Louis XI + C. VIII			L. XII + ... Francis I... +	
		Chas. IV									
1300	1350	1400	1450	1500	1550						
III... + ... Edward I	+ Edw II + ... Edward III	+ Rich II + H. IV + ... Henry VI + Rich. III + H. VII	+ ... Henry VIII								
1272	1307	1327	1377	1399	1413	1422	1461	1485	1509	1547	
	Decorated English		Perpendicular								
2nd Epoch											

Figure 3: A comparison of Rickman's (1817) and De Caumont's (1825) periodizations, in Poynter (1839).

Despite being almost contemporary, these periodizations present noteworthy differences. Starting from almost the same date in history, Rickman's classification appears to be more essential, trying to establish a chronology of successive periods throughout English history. To the contrary of that, De Caumont recognised the intersection of periods among each other, as well as the differences internal to successive ages of the same period. This seems to be reflected in the division of periods into a *Primordial* and a *Secondaire* [Secondary] age. The same principle appears to be behind the presence of a period of *Transition* between the main periods of *Roman* and *Gothique*. Presumably also acknowledged by Rickman, no transition period is present in his classification.

While both nomenclatures were written in the national language i.e., English, and French respectively, the nomenclatures were cited and known without being translated also in other countries. As an example of this, Parker (1836) quoted the French periodisation, originally proposed by De Caumont (1825) using the French terms (see Hughes 2010). The attempt at standardisation by Robert Willis (1844) in his *Architectural Nomenclature* was also remarkable within the discussion. The multilingual perspective was clear from Willis' introduction to his pamphlet:

My object [...] has been to draw up an account of the **medieval nomenclature** of architecture [...]. The **words** are principally to be found in indentures and accounts relating to the expenses of buildings and monuments, which are necessary expressed in the **language** of workmen. [...] Several well-known **collections of these terms** have been already made, [...] **the alphabetical form** of these collections is not the best adapted for the **illustration and comparison of terms** like these, which are normally of a strange and capricious kind, defying the usual processes of **etymology**, and some of whose **meanings**, can only be deduced by collating every passage that contains the **term**, and comparing it with the entire **nomenclature** [...]. The scribes appeared to have been often unacquainted with the **meaning** of these **words**, and to have taken them down from the mouths of the workmen. They often **latinize** them, or couple them with the nearest **Latin synonym**

that they think may explain them; [...] I have found great assistance from the technical **vocabulary** of French workmen [...]; for the greater part of the **words** in question were of French origin (Willis 1844: 1)

In the terminological perspective of this study, some passages of the quote appear interesting. First, Willis' (1844: 1) choice to list terms "in the language of workmen" appears to relate to the importance of the etymology and meaning of terms, which can only be fully grasped by professionals of architecture. Second, the comparative perspective among terms which is adopted in the pamphlet seems important. Terms are listed, in the intentions of the author, to be compared not only among each other, but also with the entire nomenclature they belong to. Third, and last, Willis gave evidence to the practice to "latinize" terms i.e., to write next to the main term, a Latin synonym, which was supposed to better convey their meaning (ibid.). The same multilingual perspective can be retraced in the comparative charts which accompany the descriptions of terms in the pamphlet:

THE NOMENCLATURE OF MOLDINGS.

VITRUVIUS (and Alberti.)	ITALIAN.	FRENCH.	DUTCH.	ENGLISH.	GERMAN.
TORUS (Thorus. A.)	Bottaccio ... Bastone ... Tondino ... Toro ... (Mazzocchio)	Bozel ... Baston ... Rond ... Thore ... (Boudin)	Stock ... Halfrondt. ... Thorus. Bedde ...	Bowtell ... Round ... Torus ... (Bead)	(Wellen. D.) Stab ... Thorus. Pfuhl
ASTRAGALUS (Funiculus. A.)	Bastoncino ... Tondino ... Astragalo ...	Bosselette { Petit bâton } Baguette } ... { Petit membre rond } { Rondeau } Astragalle ...	Stockjen ... Rondeken } Rondtjen } ... Astragalus ...	Baguette ... Roundel ... Astragal (Bead)	Stablein
ECHINUS (Rudens. A.)	Uovolo ... Echino ...	Ove...Ovale...Oeuf. Quart de rond ... Eschine ...	{ Vovolo { Eytjen Eyrondt }	Ovolo. Egg Quarter round Half round Echinus	(Wulst)
SCOTIA Canaliculus. A.	Cavetto ... (Guscio) Scotia ... Canaletto ...	(Nasselle) { Cavet } { Creux } Rondereux (Demicreux) Scotie ... Canale ...	Cavetto ... Hol. holletje ... Holrondt ... Scotia ... Groeve. Groefjen ...	(Casement) Cavetto Hollow ... Scotia Groove	Holkelen D. Hohlleisten
SIMA UNDA (Undula, gulula A.)	Gola ... Scima ... Onda ...	(Doulcine) Ogive ... Gueule ... Cime ... (Talon)	Odiif, Odÿf ... Keel. Keeltjen ... Scima. Kim ...	(Ressant) Ogee Gula. Throat... Sina. Cyma	(SchlangenliniD.) (Glockenleisten) Kehlleisten
TENIA QUADRA ... Gradus. A ... REGULA ... (Fasceola, nextrum A.)	Listello ... Tenia ... Quadretto ... Gradetto ... Regolo ...	Filet ... Liste, listean ... Tenie ... { Quarré } { Filet quarré } Reigle. Reiglet ...	Lüst. Lüstjen ... Kant. Kantken ... Trapjen ... Regel. Regeljen ...	Fillet List. Listel Tenia Square ... Regula Rule. Ruler	Band (Riemen) (Streiffen) Eck. D.

Figure 4: Willis' (1844: 21) nomenclature of moldings.

In the chart, not only the architectural vocabularies in five languages were compared, but also synonyms, or term variants for the same architectural elements were listed. The comparison provides

insights into the significance of languages in architectural research at the time. Based on the languages compared in the chart, an international perspective on the specialised language of the discipline seemed to be present. Experts, such as Willis, appeared to be concerned with the comparison and systematisation of the specialised language of their field in multiple languages, to allow comprehension among experts, as Willis (1844: 1) stated in the introduction to his pamphlet.

In the first half of the 19th century, the discussion on naming and classification in architecture involved multiple languages. There, the scholars showed a particular interest in the use of language and descriptions of architectural elements and periods. This attention for language is attested, among others, in William Whewell's work on German architecture:

In **architectural description**, I have ventured to employ **a few new phrases**: or rather, I have fixed and limited the **meaning** of some of the phrases [...] with a view to their being employed steadily and precisely for the future. [...] it is scarcely possible to **describe new features** without this much of innovation, [...]. Mr Rickman has shown that by the **careful use of terms** well selected and previously defined, **language** may convey almost as exact and complete an idea of a **building** as can be got from reality or the **pencil**; but in order to do this [...], our **vocabulary** must be **extended**. We may learn from the **descriptive sciences**, as for instance Botany, how much may be taught by means of a **copious** and **scientific terminology**; and architects are already in possession of a very numerous lists of **terms** of art [...]. To establish a complete **language** of Gothic Architecture, is a proceeding which might not be beyond the jurisdiction of our eminent architectural authorities; but such a language would require to be illustrated by abundant **drawings** and **references**. (Whewell 1830: XXXI - XXXIV)

The most significant comparison in Whewell's words is the one between language and a drawing: in Whewell's opinion, the description of a building could be so precise as a drawing. To do so, however, the specialised language used in this description should be as precise as possible. This comparison appears to underline the importance of descriptive language.

Finally, it could be said that the same terminological processes i.e., term formation and variation, which were described in the formation of the nomenclature of clouds could be recognised in the discussion on architectural nomenclature. Indeed, also in architecture the beginning of the century saw multiple attempts at periodisation of the English and French medieval architecture, through the proposal of nomenclatures (see Rickman 1817; De Caumont 1825). As presumably a consequence of that, some years later, scholars proposed a further refinement of the existing vocabulary, as did Whewell (1830). At the same time, pamphlets as the one published by Willis (1844), commented on the simultaneous presence of terms in various languages, which identified the same concepts.

Willis' (1844) attempt at standardisation of the architectural nomenclature of the Middle Ages seemed to respond to the necessity of order among parallel nomenclatures and systems from various European countries. This example aimed to address the importance of multilingualism in the debate

on the construction of the scientific language in architecture. At the same time, the particular attention for the description of concepts through language testified the presence of a linguistic and terminological activity within the formation of the discipline at the time.

Willis' work seemed to anticipate the efforts in standardisation in other fields of study at the end of the century. Indeed, not only as mentioned in the main example, meteorologists from all over Europe agreed on the publication of an international nomenclature of cloud formations in 1890, also experts in medicine published a standardised *Nomenclature of Diseases* in 1884.

5.5.A reflection on the presence of multilingualism in terminological processes

A reflection is needed, at this point, on the ways in which multilingualism can be present in the described terminological processes. Lamarck and Howard appear to show different attitudes towards the presence of multiple languages in their nomenclatures. Lamarck wrote his nomenclature exclusively in French, presumably addressing a French-speaking public and using it as an international language of scientific communication. Howard, however, planned his nomenclature as bilingual. As Howard (1803a) himself explained in the presentation of his terms in the *Philosophical Magazine*, he planned the terms in Latin, and searched then for English equivalents, to explain the concepts they represented. Secondarily, to the best of my knowledge, I was not able to ascertain a connection between the two, almost contemporarily, nomenclatures. However, future research might investigate a possible influence of Lamarck on Howard's nomenclature, or alternatively, of Howard's on Lamarck successive classification (Lamarck 1805b).

Multilingualism appeared to influence the proposal of term variants in different ways, according to the language. Thomas Forster (1816) observed that a more specific English nomenclature for the classification of clouds was needed, and that the use of English, instead of Latin would be beneficial for the local scientists. Translating Howard's nomenclature into French, Cotte (1804) and Brandes (1810) commented that the terms were too distant from reality and the description of meteorological phenomena. The German reaction to Howard's nomenclature was instead overall positive. Howard was praised by the editor of the *Annalen der Physik*, who translated his terms (Pictet 1805), and by Goethe (1834), who adopted them in his observations. Regarding multilingualism in terminology, as dependant from the context, the different national contexts in which Howard's nomenclature was translated appeared to have received it differently.

The standardisation of the nomenclature of clouds was characterised by the presence of terms in multiple languages i.e., English, French, and German (Hildebrandsson et al. 1890). This process seemed to be influenced by multilingualism since for the experts it appears to be impossible to create an official nomenclature in only one language, and to translate terms from one language to the others. Indeed, the Latin terms, originated with Howard, were not translated into the other languages, instead,

equivalents of them were provided, according to the different languages, and therefore cultural contexts and conventions.

5.6.A comment on the processes from the perspective of terminology theory

Literature in terminology theory entails different positions on multilingualism. The presence of multiple languages as an obstacle to standardisation in terminology is addressed by Gerhard Budin and Sue Ellen Wright (1997) with a reflection on terminology in a multilingual setting:

Languages evolve and survive in a permanent state of tension among at least three conflicting forces: the urge for linguistic improvisation, which constantly introduces change; internal and social pressures to safeguard ethnic identity by preserving even very small separate languages embedded in larger language communities; and the necessity to **standardize meaning** [...] to facilitate understanding. (Budin and Wright 1997: 246)

The reflection addresses the relation, and possibly the conflict, between the preservation of the identity of languages, and the necessity of standardisation and understanding. The same topics seemed to have been addressed in the debates among 19th- century experts illustrated in the chapter. In this conflict, terminology and specifically the terminological process of standardisation play a significant role. Another passage in their reflection deals with the role of monolingualism in past forms of government, which was represented in reference to the Soviet Union, or the English Empire and how imperialist forms of governments were against linguistic variation:

In the past [...] monolingualism has been driven by social, political, religious, and economic forces. [...] Imperialism has traditionally militated against **linguistic variation**, resulting in the ascendancy of so-called **world languages** such as Greek, Latin, Arabic, English, French, Spanish, and Russian. From their beginnings as languages of national unity, all of them were used at one time or another at least in areas of government and economics to impose varying degrees of monolingualism within their expanding spheres of influence. (Budin and Wright 1997: 246-47)

This relation between monolingualism in "world languages" (Budin and Wright 1997: 246-247) and multilingualism is important in the primary sources. Indeed, the case studies described, among other aspects, the implications of writing an official nomenclature in Latin or English i.e., the languages which were recognised as "world languages" (ibid.) at the time and coining the same terms in languages such as French and German.

Further challenges in a multilingual setting, such as the creation of terminology and the presence of term variants are addressed by Temmerman (2011a; 2011b). Specifically, Temmerman recognises term variation to be due to cognitive causes, and the reasons behind it to be most important to understand the expert's choice of a term, to express a different meaning, from the one of the standardised terms. In this, Temmerman's approach to standardisation differs from the one of

traditional terminology (Wüster 1979 [1991]). While Temmerman and Bowker (1998, in Temmerman 2011a: 108) believe that term variation can be "well motivated and useful in expert discourse", the traditional theory of terminology considered standardised terms to have a univocal relation to the concepts they represented:

[...] we believe that terminological **variation** is not "a random act of defiance or carelessness, but one which is well motivated and useful in expert discourse". The thought that an author wishes to express may be slightly different from the meaning of the standardized (or most commonly used or best known) term to express the thought. (Temmerman 2011a: 108)

As a further aspect of multilingualism in term formation, the relation between terms and the cultural and historical context of the language in which they are created is also addressed. Temmerman's reasoning could indeed be applied to the creation of terms in various languages, as presented in this chapter. As acknowledged by the field experts in the primary sources, and as dealt with in translation theory, the creation and use of terms in a specific language were unavoidably related to the cultural and historical context they pertained to:

The reasons why translations are hardly ever a word for word transfer from a source language to a target language have been dealt with extensively in the literature on translation theory. Basically, translation shifts like e.g., modulation and transposition, are often the result of the inherent lexical and structural limitations of each language. Moreover, each language carries **historical** and **cultural elements** that allow its users to express messages in particular ways (e.g., figurative language based on metaphorical understanding, allusions to culture-specific elements). (Temmerman 2011a: 115)

Another important aspect of multilingualism addressed in the article is the relation between language diversity, understanding, and human cognition. Naturally, the reflection relies on the premise that variation is always motivated, and that diversity in language, and specifically in terminology, always represents a difference in understanding of the same concepts, which should be reflected in terms:

For Evans and Levinson (2009) **language diversity** is a crucial fact for understanding the place of language in human cognition. In their opinion the belief in **language universals** i.e., "the impression that languages are all built to a common pattern" (429) is a fallacy. They point out how diversity can be found at almost every level of linguistic organisation and how this fact changes the object of enquiry altogether, from looking for universals to studying the diversity offered to us by the world's languages [...]. They remind us that each language has built-in **cultural–historical factors** [...]. (Temmerman 2011a: 167)

Temmerman's (2011a) reflection on multilingualism in the European setting also involves term variation and secondary term formation. The idea that "diversity must serve a purpose" (Temmerman 2011b: 168) can be used to interpret the differences among the various nomenclatures presented in this chapter: the diversity of languages in the creation, modification, and standardisation of terms

seems to represent an added value in the processes. Indeed, the different nomenclatures and term variants in multiple languages provide a further understanding of the concepts being named.

It seems important to underline how the presence of languages in all terminological processes described in this study, reflects the importance the experts attached to the preserving of multilingualism in the specialised language of their field. Presumably aware of the significance of forming terms in the major languages of scientific discourse at the time, multiple languages were maintained in the official nomenclatures. Even in the 19th century, well before the codification of official terminological principles, it was not enough for the experts to create and standardise terms in one language. They implicitly or explicitly acknowledged that these terminological processes should occur in multiple languages at the same time, to preserve the international and multilingual reality of scientific communication in Europe.

The difficulties of translation in a multilingual context were also examined in terminology theory. According to the Derlén (2014), legal terminology cannot be translated due to the cultural and historical background and content of concepts, which can be found only in the language in which they originated:

[...] When translating legal concepts, we are not only translating between two languages, we are translating between two legal systems. [...] When confronting the concept lawyers in different countries will give it different meanings, reinterpreting it based on the national legal culture. [...] there is no way to move a concept without moving the entire language and culture. [...] the **complexities** of multilingualism have been largely overlooked in the debate on the future of European legal integration. [...] it is commonly believed that legal concepts can be translated from one language to another, and that **multilingualism** does not impede legal integration [...] (Derlén 2014: 28)

Inspired by Johnson and Sager (1980: 100), the processes presented in this chapter were part of a "dynamic process of language development", which was reconstructed in its most interesting aspects. Indeed, we saw how the formation of an official nomenclature was both a dynamic and a collaborative process, in which multiple factors and actors were involved. It was the result of decades of discussion and proposals in different languages, which led to the formation of terms. These terms first became widely used, and then official. In a process such as that described by Kuhn, these terms, as part of the specialised language of a field of study, were a shared property of a scientific community, and should therefore be studied in the context of a specific scientific discipline:

Scientific knowledge, like language, is intrinsically the common property of a group or else nothing at all. To understand it we shall need to know the special characteristics of the groups that create and use it. (Kuhn 1970: 210)

From a terminological perspective, terms and nomenclatures should be studied as the result of a continuous process of defining and naming, which presumably never ends, and should always keep up with the advancement of knowledge.

5.7. Summary of the contents

This chapter illustrated the role of multilingualism in three terminological processes, as applied to knowledge construction and exemplified through the history of the formation of the nomenclature of clouds i.e., term formation, variation, and standardisation. The role of multilingualism in this classification was then compared to the one in the periodisation of medieval architecture (Willis 1844). After an overview of the existing literature on terminology theory, the role of multilingualism in these processes was analysed in an international perspective and set in a broad historical context. The classification of clouds was illustrated as part of a wider discussion on the organisation of scientific knowledge, in which many disciplines were involved (Daunton 2005; Yanni 1997). Indeed, while this classification was described in detail, it should be mentioned that other, similar initiatives were occurring simultaneously in other fields of study, such as minerals (Werner 1774) and architecture (De Caumont 1825).

Among numerous reflections on the creation and systematisation of terms in different languages, the attention devoted by 19th- century experts to the preservation of language diversity and multilingualism in their field of study was underlined. If terms which were not specific of a certain culture or context could be defined with equivalent terms in other language, such as, for instance, the terms identifying cloud formations; experts became aware that culturally related concepts could not be identified with the same terms, or translations thereof, in another country. Therefore, as Willis (1844) showed, terms and nomenclatures from various European countries were compared, as their differences were maintained as a relation to the culture in which they were created.

6. Term translation as a form of term variation

6.1. Introduction

This chapter is dedicated to multiple forms of term translation and specifically, to some applications of interlinguistic and intersemiotic translation within the formation of scientific language. It will show not only how term translation can happen in multiple forms, such as the translation of terms across languages, or into symbols or numeric scales, to respond to the necessities of the experts but also how term translation across languages and semiotic systems could be interpreted as a form of denominative variation, as defined in contemporary terminology theory (Freixa 2022).

The use of terms, symbols, drawings, and numbers is interpreted in the analysis of the sources as an attempt to further describe the concepts. Therefore, the examples of term variation and translation analysed in this chapter are presented as strategies for the description of concepts, towards their better definition. Taking as an example the use of numbers and letters in the meteorology, and of multiple languages and images in the classification of colours, the study argues that term translation into different languages and semiotic systems was determined by the necessities of use of terms in a specific context and should thus be considered as a form of variation.

The chapter explores the relation between term translation and term variation, within the process of term formation (see Sager 1990; 1997; Freixa 2006; 2022; Drouin et al. 2017). Both the analysed case studies illustrate the translation of designations across semiotic systems i.e., from lexical terms to symbols, letters, and drawings, and across languages (see Jakobson 1959; Dusi 2015). In this analysis, term translation is described as a form of term variation and two further principles are addressed. First, the cognitive dimension of terms as instruments employed by the experts towards the advancement of knowledge (see Pecman 2012; 2014; 2018); second, the semantic differences which terms present in different languages (Temmerman 2008). In this, relevance is attributed to all nomenclature proposals, as instruments to describe concepts and thus advance knowledge. In reference to this, Sager's (1990: 60) theorised terminologisation process is mentioned, as the practice of describing specialised concepts and advancing knowledge through naming (see Sec. 2.7.2.).

Two examples are discussed, based on a selection of primary sources. The main case study presents term translation applied to the nomenclature of colours and the visual representation of concepts, such as the colours of minerals in this case, across European languages i.e., German, English, and French (Werner 1774). A further case study is concerned with the classification of wind strength. In addition to alternative classifications in English, and French, examples of nomenclatures using other semiotic systems are mentioned, such as symbols, numbers, drawings, and letters (Beaufort 1832).

Further examples of term translation are presented in a following overview. Among others, connected to a possibly new classification of mental diseases presented in *The Asylum. Journal for*

Mental Science (Monro 1855), a graphic representation of these diseases was realised by the French painter Theodore Gericault between 1822 and 1823. Concurrently, graphic representations of architectural elements are mentioned (Rickman 1817; Willis 1844), in an overview which shows how Intersemiotic translation extended at the time to paintings and technical drawings.

The remainder of the chapter is structured as follows. Section 6.2. introduces the main example i.e., the classification of colours in mineralogy, while section 6.3. discusses the classification the wind strength. Section 6.4. contains an overview of further similar episodes related to term translation in the primary sources, while section 6.5. comments on the sources from a terminological perspective. Lastly, section 6.6. concludes the chapter with a summary of its contents.

6.2. The translation of colour terms in mineralogy across European languages

The main example of term translation concerns the formation of the nomenclature of colours, as part of the studies in mineralogy. More in detail, this section presents the evolution of Abraham Werner's (1774) nomenclature of colours from being applied to the classification of fossils to becoming a nomenclature of colours in natural history. Werner's nomenclature represents indeed an example of a classification which, throughout its successive translations was applied to different concepts. Originally proposed as a classification of the colours of fossils to identify their external characteristics, the nomenclature was later extrapolated from Werner's (1774) original treatise and became independent as a classification of colours in natural history, applied to plants, animals, and minerals (Syme 1814).

Werner's (1774) nomenclature, originally published in German, was first translated into French (Werner 1790), and then into English (Weaver 1805). Aside from the translation of terms, to describe Werner's (1774) nomenclature of colours in other languages and make it as efficient as possible for the employment in natural history, examples of real animals, plants, and minerals were associated to each term with descriptive purposes. This strategy of definition could be considered as one of the reasons behind Werner's nomenclature success in natural history (Simonini 2018).

6.2.1. The first translation of Werner's nomenclature into French

Werner's (1774) original German volume, entitled *Von den ausserlichen Kennzeichen der Fossilien* [Of the external characteristics of fossils], was translated first into French at the *Bureau de Traduction de Dijon* [Translation Office of Dijon]. The group of translators and linguists was particularly famous in France at the time: it was led by Guyton De Morveau, one of the authors of the recently published *Méthode de Nomenclature Chimique* [Method of Chemical Nomenclature] (Guyton De Morveau et al. 1787), which proposed a major reform of the French chemical nomenclature. As Bret (2014; 2019; Bret and Chappey 2018) describes, however, the volume was not translated by Guyton De Morveau himself, but by his wife, the experienced translator of works on chemistry, Claudine Picardet (Werner 1790).

Picardet's biography became famous in historical studies on the subject, since it represented a case in which the author, a woman, was never explicitly mentioned in the translations.

However, within the group of experts in Dijon, as Bret (2019) recalls, she became well-known, and she specialised in the translation of foreign works on chemistry into French and gained some experience in the translation of terms identifying shades of colours. She was therefore the most suitable translator for Werner's work. Regarding the translation, interestingly, we know that Werner's (1790) treatise was translated by Madame Picardet from a reference on the cover of the first French edition which reads:

Traité des caractères extérieurs des fossils. Traduit de l'Allemande de M. A. G. Werner, Inspecteur des Mines et Professeur de Mineralogie a l'Academie des Mines de Freyberg; de la société économique de Leipsick, de celle des amis de la Nature de Berlin et de celle de l'Art de l'exploitation des Mines Par le **traducteur** des Mémoires de Chymie de Scheele³¹. (Werner 1790)

On the cover, Madame Picardet is referred to as the "traducteur", masculine, of Werner's work and Scheele (1777) *Chemische Abhandlungen* [Observations in Chemistry], originally published in German. The identity of the translator of Werner's (1790) work was confirmed at the time in a review appeared in the *Critical Review* in 1798, Though the author is not reported, the review stated that "The translation which is now in our hands is the work of Madame Picardet" (Unknown 1798: 524). Picardet's notes in her translation of Werner's (1790) volume are very interesting and include some reflections on her translation choices. In an example, the main text of the translation read as follows:

On met à la fin [du nom composé] comme **dénomination de genre**, la couleur qui domine dans le mélange, & pour laquelle on a aussi porté la couleur mêlée sous l'une ou l'autre couleur principale ; & que l'on met en premier ordre, comme **dénomination d'espèce**, par forme de relation, avec la **terminaison** en être (*lich*), celle qui a principalement changé celle-ci ; comme, par exemple, bleuâtre-noir, rougeâtre-jaune, brunâtre-rouge³². (Werner 1790 : 91)

And Picardet's note on this passage was:

On a cru devoir **traduire littéralement** pour faire entendre le principe de l'Auteur, qui, dans sa **langue**, était obligé de mettre en premier **ordre** les adjectifs & autres mots employés adjectivement. Mais on sait qu'en

³¹ English Translation: Treatise on the External Characters of Fossils. Translated from the German by M. A. G. Werner, Mining Inspector and Professor of Mineralogy at the Freyberg Academy of Mines; of the Leipsick Economic Society, of the Berlin Society of Friends of Nature and of the Society for the Art of Mining. By the translator of Scheele's Memoirs of Chemistry.

³² English Translation: At the end [of a compound name], the colour that dominates in the mixture and for which the mixed colour has also been used under one or other of the main colours is used as the name of the genus, while the colour that mainly changed the genus is used first as the name of the species by virtue of its relationship with the ending (*lich*), as, for example, bluish-black, reddish-yellow, brownish-red.

Français l'usage est absolument **contraire** ; il faudra donc dire noir-bleuâtre, jauneroûgeâtre, rouge-écarlate³³. (Werner 1790: 91)

The reflections on the different word order in German and French are relevant for the purposes of the present thesis. Picardet specified in this note the difficulties she encountered while translating terms from German into French, focusing specifically on the different word order of the languages. Picardet's reflections also highlighted how terms vary while being translated into other languages. As other sources analysed in this study, Picardet's note also provided insights into the real context of term translation in history, offering a different historical perspective on the process in a real context.

6.2.2. The translation of Werner's nomenclature into English and the need for an English nomenclature of colours

In the first years of the 19th century, the debate on the need to construct a nomenclature of colours spread across disciplines. An excerpt of that can be found, like many of the debates at the time, in the *Philosophical Magazine*, in an article by the meteorologist Thomas Forster entitled "On a systematic arrangement of colours" (1813):

[...] among the desiderata of philosophy may be included **the want of a systematic arrangement of colours** with **specific names** for each, whereby the numerous combinations and shades of colour, [...] may be expressed with **greater precision** than they can be at present with our **imperfect and indefinite names**. I was first induced to think on this subject from the great difficulty that I experienced from time to time in **conveying on paper an adequate idea of the various and dissimilar tints** displayed by the clouds and the haze on different occasions, which were occasioned by the refractive power of the nubiform particles of water, on **which I wish to register on my Meteorological Journal**. [...] The terms in common use, such as red, yellow, blue, green, orange, purple and c. were **not sufficiently definite**, for of all these there are numerous varieties. That any **nomenclature** should be **constructed** which shall **precisely define** every **combination** and **shade** is almost impossible, since the varieties and approximations of one colour towards another are infinite, [...] the quantities of which we may suppose capable of being varied infinitely; but still, **a more perfect set of names** might be arranged than has yet been done. I am surprised that scientific persons, but botanists in particular, have not before this attempted something of the kind. (Forster 1813: 119)

In the article, the expert, who was involved in the discussion on the construction of a nomenclature for cloud formations, and in the choice of the language for the official nomenclature (Forster 1816), highlighted the necessity of an official classification of colours, which could be shared across disciplines.

³³ English Translation: It was thought necessary to translate literally to convey the principle of the Author, who, in his language, was obliged to put adjectives and other words used adjectively in the first order. But we know that in French the usage is absolutely the opposite; we should therefore say noir-bleuâtre, jauneroûgeâtre, rouge-écarlate.

The article was representative of a diffused necessity among the experts of various disciplines. In his description of a prospective nomenclature of colours, Foster (1813) remarked the necessary completeness and preciseness of terms, which should describe the widest possible variety of shades of colours, in the most precise way possible (ibid.).

In the context of this request by the experts for a nomenclature of colours, Werner's nomenclature was translated into English and first published in 1795, while the most famous version of it was published in Edinburgh in 1814 (Syme 1814, see Simonini 2018). The first English translation appeared to be the one by Thomas Weaver (1805). This translation, as the French one, maintained the original structure of Werner's volume, in which the nomenclature of colours was only part of the description of the external characteristics of fossils. However, Weaver (1805) made some adjustments to the original German version, as he reported in the preface to the English edition:

Mr Werner published his work in the year 1774. Since that time, a period has elapsed in which rapid strides have been made in every branch of Mineralogy; and, as it might be expected, considerable **improvements** have taken place in the Treatise on the External Characters of Fossils. Aware of such, the lovers of Mineralogy in Germany have frequently called on Mr Werner for a new edition of his work. His numerous avocations have hitherto prevented a compliance with the wishes of the public [...]. Under these circumstances, the **Translator**, desirous of completing the **integrity** of the work, has had recourse to other sources to supply the **deficiency** of the printed original. (Weaver 1805: VIII).

Weaver's (1805) integrations to Werner's (1774) original work to reflect the advancement of knowledge in the subject. The same preface is commented upon also in a review appeared in 1807 in *The British Critic*, an English journal:

It appears from the **translator's preface**, or advertisement, that this publication is not a mere **translation** of the original work. (Unknown, *The British Critic* 1807: 171)

As it appears from these original quotes, every translation of Werner's volume seemed to add to the original version. As part of Werner's original work, the nomenclature of colours was also modified over time and through the successive translations.

The evolution of Werner's nomenclature of colours for fossils appears interesting, as it became independent, and applied to natural history. According to Thomas Forster (1813), a precise classification of colours was needed in natural history. This would allow experts to precisely describe their discoveries and the natural objects they encountered during their expeditions. Patrick Syme, a Scottish painter, and member of the *Wernerian Society of Edinburgh* produced a new version in English of Werner's nomenclature as a pamphlet and was dedicated to the classification not just of fossils, but of all natural colours. The pamphlet was published in Edinburgh in 1814, under the title *Werner's Nomenclature of Colours* (Syme 1814, see Simonini 2018).

Important novelties were implemented in Syme's version of the nomenclature. As can be seen in Figure 5, Syme illustrated each single shade of colour with an image reported next to the term. Also, each term was explained through an example of an animal, plant, and mineral, in which it could be found. Syme's strategy for explaining terms was noteworthy, since it employed real natural specimens.

Lastly, Syme chose the pamphlet format so that it was easily portable, allowing it to become a sort of *handbook* for the expert in his travels, which probably contributed to its popularity and widespread use (see Keynes 2000). Charles Darwin used Syme's translation of Werner's nomenclature, to define and describe the colours of plants and animals during his explorations on the *HMS-Beagle* (Simonini 2018). The exactness and reproducibility of terms, or their ability of being transmitted to someone i.e., their *transmittability*, as Huler (2004) puts it, was essential:

I had been struck by the beautiful colour of the sea when seen through the chinks of a straw hat, [...] it was according to *Werner nomenclature* "**Indigo** with a little **Azure blue**" [and] the sky at the time was "Berlin [blue] with little Ultra marine [blue]". (Darwin 1832, in Keynes 2000: 30)

B L U E S









No	Names	Colours	ANIMAL	VEGETABLE	MINERAL
24	<i>Scotch Blue</i>		<i>Throat of Blue Titmouse.</i>	<i>Stamina of Single Purple Anemone.</i>	<i>Blue Copper Ore.</i>
25	<i>Prussian Blue</i>		<i>Beauty Spot on Wing of Mallard Drake.</i>	<i>Stamina of Bluish Purple Anemone.</i>	<i>Blue Copper Ore</i>
26	<i>Indigo Blue</i>				<i>Blue Copper Ore.</i>
27	<i>China Blue</i>		<i>Rhynchites Nitens</i>	<i>Back Parts of Gentian Flower.</i>	<i>Blue Copper Ore from Chessy.</i>
28	<i>Azure Blue.</i>		<i>Breast of Emerald-crested Manakin.</i>	<i>Grape Hyacinth. Gentian.</i>	<i>Blue Copper Ore.</i>
29	<i>Ultramarine Blue.</i>		<i>Upper Side of the Wings of small blue Heath Butterfly.</i>	<i>Borragé.</i>	<i>Azure Stone or Lapis Lazuli.</i>
30	<i>Flax-flower Blue.</i>		<i>Light Parts of the Margin of the Wings of Devils Butterfly.</i>	<i>Flax flower.</i>	<i>Blue Copper Ore</i>
31	<i>Berlin Blue.</i>		<i>Wing Feathers of Jay.</i>	<i>Hepatica.</i>	<i>Blue Sapphire.</i>

Figure 5: An example of Syme's (1814) painted tables of colours.

The example of Werner's nomenclature of colours provided evidence of both forms of term translation discussed in this chapter. While this chapter briefly reconstructed the history of the translation of the German terms (Werner 1774) into French (Werner 1790) and English (Weaver 1805), it presented examples of term translation into other semiotic systems, such as the images of colours painted by Patrick Syme (1814). Syme included these images in his translation of the nomenclature as a self-standing *handbook* for the 19th century expert of natural history. In addition to that, examples of the applications of Werner's terms to natural objects provided evidence of term description, and the description of the concepts behind the terms was addressed as a component of term translation.

6.3. Classifying the wind force: an example of term translation across semiotic systems

The episode presented in the following sections concerns the classification of the wind force across the 18th and the beginning of the 19th century. The historical reconstruction of the episode was inspired by the one presented by Scott Huler (2004).

The case study examines the classification of the wind force in English and French, as well as in multiple semiotic systems, such as numbers, symbols, and acronyms. The exemplification of term translation illustrated in this case study is twofold. The first one is interlinguistic and illustrates the classification of concepts in two languages, and the second one is intersemiotic, and describes the use of multiple semiotic systems to convey the meaning of concepts. In the absence of shared terms to identify the grades of the wind force, these were described according to their effects on natural objects, and as part of other meteorological phenomena, such as storms and tempests. Indeed, the description of the concepts i.e., the grade of the wind force, through their effects on natural objects, allowed them to be widely understood, while fostering communication among experts.

6.3.1. Intra- and interlingual variation in the classification of wind force

This section examines some examples of English classifications, as well as a French alternative to them, as illustrations of term variation in the classification of the wind force. The French classification is seen in this thesis as an alternative to the English one since the analysis aims to see how the different classifications influenced one another. While the nomenclatures are not direct translation of one another, the present analysis describes connections and influences among them. At the same time, the various nomenclatures are seen as parallel attempts to describe the same concepts, and consequently terminological variants.

The comparison of the nomenclatures in English and French presents examples of intralingual and interlingual variation. The aim of this comparison is twofold. First, it shall illustrate the similarities of these classifications, and why they could be seen as steps towards the definition of Beaufort's (1817) official scale. Second, the comparison aims to show how the description of meteorological phenomena, as well as of their effects, constituted a central component of these nomenclatures. With reference to intralingual and interlingual translation, the examples try to show how the nomenclatures helped the construction of knowledge on the topic. Some of these classifications, which preceded Beaufort's (1817) official scale, are listed as follows as examples:

Daniel Defoe (1704: 271)	John Smeaton (1759: 165)	James Capper (1801: 226)
Stark calm	Hardly perceptible	Almost calm.
Calm weather	Just perceptible	Just perceptible.
Little wind	Gentle pleasant wind.	Gentle breeze.
A fine breeze	Pleasant brisk gale.	Fresh breeze.
A small gale	Very brisk	Fresh gale.

A fresh gale A topsail gale Blows fresh. A hard gale of wind. A fret of wind. A storm. A tempest.	High winds Very high A storm or tempest A great storm An hurricane. An hurricane that tears up trees, carries buildings before it etc..	Strong gale. Hard gale. Storm. Violent hurricanes, tempests & c.
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Table 5: Comparison of successive English nomenclatures classifying the wind force.

The successive nomenclatures shall be representative of the interest in the subject throughout the 18th century. As is visible from Table 5, the terms defining the grades of the wind force did not vary considerably throughout the century. More relevantly, their shades, or sub-definitions did develop throughout the century. These sub-definitions were represented in the nomenclatures mainly through adjectives, and their change appears to mirror the advancement of knowledge on the subject, as they were adapted throughout the decades.

The use of a descriptive language appeared to be a constant component in the classification of the wind force. As can be detected from the use of adjectives and from the presence of brief descriptions associated to some grades of the scales, as for instance, Smeaton's (1759: 165) "hurricane that tears up trees, carries buildings before it, etc." the descriptive component is central in the formation of the nomenclature. The same will happen, some years later, in Beaufort's scale.

Daniel Defoe (1704) and William Derham (1698; 1704) were among the first authors who named the meteorological phenomena connected to the wind force, by the mid-18th century a further classification of "common appellations of the force of the winds" (Smeaton 1759: 165) appeared in the *Philosophical Transactions of the Royal Society of London* (Smeaton 1759). Another volume by James Capper (1801) entitled *Observations on the Winds and Monsoons* reported a classification of the wind force. In the same year, 1801, the passionate French meteorologist Jean-Baptiste Lamarck, presented a description of the characteristics of the winds entitled "Sur la distinction des tempêtes d'avec les orages, les ouragans, etc. Et sur le caractère du vent désastreux du 18 brumaire an 9" [On the distinction between storms and thunderstorms, hurricanes, etc. And on the character of the disastrous wind of 18 brumaire year 9], published in the *Journal de Physique, de Chimie, d'Histoire Naturelle, et des Arts*. There, Lamarck (1801: 378) listed the features of the "orages et tempests" and reflected on the names of the phenomena and of their modifications. What follows is an excerpt of this description :

L'ouragan **proprement dit** n'est réellement qu'une des modifications du phénomène météorologique **appelé** orage. C'est, en effet, une espèce d'orage, dans lequel plus de vent, que de tonnerre se manifeste distinctement ; et ce vent part évidemment d'un nuage orageux. Aussi le **nom d'ouragan**, qui dérive

clairement du mot **orage**, indique-t-il par lui-même l'usage le plus convenable de son **application**³⁴. (Lamarck 1801: 378)

The quote exemplifies Lamarck's attention to the definition of terms. Indeed, the excerpt contains not only a description of the phenomenon, described as a variant of thunderstorm, but also an explanation of the origin of the term "ouragan" [hurricane], as deriving from "orage" [storm].

The first part of Lamarck's (1801) article was devoted to a list of definitions of meteorological phenomena and modifications thereof, with which different forces of the wind were connected. It was, indeed, a typical practice at the time to start scientific articles with the definitions of the examined concepts, at least in the sources I examined. The second part of the article was dedicated to the description of the features of the storms and their modifications. In these descriptions, a significant element was the reference to the effects of the storms and their modifications. This element, indeed, constituted a similarity between Lamarck's (1801) and Beaufort's (1817) classifications. As Huler (2004) suggests, the wind was a particular subject to classify, compared to other natural elements, such as clouds, or tides (see Todhunter 1876; Ducheyne 2010). To classify the wind force, the description of other natural objects or phenomena was needed.

Lamarck's (1801) article was divided into two categories: the characteristics of the storms and their modifications, and the characteristics of the tempests. There again, the force of the winds was not classified directly, but through the description of the natural phenomena it was involved into i.e., storms, tempests, and their modifications, also defined as "Caractères des orages et de leurs modifications" [Features of Storms and their Modifications] (Lamarck 1801: 380).

Lamarck's definitions are interesting for many reasons. First, since they describe the specific features of each meteorological phenomenon, to allow the reader to identify each of them. Second, because the phenomena are described through the effects on the environment on which they insist. Lastly, the classification method is noteworthy, since it involves multiple grades. Indeed, Lamarck does not just describe a series of phenomena, he also specifies several variations of each of them, implying a further classification level.

The comparison of Lamarck's and Beaufort's systems shows how the interest in the classification of the wind force spread at the time across European countries and languages. From the comparison, some common traits can be recognised. For instance, the practice of describing the effects of the storms on natural objects is common to both Lamarck's and Beaufort's classification. Additionally, in both classifications, the wind force is not described as an independent entity, but as

³⁴ English Translation: The hurricane proper is just one of the modifications of the meteorological phenomenon known as a thunderstorm. It is, in fact, a kind of thunderstorm, in which more wind than thunder is distinctly apparent; and this wind obviously starts from a thundercloud. The name hurricane, too, which clearly derives from the word storm, indicates by itself the most appropriate use of its application.

part of other natural phenomena such as storms and tempests. In the classification of wind force the influence of previous naming attempts on Beaufort's prospected official one is important, as well as the interaction among authors.

Through the 18th century, the classification of wind force evolved in studies in engineering and meteorology. As previously mentioned indeed, wind force was central for knowledge development in both disciplines. In 1703, William Derham, an English engineer and member of the *Royal Society of London*, as Huler (2004: 90) reports, in an article for the *Philosophical Transactions*, described the same *Great Storm*, measuring the wind force with Defoe's (1704) same scale.

The second half of the 18th century was characterised by other attempts at classification of the wind force, which decisively influenced the evolution of Beaufort's Scale. A milestone was reported in the *Philosophical Transactions* in 1759, where John Smeaton, an English engineer and passionate meteorologist, reported a chart entitled *Table VI containing the Velocity and Force of the Wind, according to their common appellations* (Smeaton 1759, see Figure 6). Notably, the scale was very similar to Beaufort's own, but it was divided into 11 grades instead of 12 since the initial term *Calm* was missing. The same chart appeared, some years later, in James Capper (1801) volume entitled *Observations on Winds and Monsoons*, published in 1801.

Apparently, as Huler (2004) highlights, the English hydrographer, Alexander Dalrymple, directly suggested that Beaufort considered John Smeaton's scale. According to Dalrymple, Smeaton's scale, originally applied to engineering, could be used also for navigation and meteorology.

As always Huler (2004) reports, Dalrymple himself wrote a pamphlet on the matter in 1779 with a further proposal for the classification of the wind force. The pamphlet, entitled *Practical Navigation*, was never published. Instead, a table reported John Smeaton's (1759) classification based on the studies on windmills and compared it to the words used in navigation. Dalrymple's table was therefore apparently directly anticipating Beaufort's work and constituted, as Huler (2004: 103) puts it, the "Rosetta Stone of the Beaufort's scale".

Velocity of the Wind.			Common appellations of the force of winds.
Miles in one Hour.	Feet in one second.	Perpendicular force on one foot area in pounds avordupois.	
1	1,47	,005	Hardly perceptible.
2	2,93	,020	
3	4,40	,044	Just perceptible.
4	5,87	,079	
5	7,33	,123	Gentle pleafant wind.
10	14,67	,492	
15	22,00	1,107	Pleafant brisk gale.
20	29,34	1,968	
25	36,67	3,075	Very brisk.
30	44,01	4,429	
35	51,34	6,027	High winds.
40	58,68	7,873	
45	66,01	9,963	Very high.
50	73,35	12,300	
60	88,02	17,715	A storm or tempeft.
80	117,36	31,490	A great storm.
100	146,70	49,200	An hurricane.
			An hurircane that tears up trees, carries buildings before it, &c.
1	2	3	

Figure 6: John Smeaton's (1759: 165) table of "Common appellations of the force of the winds".

6.3.2. Intersemiotic variation: the use of symbols for the classification of concepts

The present chapter deals with term translation, and it examines examples of intralingual, interlingual and Intersemiotic translation. Translation across semiotic systems was used to classify the wind force. Not only were multiple semiotic systems useful for the classification of concepts, but they were also combined with one another.

Among different versions of the Beaufort's scale, the one which appeared in *The Nautical Magazine* (1832: 538, see Figure 7) is interesting from a terminological perspective, since it showed all the semiotic systems applied by Beaufort for the classification of wind force, in connection with one another. As can be seen in the following chart, this version of Beaufort's scale entailed not only the 12 grades of classification of the wind force, but also the letters used to classify the *State of the Weather*. The first two semiotic systems in the classification were numbers, associated with the degree of wind force, and letters, "to denote the State of the Weather" (Beaufort 1832: 538). These letters, present also in the first version of the scale, have been since known as *The Beaufort's letters*:

FIGURES to denote the Force of the Wind.

0	CALM.		
1	LIGHT AIR, - - -	Or just sufficient to give steerage way.	
2	LIGHT BREEZE, - -	Or that in which a well-conditioned man-of-war, with all sail set, and clean full, would go in smooth water, from - - - - -	1 to 2 knots.
3	GENTLE BREEZE, - -		3 to 4 knots.
4	MODERATE BREEZE,		5 to 6 knots.
5	FRESH BREEZE, - -	Or that to which she could just carry in chance, full and by	Royals, &c.
6	STRONG BREEZE, - -		Single-reefed topsails and topgallant sails.
7	MODERATE GALE, - -		Double-reefed topsails, jib, &c.
8	FRESH GALE, - - -		Triple-reefed topsails, &c.
9	STRONG GALE, - - -		Close-reefed topsails and courses.
10	WHOLE GALE, - - -	Or that with which she could scarcely bear close-reefed maintopsail & reefed foresail.	
11	STORM, - - - - -	Or that which would reduce her to storm stay-sails.	
12	HURRICANE, - - -	Or that which no canvas could withstand.	

If the above mode were adopted, the state of the wind might be regularly marked, in a narrow column, on the log-board every hour.

LETTERS to denote the State of the Weather.

b	BLUE SKY; whether clear or hazy atmosphere.
c	CLOUDS; detached passing clouds.
d	DRIZZLING RAIN.
f	FOGGY— ^f Thick fog.
g	GLOOMY dark weather.
h	HAIL.
l	LIGHTNING.
m	MISTY hazy atmosphere.
o	OVERCAST; or the whole sky covered with thick clouds.
p	PASSING temporary SHOWERS.
q	SQUALLY.
r	RAIN; continued rain.
s	SNOW.
t	THUNDER.
u	UGLY threatening appearances.
v	VISIBLE clear atmosphere.
w	WET DEW.
.	Under any letter, indicates an extraordinary degree.

By the combination of these letters, all the ordinary phenomena of the weather may be expressed with facility and brevity. *Examples*:—**Bcm**, Blue sky, with passing clouds, and a hazy atmosphere. **Gv**, Gloomy dark weather, but distant objects remarkably visible. **Qpdlt**, Very hard squalls, with passing showers of drizzle, and accompanied by lightning, with very heavy thunder.

Figure 7: All semiotic systems of Beaufort's classification, published in *The Nautical Magazine* (Beaufort 1832).

The comprehensiveness of the Beaufort Scale is noteworthy. While the scale is primarily concerned with the classification of wind force, the multiple states of the weather are also classified in a parallel nomenclature, to which letters are associated. This makes the scale a very comprehensive tool for the description of wind and weather. On the same page as the Beaufort Scale, *The Nautical Magazine* (Beaufort 1832: 538) reported a note on the possibility to combine letters with one another, to create more articulated descriptions of the weather:

By combination of these letters, all the ordinary phenomena of the weather may be expressed with facility and brevity. Examples:

Bcm – Blue sky, with passing clouds and a hazy atmosphere.

Gv – Gloomy dark weather, but distant objects remarkably visible (Beaufort 1832: 538).

The strategy of providing multiple denominations for the same concept and in particular a series of letters and numbers, designed for faster annotation in logbook or diaries. The construction of a code, such as the Beaufort's letters, with the possibility to combine them to one another, constituted a relevant process within this strategy, as well as in the formation of terms, of which this process is part.

These denominations belonging to alternative semiotic systems, such as numbers, symbols, and letters, and used to identify the specialised concepts, were equally important for communication

and knowledge exchange. In this perspective, this case study highlights the importance of non-lexical terms in term formation. As shall be demonstrated in the next sections, these terms were also used as a means of knowledge transfer across different languages.

Lastly, the use of numbers associated with terms shall be commented, as Alexander Dalrymple used a similar classification in his nomenclature of wind force, while clarifying that the aim of his classification was not only to record meteorological data, but much more than that, the *transmissibility* of the data, as Huler (2004: 111) reports. Indeed, Dalrymple terms could immediately be used by other experts, as happened with Beaufort's scale.

6.3.3. The Beaufort Scale and the description of concepts

One of the most innovative elements of the Beaufort Scale of wind force was the association of brief descriptions to the grades, with the use of multiple semiotic systems. Descriptions were dedicated to the effects of the winds on natural objects, or to the definition of connected meteorological phenomena in which the wind was involved i.e., a storm or a hurricane. As seen in the previous examples, the practice of defining wind force through the description of its effects was not a new one.

As Huler (2004: 78) specifies, since the wind could not be seen, its effects had to be described, by looking at other things. The descriptions Beaufort associated with the terms of his scale evolved with time and the successive revisions of the scale. After several modifications, a definitive form of the descriptions could be found in the *Specification of the Beaufort Scale with Probable Equivalents of the Numbers of the Scale*, published by the MET Office of England in 1906 (see Huler 2004: 78). Some of the definitions in their final form are reported as follows, as examples:

- 0 **Calm** - Calm; smoke rises vertically.
- 1 **Light air** - Fishing smack, just has steerage way: Direction of wind shown by smoke drift, but not by wind vanes.
- 2 **Slight breeze** - Wind fills the sails of smacks, which then move at about 1-2- miles per hour; Wind felt on face: leaves rustle, ordinary vane moved by wind. (MET 1906. Publication nr. 180, in Huler 2004: 78)

As Huler (2004) notes, as for Dalrymple's classification, the scale was immediately usable by experts, which was one of its most useful features. The use of language to describe the grades of wind force was interesting. These definitions were normally considered, in the discussion on term formation, less relevant than the actual terms.

6.3.4. Beaufort's success in standardisation

The Beaufort Scale constituted an example of a classification created in time by multiple authors, and which was already known in the discipline before its standardisation. The terms and concepts which became official in the Beaufort Scale (1817) had been proposed many years before by other experts.

Given the interdisciplinary use of the terms across engineering and meteorology, Beaufort's main merit seems to have been the standardisation of terms in meteorology and for navigation, as well as the use of parallel classifications employing multiple semiotic systems (see also Smyth 1849).

The *transmittability* of the data mentioned by Huler (2004), with reference to Beaufort (1817) classification, was central for the development of knowledge at the time. Experts were aware that the recording of data could not be the unique purpose of classifications. Instead, an efficient communication needed to become a priority, and therefore the creation of terms, which were usable in the widest possible range of contexts. As it appeared, the correct transmission and recording of data seemed to have motivated Beaufort's nomenclature in which semiotic systems were connected to one another, and concepts were defined through multiple terms. The use of descriptions of the effects of the wind as definition of terms was important. While describing the effects in a simple, and yet generally understandable manner, Beaufort managed to render his scale universally comprehensible. In a terminological perspective, the association of terms and descriptions made the two even more independent from one another, allowing the experts to use the descriptions in reference to terms created by other experts, ensuring nevertheless the same level of comprehension. It is important to remember how, in the 19th century, the classification of wind force was relevant not just for meteorology and navigation, but also for the industrial development of wind machines, and the engineering studies on that, in the 18th and 19th century, as Huler (2004) acknowledges:

This was a leap forward for the wind scale [...]. Smeaton designed his scale to help people use windmills, nothing more. Dalrymple adapted it to improve sailing. But Beaufort's scale, finally, was designed to **gather, store, and communicate data**, for whatever **purposes** it might eventually be used. This was a whole different undertaking, and it's a true contribution to science. (Huler 2004: 134)

As Huler (ibid.) observes, Beaufort's classification appears to be the first one constructed for a classification of the wind, without being applied to a specific sector or field of research. The purpose of this classification was indeed different from the ones of its precursors.

6.4. Some additional forms of translation: symbols, images, and numbers

Similar processes of translation of terms into other semiotic systems occurred at the time in multiple fields of study. As an example, the English meteorologist Luke Howard (1803a) associated symbols to the terms of his nomenclature of cloud formations. The use of terms in different contexts and the possibility to use symbols to annotate the observations on the state of the weather, could have motivated Howard's choice. Regarding term translation, in Howard's nomenclature, terms were in Latin, with English translations. The experts expressed contrasting opinions on Howard's choice of the language for the official classification. While Howard and other experts preferred Latin as the language

of the international scientific community; other experts wanted the nomenclature to be in English for better comprehension by the local experts (see Forster 1816, in Sec. 5.3.2.).

Psychology constituted another field for experimentation in the use of alternative systems of concept representation. The arts appeared to be reflecting the spirit of the time, as a graphic representation of mental diseases was realised by the French painter Theodore Gericault between 1822 and 1823 entitled *Les Monomanes. Portraits of the Insane*. The series of paintings reflected a classification of mental diseases which, according to scholars in psychology, could be classified with reference to the physical appearance of the patients (Duffy 2010; Boime 1991). A broader discussion was taking place, at the time, on the nomenclature and classification of the states of the mind mainly, but not exclusively, in the sector journal *The Asylum* (Monro 1855, see Sec. 7.4.). While the representations in painting of the states of the mind cannot be considered as a further system of classification, the paintings presumably stated the importance of the classification at the time.

A strategy like the one adopted in psychology was employed in architecture. There, the periods of English medieval architecture were being classified in a discussion among experts which lasted through the first half of the 19th century. In the debate, the periods were named according to the features of windows of English churches, and drawings were used to represent those windows. This is however different from the activity of a painter. Indeed, the architecture scholars used drawings to represent the differences among periods and their most important architectural elements, while painter did not have the same scientific and classificatory purposes.

Contemporarily, other architectural elements were represented with the aim of classification. Among others, Robert Willis' (1844) pamphlet *Architectural Nomenclature of the Middle Ages*, compared several European languages in charts on the naming of architectural elements, while he presented drawings of them to univocally define the concepts (cfr. Sec. 5.4.). In this method of concept description, Willis appeared to employ two parallel strategies. First, the exact concept, or architectural element in this case, was identified through the drawing. That way, experts were allowed to identify the concept, independently from the term they used to describe it. Second, terms and term variants used in the various languages to identify that concept were listed in tables parallel to one another. That way, term variants in different languages were connected to one another. Not all experts acknowledged the validity of the proposed terms. Indeed, while the illustrated architectural element was the same, the experts named it differently, according to the term they deemed most suitable. This phenomenon could be addressed as an application of term variation in an historical perspective.

As a further insight into term translation, reference should be made to the reflections of the scholars in electrochemistry, in a discussion among experts on term formation (cfr. Sec. 7.2.). The experts discussed the employment of newly coined terms in international communication, as well as their possibility to be properly translated into other languages. Specifically, William Whewell (1835,

December 11th, cfr. Sec. 7.2.10.) approached the topic of possible issues in the German translation of terms. The excerpt seems to remark the importance the experts attributed to term translation and their use outside of the national context. As Whewell's words exemplified, in a discussion on the formation of terms, experts evaluated their form to be suitable not just in the language in which they were created, but also thinking about their possible translation into other languages.

6.5.A comment from the perspective of terminology theory

The process examined in this chapter is term translation, presented as a form of term variation. In this, different and untraditional forms of translation are considered, as well as other forms of terms, beyond the lexical ones, as alternative semiotic systems. This parallel use of semiotic systems is a defining character of the examples in this chapter, towards a better explanation of the concepts. Through the examination of primary sources from the 19th century, the chapter presents three parallel applications of term translation: an intralinguistic, an interlinguistic, and an intersemiotic one.

The first form of variation was interlinguistic, across English and French in the first case study, and across German, French, and English in the second. As noted by authors in contemporary terminology theory, term translation across languages always implies a semantic evolution of the translated terms and an adaptation of terms and concepts to the target language and culture (Temmerman 2008). In the case studies, different forms of terms are presented, too. While in some nomenclatures lexical terms were proposed, other classifications merely defined the concepts, without naming them. This is an important difference in classification, in which also the contrasting approaches of the authors were mirrored.

A second form of variation occurred across semiotic systems such as images, drawings, numbers, and letters. In this declination of term variation, which could be termed as intersemiotic variation, symbols and letters were used to refer to concepts and adapt them to their most common context of use. The use of Intersemiotic translation is a trait that is common to both examples. Indeed, while drawings, and examples of natural objects were employed in the classification of colours, meteorologists used symbols and drawings to efficiently convey the different grades of wind force. Comparing the two case studies, their common aim seems to be the explanation of concepts in a detailed manner. All nomenclatures in different semiotic systems are created to make terms as efficient as possible, as well as usable in different contexts.

A form of cognitive variation was retrieved in the primary sources, and thus addressed (Freixa 2022). In the classification of the wind force, indeed, semiotic systems such as symbols and letters combinations were employed by the experts to explain concepts to a wider public in a clearer manner; and to make the classification applicable in multiple contexts. As Huler (2004) specifies, while the 18th

- century classifications of the wind force specifically addressed engineering or navigation, Beaufort's (1817) classification was the first one planned to be used in different contexts.

The translation of terms into parallel semiotic systems could also be addressed as a means towards a *domain conquest* (Lauren et al. 2004; 2006). Indeed, while terms existed already for the description of wind force, they were not suitable for specific contexts. The contemporary use of multiple semiotic systems could thus be considered as a strategy, to conquer a domain, in which communication was, until then, as it appears, not efficient enough:

Domain conquest: Development of the necessary means of professional communication needed for communication at all levels of a domain for which previously means of communication were lacking or only available to an insufficient degree. (Lauren et al. 2006: 5)

Variation could be described as a strategy in the development of the necessary means for communication in a specific context of use. Referring to the notion of domain loss and conquest (Lauren et al. 2004; 2006), terminological variation can also be said to constitute a strategy of improvement of a discipline's existing vocabulary, to prevent, as Lauren et al. (2006: 5) specified, the "loss of ability to communicate". Indeed, in the examples presented in this chapter, it becomes clear how the experts proposed different classifications to foster communication within the scientific community, and to find the most suitable terms and semiotic systems to the purpose.

A similar process appears to occur in the classification of colours, where term translation was flanked by a change of purpose of the original nomenclature or, a generalisation of terms which are employed in a more specific context. For instance, Werner's (1774) colour terms, originally coined for fossils, are then applied to the whole natural history, after being translated into English. In a similar translation process, the classification of wind force, originally coined for engineering in the 18th century, is adapted to the purposes of mariners and employed also in meteorology.

The definition of term translation as a form of variation, as referred to in terminology theory (Sager 1990) constitutes a starting point of the analysis. In reference to this different form of term translation are presented also as example of term variation. They are, specifically, intralingual, interlingual, and Intersemiotic translation (see Jakobson 1959).

Denominative variation represents one of the conquests of the theories of terminologies of the last decades, in which the discipline recognised the real nature of terms in context (see Drouin et al. 2017; Freixa 2022), as opposed to their objective and neutral vision, acknowledged by Wüster's (1979) traditional terminology theory.

This underlines the importance of the context in the processes of term formation and variation. indeed, what is defined in theory as term formation, was shown to be decisively determined by its context, as well as by the necessity of its authors. Term translation was addressed also in contemporary

terminology theory, as related to communication and knowledge advancement. While terminology was often addressed as problematic in translation across languages (Faber and Montero Martinez 2009), according to Cabré (2010) both terminology and translation stem from the same practical necessities:

[...] **Terminology and translation** are characterized by their long tradition as applied subjects, in contrast to their recently established character as disciplines. Terminology and translation arose from the **practical activity** caused by the need to express specialized thought or to solve comprehension problems. [...] terminology and translation are interdisciplinary fields having a cognitive, linguistic and communicative basis. As a result, their foundation principles come from the cognitive, language and communication sciences. Besides, both subjects are information and communication areas which have knowledge categories and units expressing them that are projected on communicative acts immersed in particular social contexts. (Cabré 2010: 356)

With reference to the examined sources, term translation across languages and semiotic systems appears to represent a sort of denominative variation of concepts, where terms are transposed into a new context and, therefore, need to be adapted. This is visible through the comparison of the multiple nomenclatures across languages and semiotic systems: each term translation is different since it responds to different necessities. Moreover, as expressively declared by the 19th century experts, the equivalence of multiple semiotic systems was introduced to respond to new communicative necessities, and to help the transmission of knowledge.

While terms and concepts are defined as intrinsically unstable in terminology theory (see Antia 2000), given the constant evolution of knowledge, the practice to define a concept allows to precisely fix its meaning, and to position it in a conceptual system and in relation to other concepts. Antia's (2000) statement on the importance of definitions in terminology underlined the importance of reconstructing the historical and contextual conditions of term formation, to access a proper history of term formation. Among the studies addressing these contextual factors, Myking's (2009; 2020) discussion of the motivations behind term formation should be mentioned.

This topic remarks the importance of the use of descriptive language in terminology, and the relevance of elaborating efficient definitions of terms, which can make them usable in multiple contexts. The contemporary use of multiple semiotic systems in the primary sources was aimed to foster communication, which is, back then as nowadays, one of the main aims in term creation.

Specifically, in the examples presented in this chapter, providing an exact description of the specialised concepts, which could constitute a basis for communication throughout the international scientific community seemed more significant than naming concepts on their own. Moreover, as part of these descriptions, the reference to real objects was important since these references constituted important means for the comprehension of the described concepts.

Term variation was addressed in this study also as an instrument of knowledge advancement. As exemplified by Beaufort's (1817) scale of wind force, terms were proposed in successive versions through the years. This process could resemble Sager's (1990: 60) theorised stages of naming within the process of "terminologisation" and its diachronic evolution in time, where nomenclatures contributed to the evolution of knowledge. Contemporarily, terms and their successive stages of development could be addressed as "cognitive devices" (Pecman 2014: 1).

The role of translation as the definition of alternative terms for concepts was considered as part of the process of conceptual definition and the evolution of terms in a diachronic perspective. Parallel to that, relevance was attributed to the differentiation of these processes of variation, from the episodes of proper neology or primary term formation (Sager 1990). In this, the difference between the phenomena illustrated in this chapter and the ones related to the classification of cloud formation (cfr. Sec. 5.2.) was highlighted, as comparable to the one between primary and secondary term formation. While no scientific term existed for cloud classifications when Howard (1803a) first named them and organised them into a nomenclature; Beaufort (1817) made official terms which not only existed already, but also came from a long tradition of classifying the strength of the wind, since at least the 18th century in England (Defoe 1704).

Term variation is also described as a collaborative practice, in which multiple actors were involved. Indeed, the case studies illustrate the extent to which cooperation represents a fundamental factor in term formation, where experts influenced each other in the creation of terms. Concurrently, nomenclatures contributed to shape their successive alternatives. In these examples, more than in others, was clear how the history of a nomenclature was always also the one of its predecessors, and of terms which were never original, but always inspired by previous naming attempts.

The reason for the choice of the two case studies to illustrate multiple applications of term translation was threefold. First, the examples were chosen since they illustrated complementary aspects of term translation as a form of variation. Namely, while the classification of the wind force focused not just on the definition of lexical items, but on the implementation of further semiotic systems in the nomenclature; the nomenclature of colours was centred on the translation of terms across languages, and on the visual representation of concepts i.e., the different shades of colours.

Second, the classifications of colours and the wind force named entities which could not be described as independent concepts. Instead, they both need natural objects or their effects on other elements to be defined. While the colours are described with reference to plants, animals, and minerals in which they can be commonly detected, the wind force is illustrated through its effects on natural objects. Both nomenclatures change their application over time. While they first apply to specific objects in one field of study, both classifications extend their application to other domains.

As the reconstruction of previous naming systems presented in this chapter demonstrates, most of Beaufort's terms were already common in the description of meteorological phenomena. Beaufort's main innovation consisted in rendering the nomenclature official, with the help of alternative semiotic systems and descriptions of the concepts, in a process which could be assimilated, in a terminological perspective, to standardisation. In the perspective of this thesis, this represents a relevant aspect in the formation of terms, as Huler specifies:

That's what was happening in the early nineteenth century. **Observation** was turning to **data – science** was becoming a **profession**, an identifiable pursuit with a **standard pattern** and **method** and even a recognizable practitioner. (Huler 2004: 124)

With reference to the evolution of observation into data, which Huler addresses, in Beaufort's classification of the wind strength and in the classification of colours, a common intention to systematise shared concepts can be perceived. Indeed, both Beaufort (1817) and Syme (1814) classifications were aimed to be employed by the largest possible number of users, and in the most diverse contexts. These classifications appear therefore to be part of the "standard pattern and method" which Huler (2004: 124) describes as being at the origin of science in the 19th century.

6.6. Summary of the contents

This chapter presented term translation as part of the formation of 19th- century scientific language. More specifically, term translation across languages and semiotic systems was addressed as a form of term variation, as defined in terminology theory, where the use of alternative terms to describe the same concept expressed the inherent multidimensional nature of concepts and served their better description (Freixa 2022; Bowker 2022). The examples presented different forms of term translation. Werner's (1774) classification of colours was translated into other languages, and concepts were visually represented into images. In Beaufort's (1817) classification of wind force, terms were translated into parallel semiotic systems, such as numbers, or acronyms.

While the two nomenclatures underwent different translation processes, they showed common traits. Both nomenclatures changed purpose throughout their formation, as well as the field of studies to which they applied. Another similarity of the nomenclatures was that they both classified entities, which could not be seen or described independently i.e., without reference to other natural objects. Indeed, the wind force was classified according to the description of its effects on natural objects or as part of other natural phenomena, such as storms and tempests. Similarly, colours needed the reference to plants, animals, and minerals to be identified.

Moreover, the comparison among alternative and successive classifications was central in the analysis. This aimed to show how, the evolution of every term in a diachronic perspective involves the history of alternative terms, which contributed to its formation. Lastly, the chapter aimed to show how

translation could influence the formation of terms in multiple forms, and how, this process, together with other ones described in this study, was part of a dynamic, which appears to be much more complex and multifaceted, than yet described in terminology theory.

7. Discussions among experts as the social dimension in term formation

7.1. Introduction

This chapter illustrates the role of discussions among experts as the social dimension of term formation in the 19th century. Specifically, the chapter describes how term formation is linked to or results from expert discussions on the naming of specialised concepts. The primary focus is to explore how these processes of term formation – as outlined in the theoretical studies of terminology since the development of the *General Theory of Terminology* in the 20th century (Wüster 1931) – manifest in 19th-century research disciplines. More in detail, the chapter investigates how these processes are reflected in the 19th-century publications. Concurrently, it aims to assess the extent to which the analysis of these primary sources can provide new insights into the development of term formation in real communicative situations among scholars, and shall help to expand knowledge on these processes, through the study of historical sources, which were not analysed before in this perspective.

The social dimension of term formation was addressed in numerous studies in terminology theory to date, which pertain particularly to Socioterminology (Gaudin 1993b; 2005; 2007; Balliu 2005). These studies evidence numerous aspects of the formation of terms. Among them, the necessity to describe the "discours terminologiques" (Gaudin 1993b: 296), which involve different sources, as well as an "histoire des termes" (Gaudin 2007: 33), to understand the different factors involved in their formation. More in detail, Socioterminology (Gaudin 1993b; 2005) focuses on the dynamic vision of terms as part of linguistic interactions in which they are formed and continuously updated. These social interactions are of interest for the analysis conducted in this chapter. In the present analysis, a focus is set on the role of human agency, or the importance of the exchanges of ideas among experts and their meta reflection, as a central factor in the formation of terms (Myking 2020). The theoretical framework of this analysis in terminology theory is presented in section 2.7.3.

The chapter applies insights from these studies to examples within my primary data. The first case study analysed in this chapter is the "consultation of the experts" (Ross 1961: 187), where Michael Faraday, an English physicist, asked for William Whewell's help in the creation of terms to efficiently describe physical entities in electrochemistry. A Professor of Mineralogy in Cambridge, Whewell was also passionate about naming (Ross 1961). In the epistolary exchange occurred in 1834, concepts were described, and terms evaluated, according to multiple criteria.

A further example presents a discussion among astronomers (Case 2020). The *Committee for the Revision of the Nomenclature of the Stars* was nominated by the *British Association for the Advancement of Science* (BAAS) to revise the official astronomical nomenclature (Herschel, Whewell, and Baily 1844) and issued reports to the scientific community. The debate, however, was just one of

the frequent discussions on naming in astronomy, where scholars across Europe proposed names for newly discovered celestial bodies in French, English, and German (Case 2019).

A final overview presents further discussions among scholars occurred in real contexts of other disciplines, such as the update on the nomenclature of mental diseases, published in the psychology journal *The Asylum* (Monro 1855), the more general discussion on the features of a scientific nomenclature (CWM 1861) appeared in *The Athenaeum*, and the exchange on the relation of thoughts and words presented in *Nature* in 1887, entitled *Thoughts without Words* (Romanes 1887).

The remainder of the chapter is structured as follows. Section 7.2. illustrates the case study of the discussion between Faraday and Whewell on the naming of entities in electrochemistry. Section 7.3. describes the example of the revision of the nomenclature of the stars, while section 7.4. briefly reviews some further examples of discussions among experts. Finally, section 7.5. comments on the primary sources from a terminological perspective. Ultimately, section 7.6. underlines the importance of examining term formation in a diachronic perspective, where the proposal of naming alternatives and the evolution of concepts through the exchanges of opinions among experts constituted fundamental processes towards the creation of terms and the advancement of knowledge.

7.2. Whewell and Faraday's correspondence on the naming of physical entities

The first example of a discussion on term formation is an epistolary correspondence on naming physical entities. The correspondence occurred in 1834 between the English mineralogist William Whewell and the English physicist Michael Faraday and was dedicated to the formation of terms for newly identified entities in electrodynamics. While discovering new entities in his research, Faraday consulted Whewell in search for appropriate names for them. As Faraday confirmed, the discussion involved other experts, as they proposed terms and commented on others' suggestions and on the criteria of term choice.

In 1834, Faraday was an expert in electro chemistry, as Whewell dedicated himself extensively to naming and classification (Witteveen 2016: 140; Ducheyne 2009). As in other debates during the first half of the 19th century (Case 2019), terminological practices from other fields of study were mentioned, as sources of inspiration. Whewell also created terms for other disciplines and was involved in the formation of scientific language in multiple fields of research. Among others, upon request by Charles Lyell, Whewell suggested "geological period markers" (Preyer 1988: 127), such as *Eocene*, *Miocene* and *Pliocene*. Similarly, he proposed the term *Biometry* to John Lubbock, in search for a name for his activity (Stigler 2000).

This correspondence belonged to a broader collection of letters which William Whewell exchanged with scholars from various disciplines and countries. Regarding the debate, this study claims that it is important to look at similar debates among scholars in term formation even when they did

not result in an agreement: rather, they should be conceived of as a process shaping the definition of concepts by describing them from different perspectives.

In this, the overarching character of terminological processes seems evident, as not only did experts refer to processes happening in other disciplines, but they also took inspiration from terms and practices adopted by scholars in other fields. Through these common practices at the time, a connection among fields of expertise and scholars appeared to exist. The episode presented in what follows, in which William Whewell was consulted as an expert in scientific language from a different discipline appears to reinforce this statement.

The reconstruction of the correspondence between Whewell and Faraday is inspired by historical recollections from the past. The first one is an account of Whewell's writings written by Issac Todhunter (1876). The second and third historical reconstructions are specifically dedicated to the correspondence between Faraday and Whewell, also described in this chapter. They are an article from 1937 by the historians Ralph E. Oesper and Max Speter (Oesper and Speter 1937) and another one written by the historian Sidney Ross (1961). The original letters quoted in the chapter are part of Whewell's correspondence preserved at the Wren Library of the Trinity College, Cambridge (Faraday Whewell 1834-1860)³⁵. From this correspondence between Faraday and Whewell, only abstracts of letters were selected, which provided significant details on the terminological reflections of the scholars on the formation of terms and their corresponding concepts. The selection is not meant to be complete, but to provide some insights into the scholars' terminological thinking.

7.2.1. Faraday to Whewell, April 24th, 1834

The correspondence describes the discussion among Michael Faraday and William Whewell of terms to identify concepts in electrochemistry i.e., electrode, electrolyte, electrolysis, anode, cathode, ion, anion, and cation. In the correspondence, Faraday described the newly discovered entities and the features he wishes their designations possess, in reference to the existing knowledge and nomenclature in the field. Whewell responded addressing various criteria of naming, to finally propose terms to identify the described concepts.

The exchange started with Faraday's request for names to Whewell. In the letter, Faraday described the concepts he wished to name i.e., the ones referring to the two opposite poles, and then identified with the official terms anode and cathode. In this initial passage, Faraday referred to a friend

³⁵ Faraday, Michael and Whewell, William. (1834-1860). Correspondence between Michael Faraday and William Whewell. From the James Catalogue of Western Manuscripts, Trinity College Library, Cambridge (UK). Reference: O.15.49. <https://mss-cat.trin.cam.ac.uk/Manuscript/O.15.49> [accessed January 2, 2024].

The complete Faraday-Whewell correspondence quoted in this chapter is available at the Christopher Wren Library of the Trinity College, Cambridge (UK). Reference to the correspondence at the following link: <https://archives.trin.cam.ac.uk/index.php/correspondence-between-william-whewell-and-michael-faraday> [accessed January 2, 2024].

of his i.e., Dr Withlock Nicholl, mentioning his suggestions. The discussion on the naming of the electrochemical entities did not start with this correspondence, but much earlier, as also other scholars were involved, and suggested other denominations:

[...] I wanted **some new names**³⁶ to express my facts in Electrical science, **without involving more theory** than I could help, and applied to a **friend Dr. Nicholl** who has given me some that I intend to adopt: [...] a body decomposable by the passage of the Electric current I call an "**electrolyte**". [...] What have been called the **poles** of the battery I call the **electrodes**. [...] All these **terms** I am **satisfied** with, but not with two others which I have used thus far. It is **essential** to me **to have the power of referring to the two surfaces** of a decomposable body by which the current enters into it and passes out of it, without at the same time referring to the **electrodes**. [...] **my friend suggested**, and I have used the terms **eisode** for [...] the points where the **zetodes** are rendered. [...] the **present view** of electric currents and the **notions** by which we try to conceive of them will soon pass away, and **I want therefore names** by which I can refer to [...] **without involving any theory** [...] I shall express these parts by reference to a **natural standard** which, whatever **changes** take place in our **theories** or **knowledge** of electricity, will still have the same relation. [...] **Eastode** and **Westode** or **Oriode** and **Occiode** are names which a **scholar** could not suffer [...]. Now **can you help me to two good names**, not depending upon the idea of a current in one direction only [...] ³⁷. (Faraday 1834a, April 24th)

The most important concept of the passage was the presence of a connection between terms and theories on electricity. Indeed, Faraday would like to adopt names which did not involve any theory, so that, as knowledge advanced and new theories would necessarily be adopted following further discoveries, names would not change. Moreover, Faraday seemed to refer to contrasting theories in electricity, which could prevail in the future development of the discipline. Terms should thus reflect not debatable concepts, which were not related to any prevalent position in the field at the time.

Faraday's introductory letter presented multiple naming attempts. These could represent first attempts at defining the concepts. Interestingly, Faraday described concepts also by referring to their opposites, represented in this case by the positive or negative pole. The description of concepts not just through their features, but also through the features of their opposites might also have been Faraday's strategy to explain the concepts to his interlocutor.

Regarding this, it is worth underlining the significance Faraday gave not just on naming a single concept, but on the relation of a term to its opposite. In this perspective, terms were not considered as independent entities, but as part of a nomenclature, which was formed both by their synonyms and by their antonyms. This seemed to demonstrate Faraday's ability in seeing a nomenclature as a coherent entity in its entirety.

³⁶ Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

³⁷ Original in Trinity College Library; Ross 1961: 199.

7.2.2. Whewell to Faraday, April 25th, 1834

In his first reply, Whewell addressed the issue of uniformity of a nomenclature and the urge to avoid "incongruities of language". Whewell's purpose in suggesting terms for electrodynamics was indeed not just to name concepts, but to create a coherent nomenclature for the subject, in which the connections among terms could also be considered as a decisive criterion for the choice of new ones in the future:

[...] I had the pleasure of being present [...] at the reading of your paper in which you introduced **some of the terms which you mentioned** [...] these **novelties** had been forced upon you by the **novelty** of the extent and the new **relations** of your views. In cases where such causes operate, **new terms inevitably arise**, [...] it is an **additional advantage**, when they humour philologists so far as to **avoid gross incongruities of language**. I was well **satisfied** with most of the terms [...]; and shall be glad and gratified to assist in freeing them from **false assumptions** and **implications**, [...] ³⁸ (Whewell 1834a, April 25th)

Besides the coherence of a nomenclature, Whewell examined the difference between single words and compounds, when they become terms. In this regard, Whewell seemed to prefer existing Greek words, instead of compounds created to identify a new concept. Indeed, Whewell proposed the terms anode and cathode as already existing ones in the Greek language, and with a meaning near to the concepts Faraday wanted to define i.e., the one of two opposite poles:

I have considered the two **terms** you want to **substitute** for **eisode** and **exode**, and upon the whole I am disposed to **recommend** instead of them **anode** and **cathode**; these words may signify **eastern** and **western** way, just as well as the longer **compounds** which you mention, which **derive** their **meanings** from words implying rising and setting, notions which **anode** and **cathode** imply more simply. [...] I may mention too that **anodos** and **cathodos** are good genuine Greek words, and not **compounds coined** for the purpose³⁹. (Whewell 1834a, April 25th)

In the same letter, Whewell proposed an alternative for an existing term i.e., *zetode* which he disliked. Whewell's alternative term for the concept i.e., *electrostecheon*, derived from another term in what Whewell named "our scientific language" (Whewell 1834a, in Ross 1961: 202). This was important in the context where scientific language was considered as a common entity, which all members of the scientific community shared and which extended beyond the single disciplines. Specifically, in the opinion of experts at the time, scientific language existed as a shared entity across disciplines, and was then applied by the scholars in their field, according to their necessities. A term already in use in another discipline, was thus proposed to be adopted in a different field of studies. According to

³⁸ Original in Trinity College Library; Ross 1961: 201; Todhunter 1876, volume 2, 178-181.

³⁹ Original in Trinity College Library; Ross 1961: 201; Todhunter 1876, volume 2, 177-181; Oesper and Speter 1937: 542-543.

Whewell, this constituted an advantage for a nomenclature, since it helped the understanding and diffusion among scholars, as well as the cooperation with other disciplines. While the meaning of the Greek term was the same, its context of use differed. Another criterion addressed by Whewell in suggesting terms was that terms with similar terminations should indicate related concepts:

I have already said that I like most of your new words very well, but there is one which I should be disposed to except from this praise: I mean **zetode**. [...] The word being grouped with others with the same **termination** might be expected to indicate a modification of electrode, [...] as anode and cathode do. Instead of this, it means a **notion** altogether **heterogeneous** [...] all that you want is a word which implies an element of a **composition**, [...]. Perhaps the Greek word **stecheon** [...] would answer the purpose. It has already a place in **our scientific language** in the term **stoecheiometry** and has also the **analogy** in its favour [...] if you want a word which has a **reference to your other terms**, the reference must be to the process of decomposition by which these elements are obtained. [...] **anode, cathode, zetanode, zetocathode** fulfil your requisitions; **anode, cathode, anastecheon, catastecheon** are what I prefer⁴⁰. (Whewell 1834a, April 25th)

Whewell's proposal of borrowing existing terms from another discipline hinted at a possible connection of terms in scientific language, then applied to single subjects. As remarked in other works on the topic (Whewell 1840a; 1840b), Whewell was convinced that scientific language was an entity common to all disciplines: the experts attributed various meanings to terms, according to their necessities.

7.2.3. Faraday to Whewell, May 3rd, 1834

The analysis Faraday provided in his answer was equally interesting, as the scholar distinguished between the "sense and expression" of the proposed terms, and their "length and sound". The first criterion i.e., the "sense and expression" appeared to refer to the meaning of terms, while the latter, the "length and sound" seemed to hint at the length of terms when compounded with other ones. While he agreed with the first, he questioned the latter pair of attributes of Whewell's proposed terms, especially when compounded. The "length and sound" of terms when compounded seems to be – together with other criteria – also a guiding principle in choosing the most appropriate terms. Again, in the choice of these principles, Faraday seemed aware of the importance of considering terms as part of a nomenclature, and not just for their "length and sound" alone. This, again, seemed to state his forward-looking perspective on term formation:

[...] All your **names** I and my **friend** approve of, [...] as to **sense** and **expression**; but I am frightened by their **length** and **sound** when compounded. [...] I have taken **dexiode** and **skiaode** because they **agree** best with my **natural standard** East and West. I like **anode** and **cathode** better as to sound, [...]. Then **Stechion** I have taken although I would rather not have had the hard sound of ch here, [...]. But when we come to **combine**

⁴⁰ Original in Trinity College Library; Ross 1961: 202; Todhunter 1876, volume 2, 177-181; Oesper and Speter 1937: 542-543.

it with the two former as dextio-stechion and skaio-stechion, [...] I am afraid it becomes **inadmissible** simply from its **length** and **sound** forbidding its **familiar use**; [...] I had better not **give a new word** than form one which is not likely **to enter into common use**. It is possible that by this time **some other shorter word may have occurred** for Stechion; if so will you favour me with it. If not, I think I must strike out the two compounds and express my **meaning** without the use of **names** for the two classes of stechions [...] ⁴¹ (Faraday 1834b, May 3rd)

Another relevant point in Faraday's response related to the "familiar" use of terms. Whewell's proposed denominations, according to Faraday, were not suitable to become terms since they were – due to their specific features – not likely to become popular in the scientific language of the field. Other words should thus be turned into terms, which were more likely "to enter into the common use".

Interestingly, both scholars were concerned about the use of terms in familiar and daily communication among experts. This highlights how not only the features of terms were considered in their evaluation, which made them suitable to become part of the official language of the field, but also their possibility to become popular in the informal communication among experts. This reveals, indeed, the significance of terms as connected to their ability to convey a specific meaning in communicative situations (see Meyer and Mackintosh 2000).

7.2.4. Whewell to Faraday, May 5th, 1834

Whewell agreed with Faraday's objections to his terms. By suggesting *anode* and *cathode*, Whewell remarked the advantage of simplicity and brevity of terms, which would become evident, according to the expert, when the terms would be "firmly established". As part of the discussion, the scholars considered simplicity as another guiding principle for the choice of terms:

I quite **agree** with you that stechion or stecheon is an awkward word, both from its **length** and from the letters of which it is composed, and I am very desirous that you should have a better for your **purpose**. [...] I can suggest one, but before doing this I would beg you to **reconsider** the **suggestion of anode and cathode** [...] these words are much **simpler** than those on your proof sheet, and the **advantage of simplicity** will be felt very strongly when the **words** are once **firmly established** [...]. As to the objection to **anode**, I do not think it is worth hesitating about. **Anodos** and **cathodos** do really mean in Greek **a way up and a way down**; [...] If you take anode and cathode, I would propose for the two elements resulting from electrolysis the terms **anion** and **cation**, which are neuter participles signifying that which goes up and that which goes down; and for the two together you might chose the term **ions** [...] I am persuaded that the **brevity and simplicity of the terms** you will thus have in a fortnight procure **their universal acceptance**. ⁴² (Whewell 1834b, May 5th)

⁴¹ Original in Trinity College Library; Ross 1961: 203; Oesper and Speter 1937: 542-543.

⁴² Original in Trinity College Library; Ross 1961: 204; Todhunter 1876, volume 2: 181-183; Oesper and Speter 1937: 543-544.

In the following passage, Whewell stated that terms should be chosen in relation to their possibility of entering a specialised language and become common. In a final statement, Whewell declared simplicity and brevity as fundamental qualities of terms. In doing this, he mentioned the example of chemical notation. In this case, the universal adoption and duration of the notation were due, according to Whewell, primarily to its simplicity:

We propose calling that towards the **east** the **anode**, and that towards the **west** the **cathode**. I propose to distinguish those bodies, by calling those **anions** which go to the anode of the decomposing body, and those passing to the cathode, **cations**. And when I have occasion to speak of these **together**, I shall call them **ions**. [...] these terms are for their **simplicity** preferable to those you have printed, that I shall think it a **misfortune to science** if you retain the latter. [...] The existing **notation of Chemistry** owes its wide **adoption** and **long duration** to its **simplicity**⁴³. (Whewell 1834b, May 5th)

Not only terms, but also their form and related accessibility for the users to their meaning and connection to other terms, are parameters to consider in their adoption.

Whewell's reference to chemistry demonstrates a certain connection among fields of studies and research on scientific language at the time. It was not uncommon for scholars at the time to be inspired by naming and classification practices of other disciplines.

Beyond this, the discussion among experts on the creation of disciplines as independent entities at the beginning of the 19th century seemed to convey a more general vision of research on naming as a shared practice across fields of study. In this process of naming and classifying specialised concepts, scholars seemed to be used to work on multiple subjects and fields at the same time, as well as to discuss with colleagues from other fields (see Yanni 1997). This situation in the 19th century appears to reinforce, again, the idea of naming and classification as interdisciplinary processes.

7.2.5. Faraday to Whewell, May 5th, 1834

Faraday dedicated the following letter to the proposal of further alternative denominations. Dr Withlock Nicholl, a friend and colleague of Faraday, suggested these alternatives. As other scholars, Dr Nicholl appeared to have been directly involved in the discussion before the beginning of this correspondence:

[...] I hasten to mention two **names** instead of **eisode** and **exode** which are free I think from objection as to involving a **point of theory**, namely **Voltode** and **Galvanode**. My friend **Dr Nicholl** proposes **Alphode** and **Betode**. Then the **compounds** are good in **sound**: Voltastecheon, Galvastecheon, or Alphastechion and Betastechion.⁴⁴ (Faraday 1834c, May 5th).

⁴³ Ibid.

⁴⁴ Original in Trinity College Library; Ross 1961: 206.

The suggestions addressed the "sound" of the compounds, which the terms were deemed to form. Additionally, some proposals were inspired by names of experts in the field i.e., Alessandro Volta and Luigi Galvani.

This was not an unusual practice at the time, as the same strategy was discussed, among others, in Strickland's (1837a) *Rules for Zoological Nomenclature* to name newly identified animal species. However, as criticised by experts in zoology (McOuat 2001a), terms derived from names of scientists would inevitably connect the concept, or new discovery, to the work and positions of the expert. This would imply that, with an update of the theories, the concept would possibly also be renamed, as is true of any term and concept. However, as part of guidelines for naming in zoology (Strickland 1837a), the right of the discoverer to name newly formulated concepts with his own name, was granted as a matter of principle (see Sec. 8.3.1.). Mohs (1820) expressed a different position in his guidelines for nomenclature in crystallography. According to Mohs (1820: 338), to limit the "arbitrary application of names", newly discovered minerals which did not belong to any known species, should be named after a known genus, or order. Indeed, Mohs seemed not to share Strickland's (1837a) opinion, according to which the right of the discovered should be granted (see Sec. 8.2.1.).

7.2.6. Whewell to Faraday, May 6th, 1834

In his reply, dated May 6th, 1836, Whewell discussed Faraday's suggestions for the electrodes through which the conventional current enters and leaves a device. The two opposite electrodes were then identified as *anode* and *cathode*.

The proposed terms i.e., *anode* and *cathode*, or any alternative, should primarily express the opposition between the concepts they represented in electrochemistry. Regarding the alternatives *Voltode* and *Galvanode*, Whewell argued that the reference might be too arbitrary, as the scientists by which the terms were inspired were chosen among others involved in the development of the science. Moreover, the choice to name concepts after two experts would inevitably lead to the conclusion that the concepts were influenced by their theories. This was not true:

[...] I still think that **anode and cathode are the best terms** [...] the **essential** thing is to **express the difference** and **nothing more**. (...) The terms you suggested are objectionable in not doing this. They are also objectionable, [...] in putting forward too ostentatiously the **arbitrary nature of the difference**. To talk of **alphode** and **betode** would give some persons the idea that you thought it absurd to pursue the **philosophy of the difference of the two results**, [...]. **Voltode** and **Galvanode** labour no less under the **disadvantage** of being not only entirely, but **ostentatiously arbitrary**, with two additional **disadvantages**; first, that it will be very difficult for anybody to **recollect** which is which; and next that I think you are not quite secure that further investigations may not point out some **incongruity in this reference to Volta and Galvani**. I am more and more convinced that **anode and cathode are the right words**; [...]. **Ana and Kata** which are prepositions of **the most familiar use in composition**, which indicate **opposite relations in space**, and which yet **cannot**

be interpreted as involving a theory appear to me to unite all desirable properties. ⁴⁵ (Whewell 1834c, May 6th, in Ross 1961: 206)

Remarking the necessity of terms to be always applicable, and not related to any specific theory, Whewell concluded that *anode* and *cathode* were the best options, since they "cannot be interpreted as involving a theory" (Whewell 1834c, in Ross 1961: 206). Moreover, as Whewell observed, by adopting the terms *Voltode* and *Galvanode*, no expert would be able to discern the positive and the negative pole, while the reference to the two scholars might lead to misinterpretation. The terms would thus be unable to express their meaning, which should be, after all, their principal function.

7.2.7. Faraday to Whewell, May 15th, 1834

In Faraday's last letter, two topics were introduced. While Whewell's authority in coining terms and constructing scientific language within the community of scholars at the time was confirmed (see section 7.3.), the "facility of expression" which the newly proposed terms for electrodynamics allowed in scientific discourse was highlighted:

[...] I ought before this to have thanked you for your great **kindness** in the matter of the **names** [...]. I have taken your advice and **the names** used are **anode, cathode anions, cations, and ions** [...]. I had some hot **objections** made to them [...]; but when I help up to **the shield of your authority** it was wonderful to observe how the tone of objection melted away. I am quite delighted with the **facility of expression** which the new **terms** give me and shall ever be your debtor for the kind assistance you have given me. ⁴⁶ (Faraday 1834d, May 15th).

The letter ended Faraday and Whewell's discussion on the formation of terms in electrochemistry. However, as illustrated in the following sections, both scholars referred to the debate in their following works and exchanged further letters on related subjects.

7.2.8. Whewell's and Faraday's further declarations

As Ross (1961: 208) reported, in the section of his volume entitled *The Philosophy of the Inductive Sciences* devoted to the language of science (Whewell 1840b), Whewell remarked his objection to Faraday's and Dr Nicholl's term suggestions, but he did not reveal that he had any part in the events. The arbitrariness of terms in scientific language was the main topic of the passage:

The **extension of the arbitrary names in scientific terminology** is **by no means to be encouraged**. I may mention a case in which it was very properly **avoided**. When Mr Faraday research on Voltaic electricity had led him to perceive **the great impropriety of the term poles**, [...] since the processes have not reference to

⁴⁵ Oesper and Speter 1937 544-545; Ross 1961: 206. The Trinity College Library preserves photostat copies of a letter from Whewell to Faraday, 6 May 1834, the original in the Royal Institution (RI MS F1 H70).

⁴⁶ Original in Trinity College Library: Ross 1961: 207; Oesper and Speter 1937: 545.

any opposed points, but to two opposite directions of a path, he very suitably wished to substitute for the **phrases** positive pole and negative pole two words ending in **ode** [...], a way. A person who did not see the value of our present maxim, that **descriptive terms** should be **descriptive in their origin**, might have proposed **words perfectly arbitrary**, as **Alphode** and **Betode**: or, if he wished to pay a tribute of respect to the discoverers in this department of science, **Galvanode** and **Voltaode**. But such words [...] would hardly have **obtained any general currency among men of science**. **Zincode** and **Platinode**, [...], are to be **avoided**, because in their **origin** too much is **casual**; and they are not a good **origin for derivative terms**. [...] the terms which Mr Faraday adopted, were free from these **objections**; for they refer to a **natural standard** of the direction of the voltaic current, in a manner which, [...], is easily understood and retained. (Whewell 1840b, I, XCV, in Ross 1961: 208)

The reflection on the introduction of arbitrary names in scientific terminology was noteworthy. In Whewell's opinion, terms should not be arbitrary but follow specific principles, the most important of which was that they should describe the concepts they represented. Secondly, terms should also be chosen according to their possibility of obtaining currency among scholars.

As Ross (1961: 209) states, Faraday (1839), too, commented on the invention of the terms in his *Experimental Researches*. As was custom at the time, the volume, began with the introduction of newly coined terms in the discipline, as part of the nomenclature employed in the volume:

The **theory** which I believe to be a **true expression of the facts** of electro-chemical decomposition [...] is so much at **variance** with those previously advanced, that I find the greatest difficulty in stating results, [...] whilst limited to the use of **terms** which are current with a **certain accepted meaning** [...] To avoid therefore **confusion** [...], and for the sake of **greater precision of expression** [...] I have deliberately considered the **subject with two friends**, and with their **assistance** and **concurrence** in framing them, I propose henceforward using **certain other terms** [...]. (Faraday 1839, I: 661-663, in Ross 1961: 209)

In the introduction to the nomenclature of the volume, Faraday stated that the purpose of the new terms was to create a "natural standard" in the language of the discipline. As referred to in a previous quote, this standard should not be influenced by any theory or change in the views of the concepts by the experts in time:

Wishing for a **natural standard** of electric direction to which I might refer these, expressive of their difference and at the same time **free from all theory** [...] we propose calling that towards the east the **anode**, and that towards the west the **cathode**; and whatever **changes** might take place in our **views of the nature of electricity** and **electrical action**, as they might, as they must affect the **natural standard** referred to, [...] there seems to be no reason to expect that they will lead to **confusion** or tend in any way to support **false views**. (Faraday 1839, I: 661-663, in Ross 1961: 210)

Though most interesting, a "natural standard" seemed very difficult to realise, as it should remain unvaried through the evolution of the discipline and independent from all theories. However, Faraday's

definition revealed great expertise in the mechanism of knowledge development and discussions among experts, where concepts were constantly redefined and new meanings attributed, according to new discoveries and prevailing positions among the scholars. As Ross (1961: 212) further reports, the dispute on naming continued after the publication of the abovementioned volumes, as Faraday and Whewell proposed revisions of the discussed terms. The following sections comment on some later letters Faraday and Whewell exchanged after the publication of their volumes. These last letters dealt with proposed revisions, none of which was adopted.

7.2.9. Whewell to Faraday, December 3rd, 1834

Whewell's letter, dated December 3rd, 1834, proposed a variant to the term *ion*, i.e. *stechion*. There, Whewell confirmed that the term *stechion*, already in use in the scientific language as part of a derivate term, would be better adopted by the community of experts, as already stated in a previous letter. Moreover, the term would harmonise not only with its derivates, but also with other terms previously introduced in the discussion, such as *anion* and *cathion*:

[...] you did not like **the word ion** as a general **term** which I was not satisfied with. If you think it worthwhile to make the **alteration**, I would propose **stechion** "element" as a general **term** which shall mean the **anion** and **cathion** together. The **Greek term** is the proper word for element, and occurs in our **derivate** [...], a word sometimes used in **chemical** literature; but **the word stechion, the proper English form** of it, is not used and therefore you may introduce it in what sense you like. Moreover, the **derivation** of *stechion* will sufficiently **harmonize with anion and cation**, which it is **to put people in mind of**, and so will keep them in their places⁴⁷.
(Whewell 1834d, December 3rd)

As previously mentioned, the coherence and harmonisation of terms within a nomenclature were most important for Whewell. According to the scholar, this harmonisation would, among other advantages, help people remember terms and their connection. Moreover, the perspective of employing a term for which a derivate was already in use in chemistry would apparently facilitate its adoption as part of scientific language.

7.2.10. Whewell to Faraday, December 11th, 1835

As a further perspective on term formation, the experts discussed the possibility of the newly coined terms to be employed in international communication, as well as their possibility to be properly translated into other languages. Specifically, Whewell approached the topic of possible issues in the German translation of terms:

[...] I was little **dissatisfied** with the cation from its resemblance to the **common termination of words** which is made into cayshion in pronunciation. To avoid this, I would recommend putting two dots over the I, cation.

⁴⁷ Original in Trinity College Library, Ross 1961: 212.

[...] it would prevent your **German translators** from making your ions into jons [...]. I am desirous your **terms** should be as **unexceptionable** as possible [...] it is easy to see how important are the **purposes** to which you and your **successors** will have to apply those **terms** [...]⁴⁸. (Whewell 1835, December 11th)

The excerpt introduced two significant themes. First, the topic of term translation and the issues related to the use of the terms in other languages were discussed. Second, the use of terms in the future was introduced, as the experts discussed the possibility of these terms to adapt to the development of knowledge in the field.

Some years later, in his *History of the Inductive sciences*, Whewell declared his preference for the term *cat^{ion}*, as he stated that this choice would "avoid a violation of the habits of the English pronunciation" (Whewell 1837,3: 166). Regarding this, while the scholars considered the international dimension of term translation during the choice of terms, the English language's perspective seemed to remain central for them: they evaluated term variants according to their pronunciation and the advantages of their future employment by English users.

As Ross (1961: 214) observes, other scholars added to the debate in the following years. Among them, Alfred Smee (1841) mentioned the newly introduced terms in his *Elements of electro-metallurgy*, as did George William Francis (1846), in his *Dictionary of the Arts and Sciences*. Ultimately, John Tyndall (1870) commented on the diffusion of the new terms, in his volume, *entitled Faraday as a discoverer*:

All these **terms** (electrode, electrolysis, and electrolyte) have become **current** in science. **Faraday** called the positive electrode the **Anode**, and the negative one the **Cathode**, but these terms, though **frequently used**, have not enjoyed the same **currency** as the others. The terms **Anion** and **Cathion**, and the term **Ion**, are still less frequently employed⁴⁹. (Tyndall 1870: 56)

Following Tyndall, in 1868, there seemed still to be inequalities in the diffusion of the terms. However, the reference to the terms in various volumes appeared to testify to the relevance of the debate among experts in the years after the terms' introduction. As could be inferred from the analysis of the primary sources, not just the development of knowledge in their field of study, but also the progress of the own scientific language was of primary importance for the scholars at the time.

7.2.11. Faraday to Whewell, October 12th, 1837

A couple of years later, in 1837, Faraday replied to Whewell. There, the scholar asked for further terms for his discipline, in case Whewell could think of any:

[...] I will merely mention some other cases where they are wanted. [...] One is sadly **wanted** to replace **current**; others for Positive and Negative; and **some terms are required** to express direction of the force [...].

⁴⁸ Original in Trinity College Library, Ross 1961: 213.

⁴⁹ Original in Trinity College Library, Ross 1961: 215.

If **anode** and **cathode** were to be **received into use** perhaps, they would serve as **bases**: but something still more **general** and founded rather upon the words to be used instead of current wouldn't be better⁵⁰. (Faraday 1837, October 12th, in Ross 1961: 213).

It seems significant that Faraday turned again to Whewell when needing terms. This testifies to the authority of the expert in the formation of scientific language (Yanni 1997). However, Faraday did not properly specify the definition of the concepts to be named and the required features of the terms, which made the naming more complicated, as Whewell underlined in a successive comment.

Whewell's answer, on October 14th, 1837, entailed a reflection on term formation. Indeed, the author connected term creation to great discoveries in science, and compared them to the coinage of new currency, which gained "value and influence" by their circulation or, as for terms, through communication (Whewell 1837, October 14th, in Ross 1961: 215). Like currency, when terms were created, their circulation among scholars determined their diffusion and thus their success in the discipline i.e., their capacity to become part of the specialised language of the field. Not less relevantly, Whewell underlined how the current time was an era of "great discoveries" in which new concepts were formulated, and thus also terms to name them. The discussion continued about further possible terms, derived from the ones recently introduced (Whewell 1837, October 14th, in Ross 1961: 215).

Whewell further stated on the importance of discussion when forming terms: concepts cannot be defined and properly named without the necessary exchange of ideas among scholars, which should preferably take place in person, to understand each other's views. Whewell and Faraday's discussion evidenced how the formation of terms could happen in multiple manners, according to the context. Examples of that are for instance the different case studies of discussion among experts exemplified in this chapter. As will be shown in the following example, the discussion and choice of the most suitable terms for specific concepts seemed to entail some relevant criteria, which appeared to apply across disciplines and situations.

7.3. The Committee for the Revision of the Nomenclature of the Stars

This section introduces a different discussion among experts in astronomy. The section describes the debate that occurred among astronomers from 1833 to 1846 over the constitution of a *Committee for the Revision of the Nomenclature of the Stars*. The committee was composed of three experts i.e., William Whewell, John Herschel, and James Baily. While Whewell was an expert on scientific language, Herschel and Baily were astronomy scholars. During the years, the committee issued regular reports, which entailed reflections on revising existing terms, nomenclatures, and parallel systems of classifications of the stars. These reports were published by the *British Association for the Advancement of Science* (BAAS) in collected volumes and – based on my research - were published until 1846. This

⁵⁰ Original in Trinity College Library, Ross 1961: 215.

discussion on the revision of the official nomenclature of the stars involved naming attempts in English, French, and German. The nomenclature of the stars was, indeed, a widely debated topic during the first half of the 19th century (see Case 2019; 2020). Some reflections from these reports are commented in what follows, and their relevance for the principles of contemporary terminology theory is highlighted.

The Report issued in 1844 (Herschel, Whewell, and Baily 1844) seems interesting, as it discussed the necessity of uniformity and regularity of a nomenclature and defined this as a "guidance" for the expert in a discipline. This should be, indeed, the main aim of a nomenclature:

Before a catalogue of any considerable extent, [...] is finally arranged as to its **nomenclature** [...], ought to be laid down upon some **uniform** and **acknowledged** system, for the **guidance** of the **astronomer**. [...] whatever plan be adopted, it ought to be preserved with some degree of **uniformity** and **regularity**: so that if an author has inadvertently designed a star by a wrong constellation, the **name in the catalogue should be amended**, rather than the boundary of the constellation distorted. (Herschel, Whewell, and Baily 1844: 36)

As stated in the Report, the debate focused on two opposite necessities of the scientific community: on the one side, the need to standardise and update the official nomenclature, as this was needed for the advancement of studies on astronomy. On the other, the experts underlined the necessity to maintain the established and traditional terms, which enjoyed the "favour" of the scientific community:

In order that our catalogues and our maps (or globes) should **speak** the same **language**, and that they should at the same time be **clear** and **intelligible** to those who consult them for the purpose of **identifying** the stars in the heavens, it is requisite that the **nomenclature** of the stars [...] should be placed on a more **uniform**, **regular** and **well-defined** plan: but in making this necessary **reform**, regard must be had [...] **to long-established names** and **authorities**, which by their **antiquity** and **constant use** have acquired **full possession** of the public **opinion** and **favour**. (Herschel, Whewell, and Baily 1844: 38)

As in the discussion on naming between Whewell and Faraday (see Sec. 7.2.), the issue of maintaining established and traditionally employed terms of the discipline was of primary relevance for the experts, who were concerned that newly introduced or reformed terms might not be accepted by the users and adopted in the specialised language of the discipline.

The 1844 report of the *Committee* ended with a list of suggestions for the future revision of the nomenclature of stars. As illustrated in another chapter of this thesis (cfr. Sec. 8.2.), it was not unusual for experts to write recommendations or guidelines for future intervention on the nomenclatures (Mohs 1820; Strickland 1837a). The same occurred in astronomy, which appeared to be a much-discussed field of study in the 19th century. As Case (2015) notes, scholars engaged frequently in naming attempts, following the numerous discoveries at the time of new celestial bodies.

As a member of the *Committee* and being particularly interested in the naming of the stars, Herschel expressed his positions on the topic also in his *Treatise on Astronomy* (1833):

[...] to enable us to talk of groups of stars, [...] by **names** which, though **absurd** and **puerile** in their origin, have obtained a **currency** from which it would be **difficult**, and perhaps **wrong**, to **dislodge** them. In so far as they have really [...] any slight resemblance to the figures called up in imagination by a view of the more splendid "constellations", they have a certain **convenience**; but as they are otherwise **entirely arbitrary** and correspond to no **natural subdivisions or groupings** of the stars, astronomers treat them lightly, or altogether **disregard** them. (Herschel 1833, note 22)

As Case (2015) further observes, Herschel was also the author of the so-called *Celestial Reform Bill*, a list of nine principles on the naming of celestial bodies, which the scholar elaborated in his *Treatise* (Herschel 1833). Indeed, Herschel was involved in numerous debates on the nomenclature of astronomy at the time (Case 2015). Among them, the one around the *Naming of Neptune* became particularly well-known at the time (Kollerstrom 2009). In Case's (2020) words, Herschel's attention for the construction of names and the coherence of nomenclatures was remarkable. As the analysis of the *Reports* highlights, the project of a revision of the nomenclature of stars was popular within the scientific community. This was shown in numerous primary sources, such as Herschel's (1833) reflections on the necessity of a reform of the nomenclature of the stars, which appeared also in further works. As it frequently happened at the time, indeed, the discussion occurred not just in one journal, but was recalled in multiple works, with experts providing their own opinion on the topic.

This section presented the reflections of the Committee on the revision of astronomical nomenclature as a declination of debates among experts. While replies from other scholars in the field were not published in the reports, historical reconstructions of parallel discussions confirm that the debate on terms was very animated among experts in the field (Kollerstrom 2009; Case 2015). At the same time, the reports could be considered the result of a debate among the components of the Committee, which discussed processes related to the revision of a nomenclature.

7.4. Further examples of debates from other disciplines

While debates occurred at the time in presumably every discipline on term formation, popular sector journals reported some major ones. Discussions identified in the primary sources involved update proposals of existing nomenclatures. Due to new discoveries in the field, or the necessity of the disciplines new concepts were introduced and consequently named.

In 1856, for instance, the sector journal *The Asylum*, hosted a discussion among scholars in psychology on the renewal of the existing "Nomenclature of Various Forms of Insanity" (Monro 1855: 286). There, Dr Henry Monro praised the existing nomenclature, introduced by Dr Daniel Noble (1853). According to Monro, the nomenclature needed to become more specific, and additional terms were

necessary to define the name specificities of the illnesses. While a general classification was needed, no two patients were alike in his studies, and therefore, a classification that was too detailed could also lead to false generalisations. In *The Asylum*, Monro proposed an updated classification of mental diseases, inspired by the existing one. The debate extended internationally, as Monro's classification was translated into German, and re-published for the foreign scientific community (Jansson 2021).

A further category of debates involved the general nature of scientific language. To the contrary of discussions in a specific field of research, these debates did not involve a single discipline and occurred therefore in periodicals of general interest, such as *Nature* or *The Athenaeum*. Since the journals did not relate to a specific sector, they frequently hosted general discussions, such as the ones on the features of scientific language. An example was the debate in the English journal *The Athenaeum* in 1861, entitled *Scientific Nomenclature* (CWM 1861). There, the experts discussed the ideal features of a nomenclature, with a focus on the relation of concepts and terms, and the formation of new names for already named concepts, as "rules" were proposed by one of the participants:

I shall content myself with suggesting the following **negative rules**: Never **invent a name** for a thing which already possesses an exclusive one. Never **alter an individual name** to accord with any theory. Even if a name be not exclusive, do not distinguish, until absolute necessity arises. Look upon **individual names** as subjects for certainty and fixity; but upon systems as provisional modes of grouping them. (CWM 1861: 582)

The reflection is related to both the discussions among experts on term formation and the practice of writing guidelines for term creation (cfr. Ch. 8). Indeed, also in a general discussion as this one on scientific nomenclature, "rules" (CWM 1861: 582) for naming were suggested. At the same time, the alteration of traditional names and the relation of terms and conceptual systems were addressed as central topics of discussion on naming.

The exchange published in 1887 in *Nature* entitled *Thoughts without words* represented another example of a discussion on terminological processes among experts. In this discussion, positions on words as the "scaffolding" of thought were expressed (Romanes 1887: 172). The debate involved experts in linguistics and psychology and dealt with the relation of concepts and terms in our mind, as terms were formed, and concepts defined (Müller 1887, Galton 1887).

Ultimately, this overview remarked on how discussions among experts on concepts and terms occurred throughout the 19th century in various forms. While some were published in journals, others happened more privately through letters exchanged among the scholars. As became evident from the analysis of the primary sources, the debates on the creation and organisation of scientific language seemed to be part of the scientific activity of experts throughout the century, as well as of the development of almost all disciplines.

7.5.A comment from the perspective of terminology theory

The historical sources examined in this chapter provided insights into the 19th- century process of term formation, and the analysis of the aspects they focused on could foster reflections on the subject in contemporary terminology theory.

The social aspects of term formation are addressed mainly in studies on Socioterminology. Among these, the importance of the connection of terminology and the social context in which it is formed is highlighted by Balliu (2005) in the context of medical terminology. Specifically, the author analyses how language in medicine has multiple roles in the description of illnesses and symptoms. As in this chapter, the role of terminology is analysed also in its evolution over time, and in the power, it has in naming discoveries and orientate the development of the discipline. Another aspect of the study of terms which this thesis shares with Socioterminology, according to Gaudin (2005), is the choice to see them as part of a dynamic context, and interactions among experts in which these terms and concepts are shaped and discussed:

De telles analyses supposent d'adopter une vision dynamique des termes, lesquels ne doivent plus être conçus comme des étiquettes de concepts, mais resitués dans le cadre des échanges langagiers au sein desquels ils apparaissent et se maintiennent. L'autre apport théorique important à souligner fut celui de la linguistique de l'interaction, qui obligeait à considérer les termes, non seulement comme des signes linguistiques, mais comme des formes prises dans des échanges langagiers réels et donc liés à des types d'interactions. Dans cette perspective, il n'y pas de mot juste en soi. Il n'y a que des mots appropriés à des interactions définies⁵¹ (Gaudin 2005 : 85)

At the same time, terms are described in Socioterminology as entities used by collective speakers in different areas of the human experience, mostly not limited to a single area of specialisation, but connected to the production of knowledge. this study shares with Socioterminology this interpretation of terms in different contexts.

The analysed examples could represent instances of Sager's (1990) theorised processes of primary and secondary term formation. While the formation of terms in electrochemistry illustrates the naming of newly formulated concepts, the case study in astronomy examines a revision of an existing nomenclature, which also entails suggestions for the development of terms in the future, and hence secondary term formation (see Herschel, Whewell, and Baily 1844). Both discussions address the relation of names and progress of knowledge from two contrasting angles. In one case study, the

⁵¹ English Translation: Such analyses require a dynamic view of terms, which should no longer be conceived as labels for concepts, but should be in the context of the linguistic exchanges in which they appear and are maintained. The other important theoretical contribution to be highlighted was that of the linguistics of interaction, which forced us to consider terms not just as linguistic signs, but as forms taken in real language exchanges and therefore linked to types of interaction. From this perspective, there is no right word in itself. There are only words appropriate to the defined interactions.

creation of terms the reference to standards of the discipline is the aim, so that, terms would not have to be updated in relation to emerging theories (Faraday 1834a). Contrary to that, in the other case study, the revision of terms is presented as a necessity, following the development of knowledge in the discipline (Herschel, Whewell, and Baily 1844).

The discussions among experts also focus on various criteria employed for evaluating and selecting terms. The deriving other terms from existing ones already in use in other disciplines seems common at the time of the examined case studies. As in the discussion on electrodynamics, terms were inspired by existing ones in chemistry, also naming practices used in other disciplines were mentioned, such as the construction of simple and intelligible nomenclatures which could last in time, also derived from chemical notation.

A further subject of discussion was the reference to terms to "natural standards" (Faraday 1834a, April 24th) that are not related to any specific theory or personality in the field. Since terms should always be applicable, they should not reflect current theories or personal opinions on scientific concepts, which needed to be unequivocally named. If so, indeed, they could not be rendered false by further development and future studies. This aspect of the discussion seemed not to consider the possibility of term variation (Daille et al. 1996), or the acknowledgement of modern terminology, that both terms and their meaning evolve in time (Temmerman 2000b). The intention of the experts to create clearly defined terms which reflected standards in the discipline, could presumably be motivated by the context of the discussion. As newly formulated concepts were named for the first time, the highest possible level of precision was aimed for in the definition of their meaning. Moreover, the reference to standards in the definition of concepts seemed to recall traditional views in terminology, from a time in which the inherent multidimensionality of concepts was still not recognised as a principle, according to which a concept could be described by more than one term (Bowker 2022).

As precision was admittedly the primary aim in defining clear and intelligible concepts, as Whewell (1840a) stated, the scholars tended to discourage the use of arbitrary terms in scientific language. This was a debated position on naming at the time. Experts seemed to avoid arbitrariness, since, like Whewell (1840a), they were convinced that the etymology of terms should primarily justify their application. In this context, through their etymology and clear origin, their meaning was to be conveyed in the most unambiguous manner possible.

At the same time, in other disciplines, such as zoology, proper names were allowed to become terms to honour the discoverers of new species and their place in history (Strickland 1837a). In connection to this, the main subject of discussion was, indeed, the role of motivations behind the selection of a term. The same topic is addressed in contemporary terminology (see Kocourek 1991; Myking 2020). In the 19th century as nowadays, this interest in the clear motivations behind the choice

of terms and their relations to one another, seems to reveal a specific attention of the experts for the relations of terms in a nomenclature, and not as independent entities.

The debates among scholars show that multiple criteria were mentioned for the selection of terms. In their intentions, terms should be selected which could be easily remembered and understood by the users, as the perspective of efficient communication seemed to be most relevant in naming. Beyond this, the probability of terms entering the traditionally employed language of a specialised field was evaluated as a criterion for their choice. In the debate in electrochemistry the possibility of terms to become "familiar" was considered as an advantage (Faraday 1834b), connected to the simplicity and easiness to be compounded; the discussion on the revision of the astronomical nomenclature, on the contrary, addressed long-established terms in the discipline, to be adapted to the contemporary necessities of the field. Again, the debates appeared to illustrate opposing attitudes towards the creation and stability of terms. Physicists in the main example wished to form terms to last in time and become standards in the discipline; astronomers recognised the necessity to revise even traditional terms, in a most forward-looking process of revision which considered the contemporary necessities of the field of studies.

A common trait of both examples was an interest in the creation of a coherent nomenclature. It is indeed noteworthy to see how experts did not seem concerned with the formulation of single terms, but of coherent nomenclatures, primarily aimed to express relations among concepts.

Besides the study of terms in a communicative dimension among experts, this chapter wishes to promote the analysis of them not as abstract entities, but as elements within a real historical, communicative, and social context, in which they are created and employed. When examined in real contexts, terms appear to result from the evaluation of discarded alternatives.

The selected examples show how the discussion on naming among experts seemed to be present at the time at all stages of term formation. Indeed, the chapter aims to add to the existing knowledge on term formation by describing the process of its development in detail. In this, the focus is set not on its results i.e., terms, but on term formation as a process, characterised by a diachronic evolution, which involved multiple reflections and aspects. The diachronic perspective should allow terminologists to see which factors are entailed in the process of concept definition and term formation. Among them, for instance, are numerous naming attempts, then discarded through the exchange of opinions among the experts or contrasting motivations behind the definition of a term.

7.6. Summary of the contents

The chapter aimed to contribute to the description of term formation and its dynamics in real historical contexts. While the existence of a process of discussion of naming alternatives among experts is recognised in terminology theory, in the few studies which address term formation in a diachronic

perspective (Temmerman 1995; Van Campenhoudt 1998; Dury and Picton 2011 *inter alia*), a detailed illustration of the process seems to be missing from the existing literature. This chapter wished therefore to enrich this description, by examining real instances of term formation in the 19th century.

The chapter also sought to encourage a more specific definition of the role of experts in term formation (Kocourek 1991). Various studies on the communicative and social dimension of terminology address the role of humans as interlocutors (Myking 2020). However, the dynamics of application of this agency could be investigated more in detail and in relation to their actual development in real contexts. As recalled in the theoretical framework of this thesis (see Ch. 2), the importance of a diachronic study of the dynamics of term formation, and not just of the result, should be remarked (Picton 2009; Dury and Drouin 2011). This chapter thus wished to promote the adoption of a diachronic perspective in future terminological studies in which terms are not merely considered as synchronic entities, but as the result of a process of discussion among experts and evaluation of alternatives, according to different necessities and terminological criteria.

Ultimately, the examples presented in this chapter showed fragments of broader debates among experts and how these seemed to be part of further extended discussions. At a time of great scientific development and newly discovered concepts, the necessity to name concepts seemed to be perceived in numerous fields of study and reflected in conversations among scholars or the formation and revision of nomenclatures. Because of that, the chapter did not aim to provide an exhaustive description of the presented processes, which were naturally not limited to the original fragments commented in the present selection. Conversely, it intended to underline the presence of terminological discussions as part of a general and habitual exchange of ideas among experts which occurred regularly in the 19th century, as it presumably does nowadays.

8. The practice of writing rules for naming

8.1. Introduction

The chapter aims to contribute to the description of the terminological activity of experts in the 19th century, to investigate how an activity *ante litteram* existed already before the first schools of terminology. Specifically, it describes the practices of experts related to term formation, to provide new insights into the knowledge of these processes, as described in the contemporary terminology theory.

This chapter addresses the practice of writing rules to regulate term formation, as an attempt at standardisation of the nomenclature of the discipline to which they apply. It also analyses the relation between the development of an efficient language for communication and the organisation of the conceptual system on which it based. Indeed, the purpose of the experts in developing guidelines appeared to be the creation of an efficient code of communication for the scientific progress of their field of research.

The practice of writing rules for naming is described as an attempt at standardisation and a strategy to orientate term formation towards features they should possess. Following their discussions, the experts issued guidelines for naming in dedicated publications and sector journals, as part of a process which spread across disciplines and languages (McOuat 1996; Case 2019; Case 2020 inter alia). From the perspective of terminology theory, the process is described within the framework of the existing literature on standardisation particularly in Wüster's (1931) *General Theory of Terminology* and in Cabré (1999) work on the definition of terms, with a focus on the principles for naming presented in the ISO Standard 704 (1987) and the ISO Standard R860 (1968), to address the criteria through which terms are formed and the rule they are intended to conform to. A more detailed description of the theoretical framework of this chapter in terminology theory can be found in section 2.7.4.

The main example concerns the guidelines for nomenclature in crystallography proposed by the German mineralogist Friedrich Mohs (1820; 1821) in the *Edinburgh Philosophical Magazine*. Mohs quoted the rules from his volume *A Treatise on Mineralogy* which was written in German (Mohs 1822: 1824) and then translated into English (Mohs 1825). The guidelines were part of a wider discussion on the revision of the nomenclature in crystallography, in which scholars promoted the independence of the field from mineralogy, to be realised through the construction of a separate classification and corresponding nomenclature (Kirwan 1800). The second example examines the "Rules for Zoological Nomenclature" by the English zoologist Hugh Strickland (1837a). Strickland's rules and the debate which followed their proposal (McOuat 1996; 2001a; 2001b; 2016) concerned both newly created and traditional terms. As Strickland (1837a) attempted to organise the features of terms in zoology, the subject of the debate was not limited to zoological terms but extended instead to the ideal features of scientific nomenclature and good practices in naming in general.

Comparable examples are mentioned to prove the diffusion of the practice of writing rules for naming across disciplines and languages. Among others, this interest in standardisation was reflected in publications such as the *Nomenclature of Diseases* (1884) and the *International Cloud Atlas* (Hildebrandsson et al. 1890). Parallel to that, also a theoretical interest in the features of terms and their formation was present in works such as Coleridge's (1821) contribution to the creation of terms in meteorology and Whewell's (1840a; 1840b) *Aphorisms on the language of science*.

The remainder of the chapter is structured as follows. Section 8.2. presents the rules for naming in crystallography, while section 8.3. illustrates the rules for zoological nomenclature. Finally, section 8.4. overviews further attempt at standardisation through the writing of rules in other disciplines. To conclude, section 8.5. comments on the analysis from the perspective of terminology theory, while section 8.6. briefly sums up the results of the chapter.

8.2. Mohs' (1820) rules for nomenclature in crystallography

This section examines Friedrich Mohs's (1820) attempt at illustrating the ideal features of terms for a prospective official nomenclature in crystallography. The presentation of Mohs' volume was published in two consecutive issues of the *Edinburgh Philosophical Magazine* (Mohs 1820; 1821) and presented the guidelines for the official terms to the scientific community, as part of his treatise entitled *Grundriss der Mineralogie* [Outline of Mineralogy]⁵² (Mohs 1822; 1824), which was originally published in two volumes in German (Mohs 1822; 1824). Shortly after that, the translation into English of Mohs' theory on naming was presented in his *Treatise on Mineralogy* (Mohs 1825). The following sections analyse some relevant passages of Mohs' (1820) guidelines for terms published in the *Edinburgh Philosophical Journal* and from the English translation of his treatise (Mohs 1825).

Friedrich Mohs was a German chemist and mineralogist. After studying at Graz University, in 1818, he succeeded to Abraham Werner as director of the Freiburger Mining Academy, at which he also studied, under Werner's guidance, from 1798. Among his achievements, he proposed a scale of mineral hardness, also known as Mohs Scale (1812). Mohs played a relevant part in the discussion on naming in mineralogy, developing a classification of crystal forms, independent from the traditional one introduced by Christian Samuel Weiss (1813) in his treatise entitled *Über die natürlichen Abtheilungen der Crystallisations Systeme* [On the methodical and natural distribution of the different systems of crystallisation]. In Mohs' words, a more systematised and updated nomenclature was needed, to make the discipline independent from mineralogy and to attract scholars from other fields.

The historical context of term formation in mineralogy was particularly lively at the time. Several features of minerals, such as colours (Werner 1774) and hardness (Mohs 1812) were classified, as numerous experts participated in the discussion. For this reason, the historical context of this

⁵² Unless otherwise specified, translations are provided by the author of this thesis.

episode intersected the one of Abraham Werner's (1774) classification of colours of fossils (see Sec. 6.2.), which slightly preceded it. Mohs' (1822) proposal for rules for nomenclature in crystallography and Werner's (1774) classification of colours were both discussed within the context of the discipline of mineralogy and revealed how the expert debate on naming and classification extended within the same discipline to multiple subjects at the same time.

Mineralogy experts discussed Werner's (1774) classification in Germany, France, and England. Among them, the English chemist Richard Kirwan (1800) compared the German and French naming traditions in chemistry and mineralogy in an article published in *The Philosophical Magazine* entitled "On the chemical and mineralogical nomenclature". The article examined as a model the rules for chemical nomenclature presented by the French school led by Guyton De Morveau (Guyton de Morveau et al. 1787) in the newly published *Méthode de Nomenclature Chimique* [Method of Chemical Nomenclature], as opposed to the German traditional nomenclature of mineralogy, theorised by Werner (1774). Indeed, the practice of writing rules for nomenclature seemed common in chemistry, as the already established discipline provided a model for crystallography, seeking its independence from the discipline of mineralogy.

From the analysis of the context of production of these guidelines, scholars formulated them to direct the creation of terms. Several works in the history of science (e.g. Case 2020) show that the emergence at the beginning of the 19th century of multiple nomenclatures for the same field of study might have caused discussions among experts on which terms to officially adopt (McOuat 1996). Among other factors, the presence of multiple term variants for the official concepts of the discipline motivated the scholars to discuss and regulate the creation and selection of official denominations.

In the example of crystallography, the choice of parameters according to which terms should be created coincided with a new phase of development of the discipline (Mohs 1820). As Mohs (1820: 336) stated, the knowledge of the domain should be *reflected* in its nomenclature as in a *mirror*. As a prerequisite to gaining credibility as an independent field, crystallography should thus be provided with a consistent and structured nomenclature and conceptual classification. The main reflections in the volume dedicated to the *Nomenclature* are examined in the following sections.

8.2.1. Mohs' proposals for guidelines for naming in crystallography

As part of the presentation of his *Treatise* (1825), the German Professor and Mineralogist Friedrich Mohs (1820; 1821) introduced in the *Edinburgh Philosophical Magazine* his classification of crystals. In a section of the article, entitled "Nomenclature", published in 1820, Mohs listed the features of the projected nomenclature of crystallography in twenty-two statements, each of which described an ideal feature of terms (Mohs 1820).

As often happened at the time, nomenclatures were translated into other European languages, to promote them among scientific communities across national boundaries. When the correspondent volume was translated into English, the nomenclature was presented in an article and discussed by experts (Mohs 1820). Other journals and related discussions were mentioned, presumably with the intention to provide an overview of the debate on the topic (see Pictet 1805). The first statement described the relation of the official nomenclature and its discipline, since, according to Mohs, the nomenclature should reflect the development of the discipline as a mirror:

1. **Nomenclature exhibits the scientific condition of mineralogy** – In every department of Natural History, nomenclature is a **mirror** in which the whole science is represented. The **image** which this **mirror** reflects back upon mineralogy, has so few charms, that it seems to have repelled **zoologists** and **botanists** from studying the production of inorganic nature; [...] ⁵³ (Mohs 1820: 336)

In his first statement, Mohs argued that the limited development of the discipline might be connected to the less advanced state of its nomenclature. Since the progress of the domain should be reflected in its language, as was already the case in zoology and botany, the scholar expressed the necessity of an efficient language for knowledge to advance. Additionally, Mohs stated that the lack of development of scientific language in mineralogy, failed to raise the interests of experts from other disciplines. The next statement revealed Mohs' reason for his work on naming: for the development of mineralogy, a coherent and efficient nomenclature was needed. In the absence of that, an "almost intolerable synonymy" characterised its terminology:

2. **Why it has not been improved** – The **discontent** with our existing system of mineralogical nomenclature is **universal**. This feeling has not, however, produced any advantageous consequences. **Names** only have been **altered** without the principles being **improved**; and no result has followed from this procedure, but **an almost intolerable synonymy**, which is certainly a **negative advantage**. (Mohs 1820: 336)

This "intolerable synonymy" observed by Mohs was due, according to the author, to the invention of new terms in the discipline, without a revision and update of the principles on which they were based. Therefore, the principles of the mineralogical nomenclature should be reformed before coining new terms. The opposite would lead to the presence of multiple term variants for the same concepts, impeding an efficient communication.

The following statements illustrated the current state of the nomenclatures in the discipline, and the reasons why no "systematic" nomenclature existed so far. This third affirmation explained the two purposes of a nomenclature in natural history:

⁵³ Unless otherwise specified, emphasis in bold font in citations is added by the author of this thesis.

3. **What it must accomplish** – In natural history, nomenclature has two purposes to fulfil: the first is to **provide** every species with a name; the second to **indicate**, by means of that name, the natural historical relation and connection, in which it stands to one or more other species. (Mohs 1820: 336)

These purposes were fundamental for an efficient nomenclature. A term should primarily name a concept, but it should also indicate the relations of a concept to other ones in the same conceptual system. Because of that, the main feature of a nomenclature should be its systematicity i.e., its efficiency in conveying the relations among concepts:

4. **Nomenclature must be systematic** – The general expression of that natural historical relation, in which the species of natural production stand to each other, is the natural system. **Nomenclature** in natural history **must** therefore, be **systematic**, [...] it must arrange itself according to some **system**, and express the **connection** in which the different species of natural productions stand to each other in that **system**. (Mohs 1820: 336)

In the statement, two principles were introduced: the importance of names and their relation to the concepts they represented, and the relevance of coherent connections among terms. In a further affirmation, the systematicity and coherence of nomenclatures were remarked. As a matter of fact, the absence of systematicity in a nomenclature could lead to disadvantages, as happened until now in mineralogy:

5. **Why no systematic nomenclature has yet appeared** – The want of a systematic nomenclature in mineralogy is capable of being accounted for. A systematic nomenclature **presupposes** a **system**, **according to which it may be constructed**. Such a system has not hitherto been discovered. [...] It must also **depend upon a single principle**; for otherwise it would not be a system at all. A system resting on more than one principle would be **deficient in unity and consistency**, and, therefore, could not express the **congruity** that subsists throughout the productions of nature. [...] (Mohs 1820: 337)

In Mohs' opinion, the presence of multiple principles of classifications of the concepts of the discipline was the reason why no systematic nomenclature was yet formulated. A systematic nomenclature should be based on a single principle of classification, which assured unity and consistency.

The following passage underlined the connection of a nomenclature to its discipline, and it stated the improper use of chemical terms in mineralogy. It also remarked the connection of subject, conceptual system, and terms, as an inherent feature of a nomenclature:

6. **The nomenclature has a reference to the nature of the science it is used in** – Chemical systematic denominations, when they appear in mineralogy are altogether out of their proper place. these **denominations**, [...] express **relations, chemical connections** of natural production among each other, with which, **natural history and consequently mineralogy has no concern**. The nomenclature is intimately **connected with the nature of the science** for which it is to serve. From the **use of chemical**

names in mineralogy, it would follow that **mineralogy is a department of chemistry**. [...] (Mohs 1820: 337)

Many experts at the time conceived scientific language as an interdisciplinary entity, which was declined into different fields of studies (Faraday 1834a). In opposition to this, according to Mohs, a nomenclature should possess an inherent and univocal connection to the discipline it described. In Mohs' opinion, therefore, terms borrowed from another discipline should be avoided, as terms and concepts from different fields might have no connection to one another. Specifically, Mohs described the connections among terms as "verbal expression" of the relations among concepts. The internal coherence of a nomenclature, which should thus mirror the one of its conceptual structures, was numbered among its ideal features:

- 7. Its structure may be unfolded from the idea of it** – From the **idea** of a **systematic nomenclature**: "That it is a **verbal expression of natural historical connections** subsisting among the productions of a series, or a verbal expression of the **system** which represents its connections" – it is easy to unfold its **structure**. (Mohs 1820: 337)

Clarity and efficiency represented fundamental features of a nomenclature, and the conceptual relations of the domain should be evident in both the nomenclature and the respective conceptual system. As happened in other disciplines (Herschel, Whewell, and Baily 1844), Mohs remarked how a systematic nomenclature should limit the use of arbitrary names. Arbitrary, or "trivial" names – as Mohs (1820: 341) defined them – did not follow the rules of a systematic nomenclature and should therefore remain unofficial:

- 8. Name is given to one of the higher steps of Classification** – To give the **name** a more definite **signification** in the case of the species, it is applied to the **genus**, or the order, or some of the higher steps of classification. The name refers not to one single **production** of nature [...], but to a **class of greater extent**; it reaches to the former only in so far as their **characters** entitle them to a place under that class. It is by this **arrangement** that the **systematic nomenclature** is enabled to restrict the **arbitrary application** of names. **A newly discovered mineral**, though not belonging to any known species, would probably belong to some known genus, and therefore obtain the name of that genus, or to some known order, and hence take its **name** from that order. (Mohs 1820: 338)

Mohs observed how a systematic nomenclature would help to introduce and classify new concepts. While these might not have been named yet, their systematic features, mirrored in the nomenclature, would allow them to be classified in an existing group, or species, even if they were still unnamed. The following statement commented on the relation of names and concepts, since, according to Mohs, the validity of a nomenclature could be assessed based on its fit with the concept system it represented:

17. How the Systematic Nomenclature is to be judged of – A systematic nomenclature must be **estimated** solely by the **system** from which it is **deduced**. If that system is founded on **relations** which constitute an object of the science under consideration; if it is **consistent** with those principles, and processes besides the other requisite qualities, in that case, the **duty of a nomenclature** extends no further than faithfully to **represent** that system by denominations. If it accomplishes this – if it be comfortable to the usual modes of speech, if it rejects unnecessary innovations, and at the same time introduce a **description** of the object into each of its **denominations** – it will then have fulfilled its **chief obligations** and may quietly entrust its **improvement** and refinement to the diligence and **reflection** of future times. (Mohs 1820: 341)

In Mohs' explanation, in fact, conceptual system and nomenclature should mutually validate each other, so that their efficiency should be judged by their ability to effectively represent each other.

Mohs recognised the existence of unofficial terms, besides the official nomenclature of a domain. Unofficial or "trivial" terms, were needed to specify aspects of the concepts which the official ones could not describe:

18. Trivial nomenclature not to be thrown away – It cannot be called a **hurtful practice** to give the production of Nature, [...] for other **purposes** than those of science, such **names** as are more comfortable to custom than **systematic** ones, and as are fitted, so to speak, for **familiar** use, the properties of the object being exhibited, or at least not obscured by its designation. Beyond this, however, entirely to relinquish **systematic names**, as its abstract from science a powerful help to its easier extension, must be a very censurable mode of proceeding. (Mohs 1820: 341)

Mohs underlined the advantages of employing trivial terms for not scientific aims i.e., for familiar use, and for the description of the unofficial properties of concepts. This reflection remarked the possibility of terms to evidence multiple aspects of the same concept or, possibly, their multidimensionality.

The discussion of Mohs' (1825) *Treatise* continued in the next issue of the *Edinburgh Philosophical Magazine* (Volume IV, Mohs 1821). However, the second half was not devoted to the examination of the nomenclature, but of the system of classification, with reference to Werner's (1774) classification of fossils, which was considered traditional in the discipline. As in the *Edinburgh Philosophical Magazine*, Mohs' nomenclature of crystallography was connected to the debate on Werner's system. While they were both part of the general discussion on terms in the development of mineralogy, they both involved German experts, as the discipline initially developed in the 18th in Germany, and the original German terms were translated and adopted in the rest of Europe (Werner 1774; 1790). Intriguingly, both cases deal with terms originally presented in German, and then translated into English to facilitate dissemination. In both cases, the question arises as to the extent in which the principles of term formation pertain specifically to German, or are of general nature, transcending the specificity of a language (cfr. Ch. 6 and Ch. 9).

A reflection on the nature of a scientific nomenclature was entailed in Mohs' *Treatise on Mineralogy* (1825). As often happened at the time, the article in the *Edinburgh Philosophical Magazine* (Mohs 1820; 1821) presented Mohs' volume to the scientific community, with a reference to the chapter of his *Treatise* dedicated to the nomenclature of crystals. Some excerpts of it are presented in what follows as an example of Mohs' position. Mohs' (1825) *Treatise* introduced as a first definition the concept of a systematic nomenclature, while underlining its connection to its corresponding conceptual system.

The Systematic Nomenclature is an assemblage of those denominations which Natural History applies to natural production, and which refer to a natural historical system [...] There is only one mode in which Natural History can **provide** the productions of nature with **denominations**; but this mode is in the closest **connection** with the whole **being** of the science. [...] We may say that we know a natural production, if we are capable to tell which of these assemblages or divisions it belongs; but we may say the same thing, **if we know its denomination**. [...] **This denomination must therefore be intimately connected with the above-mentioned ideas**; it must express the **relation**, in which the natural production, to which it is applied, stands to others, [...]. **That only mode of nomenclature** therefore which expresses this **connection**, will deservedly be called the **systematic nomenclature**. **The systematic nomenclature alone is capable of fulfilling those conditions which natural history requires from nomenclature in general**. [...] (Mohs 1825: 346)

The construction of a systematic nomenclature for crystallography was essential in the development of the discipline, as its absence impeded the evolution of the science. Inspired by Linnaeus (1735), Mohs argued how our knowledge of nature was intrinsically connected to its denominations, and to the way in which names were structured and related to one another. Therefore, not only were proper denominations needed, but also an ordered system to connect them, which could reflect the progress of knowledge:

A mass of names or denominations formed **arbitrarily** or **accidentally**, and subject to perpetual **change**, **retard the solid progress of science**, and are a **great impediment to the acquisition of knowledge** in its purity. The want of a **well-constructed systematic nomenclature** is therefore an essential defect in the Natural History of the Mineral Kingdom, and the present attempt to remove it, how **imperfect** so ever it may be, is founded on the very idea of Natural History, which **cannot exist without it**. (Mohs 1825: 347)

At the end of the section, Mohs remarked his concern on the importance of a systematic nomenclature, as mineralogy could not exist without it. A systematic nomenclature should also be stable, and not subject to "perpetual change". Like arbitrariness in naming, this variability was a disadvantage for both the formation of a systematic nomenclature, and the development of knowledge. Mohs' observation seemed to relate to the apparent lack of guidelines on naming at the time, and the existence of multiple nomenclatures in the discipline (cfr. Sec. 8.3.1., Mohs 1820: 336). In the same chapter, Mohs' (1825)

described the object of a systematic nomenclature i.e., the conceptual system on which it based, or the "principles" of the domain it represented:

The natural-historical species is the **foundation** the systematic nomenclature the **verbal expression** of the **system**. [...] Nomenclature **requires** that the **species be previously correctly determined**, according to the **principles** of Natural History. For the **necessary connection** among several of these units, which is to be represented by a **verbal expression**, cannot take place upon any other supposition; and the systematic nomenclature is degraded into a mere **jumble of words**, to which **no object corresponds**. (Mohs 1825: 347)

According to Mohs, the conceptual system should be determined before the concepts were named. The system could indeed not be specified after that, as this would cause inevitable confusion in naming. In his *Treatise*, Mohs also addressed the necessity of a systematic nomenclature, as a reference and parameter to name newly discovered entities in mineralogy:

If it be necessary to **denominate a newly discovered species**, it is still more necessary to provide a species with a new **denomination**, which has been **corrected**, because none of the old ones will express it, and because it is impossible to apply all of them at once. The **same mode of reasoning must be applied**, if a species has not yet been correctly determined, and contains **varieties** of several natural historical species. [...] In a **scientific treatment** of Mineralogy, this becomes again **a new and urging reason to alter the nomenclature**; and it could not be forgiven, if [...], we should not at the same time endeavour to give the new nomenclature **a systematic arrangement**. (Mohs 1825: 348)

As the last topic of the chapter, Mohs discussed the relation of a systematic nomenclature and the natural objects it represented. Specifically, he highlighted the role of denominations in verbally expressing the qualities of objects so that these could be recognised as part of a system and their connections to one another could be as clear as possible:

The **object** [...] of a **systematic nomenclature**, is that to express by **words**, or to **denominate**, those things or bodies (the species), of which other sciences, Natural Philosophy, Chemistry Geology e c. afford **more detailed and particular information**. This is affected by substituting names and denominations, [...]. These [...] must possess such **properties** as will enable us to find them out or **to recognise them** whenever the characters or properties natural-historical production are given. [...] If they be meant to excite or produce **an image of the natural-historical qualities** of the objects to which they refer or to remind us of those which are more or less similar to them, they must indicate the place which the species occupy in the general assemblage of the natural production. [...] (Mohs 1825: 348)

Mohs remarked the importance for scientific names to precisely identify the qualities of the concepts they represented. No matter in which context, a name should always convey the features of a concept, as well as its connections to the other ones in the field.

Beyond the already examined features, the properties of a systematic nomenclature were listed in a separate section of Mohs' (1825) *Treatise*. Not just terms, but also their order mattered, as it should reflect the hierarchy of the concepts' features. It was important for a denomination to not only allow a concept to be recognised as part of a system, but also to efficiently describe its position within the system itself:

The systematic denomination must be composed of **several words**, the **order** of which express the **connection** between the denominated object and several others [...] to recognise a given individual, or to determine the **place** which it occupies in the **system**, it is necessary to proceed with it through all the **general ideas of the system**, from the higher degree to the lowest one. For **this is the means** by which we learn the **connection** in which it is with others. (Mohs 1825: 349)

The following passage is illustrative of the attention Mohs devoted to the description of the features of a nomenclature. As part of it, denominations should be as precise as possible, and possibly formed by more words, to express in detail all the features of the concepts they represented. Additionally, the word order was relevant, since it conveyed the hierarchy on which the conceptual system was based:

If we have to **express** the **connection** by **words**, we must **construct** the denomination in such a manner that it may tell the **unities** of all the above-mentioned **ideas**, in as far as it is **necessary**; it must therefore consist of **several words**, and since the **ideas**, according to their contents, are subordinate to each other, these **words** must follow each other according to the same **order**. (Mohs 1825: 349)

The choice of language was also important in a nomenclature, as it represented the scientific tradition of the own country. In the case of mineralogy, the discipline was first theorised in Germany, with the studies of Abraham Werner (1774, cfr. Sec. 6.2.). As Mohs acknowledged, the structure and grammar of a language determined the word order in a denomination. This order differed, for instance, between Latin and German:

[...] This **distribution of words** should agree with the **general spirit of the language**, and the **Latin language**, therefore, would be **preferable** in the mineralogical nomenclature, [...]. This **language**, however, has been so very little employed in **Mineralogy**, [...] that it would be very difficult to produce a Latin systematic nomenclature, without introducing **almost endless innovations**. This has been the reason why, in the present **first attempt at constructing** a systematic nomenclature, the **German** language has been made use of, to the spirit of which the English language exactly corresponds. In these languages, however, the successive **order of the words** is exactly contrary to that required in the **Latin language**. In the **English nomenclature**, therefore, the **highest idea** will be expressed by the **last word**, while the **lowest idea** is indicated in the **first word**. [...] That **word** with which we designate a single object, or species, without regard to its genus, or a single genus independently of its connections to the others in one and the same order, **is termed its Name**. if a name be restricted by means of an **adjective**, it is transformed into a **denomination**. A name consisting

of a single word is a **simple name**, a name consisting of two words is a **compound name**. [...] (Mohs 1825: 350)

Among the more detailed statements, Mohs illustrated the difference between a name and a denomination. In the author's opinion, the hierarchy of simple and compound names should reflect the corresponding conceptual system: while simple names identified main concepts, compound names were more specific and described more detailed concepts or further declinations of an idea. Both should be present in a systematic nomenclature:

Hence the **mere simple names** are of **no use** in a systematic nomenclature, but it will **require** compound names or denominations, or even **both of them**. The **simple name** designates the **highest idea** occurring in a nomenclature, and [...] **this idea** must always be expressed by a **single name**. The compound name designates a lower degree, the denomination the lowest degree expressed by the systematic nomenclature. [...] it may be considered a **rule of the systematic nomenclature** in general, that compound names, in their event of being applied, should never contain **more than two words**, and that a denomination should never admit more than one **adjective**. [...] (Mohs 1825: 350)

In Mohs' opinion, therefore, the structure of a term should convey not only its meaning, but also its position within the conceptual system of a domain. Both in the *Edinburgh Philosophical Magazine* (Mohs 1820), and in his *Treatise* (Mohs 1825), Mohs appeared mostly concerned with the connection of the development of a systematic nomenclature and the evolution of his own discipline, as one could not exist without the other. In the end, the attention with which Mohs handled the topic and the level of detail of the reflections appeared to characterise a time of particular focus on term formation (Yeo 1991; Ellis 2014). As the further examples show, the interest in the formation of guidelines for the creation and revision of terms appeared to be shared across disciplines and languages.

8.3. The rules for naming in zoology

A comparable episode to Mohs' guidelines for naming in crystallography occurred a few years later, in 1837, in zoology, as the zoologist Hugh Strickland (1837a) proposed twenty-two rules for zoological nomenclature, first published in the sector journal *The Magazine for Natural History*, later discussed also in other journals (Strickland 1843). After their first publication, Strickland's rules were re-published in an independent pamphlet, entitled *Rules for Nomenclature* (Strickland 1878). An excerpt of the original text is reported in what follows and commented upon.

As McQuat (1996; 2001a; 2001b) recalls, the starting conditions of Mohs' guidelines in crystallography and Strickland's rules for zoological nomenclature seems comparable. The discipline of zoology, as mineralogy, was evolving, and so was the discussion on its nomenclature (see Strickland et al. 1842). At the same time, both Mohs' and Strickland's rules refer to both newly formulated and already existing terms. No connection appears to exist between the proposals, but both authors seem

interested in reforming the traditional nomenclature of the domain, with the intention to maintain long-established terms, while they suggest adapting them to new principles.

As McOuat (1996) observes, Strickland's rules caused an animated debate in two sector journals at the time: *The Magazine for Natural History* and *The Zoological Journal*. While the whole discussion cannot be reconstructed here due to space constraints, the exchange is representative of several similar debates: as an innovation was presented in a journal to the scientific community, experts responded to it in various letters, published in following issues. Through the responses, a debate occurred, where multiple principles of the discipline were discussed. This was a typical system of knowledge formation at the time, as the subject of discussion was the creation of scientific language, and linguistic reflections were also entailed in the debate (see McOuat 1996).

8.3.1. Strickland's (1837a) "Rules for Zoological Nomenclature"

Strickland's introduction to his rules was as noteworthy as the rules themselves. Strickland kept the rules as brief as possible; he notably referred to the works of other experts in the field, such as William John Swainson's volume entitled *On the Natural History and Classification of Birds* (Swainson 1825), which he quoted as his main source of inspiration. This provides the opportunity to underline how, in the reconstruction of historical episodes I conduct for this study, it becomes clear that no work was completely original, and independent from previous developments in the subject. The same also applies to Strickland's rules, in which the author clearly stated his inspiration from previous works on the subject. As in other case studies, Strickland's rules were inspired by previous research on naming, as his own reflections would influence future works on the subject, as Strickland remarks:

To exhibit more clearly my views on this subject, I have drawn up **a few general rules**, divested as much as possible of **unnecessary verbiage**; and beg to submit them to the consideration of your readers. They have little **pretension of originality**, but are selected from the writings of several naturalists, especially from the **Birds of Mr Swainson**, many of whose aphorisms are adopted here. (Strickland 1837a: 173)

The short and general form which Strickland chose for his rules could also be considered helpful for their diffusion within the scientific community, as this might have helped their publication and discussion on other specialised journal at the time. This was not the case for Mohs' rules for naming, which were much longer and elaborated (Mohs 1820). Strickland's rules were divided into two groups: the first applied to established nomenclatures, and the latter to new terms. Additionally, the rules for new names were divided into general and specific ones. Like Mohs' guidelines, Strickland's rules became more specific as they unfolded, up to the last one referring to typographic suggestions on how to write names. Some rules are reported in what follows as an example:

1. The **Latin nomenclature** forms the only legitimate language of zoology (Swainson). **Latin names** are adopted by naturalists of all nations and are therefore preferable to any other. Where one language is sufficient for the purpose, all other are superfluous.
2. Names which have been long adopted and **established**, require a different **set of rules** from names which are given for the first time. Funding new institutions, and amending the old ones, are two very different things; and what is desirable in the one case, is not always so in the other. (Strickland 1837a: 173)

Strickland – like Mohs – paid attention to the traditional nomenclature of his discipline. It seemed, indeed, that both authors were aware of the importance of maintaining the established terms, presumably due to the recognition they already enjoyed within the scientific community. According to these rules, one of the few cases in which an established name could be changed was when a new discovery or the progress of knowledge outdated it, and a new, updated name was needed for a concept, to represent a knowledge advancement:

First, rules which relate to established Nomenclatures:

3. The discoverer of a species, or the funder of a higher division, has **the best right to give it a name**.
The **person** whose industry or study establishes a new group or species, is commonly the best judge of a suitable appellation for it; yet, even should he fail in this point, it is only fair that, if his group be adopted, the **name** which he has proposed for it **should be retained**. Therefore:
4. The **first name** given to a group or species should be perpetually retained [...]
This law is subject to the following exceptions; and, in my opinion, to no others:
5. A **name** is to be **expunged** which, if specific, has before been given to some other species in the same genus, or, if of a higher order, has before been given to some other group. [...]
6. A name may be expunged whose **meaning is false**, as applied to the object or group which it represents [...]. Yet [...] where a name, though false, does not really mislead, **It should be retained, if long established**. [...] (Strickland 1837a: 174)

Strickland's attitude towards already existing terms was interesting. Established terms in the form of proper names of the discoverer should be retained, unless they turned out to be misleading, following the development of knowledge. Indeed, the importance of traditional names seemed greater than their consistency with the principles of a nomenclature. Regarding already established names, Strickland referred to another article he published the same year in *The Magazine of Natural History* entitled: "On the Inexpediency of altering established Terms in Natural History" (Strickland 1837b):

7. A name may be expunged, which has never been **clearly defined**. [...]
Unless a group is defined by description or figures when the name is given, it cannot be recognised by others; and **the signification of the name is consequently lost**. [...] Many collectors of shells and fossils are in the habit of **labelling** those species which they do not find described, **with names of their own invention**; but unless they publish descriptions of these new species, they cannot expect these names to stand. (Strickland 1837a: 174)

In this article, Strickland (1837b) commented on the intelligibility of names scholars invented independently. According to the rules, unless a description of the concept was provided with the name, these names should be discarded. The description of the concept would allow other experts to understand the motivations of the name. In the absence of that, the names would be unintelligible.

While the first section of the rules was dedicated to established names, the following one was devoted to the naming of new species and groups:

We will consider secondly, rules to be observed in naming new species or groups.

a. General rules which apply to Classes, Orders, Tribes, Families, Genera, and Species.

8. A new group must have a new **name**, which has never been given to any other group in **zoology** or **botany**. A new species must have a name new to the genus. [...]
9. It is **desirable**, but not essential, that a name should have an **etymological meaning**, [...]
10. The meaning of a name must imply some proposition which is true as applied to the object which it represents. (Strickland 1837a: 174)

The emphasis on the "etymological meaning of terms" (see point nr. 9), may appear to conflict with the principle of synchronicity expressed in the *General Theory of Terminology* (Wüster 1979, cfr. Sec. 2.7.4.). This may be pointed out as a difference to the theoretical framework in which this analysis is set. While the *General Theory of Terminology* affirms that the analysis of terms should be focused on the present, regardless of their historical evolution, Strickland seemed to care about the origin of terms in zoology, and therefore about the origin of their meaning. To be noticed is, however, that the etymological meaning of terms in "desirable, but not essential" (Strickland 1837a: 174).

A new name should identify a new species or group and not be already in use in zoology or botany. Moreover, Strickland suggested that new terms have an etymological meaning. In this, the correspondence of conceptual system and nomenclature, which Mohs (1820) also mentioned, seemed important. In Strickland's intentions, the origin and features of the concept should be intelligible through the corresponding terms. In addition to those, also rules for special cases should apply:

b. Rules which apply to particular cases.

11. The names of tribes, families, or subfamilies should each have a **distinctive termination** [...]. In consequence of the multiplicity of scientific terms, it is always desirable to assist the **memory** by indirect means, when it can be done without infringing the **laws of nomenclature**. In the case of genera and species, however, it is impossible to a distinctive termination; and in that of classes and orders it is unnecessary, for they are so few, that the memory does not require this assistance. [...] (Strickland 1837a: 175)

As a further suggestion, Strickland proposed to give terms of the same group, class, or family the same termination, to "assist" (ibid.) the memory in remembering their position within the domain. The rule seemed to be already applied at the time, and it testified to the relevance attributed to formal aspects

of terms and how this contributed to highlight the connections of terms to both the nomenclature and the conceptual system they belonged to.

The debate originated by the publication of Strickland's (1837a) "Rules for Zoological Nomenclature" is interesting from a linguistic perspective (McOuat 1996). Experts discussed multiple aspects of terms and concepts, as well common naming practices. Once again, we see how experts were conducting significant terminological discussions at the time, parallel to research in their field of expertise. The debate and its contents would, indeed, be a most interesting subject for a more detailed study on the formation of scientific language in zoology.

8.4.A general perspective on comparable processes

Both Mohs' and Strickland's rules described the ideal features that terms should possess to be officially adopted in a discipline. Discussing and listing features of ideal terms was a widespread practice, one that was attested in multiple fields of study and declined in various forms.

Among others, the English architect Robert Willis (1844) dedicated a pamphlet to the description of the state of the art of architectural nomenclature (see Sec. 5.4.). Enriched with comparative charts and drawings of the elements employed as means of classification, the pamphlet was conceived as a compendium of the contemporary status of architectural nomenclature and an overview of the parallel classifications present at the time. In the charts, Willis compared not only means of classification, but also multiple European languages (Willis 1844).

With the same purpose of normalisation of the language of the own discipline, processes of organisation of the nomenclature were undertaken at the time in medicine and meteorology. A specific interest in the publication of standardised classifications was present at the end of the 19th century, across fields of studies. Among others, this interest led to the publication of, for instance, the *Nomenclature of Diseases* (1884) and the *International Cloud Atlas* (Hildebrandsson et al. 1890).

Other major contributions to the 19th- century debate on the nature of scientific languages deserve to be mentioned. One of the most recognised works on the subject were the *Aphorisms on the Language of Science*, by William Whewell. Published first as part of the *Philosophy of the inductive sciences* (Whewell 1840a) and then as an independent pamphlet (Whewell 1840b), the aphorisms described the ideal features of terms and scientific language. As part of this description, Whewell provided examples of real applications of terms, derived from the several fields of study to which he was involved, such as mineralogy, meteorology, and astronomy. Whewell's *Aphorisms* were connected to other works on the same topic. Mill's (1895) contribution was fundamental, and specifically his reflection *On Naming*. As further examples, Samuel Taylor Coleridge's (1821) work on terms in meteorology should be mentioned, as well as numerous debates reported in sector journals among

experts who discussed the ideal features of a scientific nomenclature, both on an applied and on a theoretical level (Müller 1891; Romanes 1887).

8.5.A comment from the perspective of terminology theory

The theoretical framework for the analysis of the rules for nomenclature in this chapter is represented by the existing literature in terminology on the process of term standardisation and the definition of the rules for naming. Research works on these topics can be used to identify similarities and differences to the principles of naming discussed by the 19th- century experts. These similarities and differences can foster a better understanding of the terminological activity among experts before the 20th century and thus before the first schools of terminology.

The terminological process described in this chapter concerns the practice of writing guidelines, or listing ideal features, for the creation and revision of nomenclatures, and classifications. In a comment to the episodes described in this chapter, it is first important to remark how the scholars were not describing terms as such. Instead, through the rules for nomenclature, they defined how terms should look like and the principles they should adhere to.

The rules presented in this chapter could be described as a primitive form of standards for naming. As Cabré (1999) quotes, for instance, the ISO Standard R704 (1987) entitled *Principles of Naming* seems to show interesting similarities to the rules for naming that the experts discussed in the 19th century:

- The literal sense of a term should **reflect** the characteristics of the concept it names.
- Complex terms can be considered to be abbreviated **definitions**.
- The phonetic and written forms of terms should be suitable in the language they are to form a part of.
- Terms should be as concise as possible without compromising comprehension.
- New terms can be formed by abbreviating a simple word, the elements of a compound word, or phrase.

(ISO Standard R704, in Cabré 1999: 212)

The ISO Standard (1968) evolved in the current version as the ISO 704 (2022) but entailed the same principles to regulate terminology work and naming methods. Besides this, other contributions to terminology theory discussed the definition of terms and their distinctive features when compared to general language words (Sager 1990; 1998-99), as they sought to examine the state of the art in the description of term formation (Myking 2020).

As became evident through the illustration of the historical episodes, the practice of describing the ideal features of terms seemed widespread in the 19th century and in the cases that I studied. This could be interpreted as both a preliminary operation to the creation of terms, and a component of the process of term formation. Strickland (1837a) addressed the relation of these descriptions to actual nomenclatures in the division of his guidelines: some of them aimed to systematise existing terms,

while others dealt with how to write new denominations. The process could thus be considered as preparatory to the formation of terms, aiming to guide the experts of the discipline towards shared standards. The process seemed to be part of term formation, as experts evaluated existing terms and suggested revisions of the nomenclature. In the analysed examples, new concepts were named according to the proposed guidelines, and a revision of the official nomenclature of the discipline was conducted, in what seemed an attempt at improvement.

In the perspective of contemporary terminology theory, the rules for nomenclature aim to define the features of terms, as opposed to general language words. Following Cabré (1999), term formation happens according to naming principles within a community of experts, as the primary sources appear to underline the importance of the collaboration and shared principles for term creation. With reference to this, according to Sager (1997) term formation occurs among experts following existing patterns and models. The definition of these models seems to be discussed in the primary sources. What is more, what Sager (1997) names the "responsibility" of experts in term formation for communication and knowledge development, seems to recall Rondeau's (1984) definition of "collective awareness" of speakers in term formation. A similar awareness could be retraced in the primary sources, where experts were committed to improving their official nomenclature, so that their discipline could evolve.

In these definitions of term formation, the role of scholars seems fundamental. The responsibility to apply the proposed guidelines lied on the scholars making new discoveries, who had to decide how to name the newly discovered concepts. At the same time, the possibility to employ terms which did not respect the given guidelines, and were therefore unofficial, seemed to be contemplated by the scholars. In this, they were possibly aware of the multiple features that a concept possessed, and which could be relevant in different contexts, while they could not be defined by a single term. Following this, the experts appeared to agree on a certain level of variation in naming, where the cognitive function of term variants to express different aspects of a concept was probably acknowledged, if only implicitly.

The affiliation of a term to a conceptual system and nomenclature was also addressed by e.g., Strickland (1837a). According to the works cited in sections 8.2.1. and 8.3.1. (see Mohs 1820 and Strickland 1837a), a term should be recognisable as belonging to a nomenclature. In this respect, also its typographic features were discussed since its form contributed to its recognition within a system. While this aspect may have been less investigated in terminology so far, the reflection seems a relevant, as it states the importance of the inherent connection of a term and its conceptual system, also from in a formal perspective, regarding the typographic features of terms.

According to Sager (1997: 26), term formation "obeys strict rules that mirror conceptual relations". The 19th-century scholars used the same words to explain their purposes in listing guidelines

for naming. According to Mohs (1820), terms should be created following specific principles, as the conceptual structure of the discipline should be reflected in them. The similarity of Sager's and Mohs' positions is not difficult to comprehend. The adherence of term formation to "strict rules" (Sager 1997: 26) testifies to the importance the authors gave to the definition of principles for term formation, so that they would define the features of official terms. In addition to this, according to both authors, the intelligible connection of terms and concepts is supposed to foster the employment of terms in scientific discourse, and therefore knowledge advancement. This is reminiscent of Cabré's (2003) interpretation of the relation of concepts and terms in a terminological unit: in considering a term or a concept, a user is observing different aspects of the same terminological unit.

A further reflection concerns the nomenclature as "the mirror" (Mohs 1820: 336) of the discipline. Because of that, the efforts of the experts need to be directed to the systematisation of the nomenclature, so that the discipline could properly evolve. The intention to systematise terms for the evolution of the discipline is a common factor to both decalogues of rules presented in this chapter. The 19th- century experts discuss the principle according to which a nomenclature should mirror the conceptual structure of a discipline, as an ideal feature of their domain. Due to the presence of multiple nomenclatures at the same time, a selection was made, by listing all ideal features the official terms should possess. As Mohs (1820: 336) observed, these ideal features comprehended the univocity of official terms, while also trivial or unofficial nomenclatures were allowed, the systematicity of the official nomenclature, and its inherent connection to the structure of the discipline it represented. While trying to regulate the use of multiple term variants designating the same concepts, it is possible that experts were trying to impose their own view on the concepts, and therefore to orientate the development of knowledge. The experts mentioned the uniformity and coherence of a nomenclature. These principles and the possibility to understand the conceptual connections through the corresponding terms are confirmed in the contemporary theory of terminology (Faber 2015; Faber and Montero Martinez 2009; 2019).

The necessity of guidelines for naming could also be compared to a process of standardisation, as defined in contemporary terminology theory (Johnson and Sager 1980; Cabré 1999). For 19th- century scholars, the creation of a coherent nomenclature was of great relevance, as terms were conceived not as independent entities, but as part of a bigger structure to which they belonged.

In an introduction to the subject of standardisation, Cabré (1999: 194) discusses the activity of regulatory bodies which formulated shared rules for naming already in the 17th century. This was not the only reference to the topic, as also Rey (1995: 11; Rey 2000: 1, in Sager 2000) briefly mentions the origin of terminological practices and date them back to the 17th and 18th century. More specifically, Cabré (1999) refers to the ISO Standard R704 (1987), entitled *Principles of Naming*. As Cabré (1999) observes, the norm could be described as the main instrument in terminology to define the features

of terms and the guidelines for term creation. Some of the principles in this norm seem comparable to the ones presented in this chapter.

As an example, the ISO Standard R860 (1968) deals with the "literal sense of a term" which should reflect the meaning of the concept it referred to. This appears to recall Mohs' intention to create a nomenclature for his discipline, in which the underlying conceptual structure was visible. More specifically, the ISO Standard mentions the literal meaning of a term, as Strickland (1837a) referred to the etymology of terms, whose meaning needed to be true in reference to the object they represented. Interestingly, the ISO Standard describes the ideal "phonetic and written" form of terms, which should be suitable to the language they belong to. Strickland (1837a) also suggested that names in the same class had to have the same termination, so that their form helped the users remembering their place within a nomenclature and conceptual system. While this is not implied in the modern ISO Standard, this appears to be an interesting reflection. Terms not only have to adhere to the rules of the language they are part of, but, according to Strickland, they also need to be recognisable as part of a specific nomenclature. Indeed, multiple nomenclatures were present at the same time within the same field. As Strickland (1837a) recalled, indeed, trivial terms should not be discarded. To the contrary of that, these were extremely useful for functions besides the description of scientific concepts, i.e., the familiar use and the reference to property of the concepts beyond the meaning of the official terms. This could be associated to a first acknowledgement of the multidimensionality of concepts (Bowker 2022): while official terms conveyed the main feature of concepts, "trivial" (Mohs 1820: 336) ones could detail further characteristics of them, used in other contexts beyond scientific communication.

The rules listed by the 19th- century scholars seemed related to the *Principles of Naming* in the ISO Standard R860 (1968). More than creating new terms, the experts were interested in defining their features, and how a proper name or general language word could become a term. While terms could be created anytime, without these shared guidelines, the scholars would not have been able to distinguish terms from general language words, and therefore to adopt the official terminology of the discipline on which communication was based. As a common trait of the examined examples, indeed, the experts did not seem interested in proposing actual terms. They were aware of the presence in the discipline of multiple naming and classification systems and seemed more concerned with organising terms in their field, while prescribing naming parameters to future authors.

The practice of writing guidelines for term formation can also be interpreted as an attempt to steer the development of a discipline: In this, the role of experts in term and knowledge formation, also known as human agency, appeared to become relevant in the process (Kocourek 1991; Myking 2020). The human agency and the proposal of term variants to direct the progress of knowledge represent deciding factors in the formation and standardisation of terms for a discipline.

Interestingly, Mohs' (1820) rules for term formation in crystallography were examined in this chapter in their English version, translated from the German original (Mohs 1822; 1824). The question arising then, at the end of the analysis, pertains to the extent to which Mohs rules for naming regarded term formation specifically in German as a scientific language. In contrast to that, it could be argued whether the naming guidelines were formulated as general principles, transcending the specificity of a single language. In this regard, the analysis seems to show that the principles adopted a general perspective, as no reference to a specific language, German, or English, was made throughout the whole article in which they were presented. However, a comparison between Mohs' original rules and reflections on naming in German and their English translation would represent an interesting perspective for future research.

8.6. Summary of the contents

The chapter examined a terminological process concerned with the description of the ideal features terms should possess, to be officially adopted in the scientific language of a discipline, which could be described as an attempt at standardisation. Both traditional and newly emerging disciplines in the 19th century appeared to be involved in the practice, as the discussion among experts revolved around the description of the features of a scientific nomenclature and its relation to the natural objects it represented, as well as to the conceptual system it referred to.

According to the experts, the formation of a systematic nomenclature was central for the development of knowledge. In this, though examined at different stages of development of the corresponding disciplines, Mohs' (1820) and Strickland's (1837a) rules for naming appear to share the same purpose: guidelines should be shared among experts, to direct the naming activity towards standards which allowed them to be recognised as part of the official nomenclature of the domain. In both cases, however, this would not exclude the presence of "trivial" nomenclatures (Mohs 1820: 336), parallel to the official one. These nomenclatures would be employed for familiar purposes and conveyed secondary meanings of the concepts, which the official terms did not entail.

The practice of providing guidelines for naming appear to be both a preliminary practice to term formation, and a phase of it. While some rules referred to the formation of terms, others implied a necessary revision of the existing ones, to adhere to new standards. All in all, the process could be interpreted as an attempt at standardisation, where experts should dismiss old habits in naming, to adhere to shared guidelines for the formation of future terms.

9. Conclusions

9.1. Overview of the contents of the chapter

The chapter draws the conclusions of this thesis by presenting a summary of its aims and contents, as well as its main contributions to the existing research. In addition to that, it addresses the limitations of this study, and illustrates possible perspectives for future research.

The remainder of the chapter is structured as follows. In section 9.2., an initial overview summarises the aims of this thesis, as section 9.3. reflects on its method and aims. Following this, section 9.4. presents the outcomes of the analysis. In section 9.5., the contributions of this study to the existing research are illustrated as related to terminology theory and to its possible connections to the history of science, while section 9.6. analyses the limitations of this study. Lastly, section 9.7. addresses some possible directions for future research.

9.2. Aims of the thesis

This study described how terminology – intended as the practice of naming, classifying, and defining concepts - contributed to the formation of 19th-century scientific knowledge and illustrated terminological processes before the beginning of terminology as a discipline in the 20th century. Specifically, this study illustrated how these processes occurred as part of the activity of experts of multiple disciplines, while also investigating how these 19th-century processes could contribute to a further definition of the principles of the 20th and 21st-century terminology.

The aims of this study originated in the interest in a terminological activity before the beginning of terminology as a discipline (see Wüster 1931). This interest was motivated by the lack of descriptive studies, and specifically historical studies, on terminological practices before the 20th century. While several historical studies exist on the formation of scientific language in various disciplines from the point of view of lexicography (Lonati 2011; 2013; 2019), this is not the case for terminology. As historical studies are present in the literature on the topic (Temmerman 1995; Van Campenhoudt 1998), they are limited to the chronological reconstruction of the creation of terms or of the lexicon of single disciplines (see Becker 2005; Pitkänen 2008). From the perspective of the history of science, other studies address naming and classification in the 19th century (Bret 2019; Witteveen 2020), with reference to the same case studies this thesis illustrated. In these contributions, however, the terminological perspective is missing, as is any reference to studies in terminology theory, and the focus is set on the historical reconstruction of the episodes.

9.2.1. A summary of the research questions and contents of the thesis

This thesis analyses terminological processes involved in the formation of terms and definitions of concepts within the progress of 19th-century scientific knowledge. A definition of terminological

process – as applied in this study - was provided in section 4.2. This definition is composed of two elements. First, a terminological process is defined as a practice or dynamic involved in the naming, classification, and definition of concepts in a specialised domain. Second, these processes share the common feature of having been defined in the literature of terminology theory. Based on this premise, the aims of this study are briefly listed below.

First, this thesis investigated the role of terminology within the 19th-century progress of scientific knowledge. Specifically, the analysis concentrated on the meta-level of the experts' awareness and debate on the importance of terminology and terminological processes. To this end, this thesis described the multiple strategies and methods the experts adopted in the discussion and creation of terms and concepts, such as writing definitions of concepts, or using drawings and symbols to clarify ideas. Specifically, as seen in the case studies, the creation of terms and nomenclatures, through a process of standardisation, seemed to contribute to the formation not only of the official scientific language of a research field but also to shared and codified nomenclatures and classifications, in which the main concepts of the field were mirrored. More in detail, this thesis described how these terminological processes, as theorised in terminology theory of the 20th and 21st centuries, were involved in the construction of scientific disciplines and language during the first half of the 19th century (Cunningham 1988; Ellis 2014).

Second, the present thesis illustrated how the 19th-century terminological practices in various disciplines and languages relate to the theory and principles of modern and contemporary terminology of the 20th and 21st century. Specifically, it addressed to what extent these practices conform, or not, to modern principles of terminology. Moreover, this thesis set out to describe how terminological processes are involved in the construction of scientific disciplines and language, in the first half of the 19th century (1800 – 1850). To answer this question, four main terminological processes were identified in this primary sources as involved in the formation of scientific disciplines and – at the same time – theorised in terminology theory. These were: Multilingualism-influenced terminological processes, i.e., term formation, term variation, and term standardisation; term translation; the discussions among experts on naming and classification; and the practice of writing rules for naming.

This thesis focused on the existence of these terminological processes in various disciplines and languages. Based on the analysis, the application of these processes differed across research fields and languages, even though common traits could be recognised. These common traits were at the basis of the comparison among case studies. At the same time, the specificities of each case study confirmed that, in the sources I examined, terminological processes were always strongly influenced by the context in which they occurred. Multiple factors and actors composing this context were mentioned in the analysis, such as historical and social factors, as well as the role of scholars in term formation.

Starting from the assumption that the 19th-century experts could be described as terminologists *ante litteram* and that their meta-reflection on term formation processes could be retained as a terminological practice, this thesis tried to establish the extent to which the activity of these terminologists relates to the modern discipline of terminology. This was done to investigate, for instance, whether the historical practices of the experts were maintained over time or how they evolved into modern forms of the same practices.

From the analysis of the sources, it appeared that the practices of the experts in other disciplines – though not yet officially codified as terminological ones – very much resembled the dynamics and principles later theorised in terminology theory. Specifically, it seemed from the analysis that the practice to name, classify, and define specialised concepts has always been part of the development of knowledge in all fields of study, and has always followed a necessity for efficient communication and exchange of ideas. The analysis of the experts' reflections proved, indeed, that their practices of term formation reflected the same necessities of concepts systematisation and communication which are at the basis of the modern discipline of terminology.

Third, and last, this thesis addressed the extent to which a more detailed knowledge of these historical processes can contribute to current research on term formation in terminology theory and how the discipline would benefit from the analysis of historical sources and past practices. The study of terminological processes in this thesis seemed to contribute to a detailed description of term formation and the processes and aspects of which it is composed. In this, a focus was set on the importance of human agency in term formation (Myking 2020), as the role of experts in discussing terms and concepts was interpreted as crucial both in the examined terminological processes and in the progress of knowledge. Moreover, this thesis questioned how a diachronic perspective could contribute to the description of the process of term formation in the current debate in terminology theory and to expand its perspectives on terms and their creation, by describing their evolution in time and the way they adapted to the constantly changing contextual conditions. The importance of the context, both historical and social, in term formation was emphasised, as an aspect which could only be rendered evident through the description of the process over time. This study adopted a diachronic perspective also to show how terms and concepts constantly change over time (Temmerman 2000b). If seen diachronically, terms are never stable. To the contrary of that, they seem to be influenced by terminological processes such as their translation or the debates among experts on their definition. These processes questioned their form and meaning, developing knowledge at the same time.

9.3.A reflection on the methodology and aims of the thesis

The strategy I proposed to answer the research questions presented different methodological approaches. While the approach to the first aim of the study was descriptive in nature and was based

on the analysis of the primary sources, the approaches I adopted to address the other aims were more theoretical, proposing a meta-reflection on the relation of the examined 19th-century sources to the modern and contemporary terminology theory of the 20th and 21st centuries.

Being more descriptive in nature, my strategy to address the first aim of this study was based on a case study approach which identified terminological processes in various disciplines and languages. Through this approach, the four processes presented in this thesis were selected. As explained in the methodology chapter (see Ch.4), the method was also inductive and deductive. The method I adopted to address the aims of this thesis could be identified with an historical approach towards the case studies and the primary sources. These were examined through a first chronological reconstruction of the episodes, from which the relevant traits for a terminological analysis were selected. This was followed by a comparative approach, in which the analysis of the primary sources was commented upon within the framework of the modern and contemporary terminology theory.

A comparative approach was adopted, to show how the same process occurred in various case studies. While attention was paid to the contextual factors of the single case studies, an abstraction of the terminological processes was attempted, to see these processes as proper to the formation of scientific knowledge in general, and as such possibly applicable to further contexts. The multiple examples for the same terminological process also provided the opportunity to focus on the context of formation of terms and concepts, as well as on specific contextual factors, such as the human agency and the social aspect of term formation, represented among others in the discussions among experts.

9.4.A synthesis of the research outcomes of the analysis

This section summarises the research outcomes of this thesis, in relation to the aims presented in the previous section. In particular, the following sub-sections present the main contribution given by the analysis of the case studies to a more detailed description of term formation and to the specific aspects of it each of them described.

9.4.1. Multilingualism-influenced processes: term formation, variation, and standardisation

The first topic of the analysis was multilingualism as an aspect which could influence term formation. This aspect was examined in relation to three terminological processes. These processes were: primary term formation of unnamed concepts (Myking 2020); term variation, or the proposal of alternative terms for already named concepts (Freixa 2022), and term standardisation (Johnson and Sager 1980).

The analysis of multilingualism in these processes suggested how, beyond translation, experts adopted also other strategies for international communication. Among these, as seen in the case study on cloud classification, terms were coined in a vehicular language, such as Latin. Alternatively, term equivalents in other languages could be suggested. Indeed, the 19th century seemed an interesting

context to describe how research in the same areas of knowledge led to the contemporary appearance of classification alternatives and nomenclatures.

The analysis showed how these processes happened in different languages, and how the creation of terms and description of concepts varied, across languages, cultures, and historical contexts. The analysis also revealed that the strategies of concepts description and term formation differed between the English and the French nomenclatures. In the primary case study, the form of the English and Latin nomenclature for cloud formations with terms in English and Latin, and English definitions (Howard 1803a) seemed to lead to a more consistent diffusion of Howard's nomenclature throughout the scientific community, than the French equivalent (Lamarck 1802).

It also appeared that a multilingual perspective was already present in the creation of terms at the time. Specifically, the experts seemed to be aware of the parallel existence of a national and an international dimension of scientific discussion. Therefore, two aspects emerged from the discussion among experts on the topic. First, the formation of terms in the national language was important for the internal discussion within the country. At the same time, the efficiency of international communication was a parameter to evaluate the appropriateness of terms. The significance of international communication was visible in the adoption of Latin terms, with German and French equivalents. The international dimension of communication and knowledge exchange appeared to be present in the standardisation of the classification of clouds, as an official nomenclature was proposed in English, French, and German (Hildebrandsson et al. 1890). As the descriptive theories of terminology state (Temmerman 2000a), the importance of context in term formation was highlighted, and how the description of concepts and the creation of terms varied in different languages and cultural contexts.

9.4.2. Term translation as a form of term variation

This analysis explored multiple forms of term translation and specifically, applications of interlinguistic and intersemiotic translation within the formation of scientific language. It also argued that term translation across languages and semiotic systems could be interpreted as a form of denominative variation (Sager 1990; Freixa 2022; Drouin et al. 2017).

The case studies focused on multiple aspects of term translation and on the parallel use of semiotic systems, which the experts adopted to clarify concepts and enhance communication and concepts' representation. Among others, the case studies explored besides the translation of colour terms from German to French and English, the use of images to represent colour variants, as well as natural objects, such as minerals, animals, and plants. At the same time, the examples described the use of symbols and numbers in the classification of wind strength, as a means for the communication of concepts. Term translation was intended in the analysis not only as a process occurring across languages, but also as the parallel use of semiotic systems, to convey concepts and their relation to

terms. The analysis illustrated how the experts determined the most suitable terms in a communicative situation. As an example of that, the English translation of Werner's (1774) nomenclature of colours was published as a pocketbook for travellers with images and equivalents in nature (Syme 1814), as Beaufort (1817) employed numbers to identify the levels of wind strength and their effects on objects, such as trees and buildings.

Terms resulted from this analysis as entities strongly connected to their context, which also influenced their form. This was related to the principle of multidimensionality (Bowker 2022) i.e., the possibility of concepts to be classified differently, according to the aspect of them which seems more relevant in a specific context. Lastly, the analysis showed how translation can influence the formation of terms in multiple manners, and how, this process was part of a dynamic, which appeared to be much more complex and multifaceted, than yet described in terminology theory.

Parallel to that, differentiating these processes of variation from the examples of primary term formation (Sager 1990) was important. In this, the examples of term translation in the classification of the wind force were very different from the ones of term formation in the classification of clouds. As the translation of terms identifying the wind force seemed like a process of secondary term formation; the creation of terms to identify clouds appeared comparable to a primary term formation: while no scientific term existed for cloud classifications when Howard (1803a) first named them; Beaufort (1817) contributed to establishing terms which already existed. This represents a difference between the process of term formation and the process of term translation: Beaufort standardised existing terms and he translated them into other semiotic systems; while Howard created terms for cloud formations, which did not exist before and were not organised in a nomenclature. Indeed, taking as an example the use of numbers and letters in meteorology, the study argued that term translation into various languages and semiotic systems was determined by the necessity to use terms in specific contexts and should thus be considered as a form of variation.

9.4.3. Discussions among experts as the social dimension in term formation

The case studies focused on the discussions among experts of concepts and terms. Specifically, the analysis of debates highlighted the importance of the social dimension in term formation, as a less investigated factor in literature (Myking 2020). As evidenced in the examples on term translation, the importance of previous and discarded naming attempts was remarked. In this, the significance of studying term formation in a diachronic perspective was stated, as a process in which multiple factors and actors were involved and where naming attempts contributed to the description of concepts and thus to the progress of knowledge. An important element was the presence, within the same discussion, of experts from different disciplines. What was discussed was not only the lexicon of a specific field, but the practice of scientific naming as such (Whewell 1840a).

The presence of discussions on naming alternatives among experts is recognised in terminology theory. However, in the few studies which address term formation in a diachronic perspective (Van Campenhoudt 1998; Dury and Picton 2011 inter alia), a detailed illustration of the process seems to be missing. This analysis of the social dimension of term formation wishes to contribute to this description, by examining instances of term formation in real communicative situations, as well as the criteria the scholars considered in the creation of terms. Specifically, the case studies examined two dynamics of discussion. The first illustrated an exchange among experts on the formation of terms for newly discovered concepts (Faraday 1834a); and the second presented a revision of an existing nomenclature (Herschel, Whewell, and Baily 1844).

The analysis attempted to provide a definition of the role of experts in term formation. Various studies on the communicative dimension of terminology address the role of humans as interlocutors (Myking 2020). However, the dynamics of application of this agency could be investigated more in detail and in relation to their actual development in real contexts, as this analysis attempted to do. Ultimately, this analysis showed fragments of broader debates and how these seemed to be part of more extended discussions. At a time of great scientific development and newly discovered concepts (Daunton 2005), the necessity to classify concepts seemed to be perceived in numerous fields of study and reflected in conversations among scholars or the formation and revision of nomenclatures.

9.4.4. The practice of writing rules for naming

The practice of writing rules or guidelines for naming was presented as part of an attempt at standardisation of the multiple nomenclatures within the same area of knowledge. This terminological process was illustrated within the framework of term standardisation, as theorised in the descriptive stances of terminology theory (Johnson and Sager 1980). The same framework also entails the description of the ideal features of official terms, as they are listed in Wüster's (1931) *General Theory of Terminology* and in the ISO Standard 704 (2022).

The rules for nomenclature seemed to be representative of a necessity for standardisation, which the experts addressed to define the features that terms should possess to ensure an efficient communication. In reference to this, the process should be seen as a component of the broader process of "professionalisation of science" (Ellis 2014: 777) and the creation of scientific disciplines in the institutionalised forms we know today (Cunningham 1988). Indeed, this analysis addressed the relation of the development of an efficient language for communication and the organisation of the conceptual system on which it based. The experts recognised how terms should "mirror" (Mohs 1820: 336) the conceptual structure of the discipline they refer to, as did Sager (1997: 26), stating that term formation should "obey strict rules that mirror conceptual relations".

The 19th century rules revealed interesting similarities with the descriptive theories of terminology, such as Cabré's (1999) theory of naming happening according to principles within a community of experts, or the models which Sager (1997) described at the basis of naming carried out by experts. While the experts were aware of the presence of official and "trivial" (Mohs 1820: 336) nomenclatures in their field, they were also conscious of their responsibility while discussing the ideal features of the language of their discipline. As Sager (1997) observes, the collective responsibility of experts is part of the process of term formation. Moreover, as Cabré (1999) states, standardisation of specialised language can be retraced in history from the 17th century. In reference to this, this analysis positioned the experts' attempt to regulate naming in their discipline within the history of the standardisation processes. On the one hand, this comparison confirmed how the current reflections on terminology can be retraced in the activity of experts of the past centuries; on the other hand, how experts were always concerned with scientific language to make communication efficient in their field. Ultimately, to the best of my knowledge, no ascertained connection could be proven in the primary sources between Mohs (1820) and Strickland's (1837a) presented sets of rules. Indeed, while they both consisted of twenty-two statements on the ideal features of terms in their disciplines, a possible inspiration between them could not be retraced in the examined sources. Therefore, studies on possible relations between the experts and their works could be proposed among the future research perspectives of this study.

9.5. Contributions this study can make to existing research

This thesis aimed to contribute to research in three areas, pertaining to the theory of terminology and its intersections with the history of science. First, this thesis aimed to add to the development of diachronic studies in terminology and specifically to the description of the historical context and contextual factors involved in term formation. Second, this analysis showed that there are promising intersections between the studies in terminology and the current research in the history of science (Witteveen 2020). Regarding this, my claim was that several insights could be gained from research on historical and terminological processes, where primary sources on a specific subject and the first-hand opinions of experts can provide a significant contribution on a par with secondary sources on the history of science. These sources could be important with reference to the role of the social and historical context in term formation. The third contribution given by this thesis was methodological and regarded the introduction of archival studies in research on terminology for the analysis of still unexplored primary sources. The following sections are dedicated to a more detailed analysis of these four aspects.

9.5.1. The diachronic perspective in the study of term formation

This study contributed to diachronic studies in terminology by encouraging the adoption of this perspective in future research. Specifically, the thesis addressed processes connected to term formation in a both a short- and long-term diachronic perspective. While most of the case studies stretched over the whole first half of the 19th century, others developed within shorter periods.

This thesis strived to establish a balance between two perspectives: a more detailed one focusing on the single case studies, and a broader one which aimed to describe the relationships between the progress of naming and scientific knowledge. While terminology has always been a predominantly synchronic discipline (Wüster 2003), its theory and principles could also apply to historical sources and processes, analysed in a diachronic perspective.

This thesis proposed the application of a diachronic perspective in the analysis of to date less investigated aspects of terminology. Specifically, a more detailed description of term formation was attempted, through an analysis of terminological processes which pertained to it and with reference to human agency and the social dimension of the process. The application of a diachronic perspective could decisively contribute to the description of further aspects of the process and to gaining new insights. In contrast to a synchronic perspective, a diachronic one could foster the analysis of contextual factors, highlighting their influence on the evolution of terms over time. Contemporarily, the diachronic perspective could shed light on the motivations behind the adoption of a term, or the reasons why a term variant was discarded.

9.5.2. The intersection with the history of science

In this study I hope to contribute to the interdisciplinary dialogue between terminology theory and the history of science. At a time in which terminology theory appears to be proposing "new solutions to further a better understanding of the complex phenomena that terminologists must handle" (Faber and L'Homme 2022: 3), this thesis proposed the study of terminological processes in an historical perspective as a possible direction for future research. In this, the intersection of studies in terminology and the history of science seems fundamental, to combine the two perspectives. As evidenced in the theoretical framework of this thesis (see Sec. 2.6.), the contribution of studies on naming in the history of science could be important for the further definition of terminological processes, providing new insights into the various historical contexts. While there are specific studies on the 19th-century lexicon of single disciplines, there appear to be to date no studies, which address naming processes across disciplines and languages, describing general patterns and define common features, as this thesis attempted to do. Such a perspective would foster comparison and the connection of these processes as part of a bigger picture, as I tried to show in this study.

Moreover, the intersection with the history of science could add to the description of terminological processes before the origin of terminology and to recognise their connection to the processes of scientific thinking. While terminology has always been an inherently interdisciplinary field (Cabr  2000, in Faber and Montero Martinez 2015: 5) with respect to the subject of its studies i.e., terms and concepts, including research from other disciplines which describe the same processes and objects from a different point of view could become a promising input for further studies.

9.5.3. The inclusion in terminological studies of domain-specific knowledge

Several insights were gained through the application of an interdisciplinary perspective to the study of terminological processes, in which the specialised knowledge of experts played a significant role. This approach was suggested as a further contribution to terminology theory and possible future studies. In contrast to most studies in terminology theory, which seem to focus on a single term, nomenclature, or process at a time (see Temmerman 1995; Becker 2005 *inter alia*), this thesis proposed an interdisciplinary and comparative perspective in which terminological processes and nomenclatures were compared. Indeed, the case studies were selected since multiple examples of the same process were identified in different disciplines and languages. Following this, the adoption of a comparative approach across the domains should be fostered, in the description of terminological processes. This thesis claimed indeed that while there was a common definition of the described terminological processes, their specific application differed according to the context.

This thesis encouraged the study of further historical sources in the future. The first half of the 19th century was considered as an interesting period for the formation of scientific knowledge. However, the processes described in this thesis, which intensified in the first half of the 19th century, had already started in the 18th century, and lasted at least until the first decades of the 20th century. Following studies could thus focus on other periods and primary sources, applying the same method.

9.5.4. A methodological contribution: the introduction of archival studies to terminology theory

A methodological contribution was provided in this thesis as the present work introduced archival studies to research in terminology. As far as I am aware, no previous study in terminology has employed archival material to such an extensive degree, from such a broad and interdisciplinary perspective.

While studies are present in literature on terms and nomenclatures formed in the 19th century and in other historical periods (see Van Campenhout 1998; Pitk nen 2008), they focus on specific areas of knowledge. As historical studies on scientific language exist in literature, none of these proposes a method of archival research for the selection of primary sources. Moreover, none of these studies is based extensively on online archives for the search of online sources.

The use of online archives to consult and select the primary sources could represent a direction for future research. Within this method, the use of keywords for the selection of primary sources, as

well as the cross-reference of multiple archives could constitute the basis for further methodological applications to find out how these cross-references among archives can be improved, or how the selection of the keywords can be perfected to obtain the highest possible number of relevant primary sources. Among others, examples of this improvements could be easier cross-referencing systems among resources in online archives, as well as among issues of the same journal in different archives. Parallel to that, a broader availability of online resources could help to speed up the search for primary sources. Regarding the relevance of the sources, besides keywords, other research methods could be suggested.

9.6. Limitations of the study

This section illustrates the limitations of the present study. While I am aware of these limitations, I analyse them in the hope that they could represent directions for future research. The first limitation of this study may be connected to the mostly applied and synchronic nature of terminology in contemporary studies, as opposed to the theoretical and diachronic nature of this thesis. Due to its nature, this thesis does not belong to the most studied topics in the existing literature in terminology. As discussed in the theoretical framework of this study (see Ch. 2), terminology has been since its origin a mostly applied and synchronic discipline (Wüster 2003). This study showed the real application of terminological processes to concrete case studies in specific domains. However, its main concern was theoretical and related to the discussion of principles and theories of terminology. This first limitation is connected to the apparent reduced interest in terminology theory in the last twenty years and thus in the development of its principles, as the area does not seem as interesting for the scientific community as it once was (see L'Homme 2020).

Even if most studies in terminology adopt a synchronic perspective, there have been some diachronic studies in the last thirty years (see De Schaetzen 1989). This study proposed the application of the diachronic approach to primary sources which were never studied before from a terminological perspective. In my opinion, indeed, the originality of the study did not involve only its approach, but also the sources and historical period it chose to examine, as well as the terminological perspective in which these sources were analysed, and the representation of processes across disciplines and languages. I am also convinced that the diachronic approach presents an array of unexplored declinations in terminology theory, which could provide interesting material for future reflections. Ultimately, the adoption of a diachronic perspective should be encouraged even if only to prove that terminological studies can also adopt a different approach than the widely used and traditional synchronic one.

This also follows the recognition by the descriptive theories of terminology of the inherent development of terms and concepts over time, which occurred already more than twenty years ago

(Temmerman 2000b: 15), as well as the importance of their conditions of origin and development, against a view of terms and concepts as separated from their context.

Another limitation could be detected in the choice of this thesis to study historical processes and debates. Since the processes are complete, their result is already known from our point of view. Connected to this aspect, other questions could come from the use of historical and secondary sources to reconstruct the chronological development of the episodes included in the thesis. This means that a limitation of the method I proposed is that it relies on the availability of the primary sources and on the existing reconstructions of historical events in secondary sources. Throughout the thesis, secondary sources by historians were quoted, since they helped me not only in the chronological reconstruction of the episodes, but also in finding and connecting the primary sources with one another. In this respect, my claim is that the originality of my study did not reside in the chronological reconstruction of the historical episodes, but in the choice of the perspective from which I comment on them i.e., the one of terminology theory of the 20th and 21st centuries.

A further limitation of this thesis was due to the necessary selection of case studies to be included in the analysis. This selection was motivated by the number of primary sources which were found in the archives on naming and classification. As specified in the methodology chapter of this thesis (see Ch. 4), a main and a secondary example illustrated each terminological process. An overview of similar episodes was added in each chapter, to show how these processes were taking place in multiple fields of study. The examples mentioned in the overview should be the subject of future research and they deserve a detailed analysis. The selection of the case studies was also motivated by the structure of the thesis and the relevance attributed to the comparison among examples. The structure of the thesis was conceived to have enough material for each case study to allow the drawing of possibly meaningful conclusions and – at the same time – to allow space for a detailed reflection on the terminological processes. In the future, the same comparative perspective could be employed to other studies and include even more examples.

As was signalled as part of the methodology of this study (see Ch. 4), most of the historical sources entailed a reference to further sources and possibly interestingly naming and classification episodes, which this thesis could not examine. Further research in this direction could lead to interesting outcomes, through the examination of primary sources which were not presented in this study. More detailed research on the episodes could also expand the search for primary sources, by employing other online archives than the ones selected for this study. Indeed, the discussion on the features of scientific language appeared to have in the 19th century an applied and a theoretical dimension. While the first addressed the application of terminological processes to the naming and classification necessities of the experts, within fields such as biology and meteorology, the latter was concerned with the features of scientific language at the theoretical level. This dimension seemed to

address the ideal nature of this language, which was not applied to any field of research specifically. This level of reflection was excluded from this thesis, as the selection of the contents mainly followed a criterion of coherence among the terminological processes. While mentioned throughout this work, this reflection could represent valuable material for future studies.

Ultimately, this analysis did not aim to provide an exhaustive description of the presented terminological processes, which were naturally not limited to the fragments commented in the present selection. Conversely, it intended to underline the presence of terminological discussions as part of a general exchange of ideas among experts which occurred regularly in the 19th century, as it presumably does nowadays.

9.7. Future research perspectives

This section presents some possible direction for further research, based on the results of this thesis. As I aimed to prove in this study, experts appeared to have always been concerned with the naming and classification of concepts, to respond to the necessities of knowledge development and communication of their field both at a national and at an international level.

Consequently, the method presented in this thesis could be applied to other historical periods. The results of the analysis could then be compared, trying to determine to what extent the origin of the schools of terminology at the beginning of the 20th century might have influenced these terminological processes and the activity of scholars in their field of expertise. Indeed, further studies could focus on how term formation changed between the 19th and the beginning of the 20th century i.e., before and after the origin of the first schools of terminology.

More specifically, future studies could focus on the modalities in which the discussion of terms and concepts occurs among experts and on the motivations of naming alternatives (Pecman 2012). This thesis thus promotes the adoption of a diachronic perspective in future studies in which terms are not considered as synchronic entities, but as the result of discussions among experts and evaluation of alternatives, according to different necessities and criteria (Picton 2009; Dury 2011).

A further suggestion for future research could be to attribute even more importance to the comparative perspective among case studies. Instead of focusing on a primary example for each process, as this thesis did, more examples could be analysed for the same process. This would lead to different aims of future studies: instead of foregrounding the features of a specific example, the shared features of the processes would be evidenced.

Future studies could also address the theoretical reflections as part of the naming activity of experts in the 19th century. The amount of material I found in the archives on the theoretical reflections on scientific language could certainly represent the basis for further studies. Starting from Whewell (1840b) in his *Aphorisms on the Language of Science*, indeed, numerous scholars contributed to the

debate on the formation of scientific terms on a theoretical level. In these contributions – which appear among the primary sources in the form of articles and volumes - not the terms of a specific domain, but the general and ideal features of scientific language were discussed. Scientific language was considered as an abstract entity, which presented inherent features applying to all fields of research, as well as specificities of the single subjects.

As an added value, this study proposed the analysis of historical sources as a possible starting point to gain further insights into the terminological processes. The analysis of primary sources, indeed, could be connected to the study of the present situation in the examined research fields. Experts of various disciplines could be interested in the historical development of their vocabulary and concepts. This could represent an interesting combination of diachronic and synchronic approaches. Moreover, the focus on the evolution of terms in a specialised domain could represent a conjunction between the theoretical and the applied dimension of studies in terminology. As this thesis tried to demonstrate, indeed, a combination of inductive and deductive research methods could be employed in terminological studies in which principles of the discipline could be tested on unexplored sources, while valuable insights into the principles could be gained to enrich the existing knowledge.

Ultimately, a perspective for future studies could be the analysis of unfinished discussions among experts in the present, and of which the conclusion is not yet determined. This would allow us to see whether the contemporary discussions among experts involve – even nowadays – reflections on terminological principles. Contemporarily, it would provide the possibility to see if historical and contemporary debates present similarities and differences, in their development and in the way in which experts form terms, through the exchange of opinions and the description of concepts.

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11.1. ANNEX A

List of consulted online archives

ANNO – Austrian Newspapers Online – Historische Österreichische Zeitungen und Zeitschriften. Online Portal of the Österreichische Nationalbibliothek. Available at: <https://anno.onb.ac.at/> [accessed January 20, 2024].

BHL – Biodiversity Heritage Library. Smithsonian Libraries. Natural History Building 10th St. and Constitution Ave. NW, Washington DC, 20560. Available at: <https://www.biodiversitylibrary.org/> [accessed January 20, 2024].

Digital Bodleian Library Oxford – Oxford, Bodleian Libraries, University of Oxford. Available at: <https://digital.bodleian.ox.ac.uk/> [accessed January 20, 2024].

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JSTOR.org digital library. JSTOR provides access to more than 12 million journal articles, books, images, and primary sources in 75 disciplines. Available at: <https://www.jstor.org/> [accessed January 20, 2024].

MDZ – Digitale Bibliothek München Digitalisierungszentrum. Bayerische Staatsbibliothek München. Digitale Sammlungen. Available at: <https://www.digitale-sammlungen.de/en/> [accessed January 20, 2024].

Nilde CNR – Network for Inter-Library Document Exchange. Service available with UniBO credentials at: <https://nilde.bo.cnr.it/> [accessed January 20, 2024].

Oxfordshire Architectural and Historical Society official website, The OAHS official Library and Digital Resources: <https://www.oahs.org.uk/library.php> [accessed January 20, 2024].

RIBA – British Architectural Library Catalogue. The Royal Institute of British Library. London. Catalogue available at: <https://www.architecture.com/contact-and-visit/riba-library> [accessed January 20, 2024].

Sistema Bibliotecario di Ateneo dell'Università di Bologna. Available through University credentials at: <https://sba.unibo.it/it> [accessed January 20, 2024].

The John Rylands Research Institute and Library. The University of Manchester (UK). Digital resources available at: <https://www.library.manchester.ac.uk/resources/search-resources/digital-collections/> [accessed January 20, 2024].

The National Archives. The National Archives is a non-ministerial government department, and the official archive and publisher for the UK Government, and for England and Wales. Available at: <https://www.nationalarchives.gov.uk/> [accessed January 20, 2024].

The National Library of Scotland Digital Resources. National Library of Scotland 92 Cowgate Edinburgh EH1 1JN.
Available at: <https://www.nls.uk/digital-resources/> [accessed January 20, 2024].

The Online Archive of the Christopher Wren Library at the Trinity College, Cambridge (UK). Wren Digital Library.
Available at: <https://www.trin.cam.ac.uk/library/wren-digital-library/> [accessed January 20, 2024].

The Smithsonian Libraries Digital Collection. Smithsonian Libraries and Archives. Natural History Building 10th St.
and Constitution Ave. NW, Washington DC, 20560. Available at: <https://library.si.edu/collections> and
<https://siarchives.si.edu/> [accessed January 20, 2024].

The University of Manchester online archives (UK). Available at:
<https://www.library.manchester.ac.uk/resources/search-resources/> [accessed January 20, 2024].

WDL – World Digital Library. A project of the U.S. Library of Congress carried out with the support of the United Nations Educational, Cultural and Scientific Organization (UNESCO), and in cooperation with libraries, archives, museums, educational institutions, and international organizations from around the world.
Available at: <https://www.wdl.org/en/> [accessed January 20, 2024].

11.2. ANNEX B

List of consulted journals and recurrent publications

- A Journal of Natural Philosophy, Chemistry, and the Arts. Illustrated with engravings. By William Nicholson. London: printed by W. Stratford. Available at: <https://catalog.hathitrust.org/Record/000047111> [accessed January 20, 2024].
- Annalen der Physik und der Physikalischen Chemie. Herausgegeben von Ludwig Wilhelm Gilbert. Leipzig: Johann Ambrosius Barth. Available at: <https://catalog.hathitrust.org/Record/000636505> [accessed January 20, 2024].
- The Annals and magazine of natural history; zoology, botany, and geology. *Alternative:* Annals & magazine of natural history; or Annals and magazine of natural history, including zoology, botany, and geology; or Annals and magazine of natural history, including zoology, botany, and geology, and geology. Formed by the union of the Annals of Natural History and the Magazine of Natural History. Succeeded by: Journal of natural history. London: Taylor and Francis, Ltd. Available at: <https://www.biodiversitylibrary.org/bibliography/15774> [accessed January 20, 2024].
- Annals of Philosophy or, Magazine of Chemistry, Mineralogy, Mechanics, Natural History, Agriculture, and the Arts. a learned journal founded in 1813 by the Scottish chemist Thomas Thomson. Thomson edited it until 1821, when he was succeeded in 1821 by Richard Phillips. Succeeded by: *Philosophical Magazine and Annals of Philosophy*. Available at: <https://www.biodiversitylibrary.org/bibliography/2441> [accessed January 20, 2024].
- Annales de chimie et de physique. Par MM. Gay-Lussac et Arago. Paris : chez Crochard Libraire. Available at : <https://catalog.hathitrust.org/Record/006954249> [accessed January 20, 2024].
- Annuaire météorologique. Par Jean-Baptiste Pierre Antoine de Monet de Lamarck. Paris: chez Maillard. Some volumes are available at Hathi Trust: <https://catalog.hathitrust.org/Record/009991990> [accessed January 20, 2024].
- Astronomische Nachrichten begründet von H. C. Schumacher. Herausgegeben von Professor Dr. C.A.F. Peters. Altona: Buch- und Steindruckerei von Hammerich & Lesser. Available at: <https://catalog.hathitrust.org/Record/012456045> [accessed January 20, 2024].
- The Art Union – The Art Union. A monthly journal of the fine arts. London published at The Art Union office by Hodgson and Graves print publishers. 1839 – 1848. Then renamed in The Art Journal in 1849. Volumes 1 – 10 available at Hathi Trust: <https://catalog.hathitrust.org/Record/010363260> [accessed January 20, 2024].
- Memoirs of the Royal Astronomical Association. Published by. Royal Astronomical Society. London: Priestley and Weale since 1833. Succeeded by the Monthly Notices of the Royal Astronomical Society. Available at: <https://catalog.hathitrust.org/Record/000519124> [accessed January 20, 2024].
- Nature. A weekly illustrated journal of science. First published on November 11, 1869. Still in existence. Available at: <https://www.nature.com/nature/volumes> [accessed January 20, 2024].
- Quarterly Journal of the International Meteorological Society. A peer-reviewed scientific journal of meteorology published eight times per year. Established in 1871 as *Bibliography of Meteorological Literature*, renamed

- in 1873. It is published by Wiley-Blackwell on behalf of the Royal Meteorological Society. Available at: <https://rmets.onlinelibrary.wiley.com/loi/1477870x> [accessed January 20, 2024].
- The Asylum. Journal of Mental Science. Published by authority of the Association of Medical Officers of Asylums and Hospitals for the Insanes. Ed. by John Charles Bucknill. London: S. Highley. Published since 1855. The journal was renamed The Journal of Mental Science. Available at: <https://onlinebooks.library.upenn.edu/webbin/serial?id=asylumjmental> [accessed January 20, 2024]. Some pages are also available at: <https://www.cambridge.org/core/journals/the-asylum-journal/issue/461E87A09BD8AA3D0950B2B0FC462B4C> [accessed January 20, 2024].
- The Athenaeum. London literary and critical Journal. J.S. Buckingham. London, printed and published by William Lewes. Available at: <https://catalog.hathitrust.org/Record/009663854> [accessed January 20, 2024].
- The Builder: an illustrated weekly magazine for the architect, engineer, operative and artist, archaeologist, constructor, sanitary-reformer and art-lover. First published by Joseph Hanson in London, December 1842–1966. Then continued by a journal named *Building*, still in existence. *The Builder* began publication in 1843. It absorbed another journal titled "Architecture". No issue or contribution copyright renewals were found for this serial. In 1966, the journal ceased publication, and was continued by a journal named "Building". Available at: <https://onlinebooks.library.upenn.edu/webbin/serial?id=builder> [accessed January 20, 2024].
- The Ecclesiologist – The Ecclesiologist. Published by the Cambridge Camden Society, Ecclesiological society since 1841. London, Stevenson; Rivington; Oxford, Parker. Volumes 1841 – 1868 available at: <https://catalog.hathitrust.org/Record/000552735> [accessed January 20, 2024]. Some volumes are also available on the website of The Ecclesiological Society: The Ecclesiological Society. For those who love churches. London (2021). URL: <http://eccsoc.org/> [accessed January 20, 2024].
- The Edinburgh Philosophical Journal. Succeeded by: *Edinburgh new philosophical journal*. "Exhibiting a view of the progress of discovery in natural philosophy, chemistry, natural history, practical mechanics, geography, statistics, and the fine and useful arts. Conducted by Dr. Brewster and Professor Jameson. Some plates engraved by W.H. Lizars or D. Lizars. Contains the proceedings of the Royal Society of Edinburgh, the Wernerian Natural History Society, etc. Edinburgh, Printed for Archibald Constable, 1819-1826. Available at: <https://www.biodiversitylibrary.org/bibliography/118958> [accessed January 20, 2024].
- The Gentleman's Magazine. Or Monthly Intelligencer. London: Printed by Edward. Cave at St. John's Gate and sold by the booksellers of town and country. A monthly magazine founded in London, England, by Edward Cave in January 1731. It ran uninterrupted since 1731, until 1922. Available at: <http://benjaminpauley.net/c18booktracker/node/63> [accessed January 20, 2024].
- The Magazine of Natural History and Journal of Zoology, Botany, Mineralogy, Geology and Meteorology. London: printed for Longman, Orme Brown, Green and Longmans. Volumes 1 – 9 available at: <https://catalog.hathitrust.org/Record/010101106> [accessed January 20, 2024].
- The Philosophical Magazine comprehending the various branches of science, the liberal and fine arts, agriculture, manufactures and commerce. By Alexander Tilloch, member of the London Philosophical Society.

- London: printed for A. Tilloch. Available at: <https://catalog.hathitrust.org/Record/000505373> [accessed January 20, 2024].
- The Philosophical Transactions of the Royal Society – Journals of The Royal Society. Available at: <https://royalsociety.org/journals/> [accessed January 20, 2024].
- The Magazine of Natural History – The Magazine of Natural History and Journal of Zoology, Botany, Mineralogy, Geology and Meteorology. London: printed for Longman, Orme Brown, Green and Longmans. Volumes 1 – 9 available at: <https://catalog.hathitrust.org/Record/010101106> [accessed January 20, 2024].
- The Monist. An International An International Quarterly Journal of General Philosophical Inquiry. established in October 1890 by American publisher Edward C. Hegeler. Available at: <https://www.jstor.org/journal/themonist> [accessed January 20, 2024].
- The Nautical Magazine and naval chronicle: a journal of papers on subjects connected with maritime affairs. London: Simpkin, Marshall, and Co., 1837-. Available at: <https://catalog.hathitrust.org/Record/007561470> [accessed January 20, 2024]. Selected volumes are also available at: <https://www.cambridge.org/core/series/cambridge-library-collection-the-nautical-magazine/9618BCF448C331109E5C8566AC59F025> [accessed January 20, 2024].
- The Zoological Journal – The Zoological Journal. London, published by W. Phillips. Volumes 1 – 5 (1824 – 1834) are available at Hathi Trust Digital Library. Available at: <https://catalog.hathitrust.org/Record/000637727> ; and at: <https://www.biodiversitylibrary.org/bibliography/39584#/summary> [accessed January 20, 2024].
- Transactions of the Royal Institute of British Architects of London. Later known as: Papers read at the Royal Institute of British Architects. Published by the Royal Institute of British Architects of London. London: Longman, Brown, Green and Longmans, 1842-. Available at: <http://onlinebooks.library.upenn.edu/webbin/book/lookupname?key=Royal%20Institute%20of%20British%20Architects> [accessed January 20, 2024].
- Transactions of the Royal Irish Academy. 1787-1907, 33 vols. After 1896 the *Transactions* were divided into three sections: A) mathematics, astronomy, and physics; B) biological, geological, and chemical science; C) archaeology, linguistics and literature. Dublin: Published by the Royal Irish Academy. Available at: <https://www.jstor.org/journal/tranroyairisacad> and at: <https://www.biodiversitylibrary.org/bibliography/973> [accessed January 20, 2024].
- Transactions of the Royal Society of Edinburgh. A Scotland-based scientific journal published since the 18th century. In the 18th and 19th century it published articles on various aspects of science and mathematics; more recently it has focused on earth sciences. began publishing in 1788. It is now published as "Earth and Environmental Science: Transactions of the Royal Society of Edinburgh". *Abbreviated:* Trans. R. Soc. Edinburgh Succeeded by: *Transactions of the Royal Society of Edinburgh*. Edinburgh: Published by Royal Society of Edinburgh, Available at: <https://www.biodiversitylibrary.org/bibliography/2290> and at: <https://onlinebooks.library.upenn.edu/webbin/serial?id=trroysocedin> [accessed January 20, 2024].

Reports of the British Association for the Advancement of Science. *the British Association for the Advancement of Science* published the proceedings of the British Association for the Advancement of Science's annual meeting. The exact title of the report varied over time. The Association first met in 1831 and met annually thereafter. Meeting reports continued under this title or similar titles until 1938. Subsequent annual reports were then published under the title Advancement of Science. Abbreviated: Rep.Br.Ass.Advmt Sci. London: Published by the Association. Available at: <https://onlinebooks.library.upenn.edu/webbin/serial?id=repmeetbaas> and at: <https://www.biodiversitylibrary.org/bibliography/2276> [accessed January 20, 2024].

11.3. ANNEX C

List of main case studies identified in the primary sources

Architecture
<ul style="list-style-type: none"> - Periodisation of English, French and German medieval architecture - Main timeframe: 1808 – 1842 - Discipline: Architecture. - Languages: English, French, German. - Objects of classification: windows. - Main works on the subject: <ul style="list-style-type: none"> - De Caumont, Arcisse. (1825). <i>Essay sur l'architecture religieuse du moyen age. Principalement en Normandie</i>. Caen: Chalopin fils. - Rickman Thomas. (1817). <i>An Attempt to discriminate the Styles of English Architecture, from the Conquest to the Reformation; with notices of Eight Hundred English Buildings</i>. Preceded by A Sketch of the Grecian and Roman. Second Edition. London: Longman, Hurst, Rees, Orme, and Brown. - Sharpe, Edmund. (1851). <i>The Seven Periods of English Architecture</i>. Defined and illustrated. London: George Bell. - Main journals involved: The Builder, The Ecclesiologist. - Terminological processes involved: term formation, variation, translation. - Other forms of representation or semiotic systems: architectural drawings.
<ul style="list-style-type: none"> - Classification of architectural elements - Main timeframe: 1838 – 1868 - Discipline: Architecture. - Languages: English, French, German. - Objects of classification: mouldings. - Main works on the subject: <ul style="list-style-type: none"> - Willis, Robert. (1844). <i>Architectural Nomenclature of the Middle Ages</i>. With three plates. London: J & J.J. Deighton and T. Stevenson, John W. Parker, and Oxford: John H. Parker. Cambridge printed at the University Press. No. IX of the Publications of the Cambridge Antiquarian Society. - Britton, John. (1838). <i>A Dictionary of the Architecture and Archaeology of the Middle Ages</i>. Including words used by ancient and modern authors in treating of Architectural and other Antiquities. With etymology, definition, description, and historical elucidation. London: Longman, Orme, Brown, Green and Longmans. - Pugin, Welby A. (1868). <i>A Glossary of Ecclesiastical Ornament and Costume, compiled from ancient authorities and examples</i>. Third edition. London: Quaritch. - Main journals involved: The Builder, The Ecclesiologist, The Art Union. - Terminological processes involved: term variation, standardisation. - Other forms of representation or semiotic systems: architectural drawings.

Astronomy

- **Revision of the nomenclature of the stars**

- Main timeframe: 1833 – 1846
- Discipline: Astronomy.
- Languages: English, French, German.
- Objects of classification: stars.
- Main works on the subject:
 - Herschel, John F. (1842). "On the Advantages to Be Attained by a Revision and Re-arrangement of the Constellations". *Memoirs of the Royal Astronomical Society* 12th Meeting: 201–224.
 - Herschel, John F., William Whewell, and Francis Baily. (1843). "Report of the Committee consisting of Sir J. Herschel, Mr Whewell, and Mr Bailey, for Revising the Nomenclature of the Stars. August 14, 1843". *Reports of the British Association for the Advancement of Science* 13th Meeting: 292.
 - Herschel, John F., William Whewell, and Francis Baily. (1844). "Report of a Committee, consisting of Sir John Herschel, Mr Whewell and Mr Baily (deceased), appointed by the British Association in 1840, to revise the Nomenclature of the Stars". *Reports on the British Association for the Advancement of Science* 1844: 32–42.
- Main journals involved: Report of The British Association for the Advancement of Science.
- Terminological processes involved: term variation, standardisation.
- Other forms of representation or semiotic systems: numbers.

- **The Naming of Uranus: Debate on the naming of celestial bodies**

- Main timeframe: 1808 – 1842
- Discipline: Astronomy.
- Languages: French, German, English.
- Objects of classification: stars, celestial bodies.
- Main works on the subject:
 - Herschel, John F. (1833). *Treatise on Astronomy*. In: *The Cabinet Cyclopaedia*. Conducted by Dionysius Lardner, assisted by Eminent Literary and Scientific Men. London: Longman, Rees, Orme, Brown, Green, and Longman, and John Taylor.
 - Herschel, William. (1811). "Astronomical Observations Relating to the Construction of the Heavens, arranged for the Purpose of a Critical Examination, the Result of Which Appears to Throw Some New Light upon the Organization of the Celestial Bodies". *Philosophical Transactions of the Royal Society of London* 101: 269–336.
 - Airy, George B. (1847). "Name of the New Planet". *The Athenaeum* 1008: 199– 200.
- Main journals involved: The Athenaeum; Die Astronomische Nachrichten.
- Terminological processes involved: term formation, revision, standardisation.
- Other forms of representation or semiotic systems: numbers.

Meteorology

<ul style="list-style-type: none"> - Classification of cloud formations - Main timeframe: 1802 – 1896 - Discipline: Meteorology. - Languages: English, French, German, Latin. - Objects of classification: Cloud formations. - Main works on the subject: <ul style="list-style-type: none"> - Lamarck, Jean-Baptiste de. (1802). "Sur la forme des nuages". <i>Annuaire météorologique</i> 3 : 149–164. - Howard, Luke. (1803a). "On the Modifications of Clouds; and the Principles of their Production, Suspension and Destruction". <i>Philosophical Magazine</i> XVI (62): 97–107. - Hildebrandsson, Hugo H. Albert, Riggenbach, and Léon, Teisserenc de Bort. (1896). <i>International Cloud Atlas, Atlas international des Nuages, Internationaler Wolkenatlas</i>. Paris: Gauthier-Villars et fils. - Main journals involved: L'Annuaire Meteorologique, The Philosophical Magazine, Die Annalen der Physik. - Terminological processes involved: term formation, variation, standardisation. - Other forms of representation: drawings, symbols.
<ul style="list-style-type: none"> - Classification of wind strength - Main timeframe: 1704 – 1832 - Discipline: Meteorology. - Languages: English, French. - Objects of classification: wind strength. - Main works on the subject: <ul style="list-style-type: none"> - Defoe, Daniel. (1704). <i>The Storm</i>. Or a collection of the most remarkable casualties and disasters which happen'd in the late dreadful tempest, both by sea and land. London: G. Sawbridge. - Smeaton, John. (1759). "An experimental Enquiry concerning the Natural Power of Water and Wind to turn Mills, and other Machines, depending on a circular motion". <i>The Philosophical Transactions of the Royal Society of London</i> 51: 100–174. - Beaufort, Francis. (1832). "The Log-Board". <i>The Nautical Magazine</i> 1 (10): 537– 539. - Main journals involved: The Nautical Magazine, The Philosophical Transactions of the Royal Society of London; Quarterly Journal of the Royal Meteorological Society. - Terminological processes involved: formation, variation. - Other forms of representation: drawings, symbols, numbers.
Mineralogy
<ul style="list-style-type: none"> - Classification of the colours - Main timeframe: 1774 – 1814 - Discipline: Mineralogy. - Languages: German, French, English.

- Objects of classification: Colours of fossils; colours in natural history.
- Main works on the subject:
 - Werner, Abraham G. (1774). *Von den äußerlichen Kennzeichen der Fossilien*. Leipzig: Crusius.
 - Werner, Abraham G. (1790). *Traité des caractères extérieurs des fossils*. Traduit de l'Allemande de M. A. G. Werner, Inspecteur des Mines et Professeur de Mineralogie a l'Academie des Mines de Freyberg; de la société économique de Leipsick, de celle des amis de la Nature de Berlin et de celle de l'Art de l'exploitation des Mines Par le traducteur des Mémoires de Chymie de Scheele. Dijon : de l'Imprimerie de L. N. Frantin Imprimeur du Roi.
 - Syme, Patrick. (1814). *Werner's nomenclature of colours, with addition, arranged so as to render it highly useful*. Edinburgh: James Ballantine & Co.
- Main journals involved: Annalen der Physik; Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts ; Blackwood Edinburgh Magazine.
- Terminological processes involved: term formation, variation, translation.
- Other forms of representation: paintings, use of references from flora, fauna, and minerals.

Rules for nomenclature in crystallography

- Main timeframe: 1820 – 1825.
- Discipline: Mineralogy.
- Languages: German, English.
- Objects of classification: Crystals, existing and newly discovered.
- Main works on the subject:
 - Kirwan, Richard. (1800). "Of Chymical and Mineralogical Nomenclature". *The Transactions of the Royal Irish Academy* 8: 53–76.
 - Mohs, Friedrich. (1820). "On Nomenclature – As part of the new System of Crystallography". *The Edinburgh Philosophical Journal* 3: 336–342.
 - Weiss, Christian Samuel. (1813). *Über die natürlichen Abteilungen der Krystallisationssysteme*. Berlin: Growth.
- Main journals involved: Edinburgh Philosophical Journal.
- Terminological processes involved: term formation, translation, standardisation.
- Other forms of representation or semiotic systems: -

Zoology

Rules for nomenclature in zoology

- Main timeframe: 1837 – 1843.
- Discipline: Zoology.
- Languages: English, French.
- Objects of classification: Zoological species, existing and newly discovered.
- Main works on the subject:
 - Strickland, Hugh E. (1837a). "Rules for Zoological Nomenclature". *The Magazine of Natural History* 1: 173–176.

<ul style="list-style-type: none"> - Strickland, Hugh E. (1837b). "On the Inexpediency of altering established Terms in Natural History". <i>The Magazine of Natural History</i> (2)1: 127–131. - Strickland, Hugh E., Henslow, J.S., Phillips, J., Shuckard, W.E., Richardson, J.B., Waterhouse, G.R., Owen, R., Yarrell, W., Jenyns, L., Darwin, C., Broderip, W.J. & Westwood, J.O. (1842). <i>Report of a Committee appointed "to consider the rules by which the nomenclature of Zoology may be established on a uniform and permanent basis"</i>. London: John Murray, for the British Association for the Advancement of Science. - Main journals involved: The Zoological Journal, The Magazine of Natural History. - Terminological processes involved: term formation, variation, standardisation. - Other forms of representation or semiotic systems: drawings.
Psychology
<ul style="list-style-type: none"> - Classification of the phenomena of the mind - Main timeframe: 1803 – 1855. - Discipline: Psychology. - Languages: English, French, German. - Objects of classification: Mental diseases, phenomena of the mind. - Main works on the subject: <ul style="list-style-type: none"> - Pinel, Philippe (1801). <i>Traite medico-philosophique sur la manie, ou l'alienation mentale</i>. Paris: Caille et Ravier. - Noble, Daniel. (1853). <i>Elements of Psychological Medicine. An introduction to the practical study of insanity</i>. London: John Churchill. - Monro, Henry. (1855). "On the Nomenclature of the various forms of Insanity". <i>The Asylum</i> 2(1): 286–305. - Main journals involved: The Asylum: Journal for Mental Science. - Terminological processes involved: term formation, variation, standardisation. - Other forms of representation or semiotic systems: drawings, paintings.
Physics
<ul style="list-style-type: none"> - Faraday and Whewell's correspondence on electrochemical entities - Main timeframe: 1834 – 1860. - Discipline: Physics, Electrochemistry. - Languages: English, German, French. - Objects of classification: Newly discovered electrodynamical entities. - Main works on the subject: <ul style="list-style-type: none"> - Faraday, Michael. (1834a). Letter to William Whewell. [24 April 1834]. Correspondence between Michael Faraday and William Whewell. Christopher Wren Trinity College Library, Cambridge (UK). The James Catalogue of Western Manuscripts. Reference: O.15.49. URL: https://mss-cat.trin.cam.ac.uk/Manuscript/O.15.49 [accessed January 14, 2024]

<ul style="list-style-type: none"> - Whewell, William. (1834a). Letter to Michael Faraday. [25 April 1834]. Correspondence between Michael Faraday and William Whewell. Christopher Wren Trinity College Library, Cambridge (UK). The James Catalogue of Western Manuscripts. Reference: O.15.49. URL: https://mss-cat.trin.cam.ac.uk/Manuscript/O.15.49 [accessed January 14, 2024] - Faraday, Michael. (1839). <i>Experimental Researches in Electricity</i>. Volume 1. Reprinted for the Philosophical Transactions 1831-1839. London: Bernard Quaritch. - Main journals involved: - - Terminological processes involved: term formation. - Other forms of representation: -
<ul style="list-style-type: none"> - Naming in thermodynamics - Main timeframe: 1774 – 1814. - Discipline: Physics, thermodynamics. - Languages: German, French, English. - Objects of classification: Thermodynamical entities: existing and newly discovered. - Main works on the subject: <ul style="list-style-type: none"> - Gilbert, Davies. (1827). "On the expediency of assigning specific names to all such functions of simple elements as represent definite physical properties; with the suggestion of a new term in mechanics; illustrated by an investigation of the machine moved by recoil; and also by some observations on the Steam Engine. Read January 25, 1827". <i>The Philosophical Transactions of the Royal Society of London</i> 117: 25– 38. - Melloni, Macedonio. (1833). "Über den Durchgang der Wärmestrahlen durch verschiedenen Körpern. Aus Berzelius Jahresbericht No. 13, S. 15 d. Orig. wo es aus der Zeitung Les Temps, vom 12 Febr. 1833 entlehnt ist". <i>Annalen der Physik</i> 28, Serie 2: 371– 378. - Newcome, Simon. (1893). "Suggested nomenclature of radiant energy". <i>Nature</i> 49 (1247): 100. - Main journals involved: The Philosophical Transactions of the Royal Society of London, Die Annalen der Physik, Nature. - Terminological processes involved: term formation, variation. - Other forms of representation: -
Scientific Language
<ul style="list-style-type: none"> - Whewell's Aphorisms on the Language of Science - Main timeframe: 1840 – 1895. - Discipline: None. - Languages: English. - Objects of classification: Terms and scientific language. - Main works on the subject: <ul style="list-style-type: none"> - Whewell, William. (1840b). <i>Aphorisms concerning Ideas, Science, and the Language of Science</i>. London: Harrison and Co.

<ul style="list-style-type: none"> - Bentham, Jeremy. (1817). <i>Chrestomathia Part II, containing Appendix Nr. 5, being an Essay on Classification and Nomenclature</i>. London: Payne and Foss. - Mill, John Stuart. (1895). <i>A System of Logic. Ratiocinative and inductive</i>. Being a Connected View of the Principles of Evidence, and the Methods of Scientific Investigation. London: Longmans, Green and Co. - Main journals involved: Transactions of the Philological Society ; Quarterly Review ; Philological Museum. - Terminological processes involved: term formation, variation, translation. - Other forms of representation: -
<ul style="list-style-type: none"> - Scientific Nomenclature: letters exchange - Main timeframe: 1861. - Discipline: None. - Languages: English. - Objects of classification: Terms and scientific nomenclatures - Main works on the subject: <ul style="list-style-type: none"> - CWM. (1861). "Scientific Nomenclature". <i>The Athenaeum</i> 1775, November 2: 582. - CWQ. (1861). "Scientific Nomenclature". <i>The Athenaeum</i> 1777, November 16: 653– 654. - Main journals involved: The Athenaeum. - Terminological processes involved: term formation. - Other forms of representation: -
<ul style="list-style-type: none"> - Thought without words: letters exchange - Main timeframe: 1887. - Discipline: None. - Languages: English. - Objects of classification: Thoughts and concepts. - Main works on the subject: <ul style="list-style-type: none"> - Romanes, George J. (1887). "Thought without Words" <i>Nature</i> June 23: 171– 172. - Müller, Max, F. (1887). "Thought without words". <i>Nature</i>, June 2: 100–101. - Galton, Francis. (1887). "Thought without words". <i>Nature</i>, June 2: 100–101. - Main journals involved: Nature. - Terminological processes involved: term formation. - Other forms of representation: -
<ul style="list-style-type: none"> - Müller's Lectures on the Language of Science - Main timeframe: 1774 – 1814. - Discipline: None. - Languages: German, English. - Objects of classification: Terms, language of science. - Main works on the subject:

- Müller, Max. F. (1864). *Lectures on the Science of Language*. Delivered at the Royal Institution of Great Britain in April, May, and June 1861. Fourth Edition. London: Longman, Green, Longman, Roberts, and Green.
- Müller, Max. F. (1870). "The Science of Language. Darwinism tested by the Science of Language. Translated from the German of Prof. August Schleicher". *Nature*, January 6: 256–259.
- Main journals involved: Nature.
- Terminological processes involved: term formation, standardisation.
- Other forms of representation: -