

Textual Analysis & Comparison National Forms of Scientific Texts: Goethe + de Candolle

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Abstract

When the 19th-century European scientists were evaluating each other's ideas, they frequently validated their opinions by referring to the nationality of a given scientist as an explanatory type. But is there such a thing as "national science"? What role does nationality of an individual play in how one thinks science? Or, what role does the image of a nation play in the international receptions of scientific ideas?

To answer these questions, this project examines the widely-held ideas about the "German style" and the "French style" sciences in early 19thcentury France. During the politically volatile period, every aspect of life was politicized, and the scientific life was not an exception. Scientists found themselves in a difficult position: first, between the aggressive political reality and the ideals of the cosmopolitan scientific community; second, between the popularized image of national differences and the actual comparisons of the scientific ideas across the national borders.

As a case study, J. W. von Goethe's and A.-P. de Candolle's botanical ideas, their receptions in France, and their actual texts are compared. Goethe and De Candolle presented similar concepts of the primitive plant type, but were received in different manners in the French scientific community, partly based on their nationalities.

To examine and compare their actual scientific texts in detail, computer scientific techniques are used to transform the findings into several types of interactive visuals. The audience will easily see (1) what elements of thought built up each scientific text, (2) how these elements behave with each other in each text, and (3) how these elements and behaviors compare between the texts that supposedly represented different national styles of science.

Background



Goethe, Metamorphosis of Plants This work was originally published in 1790, but was translated

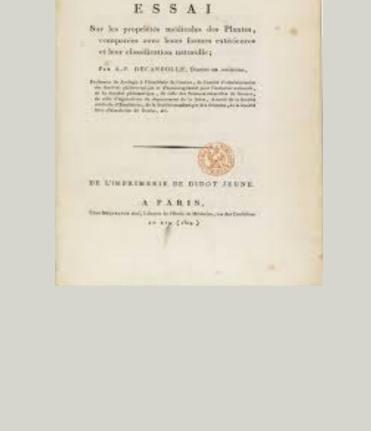
these metamorphoses could offer.

into French decades later. The famous public debate in 1830 between the two leading French naturalists, Georges Cuvier and Étienne Geoffroy Saint-Hilaire, on the theories of animal structures and the methods and philosophies behind them, put Goethe's work back in the spotlight. Goethe described plant growth in terms of serial homology, where a plant organ went through transformations (cotyledons, leaves, calyx, corolla, stamen, fruit, etc.) by alternately contracting and expanding its form. Goethe designated the leaf as the protean organ, or the Archetype. He argued that there was no hierarchy between the "regular" and "irregular" plant forms, which was a main disagreement between Goethe and De Candolle.

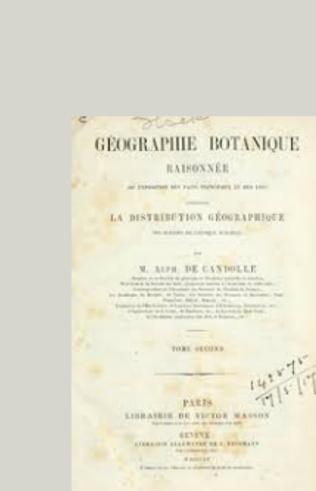


De Candolle I, Essai élémentaire de géographie botanique

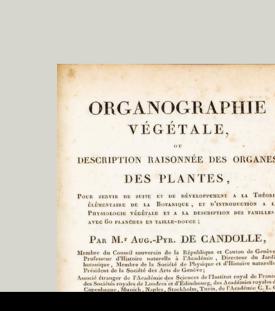
In this work, De Candolle presented his theory of analogy: there was continuity between plant forms and properties. He proposed to look beyond the immediately visible plant forms, and instead, to distinguish which plant properties and structures were normative or accidental. This practice would help get rid of the false anomalies and re-classify them correctly according to the natural order, which would benefit the practical uses of plant medicines across the world. Although he argued that the environment could modify plant forms and properties, De Candolle remained silent, unlike Goethe and Saint-Hilaire, on the evolutionary implications that



De Candolle II, Essai élémentaire de géographie botanique



In this text, De Candolle examined the distribution of plants in the world and the general laws behind it. He made a clear distinction between "habitation (countries in which plants grow)" and "station (topographic nature of localities in which plants usually grow)." De Candolle argued that certain external factors (ex. amount of light, soil type, competition with local plants, etc.) and combinations of these factors have determined the distribution of species. This text is filled with empirical observations and statistical evidences. As for the question of the origin of all plant species, he speculated that an ancient deluge had transported species to unlikely regions, thereby rejecting the idea of plant evolution.



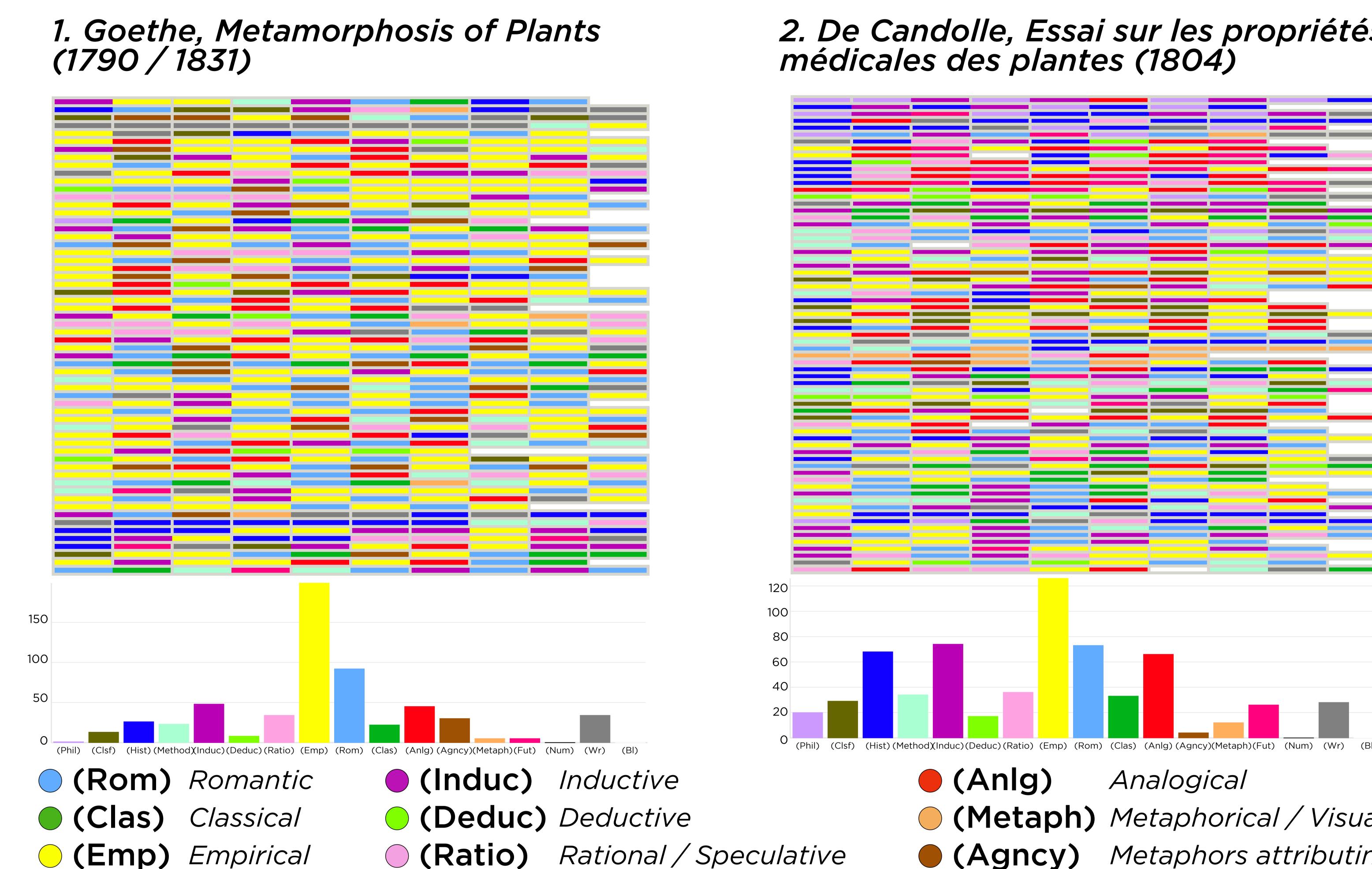
De Candolle III, Organographie végétale, Book V, Chapter II

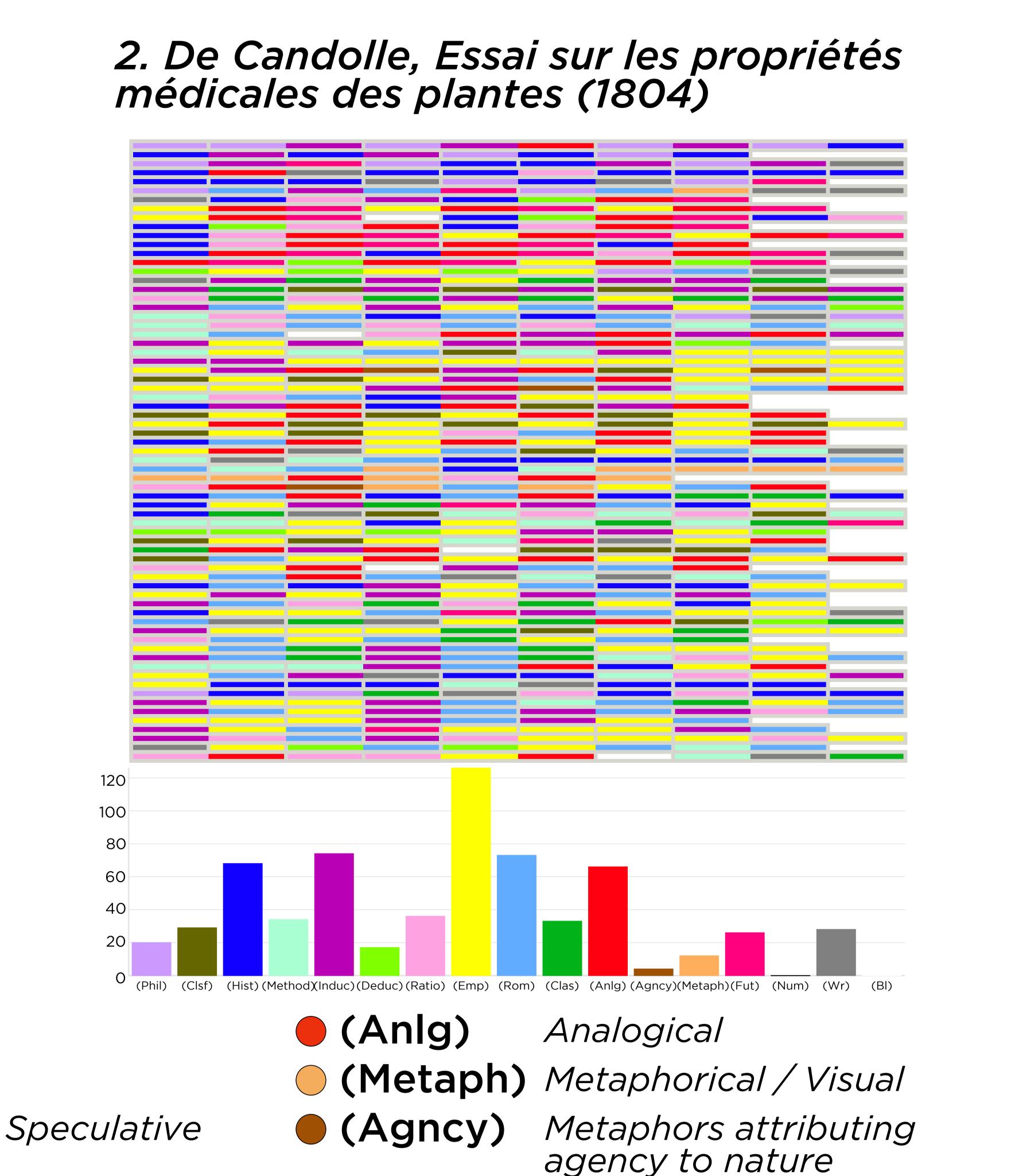
This text explains De Candolle's key concepts of the primitive

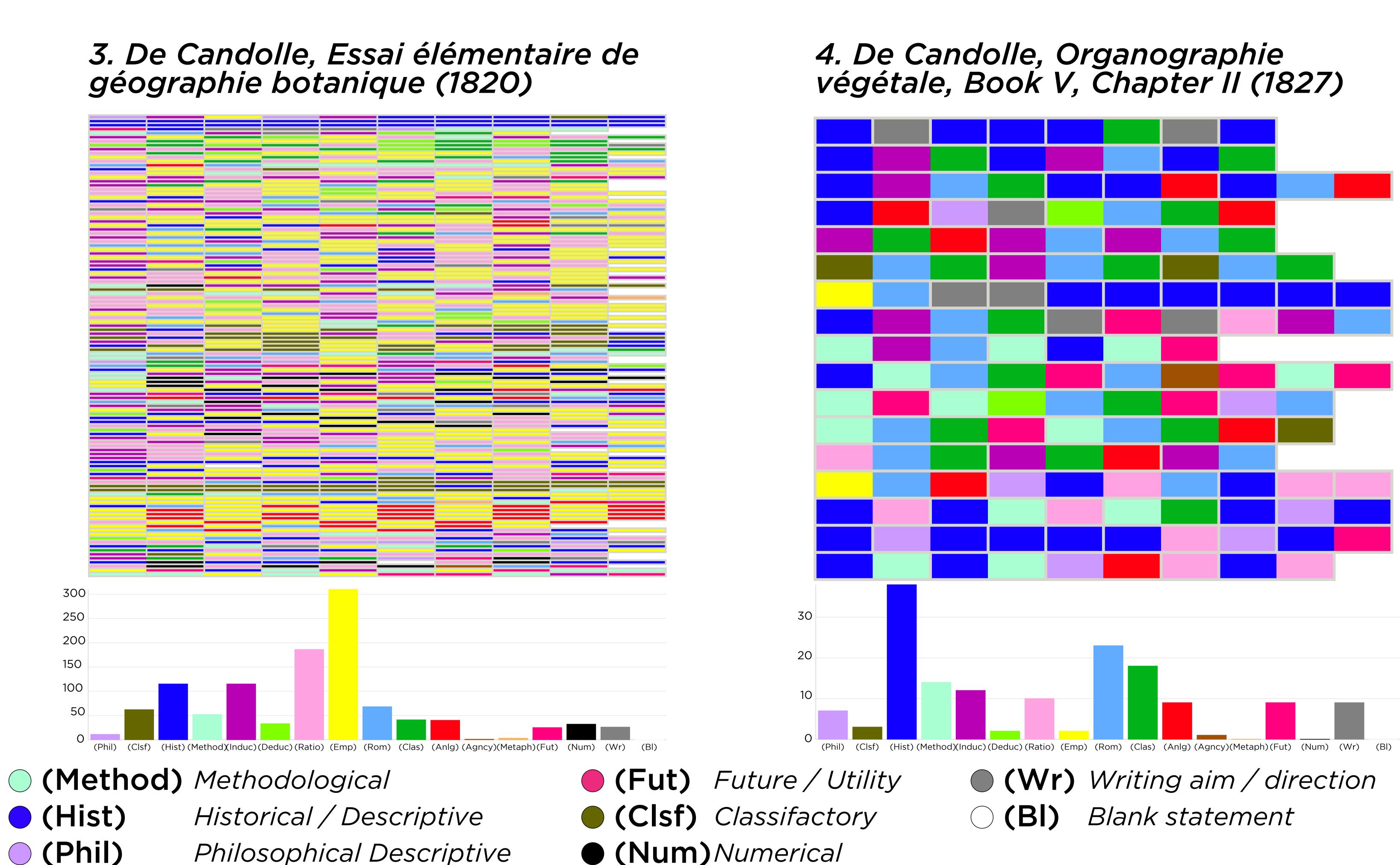
I. Overall Comparisons

Each of these square/waffle graphs represents one of the scientific texts being compared. Each graph is composed of a consecutive series of the strings of colored blocks, where each color block represents one of the 17 "thought-component" categories with which each sentence is tagged (the 17 categories are described in the "Methodology" section of this poster.) Thus, one would "read" the graphic from left to right, from top to bottom, just as one would read the actual text. For example, in the first square graph that represents Goethe's text, the first two colored blocks (purple and yellow) indicate that the first sentence of that text is tagged with the Inductive () and the Empirical ()

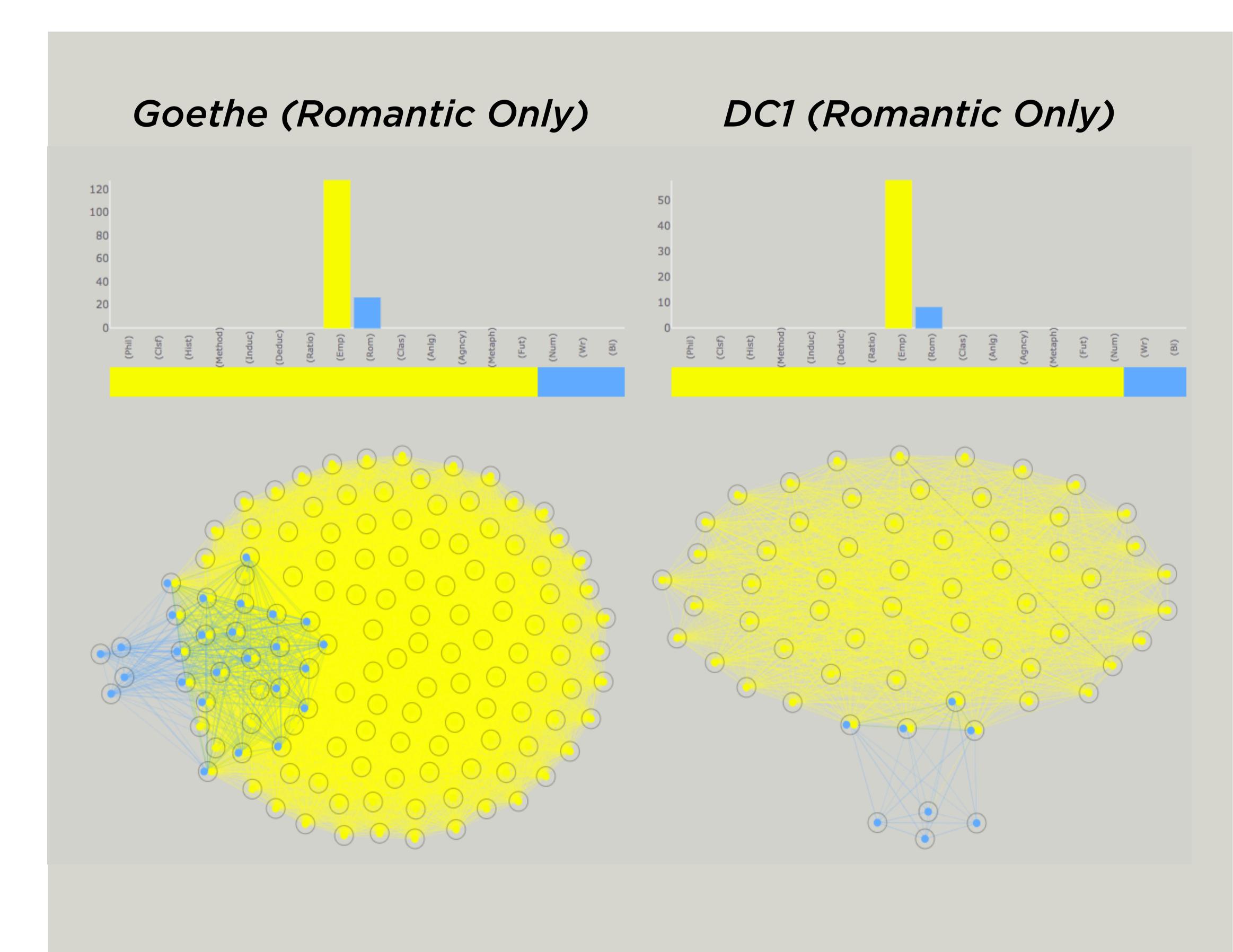
Goethe's and De Candolle's similar botanical concepts have been frequently compared. While the French scientific community labeled Goethe's work as philosophical, poetic, Romantic, and non-empirical, they touted the work of De Candolle—a Frenchborn Swiss botanist who was part of the community—as scientifically rigorous and part of the Classical tradition of French sciences. However, Graph 1 shows that Goethe's text was composed of as much empirical element (())—if not more—as De Candolle's texts, contrary to the then-popular opinions. These graphs also show that the Romantic category (i) always predominates over the Classical category () in all of De Candolle's three texts. Even though De Candolle heavily utilized the Classical language to express his concepts (see graph 4) he still required a language that was as much Romantic as Classical.





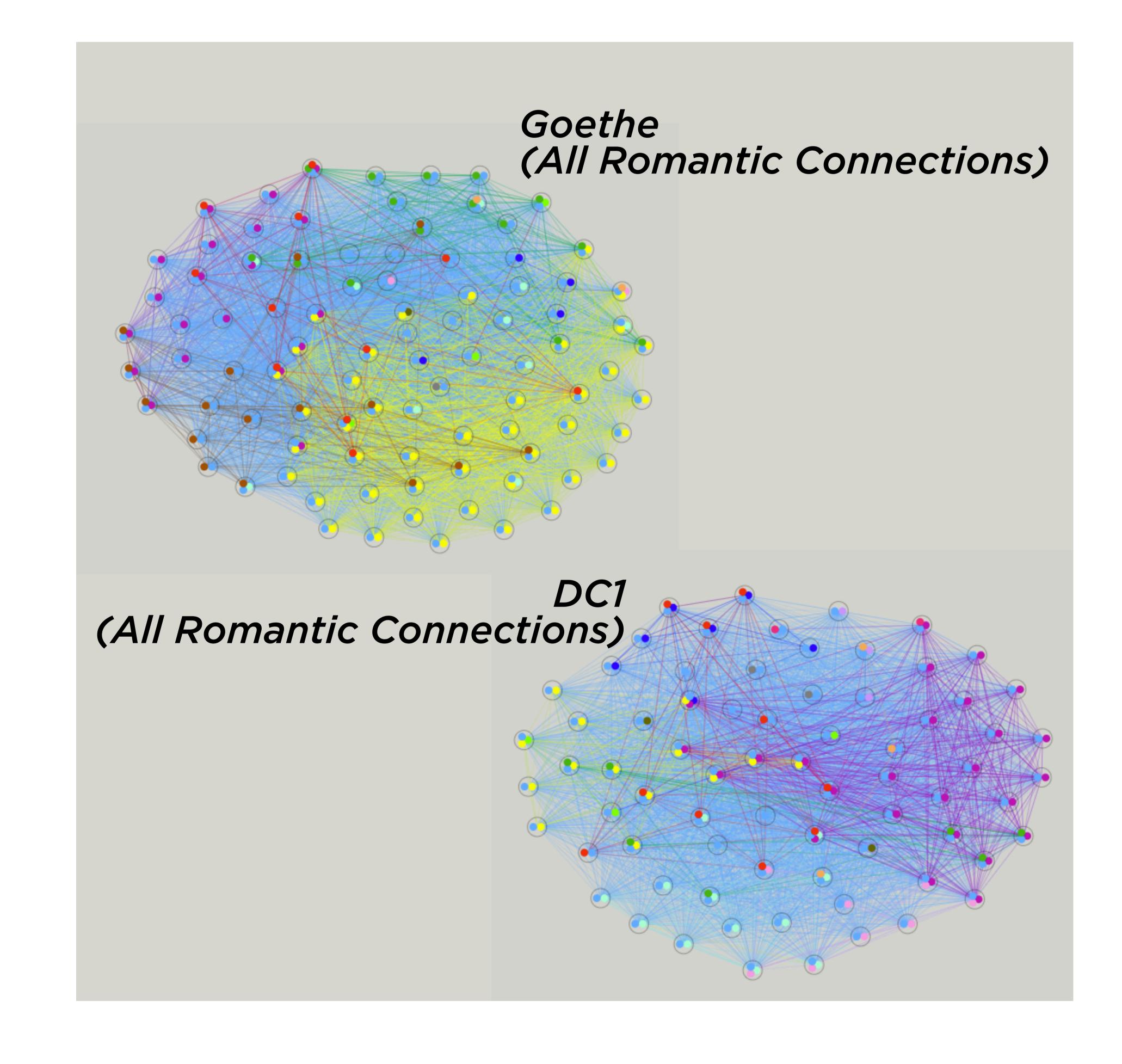


I. Goethe vs De Candolle I



The network graphs in this section represent the interactions among different categories. Using the control options, one can select specific categories out of the 17 and see their interactions. Each circle represents a sentence, which includes colored dots representing the categories with which the sentence is tagged. The lines connect the same categories across different sentences.

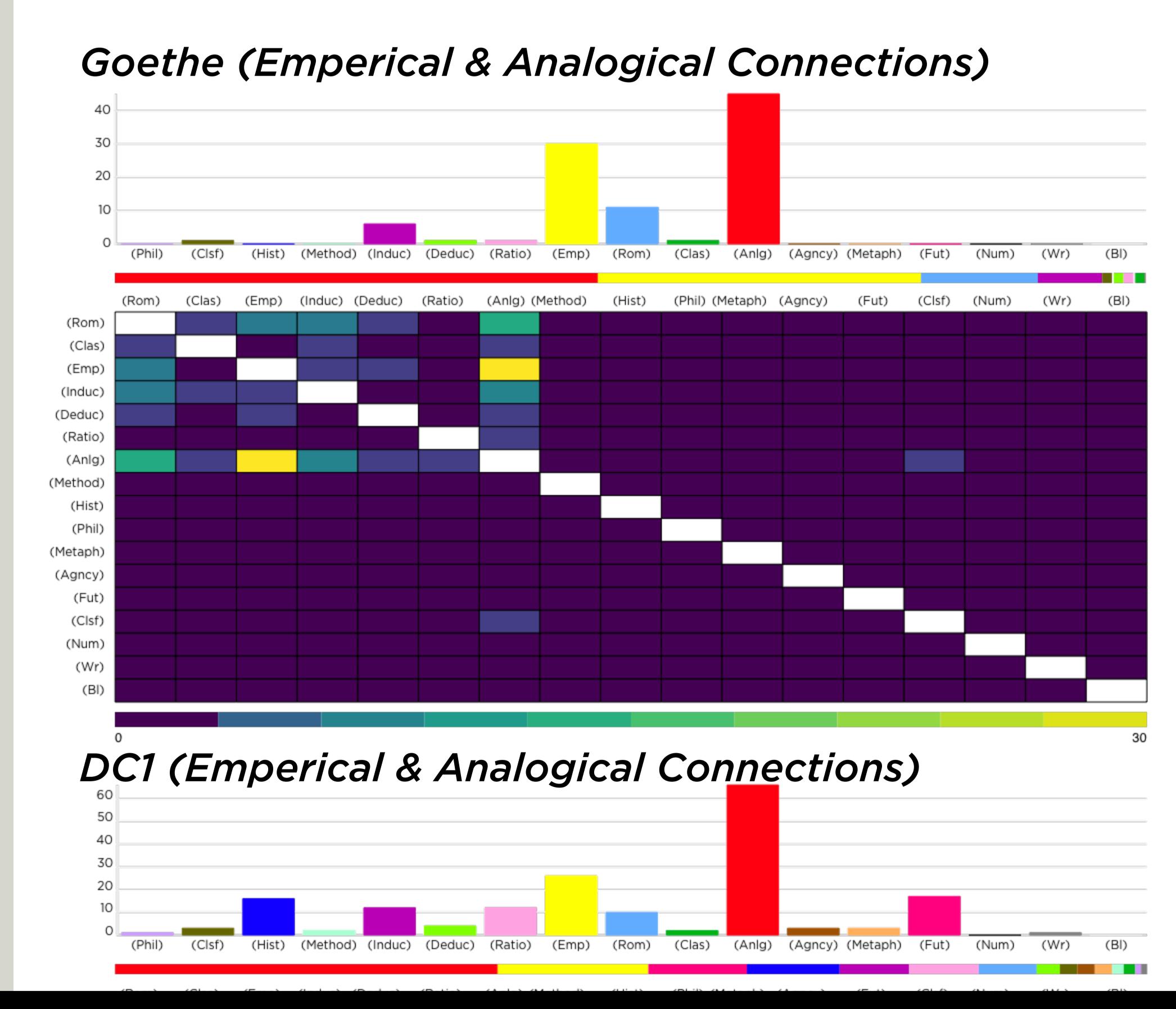
The graphs on the left compares the interaction between the Empirical element () and the Romantic element () in Goethe's Metamorphosis of Plants and De Candolle's Medical Properties of Plants. The bar graphs indicate that the ratio between the yellow and blue categories is almost identical in the two texts. However, the network graphs reveal that the yellow and blue categories interact in very different manners. For Goethe, the blue (Romantic () is completely absorbed into the yellow (Empirical ()). For De Candolle, some of the blue is associated with the yellow, but there is a clear separation between the two color groups overall. In other words, the Romantic category has an unusually strong bond with Empirical category in Goethe's text. What Goethe empirically experienced in nature may have been infused with Romantic language from the beginning. This Romantic infusion is more like a psychological or visual state, than a conceptual system that one adopts or rejects, which could indicate why the French audience felt uneasy with Goethe's language.



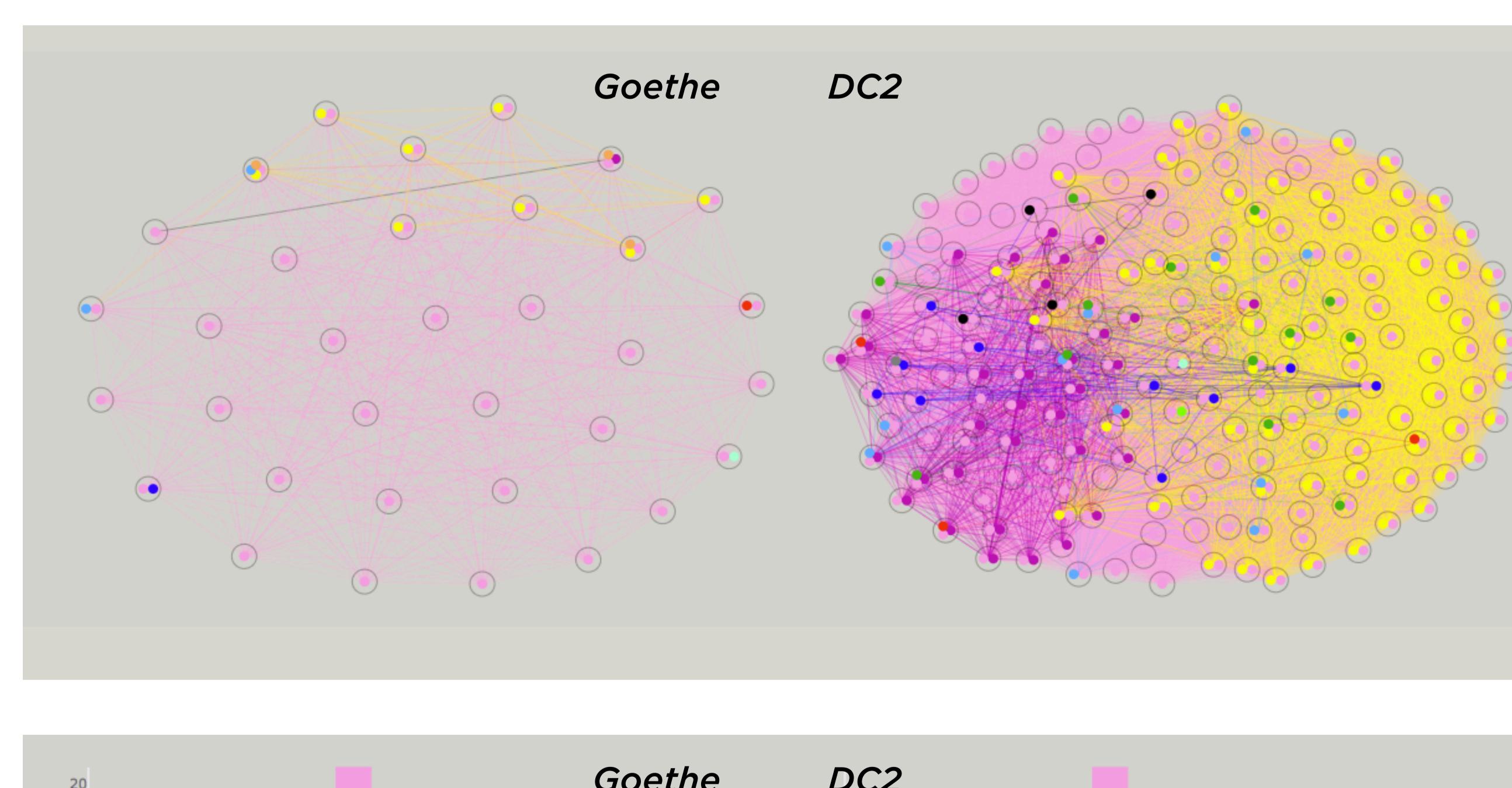
The graphs on the left focuses on the Romantic category () and shows how it interacts with other categories in Goethe's and De Candolle's texts. Confirming the observation just made, for Goethe, the blue heavily interacts with the yellow (Empirical ()), while its interaction with the purple (Inductive ()) is much lighter and pushed to the outskirt. For De Candolle, we see the opposite results: the heavily meshes in with the , while we see very light interaction with

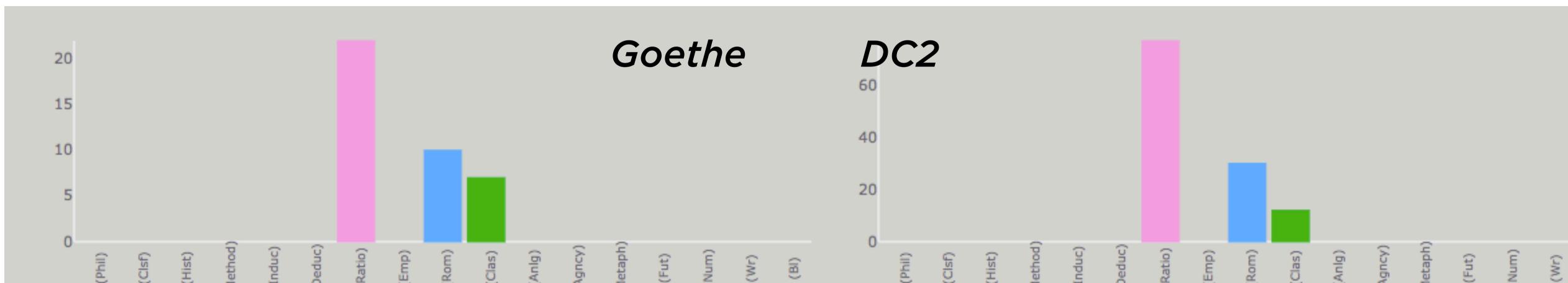
In Goethe's text, the dominant interaction between the blue and the yellow indicates that the Romantic elements are expressed more often through empirical observations, than through inductive conclusions. The inductive form of writing, which shows that the author is making a general statement based on sufficient examples, was lacking in Goethe's text, regardless of how many empirical evidences he was actually using. In contrast, De Candolle actively utilized the inductive writing (D) to express Romantic ideas, which could have led to the more positive reception by the French audience. This image of scientific rigor, however, did not depend on the actual amount of empirical evidences in the text, as Goethe's text contained even more of them than De Candolle's.

III. Goethe vs De Candolle I



IV. Goethe vs Decandole II

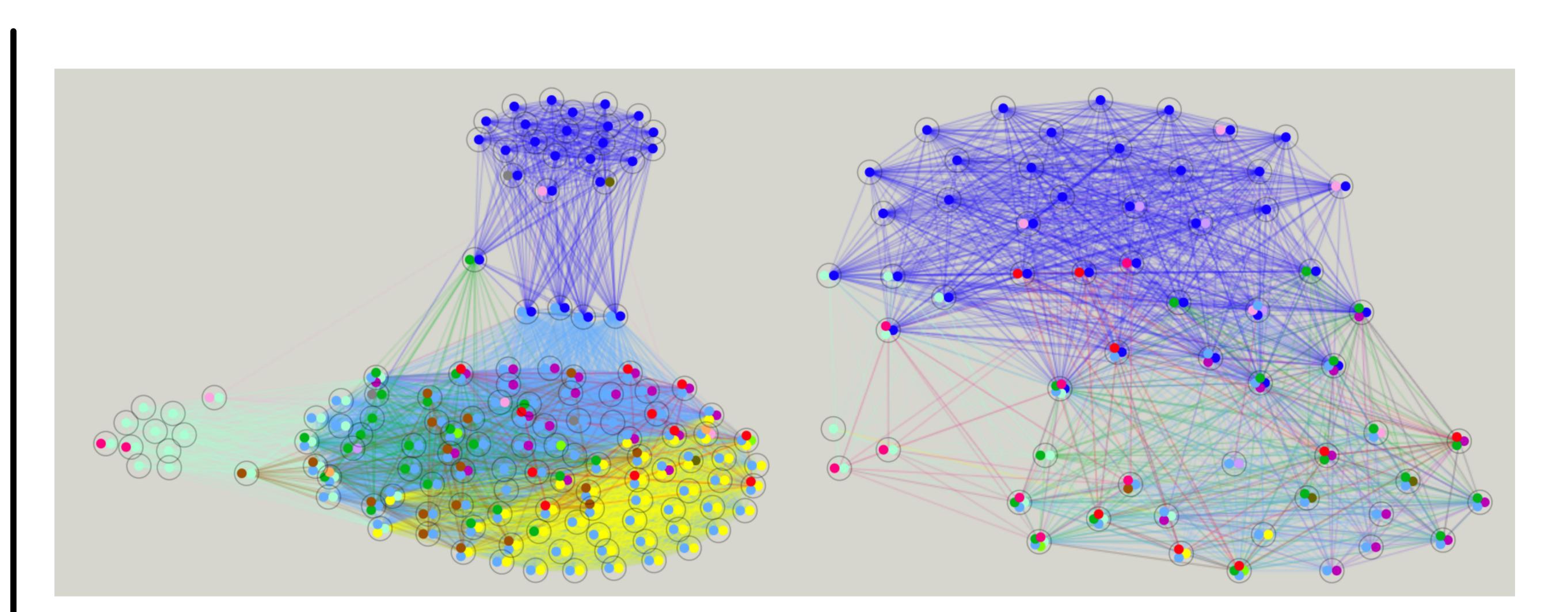




The network graphs on the left compares the behavior of the Rational/Speculative category () in Goethe's text to De Candolle's second text, "Botanical Geography." For Goethe, the graph is dominated by pink dots and lines, indicating that the sentences tagged with the Rational category are usually tagged with no other category. For De Candolle, ois heavily entangled with other colors, especially (Empirical) and (Inductive). In short, De Candolle tended to support his reasoning process with observations or inductive conclusions, while Goethe did not do so explicitly

The graphs on the left compare the relationship among the Rational/Speculative category (()), Romantic (()), and Classical (()) categories in Goethe's and De Candolle's texts. The bar graphs indicate that the ratios of these groups are similar in the two texts.

V. Goethe vs Decondole III



Finally, these visuals compare Goethe's text to De Candolle's chapter from Organography of Plants. The Historical/Descriptive category () and especially the Methodological category () play a negligible role in Goethe's text, but they are dominant in De Candolle's text, where he outlined his theory of plant symmetry and explained how this method compared to the existing methods. Much of the Romantic () and Classical () elements of the text seem to be absorbed by