Blue Pigments' Terminology: Issues in Terminological Data Representation*

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Abstract

This paper examines the terminology of pigmentary colors in French, based on Bernard Guineau's *Glossaire des matériaux de la couleur* [Glossary of Coloring Materials] (2005). The history and evolution of pigments have significantly influenced the complexity of their conceptual system, primarily because these terms have been used over centuries by various specialists—including art historians, chemists, color professionals, and artists—across different cultural and geographical contexts. Focusing on blue pigmentary color terms, we analyze the relationships among them and explore issues related to the digital, multidimensional representation of this terminological data.

Keywords

pigmentary colors, blue, terminological data, relationships between terms, data representation, colors' conceptual system, French

1. Introduction

Colors and their denominations across different languages have long attracted the interest of researchers (cf. [1], [2], [3]); however, studies that approach color from a strictly terminological perspective remain relatively rare (cf. [4], [5]). In this paper, we focus on pigmentary color terms, with the aim of analyzing the relationships between them. These terms have been used over centuries by various specialists, including art historians, chemists, color professionals, and artists (such as painters, ceramists, and dyers), each with distinct cultural and geographical backgrounds. The history and evolution of pigments have significantly shaped the complexity of their conceptual system. Considering the growing interest in recent years in areas such as automatic terminology extraction, domain-specific machine translation, and digital terminology resources, this paper also addresses issues concerning the digital and user-friendly representation of multidimensional terminological data.

2. Corpus

We examine the terminology of so-called pigmentary colors (i.e., pigments, dyes, and hues) in French. This focus is justified by the fact that France remains a leading player in the European market for manufacturers and sellers of pigments and paints, making French terminology one of the most widely used.

The terms under study have been extracted from Bernard Guineau's *Glossaire des matériaux de la couleur et des termes techniques employés dans les recettes de couleurs anciennes* [6]. This 791-page

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glossary, which contains approximately 12,000 terms, is a significant reference work for art historical and technical terminology, particularly in relation to painters' materials and paint recipes. It is based on historical data sourced from numerous specialized texts, spanning from antiquity to the 20th century. However, Guineau's work is primarily an inventory of terminological data compiled from a wide variety of sources. Despite its value, it is evident that Guineau was neither a lexicographer nor a terminologist, and as such, the glossary lacks a conceptual framework and terminological systematization [7].

In this paper, we use blue pigments as an example of our method for analyzing and representing data—an approach that could be extended to other pigmentary colors. Blue began to gain popularity in Europe systematically from the Middle Ages onward. Initially symbolizing the Virgin Mary's mourning, it later became associated with the aristocracy during the Enlightenment. The first blue dyes used for textiles were pale and unstable. Over the centuries, technological advancements enabled color professionals to produce more stable blue pigments suitable for fabric dyeing, offering a range of luminosities [8]. Naturally, the growing popularity of blue was mirrored in an expanding body of terminology, which increasingly found its way into general language dictionaries as people began to speak and write more frequently about its many shades [9].

3. Relationships between terms

For the purposes of this study, we first extracted 146 distinct designations beginning with *bleu*, such as *bleu d'airelle*, *bleu de Prusse*, and *bleu de smalt*. In Guineau's glossary, each term is presented as an entry comprising one or more of the following elements: (i) definitions, (ii) synonyms, and (iii) cross-references. Alongside synonyms—which are explicitly indicated, along with equivalents in other languages—other semantic relationships also emerge from the definitions, including homonymy, meronymy, and hyperonymy. However, the nature of these relations remains implicit. For instance, the expression *variété de* [variety of] implies hyponymy (and, conversely, hyperonymy), while *mélange de* [mixture of] or *obtenu avec* [obtained with] suggest holonymy (and conversely, meronymy). As an example, *bleu de Paris* is described as follows:

> bleu de Paris : 1 – variété de bleu de Prusse : *voir bleu de Turnbull*, 2 – ou (Roret C) variété de bleu de Prusse composé de ferricyanide de fer Fe3.[Fe(CN)6]2, obtenu en 1818 par l'industriel parisien A. Milori selon un procédé de fabrication différent de celui découvert par Diesbach en 1704, couleur bleu violet foncé : *voir bleu de Prusse*, 3 – ou (Chaplet) variété de bleu de Prusse chargé d'alumine. *Synonymes* : 2 – bleu Milori, (All.) Milori-blau, Pariser-blau, (Angl.) Milori blue
>
> [Guineau, 2005: 140]

This entry describes three pigments referred to as *bleu de Paris*, each representing a different variety of Prussian blue. Consequently, the term *bleu de Prusse* functions as a hypernym for the three homonymous *bleu de Paris*. Another term, *bleu Milori*, is listed as a synonym—but only for the second meaning described in the entry. Additionally, there are cross-references (indicated by *voir* 'see') to other entries that address the same term from a different, and sometimes more comprehensive, perspective. For example, *bleu de Turnbull* refers to *bleu de Paris* (1), while *bleu de Prusse* refers to *bleu de Paris* (2).

Based on this analysis, six distinct types of relationships can be derived from the entry for *bleu de Paris*. We applied the same methodology to the entire corpus, considering not only the terms listed as headwords in the glossary, but also all occurrences of terms mentioned as synonyms, hypernyms, hyponyms, meronyms, or cross-referenced entries. In total, we identified nearly 500 relationships, resulting in a rich network of connections among blue color terms. Synonyms and cross-referenced terms are the only semantic categories explicitly marked as such by Guineau in the entries. We have retained these categorizations as defined by the author of the glossary.

4. Terminological data representation

In general, a relational database structures information into tables, rows, and columns, facilitating searchability and enhancing our understanding of the relationships between various data points. These relationships—often forming highly complex networks—can also be visualized in many other ways, with tables typically serving as the starting point for any visualization (see Table 1). For example, certain terms, such as *bleu de Prusse*, more frequently appear as hypernyms or synonyms for other terms. The pigment known as *bleu de Prusse* is, in fact, one of the most commonly used generic terms, as numerous imitations and variants have been developed over the centuries by chemists competing in different cities and countries (cf. *bleu d'Anvers*, *bleu de Berlin*, *bleu de Hambourg*, *bleu de Paris*, *bleu de Turnbull*).

Table 1
Sample of the data collected as a .csv file: *bleu de Prusse* used as hypernym

Relation x REL y	Related term x	Headword y
Hypernym	bleu de Prusse	bleu d'Anvers
Hypernym	bleu de Prusse	bleu de Berlin
Hypernym	bleu de Prusse	bleu de Hambourg
Hypernym	bleu de Prusse	bleu Marie-Louise
Hypernym	bleu de Prusse	bleu Milori
Hypernym	bleu de Prusse	bleu Minerve
Hypernym	bleu de Prusse	bleu de Paris 1
Hypernym	bleu de Prusse	bleu de Paris 2
Hypernym	bleu de Prusse	bleu de Paris 3
Hypernym	bleu de Prusse	bleu de Turnbull

To illustrate the relationships within the conceptual system of blue, we propose a user-friendly, multidimensional, and multilayered sunburst chart, created using the Plotly Graphing Library [10]. This visualization offers a more expressive representation of the frequency and interconnectedness of various terms within a complex relational system (see Fig. 1).

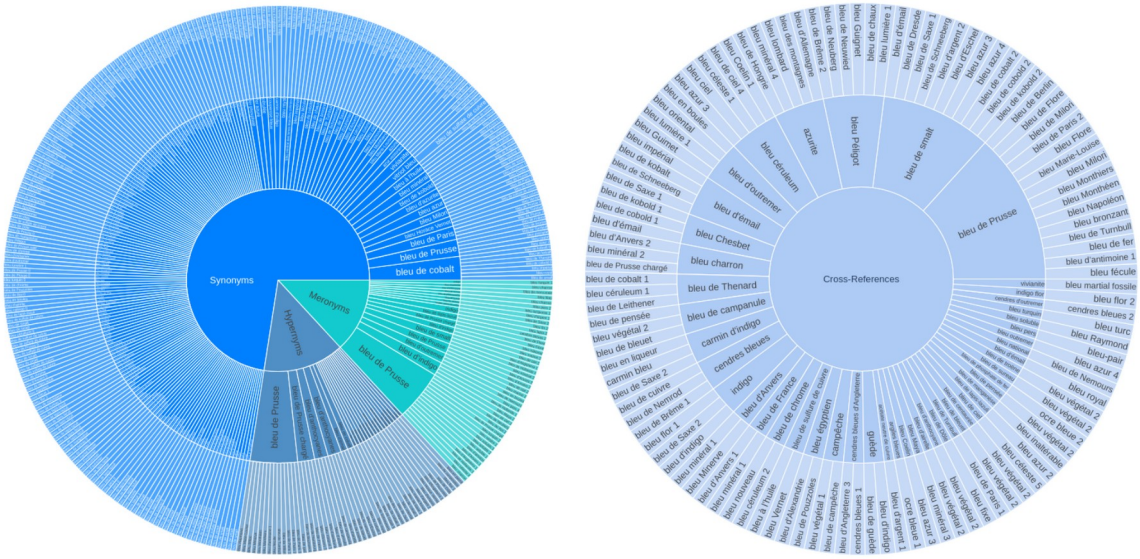

Figure 1: Blue pigments data visualization: synonyms, hypernyms and meronyms (on the left), cross-referenced terms (on the right).

The visualization is dynamic and interactive, allowing users to navigate from a general overview to more detailed levels. Figure 2 illustrates this transition, showing the shift from the complete set of hypernyms to a selected example, *bleu d'anthocyanes*, whose co-hyponyms include *bleu d'airelle*, *bleu d'awobana*, *bleu de campanule*, and *bleu de pensée*.

Figure 2: Sample of the blue pigments data visualization: all hypernyms with their hyponyms (on the left) and *bleu d'anthocyanes* as a hypernym (on the right).

The interactive graph makes it easy to identify the terms most frequently involved in various relationships, such as the aforementioned *bleu de Prusse* (see Fig. 3), which appears as one of the most common hypernyms and meronyms.

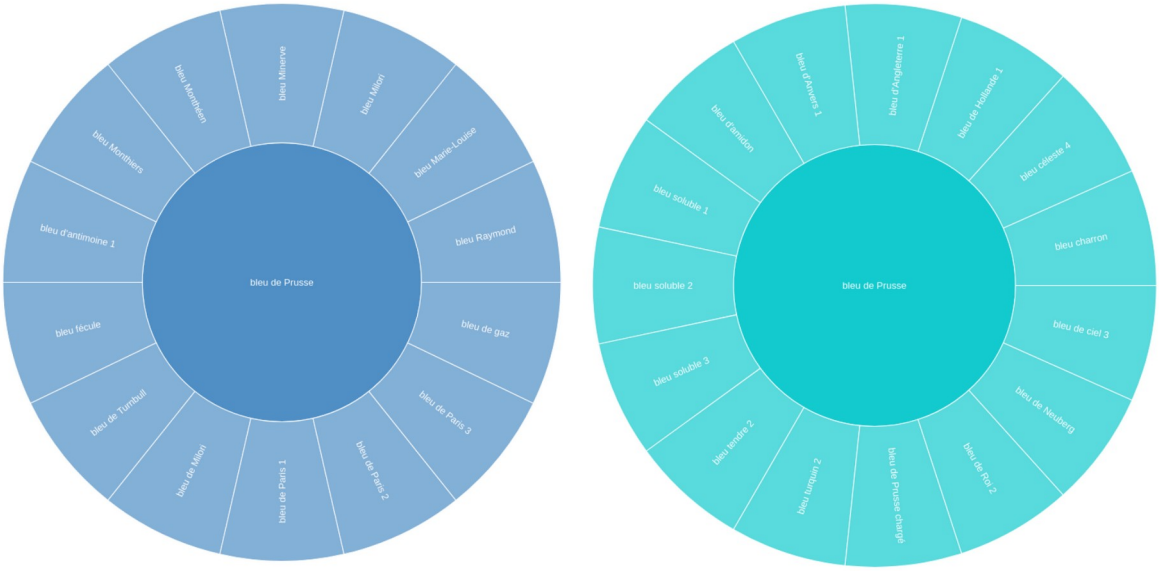

Figure 3: *Bleu de Prusse* as hypernym (on the left) and as meronym (on the right).

A more detailed representation may also need to incorporate diachronic, diatopic, and multilingual aspects, all of which are present in Guineau's glossary. In fact, these dimensions are essential for accurately representing the various relationships between terms, as illustrated in the following example of *bleu de smalt*:

> bleu de smalt : pigment bleu artificiel composé de [...] *Terminologie* : 1 – *synonymes* : (Égypte antique) chesbet, chesteb, azur, azure, (XVI^{e} s.) bleu azur, (Pernety) azur à poudrer, (XVIII^{e} - XIX^{e} s.) azur de 1er feu, (Roret T) bleu d'azur, safre, (XVI^{e} s.) saffre, (Agricola) zaffre, (Cennini) zaffera, zaffiro, safireus, (Ital.) chaffarone, (XVI^{e} s.) bleu d'émail, (Mayerne) esmail, (Pernety) émail, (XVI^{e} s.) esmalt, (Esp.) esmalte, (Mayerne) smalte, smalto, (Ital.) smaltino, azzuro di smalto, (XIX^{e} s.) smaltine, bleu de kobalt, bleu de cobold, (Pernety) bleu de kobold, bleu de cobalt, (XVIII^{e}-XIX^{e} s.) verre de cobalt, (Merrifield) cérulée, *cæruleum*, (Chomel) *antigorium*, (XVIII^{e} s.) bleu d'argent, bleu d'empois, (Angl.) starch blue, silicate de cobalt, bleu royal, (Angl.) azure blue, king's blue, bleu impérial, (All.) kaiserblau, streublau, 2 – *termes indiquant une origine géographique* : (Cennini) azur d'Allemagne, (XV^{e} s.) bleu de Schneeberg, (XVI^{e}-XVIII^{e} s.) bleu de Saxe, (Angl.) Saxon blue, bleu d'Eschel, bleu d'Allemagne, bleu de Dresde, (XIX^{e} s.) émail fin d'Angleterre
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> [Guineau, 2005: 142]

Indeed, as Dury's work has shown [11], Guineau's glossary provides further evidence that diachronic corpus analysis can significantly enhance our understanding of the history of color terminology by incorporating elements such as time periods and/or geographical areas of use, first occurrences in specialized texts, and more. Figure 4 illustrates how the diachronic dimension can be integrated to visualize the relationships that have developed over the centuries within the conceptual systems of just two pigments: *bleu de Prusse* and *bleu de smalt*.

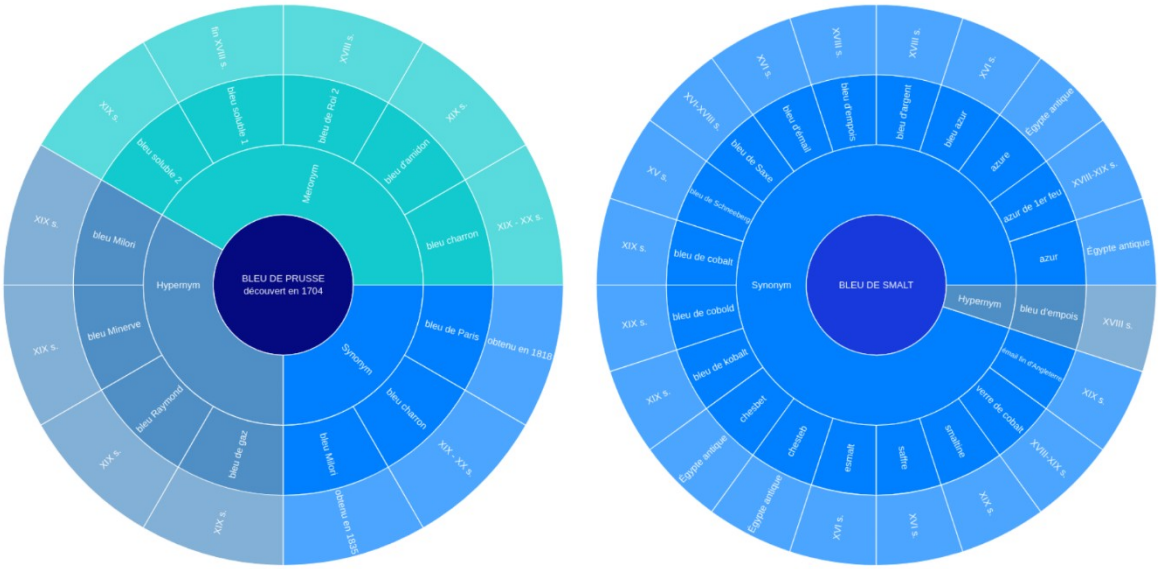

Figure 4: Sample of blue pigments data visualization including the diachronic level: *bleu de Prusse* (on the left) and *bleu de smalt* (on the right).

5. Conclusion and further work

The blue color terminology extracted from Guineau's glossary proves to be both rich and highly complex. An effective representation of terminology should facilitate the understanding of such intricately interrelated data. While the proposed visualization allows users to explore blue pigmentary color terminology from multiple perspectives—e.g., seamlessly switching between hyperonymy, synonymy, or more specific lower-level terms, all while maintaining a view of the broader dataset—it should be considered a preliminary attempt. This model is intended as a foundation for further refinement and, ultimately, for the development of a user-friendly web application capable of addressing the complexity of color terminology. Multidimensional networks are inherently challenging. The ability to navigate efficiently through different layers of a complex database—one that simultaneously integrates multiple types of data—is invaluable for visualizing the full complexity of the conceptual system of pigmentary colors. Within this system, parts of the network may shift according to factors such as time, geography, domain, and other criteria. These dynamics may influence not only core terminological relationships but also the interlingual affinities between terms stored in a multilingual database.

Declaration on Generative AI

During the preparation of this work, the authors used GPT-4o in order to: Improve writing style. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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