NOVAFCSH
FACULDADE DE CIÊNCIAS SOCIAIS E HUMANAS
UNIVERSIDADE NOVA DE LISBOA

Art and science in depicting nature: building a botanical iconography through drawing and photography

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Tese de Doutoramento em História da Arte,
especialidade em Museologia e Património Artístico

janeiro 2019

Tese apresentada para cumprimento dos requisitos necessários à obtenção do grau de Doutor em História da Arte, especialidade em Museologia e Património Artístico, realizada sob a orientação científica da Professora Doutora Sandra Leandro, e coorientação da Professora Doutora Raquel Henriques da Silva, do Dr. Pedro Salgado, e do Professor Rob Kesseler.

Apoio financeiro da Fundação para a Ciência e a Tecnologia (FCT), através de Bolsa de Doutoramento com a referência SFRH/BD/100159/2014.

[DECLARAÇÕES]

Declaro que esta tese é o resultado da minha investigação pessoal e independente. O seu conteúdo é original e todas as fontes consultadas estão devidamente mencionadas no texto, nas notas e na bibliografia.

O candidato,

Sandra Maria Ribeiro Santos

Lisboa, 4 de Setembro de 2018

Declaro que esta tese se encontra em condições de ser apreciado pelo júri a designar.

A orientadora,

Sandra Leandro

Lisboa 20 de Agosto de 2018

Os coorientadores,

To my grandparents, my parents and my sister

for their love and care since always

ACKNOWLEDGEMENTS

The moment of writing the acknowledgments is one of the most meaningful in a hardworking and long process such as this one. And it is wonderful to realize that time and space are too limited to express my thank you to so many people who, in many different ways, have supported and cared for me. To my supervisor, Professor Doctor Sandra Leandro, who always believed in me and whose encouragement and insight were precious throughout these years. Sometimes, I feel that people come into our lives for special reasons, this is the case. I am very happy to know that I have gained a friend. To my co-supervisors: Professor Doctor Raquel Henriques da Silva, for the belief, the encouragement and all her efforts to help me keep my feet on the ground, they were essential for the learning that comes from this journey; Professor Rob Kesseler, for being always available and willing to help in any way he could, for sharing his passions and inspiring his work with art and botany, always with kind and encouraging words; Dr. Pedro Salgado, who received me as co-supervisor with open arms since day one and who inspires me with his love for art and Nature. To the Foundation for Science and Technology for the funding of my doctoral grant, which made it possible for this work to be developed as it was.

I also thank the institutions that made this research possible: to the Institute of History of Art, Faculty of Social Sciences and Humanities, Universidade Nova de Lisboa, and Central Saint Martins, University of the Arts London; to the Victoria and Albert Museum, namely the V&A Archive at Blythe House, The Prints and Drawings Study Room, and the National Art Library (a special thank you to Ruby, whose welcoming chats and smiles made the, sometimes very cold, days at the National Art Library, much warmer); to the archive of the Royal Botanic Gardens, Kew; to the Christopher Dresser Society; to the Ruskin Library and Research Centre and Professor David Ingram; to the Royal Photographic Society; to the National Library of Ireland; to the Hunterian Museum and Art Gallery; to the Centro Português de Fotografia (a special thank you to Dinora).

With all that I am, I thank my family and friends who live in my heart and who have welcomed me in theirs: To Dan, for his love and support in so many ways; for joining in my smiles and laughter, and for being a safe haven in the harder times (and to

Eva, for the exclamation marks, and to Leon). To my sister, Carla for everything she does and is, and that is so, so much. To those people with an immense place in my heart. Márcio, for his belief and support. Sofia, Lara, Marco Santos, Sylvain, Marco Rodrigues, Liliana, Ricardinho, Sandro, the friends from Leiria and from m|i|mo, especially Salette, Susete, Mário, Ana, Vanessa, and to my dear Mena, for the love and for making me feel that I am never alone, even when I "am", no matter if near or far. To Telminho and to Michele, Virgílio and Armanda, Rute and Bhagya who made my move to London so much easier and happier. To Patrícia, my friend and PhD colleague, thank you so much for your generosity with the logistics, and also for all the sharing and trust, I hope I can do the same when it's your turn. To Simone, for his help with the translation from the Italian. To my sweet Leonor, Ana, Célia, and Daniel, the colleagues who also became friends, for all support and sharing. To professor Alice Semedo, Professor Carlos Neves, Professor Susana Carvalho and Ana David, for the amazing words in their reference letters when applying for my doctoral grant. To all those whom I care so much for, who make me feel I am a truly lucky person with wonderful people in my life.

To João, my brother, who is no longer here but keeps living in me.

ART AND SCIENCE IN DEPICTING NATURE: BUILDING A BOTANICAL ICONOGRAPHY THROUGH DRAWING AND PHOTOGRAPHY

SANDRA MARIA RIBEIRO SANTOS

RESUMO

O tema proposto centra-se na relação entre Artes Visuais, Natureza e Ciência. Parte do desenho de observação e da imagem fotográfica, com ênfase na fotomicrografia, para estudar as dimensões artística e científica nas representações gráficas da botânica.

Com estudos de caso focados sobretudo no período vitoriano no Reino Unido e estendendo-se ao contexto português, a investigação proposta visa explorar as especificidades, paralelismos e complementaridades das variantes da imagem botânica enunciadas. A partir de uma análise de conjunto, propõe-se aferir o potencial dessas imagens para a construção de uma iconografia botânica mais completa e significativa para as áreas da Arte e da Ciência. Centra-se, por isso, no espaço de representação pictórica onde ambas disciplinas se encontram.

Este trabalho pretende contribuir para o fomento da produção científica nas áreas de interceção entre Arte e Ciência, associando-se à valorização artística e científica dos elementos da Natureza.

PALAVRAS-CHAVE: arte, ciência, botânica, desenho, fotografia

ABSTRACT

The research we will carry out is focused on the interconnection between Visual Arts, Nature and Science. It focuses on observation drawing and the photographic image, with emphases on photomicrography, to study the technical image and the artistic image in the graphic depiction of botany.

With case studies focused mainly on the Victorian period in the United Kingdom and extended to the Portuguese context, the proposed research seeks to explore the specificities, parallels and complementarities of these variants of the botanical image. With an integrative analysis as a starting point, we assess the potential of these images for the construction of a more complete and meaningful botanical iconography for the areas of Art and Science. It focuses, therefore, in the space of pictorial representation where both disciplines meet.

With this work, we aim to contribute for the promotion of scientific production in the areas of interception between Art and Science, associated with a growing artistic and scientific appreciation of Nature and its elements.

KEYWORDS: art, science, botany, drawing, photography

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LIST OF ABREVIATIONS

- **CPF**: Centro Português de Fotografia (Portuguese Centre of Photography)
- **DSA:** Department of Science and Art
- **GSD**: Government School of Design
- **HMAG**: Hunterian Museum and Art Gallery
- **NLI**: National Library of Ireland
- **RDS:** Royal Dublin Society
- **RPSGB**: Royal Photographic Society of Great Britain
- **RLRC:** Ruskin Library and Research Centre
- **TPJ**: The Photographic Journal
- **V&A**: Victoria and Albert Museum

INTRODUCTION

> The most beautiful experience we can have is the mysterious. It is the fundamental emotion that stands at the cradle of true art and true science.
>
> Albert Einstein in "The World as I See It", p.242

Einstein's quote, above, expresses the timeless fascination for the unknown ever so present throughout the history of mankind. It also resonates the eagerness to learning and discover, while faced with the unsurmountable knowledge we, as humankind do not yet possess. The present study couples that appeal of the unknown with the eagerness to understand and to convey the intricacies of the structures and mechanisms of Nature. To uncover yet another portion of the possibilities it entails, and to explore them from a perspective where Art and Science connect.

The link between Nature and Art is broadly studied in the extant literatures[1]. It is, therefore, undoubtedly transversal to Art, and also an immense source of diversity. Part of the extant literature on the topic also covers the botanical side of Nature in its connection to Art. Nonetheless, studies which systematically identify and list the botanical specimens featured in an extensive visual universe, (regardless of the medium e.g. painting, drawing, photography) are extremely rare. The field would also benefit from a study of the botanical image which articulates its theory (from conceptualisation to artistic training) with its practice (from sketching from Nature to the pictorial finalised work), and through different mediums and techniques, preferably those less researched within the topic. Not from a purely scientific perspective nor from an exclusively artistic one, but a study focused on the territory where Science and Art find a common ground.

Our research focuses on the connection between Art and Science in regard to botanical visual records. It particularly explores the botanical image through observation drawing, conventional photography and photomicrography from 1837, throughout the Victorian period, and until the 1960s. The core of the research is supported by case

[1] As we will demonstrate in the review of literatures.

studies. These are predominately British, with one case study situated within the history of photography in Portugal. We find that four important factors sustain the worthiness of this research. Firstly, the need for appreciation and preservation of the natural world, its artistic and natural heritage. Secondly, the growing relevance of interdisciplinary and collaborative research practices towards the understanding and appreciation of Nature, its elements, structures and mechanisms. Thirdly, the identification of research gaps within the topic. And, lastly, the determination that this study will fill those research gaps and provide a valuable contribution to the field. Considering these challenges, we propose to answer the following questions:

a) May we clearly identify a consistent symbiotic approach to Botany, joining scientific understanding and artistic intent, and vice-versa, from Victorian times to the early years of the 1900s?

b) If so, what were the contributions of British Art and Design training for building a botanical artistic-scientific iconography during this period? How was it advocated and put into practice, and by whom?

c) Based on a case study, what evidence may be found to assess/attest this symbiosis in artists' preparatory sketches?

d) Expanding from the British context, can an example of this connection be found in the Portuguese history of photography, as well?

e) Expanding from the mid-1800s to the mid-1900s, what evidence may be found to assess/attest this symbiosis in British photomicrography?

f) What botanical specimens, elements, structures and features are present in the whole of the pictographic universe studied?

g) Based on this research and its results, can the study of botanical images which were grounded on knowledge and understanding of science but produced with an essentially artistic intent, and *vice versa*, enrich and inform both Art and Science? If so, what are the contributions and implications of a shared iconography between the two fields?

In light of this, our main goals are:

a) To demonstrate the existence of a consistent symbiotic relationship between Art and Science in regard to the observation, understanding and visual representation of Botany, during the Victorian period until the mid-1900s.
    - To clarify the individual and collective contributions of its protagonists to the pictorial botanical universe of this period, establishing John Ruskin and the Pre-Raphaelites as the lead examples.

b) To attest the contributions of British art and design training for building a botanical artistic-scientific iconography, through the integration of botanical studies within the curriculum of art and design education, its main figures and methods.

c) To consubstantiate the connection between Art and Science in the work of Charles Rennie Mackintosh and Margaret MacDonald, adding to the extant study of their botanical drawings in an all-encompassing perspective.

d) To construe the content and significance of the botanical pictorial universe in the photographic work of Aurélio da Paz dos Reis.

e) To evidence the gradual development of pictorial/artistic photomicrography as part of the dialogue between Art and Science in regard to the botanical image in photography.
    - To attest the contributions of photomicrography towards the enrichment of botanical iconography and the connection between science and art.

f) To systematise and present the taxonomic information regarding the botanical elements present in the visual universe covered by our research.

g) To demonstrate the contributions and implications of botanical iconography as a common ground for Art and Science, supported by the present research and its results.

h) To construct and deliver a worthy contribution to the advancement of interdisciplinary research practices connecting Art and Science, and their role in promoting the appreciation and preservation of Nature.

This thesis was written in accordance with the "Chicago Manual of Style 16th edition Author-Date" as the adopted bibliographic style. In addition to Introduction, Methodology, State of the Art and Conclusion, the thesis structure is organized in 3 core sections, each being subdivided into chapters and subchapters. Moreover, a separate volume presents the documental attachments and appendices referenced throughout the body of the thesis. Accordingly, within the text, the terms "figure" and "table" refer to images and tables in-text, while "doc." and "appendix" refer to appendices and documents in the separate volume[2].

The study begins with the review of literatures, which is structured by topics within the broader thematic. Firstly, on a more transversal note, it addresses the connection between Art, Nature and Science in nineteenth century Europe, setting the core of the chronological context of our own research. Secondly, it goes on to specifically address Botany in the centre of the connection between Science and Art: it analyses what has been written on the relation between technical and artistic in regard to the botanical image[3]; and finally it explores the extant literatures on botanical visual records in drawing and photography. The State of the Art is followed by the exposition of the Methodology.

Section 1 is entitled "Art, Science and the Study of Nature in British Art: Ruskin and the Pre-Raphaelites". It provides introductory analysis of the connection between Art, Science and the Study of Nature in British Art. It takes as references the work of five of the most central and influential figures in the context of British Art in the second half of the nineteenth century. Firstly, we turn to the thought of John Ruskin on the

[2] We were unable to obtain information on the dimensions of all the works of art presented in the attachments volume, nonetheless we have adopted the criterion of including this information whenever present in catalogue/inventory records.

[3] It is very important to note that, although our specific topic is centred on botany, the study and practice based on botanical subjects was absolutely not the only way the connection between art and science was implemented and encouraged among the training and practice of the arts. On the contrary. Art students, whether in the courses and practice of Fine Arts or Decorative Arts, the study and practice based on human anatomy, for example, is very illustrative of this link. Furthermore, the study and training withf animal specimens was also expressively included in the courses of artistic instruction. The annual reports of the Science and Art Department, for example, contain valuable information that confirms it, of which we simply highlight the botanical side. As we will see, further ahead, in the revision of literatures, the advancements of sciences (e.g. botany, to zoology, medicine or geology) clearly fuelled artistic interests and endeavours, of both prospective and established artists and designers.

connection between Botany and Art as well as to his own work as a botanical draughtsman to introduce and contextualize the core of our research: The Victorian period. We then take Ruskin's own opinions to guide us as we turn to the Pre-Raphaelite Brotherhood to explore the botanical features of their pictorial work in an artistic-scientific point of view. In the work of the Pre-Raphaelites we focus primarily on paintings, namely of William Holman Hunt, John Everett Millais and Dante Gabriel Rossetti, whilst on John William Waterhouse, we introduce sketchbook/observation drawing, as well. Thus leading the study towards drawing, within the foundation of artistic training and practice, further developed in the following section.

Section 2, presents the first group of case studies, which compose the core of the research. Firstly, we address the role of Botanical Studies in British Art and Design Training from the foundation of the Government School of Design, London (1837) until 1910. This analysis is mainly focused on the cases of London and Dublin. Expanding from this, we deepen the study of Christopher Dresser, as lecturer on Botany at the Government School of Design and the Department of Science and Art. This study is based on the articulation of three key aspects of his work: his concepts of Rustic and Suggestive Botany and their influence on Design; the ten articles he published in *The Art-Journal* (1857 – 1858) on "Botany: as adapted to the arts and manufacture"; and, finally, the set of *Botanical Diagrams* he created for the Department of Science and Art in the 1850s, and kept by the Victoria and Albert Museum (V&A)[4]. The final case study in this section focuses on the botanical drawings by Charles Rennie Mackintosh, some co-authored by Margaret MacDonald. By the end of the chapter, we succinctly refer to a selection of the artists' finalized ornamental works and the botanical elements there present. Section 3, presents the second group of case studies, on the topics of botanical photography and botanical photomicrography. Firstly, we focus on the botanical-themed work of a Portuguese photographer, Aurélio da Paz dos Reis, known for his passion and practice of floriculture, and overall appreciation of the vegetable kingdom,

[4] Dresser produced these diagrams for the Government School of Design, while still at Marlborough house. In 1856 the GSD moved to Kensington, becoming the National Art Training School, where Dresser continued to lecture. Later, in 1899, the South Kensington Museum was renamed Victoria and Albert Museum, where Dresser's diagrams are currently kept.

particularly flowers. Secondly, we focus on the evolution photomicrography as a hole and its relevance in the popularisation of science and in the connection between Science and Art, primarily based on the study of the issues of *The Photographic Journal*[5] (TPJ) of the Royal Photographic Society of Great Britain (RPSGB)[6]. We also included the study of two sets of photomicrographic collections kept by the V&A, as exemplificative of the potential relevance for both artistic and scientific fields. Finally, we explore the progress and acknowledgement of pictorial (or artistic) photomicrography. Within the core of this analyses are the intricacies and the achievements it entailed, as well as the place of botanical photomicrography in joining Art and Science, in theory and in practice. This marks the end-point of the case studies, and precedes the conclusion.

In a nutshell, we consider that our research adds to the existent literatures by providing an articulated perspective which positions the botanical image in the centre of the connection between Science and Art, and explores it from theory to practice. It is primarily supported by a series of diverse sources, from the analysis of artistic curriculums, periodicals, official institutional documents and correspondence, to the attentive observation and analysis of pictographic works. It does so, also, by studying botanical iconography through less conventional mediums and techniques which are, to some extent, under-studied within the context of History of Art. Through a series of case studies, we focus on observation/sketchbook drawing, botanical photography and botanical photomicrography. In regard to drawing, it is important to clarify our focus is not scientific illustration *per se*. Our focus is the artist's preparatory work, studies and sketches of plants featured in sketchbooks and unbound drawings, visual annotations of vegetable specimens, in short, visual botanical records of the artist's perceptions and training. In this case we present an all-encompassing study of these drawings which seeks to complement the existent research. Similarly, in regard to photography and to photomicrography, it is not our aim to focus on either their well-defined artistic and/or

[5] Between 1853 and 1857 it was denominated *The Journal of the Photographic Society of London.* It was renamed *The Photographic Journal* in 1858, the title that remains to this day.

[6] For the context of the thesis we took into account the issues between 1853 and 1964. However, we have researched all the issues from 1853 until 2013 while preparing the paper: Santos, Sandra. 2017. "Zoom: Technology, Science and Art in Botanical Photomicrography." Filter for photograph: Photosynthetic (7):112-119.

scientific facets, but to study the territories where both sides exist on their own, as well as the ones where they actually touch and/or there is the potential for a common ground.

METHODOLOGY

This study began with a comprehensive literature review where the underlying topic was explored, particularly within the context of Art and Science in nineteenth century Europe. After identifying the most relevant scientific production on the theme as well as adjacent and similar topics, the research gaps were identified, in order to soundly establish the contributions of the study to the topic of the connection between Art and Science, with particular emphasis on Botanical visual records. More specifically sketchbook drawing; photography and photomicrography which constitute the core of the study in the form of case studies. Research was developed in Portugal and, for the most part, in the United Kingdom and integrated in two host institutions: the Instituto de História da Arte da Facudade de Ciências Sociais e Humanas da Universidade Nova de Lisboa (Institute of History of Art, Faculty of Social Sciences and Humanities, Universidade Nova de Lisboa), integrated in the doctoral programme in History of Art, specialisation in Museum Studies and Artistic Heritage; and Central Saint Martins, University of the Arts London, integrated in the Postgraduate Visiting Student Programme. The initial part of the work aimed to demarcate the chronological boundaries of the study[7], as well as construct a consistent theoretical framework for the research. Figures 1 and 2 present the development of the adopted methodology and the final structure of the thesis, respectively. Although sections and respective chapters and subchapters vary in medium and specific topic within the theme (painting, drawing, photography, photomicrography, artistic training and artistic practice), there is a core of research methods and strategies common to all:

- Digitizing/photographing pictorial and written documents;
- Transcribing manuscript sources;
- Writing, systematising, analysing and cross-referencing research notes;
- Cataloguing and organizing images, including filling metadata;

[7] The option for not setting overly rigid chronological barriers for the study is justified by the chronology of the relevant documental sources found, which extends to the early - mid-twentieth century.

- Gathering and organizing documental and bibliographic references;
- Image editing;
- Using botany and biology specialised databases, as well as botanical illustration scientific publications (e.g. Curtis' *Botanical Magazine*), to assist identification of botanical species portrayed within the pictorial universe we explored in this study.[8] The most relevant databases consulted were the following:
    - The Botanical Society of Britain and Ireland
    - Online Atlas of British & Irish Flora
    - Royal Horticultural Society, UK
    - Royal Botanic Gardens of Kew botany collection database
    - NaturePlus: Community: Identification - Natural History Museum
    - National Biodiversity Network, UK
    - The IUCN Red List of Threatened Species
    - Catalogue of life;
    - Bio-diversity Heritage Library
    - Smithsonian National Museum of Natural History
    - Southwest Environmental Information Network

[8] This procedure was transversal to all chapters of the thesis where plant identification was carried out, in order to obtain as accurate identifications as possible. Positive ID can be difficult and even impossible in many cases, especially where there is a great lack of elements, details or definition of the depicted plant to provide enough data for identification. This may also happen in regard to plants which with very accentuated similarities to others. In case of unclear identification within the text we add [?], to convey uncertainty.

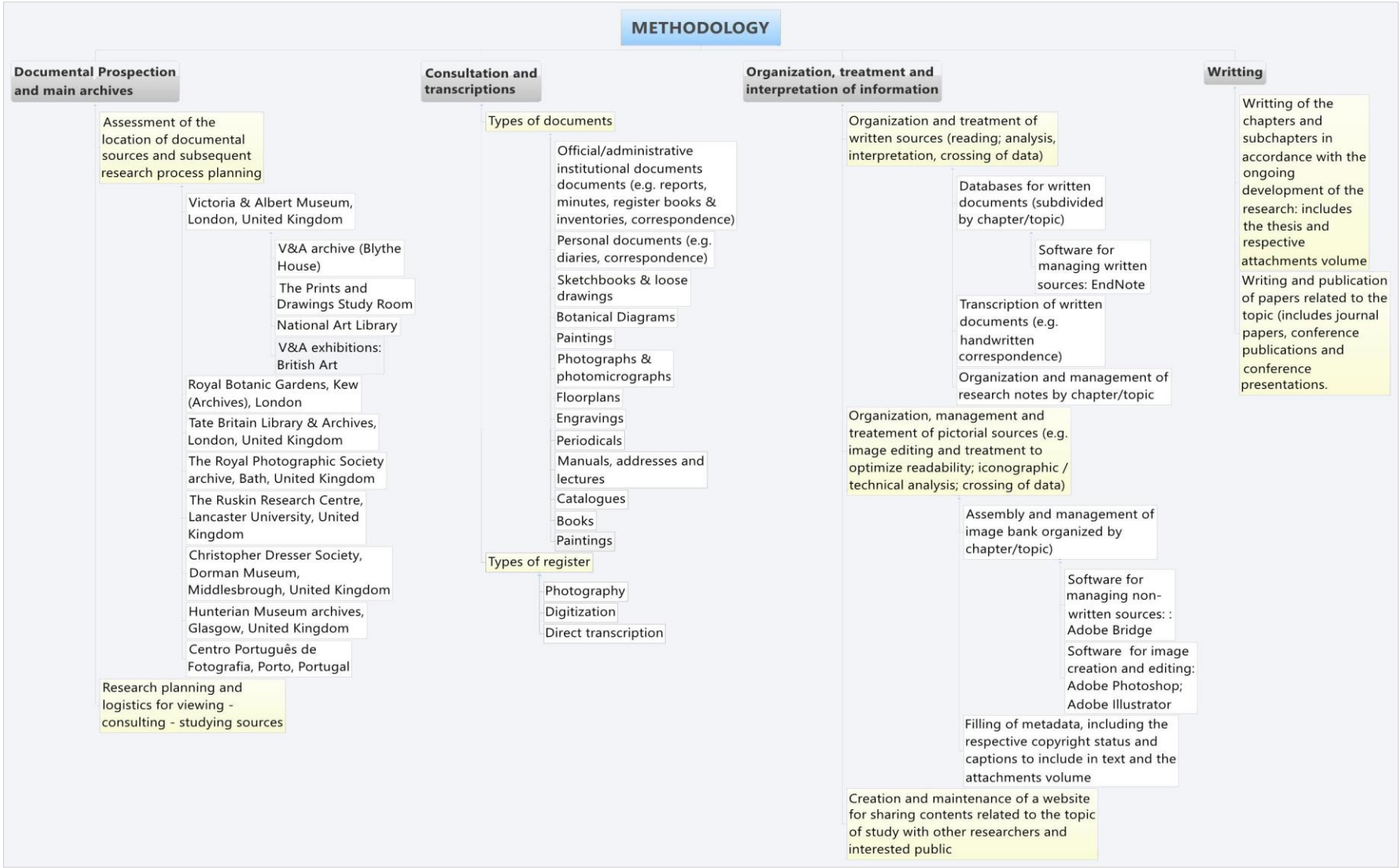

Figure 1. Diagram illustrating the research design and methodology

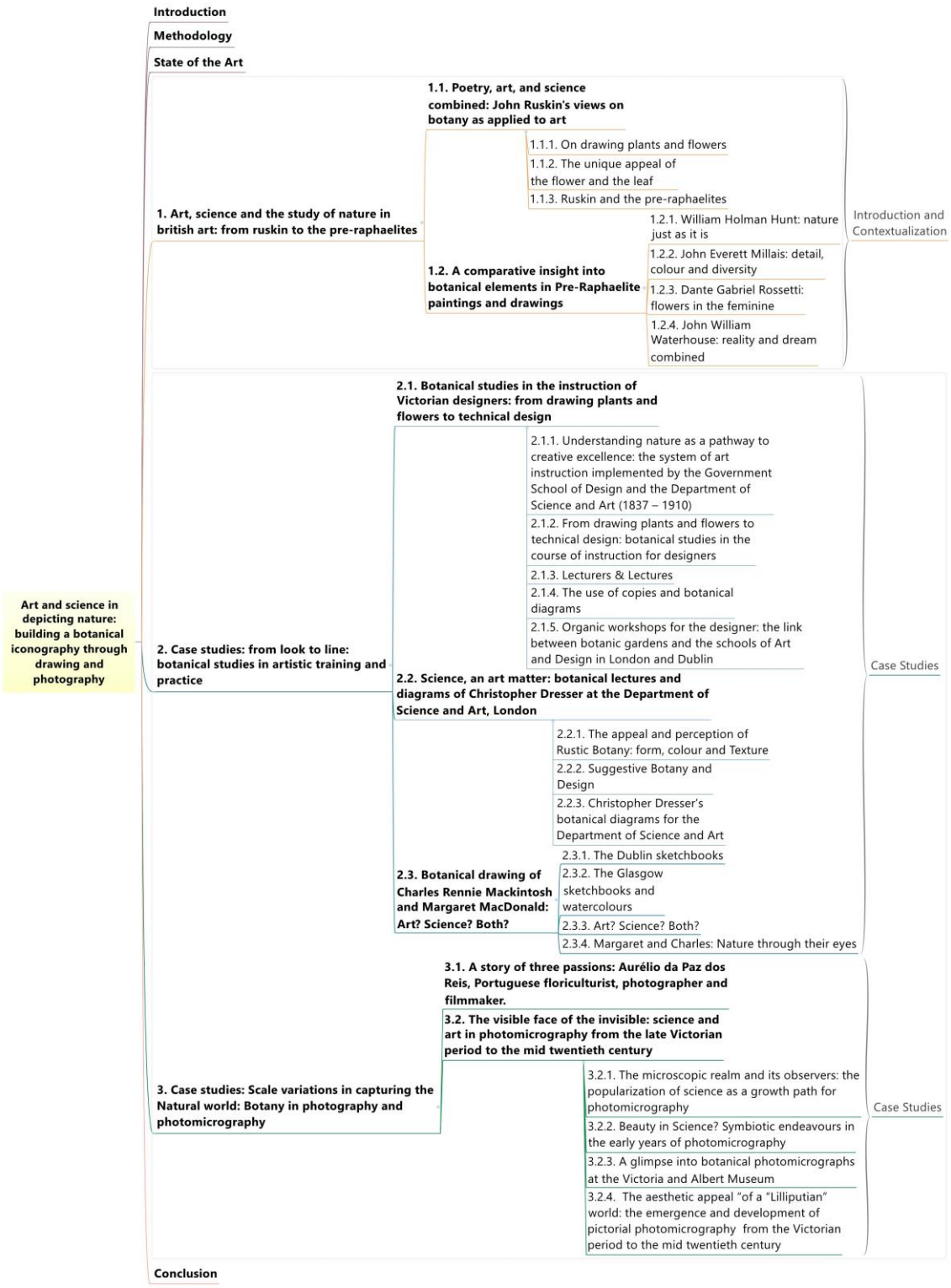

Figure 2. Thesis structure

The start of the Victorian period and the foundation of the Government School of Design in Somerset house, London, set the starting point of this study in the year 1837. However, and although the study was primarily focused on the Victorian period (1837 – 1901), its chronological scope is not rigidly confined to the reign of queen Victoria. The relevance of investigated sources which document the early years of the twentieth century and, in the specific case of photomicrography, up to the mid-1900s, justify the option for extending the chronological scope beyond the transition from the nineteenth to the twentieth century. On the whole, the relevance of the findings determined the chronology of this study and not the inverse, making this a predominantly theme-based approach[9]. We find this to have been the most efficient approach, as it allowed for a more comprehensive and evolutionary understanding of the topic, as well as the intricacies it encompassed within the dialogue between Art and Science, primarily though botanical drawing, conventional photography and photomicrography, throughout an extended period of time.

After determining the core thematic and subjacent topics to develop in the study, a prospection work was realised in order to comprehensibly identify the documents to be consulted in the respective archives, as well as the relevant bibliographical sources. This work was mainly based on catalogue searches both online and *in situ,* from various institutions, in Portugal and in the United Kingdom.

We located, consulted, analysed and interpreted written and pictorial sources and adopted an organization system consistent with the two typologies. Written sources were organized and managed through the software *EndNote,* which allowed for an optimized management of references and quotations throughout the writing process (figure. 3). Pictorial sources were catalogued and managed using *Adobe Bridge* software. This allowed for an optimum management of metadata and also the direct importation

[9] Moreover, the specific chronology of each case study, both relating to drawing and photography, vary in accordance with the respective sources found within the period between the third decade of the nineteenth century and the mid-twentieth century.

of pre-filled captions into *Adobe InDesign* software, where the attachments volume was assembled (figures 4 and 5).[10]

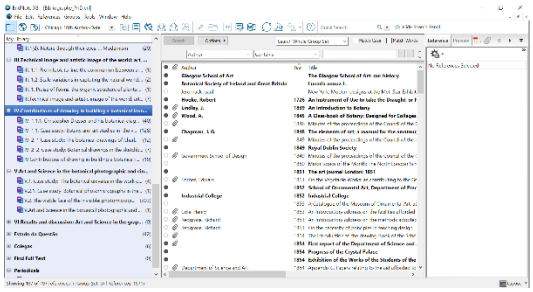

Figure 3. Screenshot: EndNote References management.

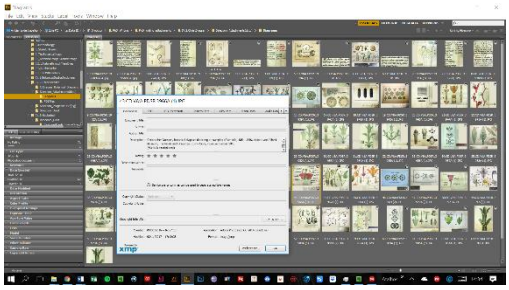

Figure 4. Screenshot: Adobe Bridge Image management.

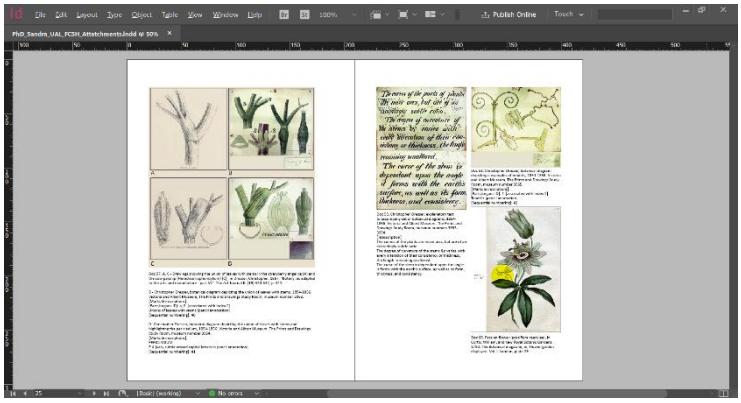

Figure 5. Screenshot: sample of appendages volume.

The first section, pertaining the contextualization and composed by chapters 1.1. and 1.2, was based on the analysis of John Ruskin's writings, cross-referenced with his botanical work, namely his botanical compositions, for the most part, drawings, kept by the Ruskin Library and Research Centre. The second part was based on an extended analysis and identification of botanical elements of Pre-Raphaelite paintings and drawings, focused on the founders of the movement, Hunt, Millais and Rossetti, and the late Pre-Raphaelite John William Waterhouse. It resulted from the image analysis complemented with research on botanical databases in order to assist identification (figures 6 to 8).

[10] Given the vast quantity of documents found, both written and non-written, an effective and up to date management of text and image records is crucial. It allows to keep track of all documental references and respective metadata, in order to access them easily and rapidly. Software that synchronizes with the text editors and image editors (e.g. Word, Adobe InDesign, Adobe Photoshop) is also a valuable asset when dealing with a large quantity of records to be referenced.

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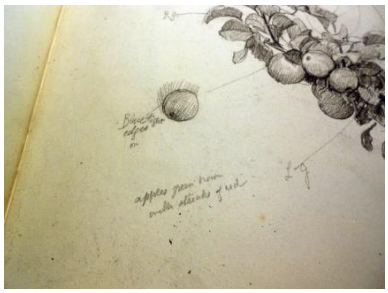


Figure 6. Folio of Sketchbook by John William Waterhouse, Victoria and Albert Museum, Prints and Drawings Study Room, E.1112-1863.

Figure 7. "The Bride" and "Beata Beatrice", by Dante Gabriel Rossetti, exhibited it Room 1840, Tate Britain, London.

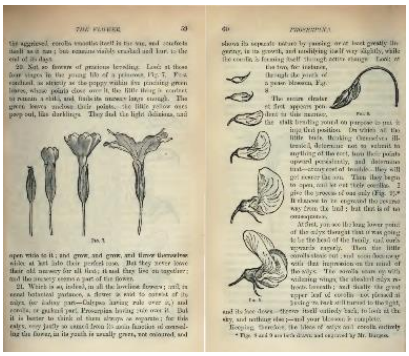


Figure 8. Extract from the lecture Proserpina by John Ruskin, 1874.

Research work for the first section of case studies (section 2, chapters 2.1 to 2.3) was more extensive and, therefore, a larger task than originally anticipated. This was primarily due to the type and quantity of documentation found and the fact that most of it was not digitized, and thus, had to be photographed, digitized (figure 9) and/or transcribed[11] (e.g. manuscript documents; the diaries of Henry Cole; drawings; architectural plans; art periodicals, especially *The Art-Journal*; extensive reports_, minutes and other official sources documenting the activity of the Department of Science and Art and its schools and the South Kensington Museum; correspondence between the Royal Botanic Gardens, Kew and the Department of Science and Art, throughout a period of over 50 years. Nonetheless, it also proved to be much more prolific than initially anticipated, resulting in the most substantial chapter in terms of original contributions of the study. Something similar happened with the second cluster of case studies, namely the subject of photomicrography and its development throughout the Victorian period to the mid twentieth century, with special focus in botanical subjects. After the necessary photographic capture/scanning, *in situ* at the abovementioned archives[12] we proceeded to organize, transcribe, systematise, analyse and interpret the written and pictorial information gathered. That is to say, build the

[11] The latter in regard to manuscript documents.

[12] Since the totality of the Indexes of the annual reports of the Department of Science and Art were digitized in the course of our investigation we compiled all the scanned files in a searchable pdf file and supplied it to the V&A archive, Blythe House, to assist other researchers.

body of our research. The most relevant documents (e.g. correspondence, extracts from periodicals, original drawings, floorplans; extracts from reports) are compiled in the volume of attachments accompanying the thesis.

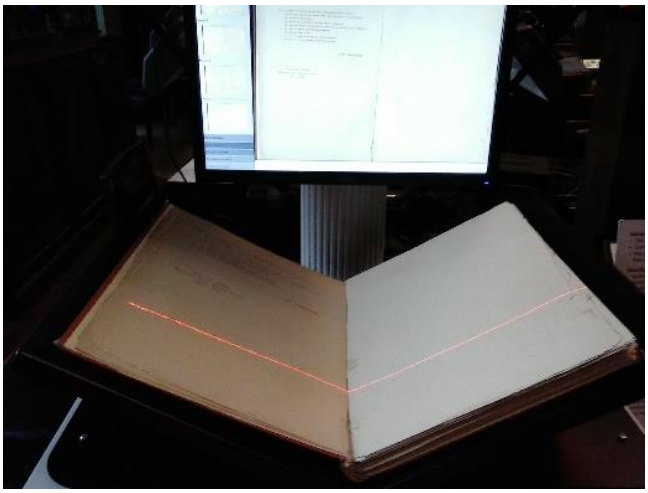


Figure 9. Archival work: digitization of documents at the National Art Library, Victoria and Albert Museum.

A similar survey work, consultation, photographic record/scanning, analysis and interpretation, was carried out for the case study regarding the role of Christopher Dresser as a lecturer of Botany at Department of Science and Art. We resorted to the archives of the Victoria and Albert Museum, in this case, the collections stored in the Prints and Drawings Study Room, containing Dresser's botanical diagrams:

- Prints & Drawings Study Room, level D, case BOX, shelf 230
- Prints & Drawings Study Room, level D, case LD, shelf 26
- Prints & Drawings Study Room, level D, case LD, shelf 11
- Prints & Drawings Study Room, level C, case TOASTRACK

All the diagrams were photographed and most required image editing to improve the legibility of Dresser's pencil annotations. The images of the diagrams attached to the thesis present the originals and the detailed enhanced views of the contained pencil inscriptions (figure 10). This information was further complemented by relevant documentation consulted during visits to the V&A Archive, Blythe House, the National Art Library; as well as the records of the Royal Botanic Gardens, Kew, and The Christopher Dresser Society; among other miscellaneous sources duly referenced within

the body of the thesis. We stress the importance of a series of eleven articles published by Dresser in the periodical *The Art-Journal*, between 1857 and 1858, entitled "Botany: adapted to the arts and manufacture", an essential source to complement the pictorial information contained in his botanical diagrams.

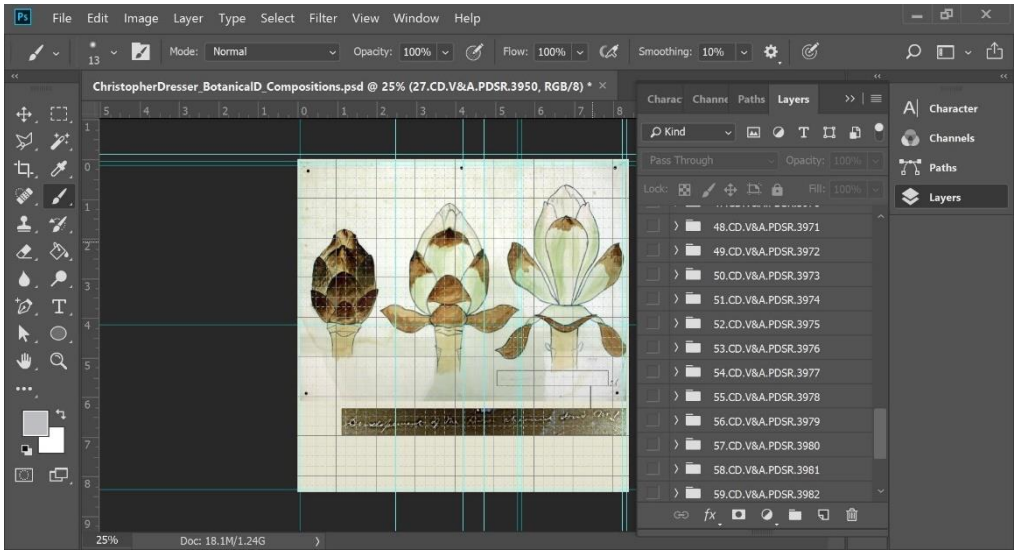
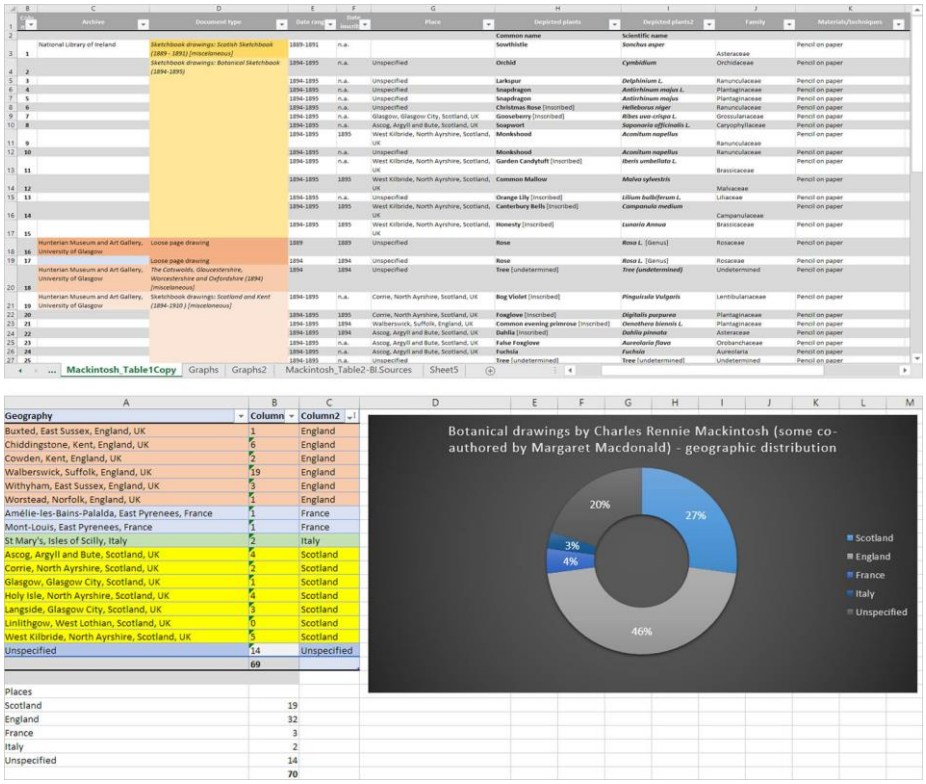


Figure 10. Image editing in Adobe Photoshop.

The third case study, still specifically connected to the role of botanical studies in training and artistic practice explores a set of 70 botanical drawings, the majority authored by Charles Rennie Mackintosh and a minority co-authored by Margaret Macdonald Mackintosh. These drawings are held by the National Library of Ireland and the Hunterian Museum and Art Gallery, Glasgow, Scotland. We compiled the existing information about the collections and organized the data required for a thorough analysis. The taxonomy of unidentified species was completed, based on various databases dedicated to biology/Botany, previously mentioned. We also collected scientific illustration images of a selection of the drawings of the couple Mackintosh, in order to assist the analysis of artistic and scientific aspects of the designs. Recurring to scientific publications, with particular focus on *Curtis's botanical magazine* (several volumes published in the 19th and 20th centuries), as well as other works, accordingly referenced in the body of the text.

Since most of these drawings contain inscriptions regarding the location where they were created (most of them are distributed by travel sketchbooks from trips of within the United Kingdom, and another group is comprised of watercolour designs).

This data allowed us to a map the botanical drawings and, hence, locate the botanical species in time and space (figure 11).



Geography	Column	Column2
Buxted, East Sussex, England, UK	1	England
Chiddingstone, Kent, England, UK	6	England
Cowden, Kent, England, UK	2	England
Walberswick, Suffolk, England, UK	19	England
Withyham, East Sussex, England, UK	3	England
Worstead, Norfolk, England, UK	1	England
Amélie-les-Bains-Palalda, East Pyrenees, France	1	France
Mont-Louis, East Pyrenees, France	1	France
St Mary's, Isles of Scilly, Italy	2	Italy
Ascog, Argyll and Bute, Scotland, UK	4	Scotland
Corrie, North Ayrshire, Scotland, UK	2	Scotland
Glasgow, Glasgow City, Scotland, UK	1	Scotland
Holy Isle, North Ayrshire, Scotland, UK	4	Scotland
Langside, Glasgow City, Scotland, UK	3	Scotland
Linlithgow, West Lothian, Scotland, UK	0	Scotland
West Kilbride, North Ayrshire, Scotland, UK	5	Scotland
Unspecified	14	Unspecified
	69	

Places	
Scotland	19
England	32
France	3
Italy	2
Unspecified	14
	70

Figure 11. Excel document showing the treatment of data regarding the botanical drawings and watercolours by Charles Rennie Mackintosh and Margaret Macdonald Mackintosh.

The second group of case studies focuses on the botanical image in photography. The first case study explores the image of flowers in the photographic work of Portuguese filmmaker and photographer Aurélio da Paz dos Reis. This chapter was predominately based on visual analysis of the images selected from the collections. These images (figure.12) were researched at Centro Português de Fotografia (Portuguese Centre for Photography), Oporto, Portugal. From a pre-selection of 173 photographic images (the majority stereoscopic glass negatives), we selected a group of 103 images containing botanical specimens. The entire selection was listed and fully catalogued with metadata elements such as captions and credits.

Figure 12. Sample of selected images from the photographic collections of Aurélio da Paz dos Reis, Centro Português de Fotografia (Portuguese Centre of Photography).

The last case study addresses botanical photomicrography, based on British documental sources. The main objective was to gain and communicate our insight into the path photomicrography, from its exclusive association with scientific practices in its early years to the growing acknowledgement of its artistic potential, realized with the emergence and development of Pictorial photomicrography. To this end we analysed 120 issues of *The Photographic Journal*, the official publication of the Royal Photographic Society of Great Britain[13], between the years 1853 and 2013[14] (figure 13), setting the chronological boundaries of our study until the 1960s. The references to photomicrography, are found in variable extents and relevance, from extensive articles, to listings of exhibitions and adverts for photomicrography contests and awards. An integrative comprehensive analysis of all the data collected led to the development of one of the most significant contributions of our research. It has proven to be expressively insightful in regard to the history of photomicrography itself, as well as the interconnections between Art and Science through photomicrographic images. The data

[13] The choice for *The Photographic Journal* as key source of information followed a combination of three main criteria. The first was its well-established reputation and credibility. The second was the fact that it is one of the world's pioneer journals of photography. The third criterion was the continuity of its publication ever since it was founded in 1853. This allowed for a consistent approach on the subject of photomicrography throughout an extended and continuous period of time within a major key source of information.

[14] For the thesis itself we have used the data until 1964, however, we extended the study to the year 2013 in order to produce two journal papers on the topic, published in 2015 and 2017, respectively: "Crossing borders: the path of photomicrography towards artistic recognition" and ""Zoom: Technology, Science and Art in Botanical Photomicrography".

from *The Photographic Journal* were complemented with other sources referenced throughout the body of the text (e.g. nineteenth and twentieth centuries technical manuals, photography and microscopy periodicals, such as the *British Journal of Photography* and *The Journal of the Royal Microscopical Society)*. Aside from the above mentioned sources, this chapter also comprises the study of two groups of photomicrographic work kept by the Victoria and Albert Museum.

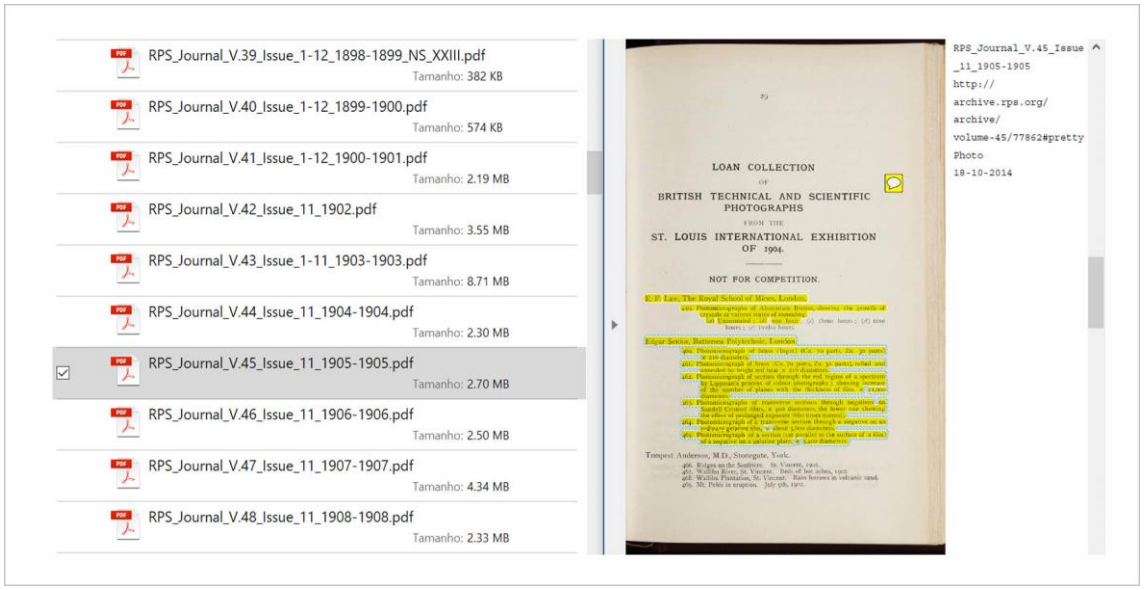


Figure 13. Files containing samples gathered from *The Photographic Journal*, and sample of, volume 45, issue 11, 1906, containing mentions to photomicrography in the "Loan collection of British Technical and Scientific Photographs, from the St. Louis International Exhibition of 1904".

The final stage of the work is based on the systematisation of all information and the thorough reflexion in regard to its results and aims, in order to summarise and demonstrate the contributions of our study for the area in which it is integrated, primarily the relevance of botanical drawing, photography and photomicrography to the construction of a botanical iconography in the hybrid territory where Science and Art communicate.

STATE OF THE ART

The connection between Art, Nature and Science in nineteenth century Europe

The link between Art and Nature is a constant throughout art historiography. With variable degrees of relevance and diverse approaches, we find it in the ornaments of medieval illuminated books, in the Renaissance with the study of Leonardo da Vinci, for instance; in the works on Goethe and his poetic-artistic-scientific views on Nature; in the studies on the Romantics and their search for the sublime; or in the studies on the Art nouveau movement and its biology- inspired motifs; to quote a few examples. What is more, the magnitude of the topic, combined with all its multidisciplinary potential, allows for a vast and varied range of possibilities for its study. In recent years, we have witnessed a significant increase of studies focused on the scientific dimension of this alliance, including the connection between artistic and scientific endeavours regarding the subject of Nature.[15] With meaningful exceptions[16] those which do cover it, as we will see, generally integrate it in five main contexts: botanical illustration, the symbolism of plants in art, camera-less photography (cyanotype), the botanical visual universe of Karl Blossfeldt and contemporary artistic practices. Others also allude to the science-art connection, their dichotomies and parallelisms in regard to representing Nature's truth, generally as part of broader narratives.

As explained by Bozal (2000, 4), Nature was and is still a preferred topic in Visual Arts. Furthermore, what emerges from this intimate relationship between Art and the Natural world is a rich and diverse universe to explore, as it originates from various different intents; unified by one great common factor but also very heterogeneous in the ways it is conceptualized, developed and the outcomes of each of those undertakings.

[15] (Armstrong and Zegher 2004, Gamwell 2002, Kulper 2012, Sicard 2006).
[16] Which is presented in the "State of the Art".

The Romantics in their connection with Nature

While referring to landscape painting, Schmied (1995, 20) states that "nothing seems so indicative of the change that occurred in art around 1800 as the new respect accorded to Nature"[17]. The author thoroughly portrays this new dimension of the encounter between Art and Nature in the early nineteenth century and presents the main concepts which, eventually, would translate the values underlying the essence of European Romantic movement. Schmied further explores the relationship between observer and Nature, referring to the thinking of Novalis and Schlegel on the "I" Nature, which, according to the author, was reduced by Walter Benjamin in "The concept of art criticism in German Romanticism" present in the formula: "knowledge is anchored in mirror images on every side." Considering Benjamin's statement, Schmied refers to perception while intellectual contemplation of Nature as being "a reciprocal inspiration and illumination: man sees Nature because he is himself Nature, and because Nature mirrors his perception of it" Schmied (1995, 24).

Furthermore, the use of optical devices to aid and affect human perception is also amply discussed in the literatures. Note, for example the work of David Hockney "Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters" (Hockney 2006). This book originates from a curious and somewhat restless look over the works of the great masters of the past. It was triggered by Hockney's own experience of as artist and the technical challenges he encountered throughout his career. It is, above all, a huge and fascinating exercise of observation. At one point, the artist abandoned painting and devoted himself to research in-depth how the great masters of the past achieved extraordinarily vivid and accurate representations of the world around them. He presents the theory that many have used optical instruments in the production of their work. The *camera obscura* being one of the main devices used[18]. The argues his thesis by seeking the visual evidence in the art work itself, and by experimenting in his

[17] This change Schmied speaks of is also mentioned by Julie Ramos (2000, 10). She highlights the popularization of the English garden, the inspiration of Jean-Jacques Rousseau's line of thought and the climbing of *Mont Blanc* in 1786, as indicators of a new human perception of Nature.

[18] We recall that the *Camera Obscura* is also deeply associated with the studies of the work of Vermeer. Philip Steadman's "Vermeer's Camera: Uncovering the Truth Behind the Masterpieces" (2002), for example, is one of the most recent works on the subject.

own work. Another device that most catches Hockney's attention is the Claude Glass. An optical tool constituted by a blackened slightly convex mirror, usually integrated in a portable small box which artists would take with them in order to draw mostly landscapes. The observer would hold the mirror in front of his/her eyes and sketch the scenery behind him/her projected onto the Claude glass[19]. This optical device, is profoundly explored by Arnaud Maillet in the book "The use of the Claude Glass in art". While referring to an exhibition on the work of Claude Lorrain, in London, 1969, where a Claude Glass was on display, the author attributes the general unknowingness in regard to this optical tool, to the "lack of interdisciplinary connections between the fine arts and the sciences" (Maillet 2004).

To some extent, the *Claude Glass*, materialized the elements of a landscape and overall observable objects surrounding the observer, on its reflecting surface. Thus, being the same elements as if observed directly by the human eye, but simultaneously mediated by the mirror, which would ultimately construct a different and unique perspective of that exact same reality. On another note, Schmied (1995, 24), who denotes to Schelling and his "Philosophy of art" and how, in line with the thinking of Novalis and Schlegel, presents an artistic-philosophic universe in which the landscape becomes a reality only under the gaze of the observer. The first, thus, being mediated by visual perception, science and optics and the latter being primarily mediated also by perception, but mainly by the observer, in other words, by philosophy and emotion.

On the whole, the concept of total communion between artist and Nature would have ultimately aim to "overthrow the artifices that obstructed the path of a return to Nature, wild and ravenous variable Nature, picturesque or sublime" (Janson 1992, 574); a true portrait of the romantic movement and their reverence for Nature. The artistic and philosophical attitude of the romantics, in a dimension deeply connected to the aspiration for scientific knowledge and the understanding of the structures and mechanisms of Nature, to a great extent mediated by philosophy, is the aspect that most interests us to explore while covering this artistic movement within this literature

[19] For reference, see the *Claude Glass* in the collections of the V&A Museum: http://collections.vam.ac.uk/item/O78676/claude-glass-unknown/.

review. This artistic-scientific dimension is also emphasized by Roger Cardinal in a very clear and comprehensive way. The author articulates Schelling's "Philosophy of art" with Schlegel's thinking, according to whom, Man should benefit from scientific discoveries and their implicit revelations about Nature, in order to seek a new intimacy with the world, and, thus developing the capability to understand it in symbolic terms. Cardinal (1975, 52) associates this concept to what Novalis labelled as *romanticization*, which entails the awareness of the interrelations between the material and the spiritual.

Moreover, it is in Goethe and Carus that the author observes what he considers the greatest expression of this announced duality: the artist-scientist. In Goethe he highlights the vision of Nature in terms of interlocking shapes and the study of the morphology of plants. Cardinal underlines the same attitude of the artist-scientist in Carus' interest for Geology and the metamorphoses of Nature:

> It is only when we recognize, or at least guess, in the vast Nature that covers the surface of our planet, the presence of a spiritual prince of life, that every landscape decoration takes a heightened sense; it is not but going there that we can understand and experience this spiritual connection that rebinds the movements and metamorphoses of Nature, exterior to variations of the feelings we carry inside of us. Karl Gustav Carus, cited by Pinto (2006, 660).

Furthermore, in the union of Goethe and Carus the author summarizes the scientific outlook on Nature in the sense that they both sought to uncover the universal truths about the world (Cardinal 1975, 130-131), admiration for nature and scientific inquisitiveness being the founding pillars of both thinkers. In the book "Exploring the invisible: art, science, and the spiritual", published in 2002,[20] Lynn Gamwell also refers to Goethe as being the "poet-scientist" who, just like "the German Romantic painters, looked at Nature both with reverence and with a naturalist's eye". Goethe and Carus are also referenced by the author, regarding the philosophical-scientific-artistic attitude that "governed their vision and action towards Nature" (Gamwell 2002, 13-19).

[20] This is one of the fundamental works for this state of the art, especially due to the transversal essence of the theme and its effectiveness in articulating the numerous topics discussed. The main topic of this work was recovered the following year in the form of two articles equally focused on the links between Art and Science: (Gamwell 2003b, a).

Gamwell also continues Cardinal's line of thought regarding the scientific attitude of the romantics. In the chapter entitled "Art and the search of the absolute: Romanticism" the author explains the concept of Kant's notion of "sublime" while addressing the artist's emotion and rapture towards the complexity of natural phenomena.[21]This existential experience of the sublime, central to romantic aesthetics, occurs when:

> one is confronted with something extremely vast, such as the heavens, or something overwhelmingly powerful, such as universal gravitation. In such situations man has an aesthetic experience of Nature during which, according to Kant, he is overwhelmed by the concept of vastness or power. Thus the experience of the sublime is thrilling not terrifying. (Gamwell 2002, 13)[22]

In addition to references about Schelling and his thoughts on the "absolute" in Nature, Lynn Gamwell (2002, 13) also highlights the importance of Caspar David Friedrich as one of the promoters of a natural philosophy based on a pantheistic reverence for natural phenomena, which she considers to be a common feature in both artists and scientists. The way both utilize intuition and, although generally seeking distinct outcomes, value the subjective experience, leads the author to consider them, artists and scientists, as actual "soul mates". All in all, it is safe to say that, given the constancy with which they are referred to when speaking of romanticism, Schelling, Schlegel, Novalis, Carus and Kant are unanimous names in the construction of a romantic approach to Nature.[23]

As for Goethe, who originally published the work "Metamorphosis of plants" in 1790, We stress the 2009 MIT extended edition, with foreword, introduction and photographic illustrations by Gordon L. Miller. In the preface, Miller underlines the range and timeliness regarding the values of respect and preservation underlying the

[21] On the concepts of "beautiful" and "sublime" see ("Analítica do sublime", Kant 1990, 137-139, 166).

[22] While referring to the beauty of flowers, Elaine Scarry (2004, 242) also alludes to Kant as she states that the world is covered with beauty, all around.

[23] A panoramic overview of this relationship between Art, Science and Nature in the romantic period, the study of morphology and metamorphosis of plants undertaken by Goethe as well as its artistic repercussions throughout the nineteenth century is of particular interest to assess and understand the current state of the art in regard to the topic of connection art-nature-science.

study of botany which he finds present in Goethe's work, written over two hundred years earlier. He believes that:

> Goethe's way of science offers hope for lessening the modern alienation from Nature that not only diminishes the beauty and joy of human life but also fuels environmental irresponsibility and apathy. ("Preface", Von Goethe and Miller 2009, xi)[24]

On the whole, our own analysis aims to emphasise these artistic and scientific values inherent to the Natural world. which, as Catherine Zegher (2004, 72) stresses, the romantics saw as "an inexhaustible spiritual treasure" comprised of a deep understanding of the life and evolution of plants. This understanding being also one of the backbones of artistic endeavours during the Victorian period and beyond the boundaries of the nineteenth century; the timeframe for our own study.

A "scientific worldview": Botany in art in the 1800s

Throughout the 1800s century the western world witnessed remarkable developments in the natural sciences, including botany. This contributed, in a grand scale, to what Lynn Gamwell refers to as the "scientific worldview" of the nineteenth century. Throughout the first four chapters of the book "Exploring the invisible: art, science, and the spiritual" Gamwell presents evidence of this new vision of the world. She identifies the engines of this particular transformation, mainly within the field of natural sciences, such as geology, zoology, botany, oceanography and evolutionary biology, as well as optics and medical sciences. With a multitude of examples whose profusion alone provides a sense of the immensity of discoveries which characterized nineteenth century science, Lynn Gamwell's brief allusions to botany are somewhat, dissolved among all the information conveyed by the book. [25] Nonetheless, the author does allude to important references on the subject of botany in art: she mentions the

[24] This enlarged edition includes photographic images taken by Miller himself. As explained in the preface, these pictures are a result of several field trips that he undertook in the United States, a highly enriching feature for the analysis of this work.

[25] Which is perfectly understandable given the comprehensive scope of the book.

expeditions of German naturalist Alexander von Humboldt[26] and the thought of British artist and art critic John Ruskin, referring to the way they both encouraged painters to study the details and the shapes of the landscape, particularly with regard to geology and botany (Gamwell 2002, 28, 29, 37). Ruskin and Humboldt are, in fact, constant references concerning the depiction of Nature in nineteenth century art.[27]

Also very noteworthy s, for instance, the royal Philosophical Expedition through the regions of Grão-Pará, Rio Negro, Mato Grosso e Cuiabá, in Brazil, ordered by Portuguese queen Dona Maria I in 1773. The leader of the expedition was the naturalist Alexandre Rodrigues Ferreira. The purpose was to get a better understanding of the aforementioned regions in order to develop the Portuguese colony. Twenty years later they return to Lisbon. The outcome was extremely enriching: primarily a portrait of the geography, politics, people, fauna and flora of a great part of the centre – north of Brazil. The presence of two draughtsmen and a botanical gardener in the voyage was determinant to the success of the enterprise. Osvaldo Rodrigues da Cunha (1991), also extremely relevant are the works "Os estabelecimentos artísticos do Museu de História Natural do Palácio Real da Ajuda e a Viagem Filosófica de Alexandre" (The artistic establishments of the Museum of Natural History of the Royal Palace of Ajuda") by Miguel Faria (Faria 1992), and the reproduction of Alexandre Rodrigues Ferreiras's memories on Zoology and Botany from the abovementioned expedition, edited by the Brazilian Federal Council of Culture (Ferreira 1972). In the present study we aim to support most of our theoretical contextualization through Ruskin, his impressions on Nature, botany and art, and his influence in British Art and Design, with special focus on the pre-Raphaelite Brotherhood.

Wendy Walgate (2003, 9) also refers to von Humboldt, as well as Goethe's work, as two of Scottish designer Christopher Dresser's major influences in regard to the study

[26] Dagnino (2008, 70) presents in Humboldt one of the features of Kant's inheritance when it comes to the way he interprets the "perception that the observer has of the object and which is always relativized by the point of view (*standpunkt*) of the subject-observer.

[27] For additional references on Ruskin's theories about Nature in art, see: (Bergdoll 2007, Blakeney 2009b, Ferreira 2011, 19, Grady 1955, 187, Grogan 2002, 139, Schmied 1995, 22, Walgate 2003, 14, 15, 17, Zegher 2004, 67). For more references on Alexander von Humboldt and his influence in the relation between Art and Nature, see: (Bergdoll 2007, 3, Brusius 2010, 5, 15, Dagnino 2008, 70, Walgate 2003, 8,9).

of botany. Dresser, enrolled in the Government School of Design in London in the mid-nineteenth century and marks the beginning of a period in which the relationship of artistic creation with botany is a prominent topic in art history literature. Having Dresser as one of the protagonists, it explores the facet of the artist-scientist, then specialised artist-botanist, and more specifically, in this case, designer-botanist. Our study aims to focus this duality having the role of botanical studies in the training of Victorian artists as a starting point and particularizing the curriculum of the courses of Design within the Government School of Design, London, later the Department of Science and Art and the Royal College of Art. Within this thematic frame we highlight the role John Lindley and particularly of Christopher Dresser, as lecturers in Botany in the context of artistic training.

It is widely documented and established that plants are one of the elected motifs among the artistic vocabulary of the second half of the nineteenth century, especially within the history of *Art Nouveau*, with particular emphasis on the floral *motifs* of the school of Nancy.[28] Regarding the literature on late nineteenth century and early twentieth century art, most of the texts focus mainly on the aesthetics of plants, their application as ornamental elements, chiefly in *Art Nouveau*, as well as their symbolic meanings in pictorial compositions.[29] As Gamwell and Bergdoll emphasise the scientific dimension of this period's art based on studies such as of Viollet-le-Duc, Ruprich-Robert, Goethe or Ernst Haeckel and associating the study of plants to the advancements in optics, more specifically microscopy.[30] In addition, even though it is a significantly prolific thematic, international literature on the relationship between botany and art in the late nineteenth to early twentieth century is usually integrated within studies of a broader character. In our research we are interested in exploring this facet of the artist-scientist as the primary theme. For this purpose, the final, or more conventional work of art will not be a mandatory starting point in what concerns the core case studies. We follow the articulation between the interest on the plant world and the training and

[28] See for instance, (Martin 2009).

[29] See Bodt (2000, 22), (Fahar-Becker 1997, 107-128, Madsen 1967, 51-52, Thomas 2007a, 1-5, Pevsner 1964, 90-91).

[30] For more references to nineteenth century microscopy (Armstrong 2004, Bergdoll 2007, 1, 16, Blakeney 2009b, Gamwell 2002, 45, Kulper 2012, Sicard 2006, 82).

practice of artists who chose the endeavour of its graphic depiction through observation drawing, conventional photography and photomicrography. In other words, in regard to non-photographic graphic work, our study mostly focuses on the preparatory stages. It is centred on the mind-set and on the training of the artist. On the other hand, it is also centred in visual aided graphic records through photography and photomicrography. In both cases, we seek to explore the territories of scientific/technical and artistic images.

Technical image and artistic image in botanical visual records

The link between technical and artistic representations of botany is predominantly referenced when related to features such as precision, imperatives of authenticity, objectivity and accuracy in regard to scientific illustration. Referring to scientific illustration, in the second half of the nineteenth century, Tuma (2004, 219) explains how botanical illustration:

> was freighted with a specific duality of intersecting (and sometimes competing) charges. On the one hand, it was bound to an overarching and historically enduring legacy that obliged representations to achieve authenticity and mimetic accuracy, as proscribed by the protocols of the scientific discipline.

Sicard (2006, 70, 96) completes this line of thought by stating that it is much more difficult to contest a botanical illustration than it is to contest a text:

> Sometimes a figuration plays the role of a certificate better than a written paper. It is the authentication of what is seen and what is known (…) By presenting scientific certainty, drawings are what should be observed in order to obtain an exact determination.

The consent and even encouragement of a fecund coexistence between artistic and scientific views on Nature, as well as the copious graphic grammar which may result from it are strongly present in Amy Kulper's article "Realism: a tautological tale" (2012, 3). The author cites embryologist Wilhelm His as he analyses a set of two drawings of jellyfish authored by Ernst Haeckel. His "demonstrates the implicit understanding that natural specimens may be perceptually skewed toward the scientific, and that, in fact, these are two sides of the same epistemological coin". As for the book "The Art of Botanical Illustration", first edited in 1950, the reader is briefly taken on a most elevating

incursion into the intricacies of scientific and artistic representations of the botanical world:

> the botanical artist finds himself at once and always in a dilemma: is he a servant of Science or of Art? There can be no doubt that he should try to serve both. Intent rather than ability separates the botanical artist seeking to record accurately the details of plants for scientific purposes and the painter of impressionistic flowerpieces [sic] seeking primarily aesthetic effect. (Blunt and Stearn 1993, 26)

The matter introduced by Blunt and Stearn is one of the constants in regard to this theme: the duality between Art and Science in the work of those who seek to depict the elements of Nature, and in this particular case, Botany, with all accuracy and truth demanded by science. According to the authors, this dilemma is easily resolved by the intention underlying the pictorial representation. Whether there is a scientific or purely aesthetic intent to the production of botanical images is, then, an important question to answer. An imperative for the scientific illustrator, who must obey the rules of truth and accuracy, but ultimately a choice for the artist, whose own vision and concepts around nature and its place in art is his/her ultimate creative compass. On the topic, scientific illustrator Pedro Salgado says:

> Regardless of how a scientific illustration can be appreciated, it should be noted what is really involved in its conception: an illustration is a scientific explanation. (…) While the artistic illustration affirms itself by the expression, the scientific illustration imposes itself by the accuracy of the information it aims to convey. The first may live with ambiguity, the second only survives with objectivity." (Salgado 2011, 55)

Blunt and Stearn (1993, 26) add that "The great flower artists have been those who have found beauty in truth; who have understood plants scientifically, but who have yet seen and described them with the eye and the hand of the artist." We will focus on this scope of conciliation, considering that it starts long before the actual visual record of the plants.

As previously discussed, during the romantic period art was, to a great extent, the result of a contemplative attitude towards Nature: while faced with all the complexity and grandeur of natural phenomena, the artist experienced the emotionally charged concept of the "sublime", which he/she visually translated into pictorial work. Our study is based on the premise that art in the second half of the nineteenth century

and the turn of the nineteenth century did not turn away from this contemplative attitude, but rather cultivated a renewed and broader view on Nature, its aesthetic values, its elements, principles and laws; where artistic and scientific endeavours shared a new common ground.

Tuma (2004, 221) emphasises the intensified interest on natural sciences, as well as the consequent scientific and amateur research developed in Victorian Britain[31], which she regards as the result of an "almost unprecedented popularization of lay scientific activity".[32] In the same book, Catherine de Zegher (2004, 68-69) reinforces the dimension of this widespread interest in the field of botany and stresses that:

> correspondences between artistic endeavour and astronomy, botany, geology, chemistry, and physics [which] were still very intricate in mid-nineteenth-century Britain, a circumstance that resulted in a period of intense intellectual curiosity for professionals and amateurs alike. Artists benefited from scientific discovery as much as scientists profited from aesthetic vision.

In addition, similarly to the shared interest in botany to both artists and scientists, the method of collecting, identifying and classifying specimens, previously exclusive to science, was, by then, also a familiar practice among artists.[33]

Moreover, Broberg (2000, 13) states that with the advancements of "more and more specialities developed within natural history", an increasing number of specialists participated in scientific endeavours as "new techniques made it possible to publish good illustrations for a growing public". Illustrations in books and journals were "executed by a range of artists, from trained specialists to scientific observers (who were not necessarily trained as professional draftsmen/draftswomen) to amateurs, often women[34]" (Zegher 2004, 76). In Portugal, we find, for example the case of illustrator Raquel Roque Gameiro. Greatly influenced by British illustration, her depictions of plants

[31] The majority of our case studies focus on the United Kingdom during the Victorian period and beyond.
[32] On the role of art in the popularization of natural sciences see also: Broberg (2000, 13).
[33] Several authors highlight the role of Carolus Linnaeus to whom we owe the basis of current taxonomy used in botanical science. "Based on the reproductive features of plants, these systems developed a means of describing the inherent characteristics of organisms according to similarities that were decipherable and constant." (Horsfield 2004, 193-194). See also (Broberg 2000, 13, Brusius 2010, 15, Gamwell 2002, 9, Simblet 2010, 20)
[34] According to Broberg (2000, 13) "From the 18th century onwards, natural history becomes relatively popular: botany is for the fair sex, zoology for the male hunter".

and flowers joined a hand and a look which were very clearly both artistic and scientific, having chosen London as opposed to Paris, the most sought destination for artists by that time, to visit as part of her studies. In the catalogue of the exhibition "Mão inteligente: Raquel Roque Gameiro (1889-1970) – Ilustração e Aguarela" (Intelligent hand: Raquel Roque Gameiro (1889-1970) – illustration and watercolour") curated by art historian Sandra Leandro, we can see exemplar botanical works. They include, for example, the depiction of an extremely accurate depiction of the *Convolvulus Sabatius* and a representation of a plant of the genus Aloe. The latter clearly confirms she was familiar with the techniques and principles of botanical illustration (Leandro 2017). Publications bursting with detailed images of Nature's elements and phenomena were one of the main sources of artistic inspiration in the second half of the nineteenth century – beginning of the 1900s. A growing minutia in the way of looking at the natural world is made evident by the "devoted attention to the minor details of every leaf and flower" (Blakeney 2009b). This growing interest directed at form and detail is yet another foundation for our research.

Within a society deeply immersed in science[35], artists, too, organized herbariums with the method and minutia of a scientist.[36] Also noteworthy is the interest in observation drawing which leads various artists of the time to be among the most assiduous visitors of botanic gardens. Considered the "emblem of comprehensive Natural History" (Broberg 2000, 13), "botanic gardens, habitats for local and foreign species, were essential for the visual record of plants that could be drawn directly from the natural" (Ferreira 2011, 16). Furthermore, many artists were also dedicated to floriculture and horticulture, activities predominantly practiced in private gardens and greenhouses (Thomas 2007a).[37] It is also the case of Aurélio da Paz dos Reis, the

[35] "Writing about science became a profession in the 1850s, many dedicated themselves to making the complex world of science accessible. Fairs and exhibitions had large areas dedicated to science and technology; many science museums were opened; Jules Verne introduces science fiction in literature" (Gamwell 2002, 61).

[36] The gathering of plant specimens to preserve in herbariums, in scientific and artistic practice of botany, is mentioned by various authors: see: (Brusius 2010, 9,10, Frizot 1998, 274, Mackintosh and Gallery 1991, 8, Meagher 2000, 1, Sicard 2006, 96, Zegher 2004, 70).

[37] Émille Gallé, for example, is renowned for his activity as floriculturist. The artist was founder of the Société Centrale d'horticulture of Nancy (Thomas 2007a, 1-2).

Portuguese filmmaker and photographer, who was also a successful horticulturist, and whose botanical work in photography we will analyse in our case studies.

Various authors also allude to the profound influence of an empirical approach to Nature in art, through the study of scientific disciplines, such as botany. With the advent of innovative graphic experimentalism techniques, most of them resulting from developments in optics and chemistry, the second half of the nineteenth century was fertile ground for the growth of a variety of ways of portraying the vegetable world. From field sketchbook drawing to photographic techniques with or without the use of a camera[38]. As a result, the mid-1800s witnessed the development of a, hitherto unforeseen, massive variety of images.[39]

Technical image and artistic image of botany: contributions of drawing and photography

In view of the information gathered from art history literature, no book exclusively addresses the boundaries and interconnections between the artistic and the technical or scientific image in the depiction of botany with particular focus on the Victorian period. Nonetheless, this aspect is not devoid of analysis. It is a subject of consideration within texts dedicated to scientific illustration, to artists who have nourished a deeper relationship with nineteenth century botany, or works dealing with the general representation of Nature in art.[40] We also find more generalist[41] publications which, even though succinctly, and not always in a direct manner, discuss the theme of the artistic image and technical or scientific image of Nature. In her Master's dissertation "Teoria e Crítica de Arte em Portugal (1871-1900)" (Art Theory and Critique in Portugal (1871-1900), Sandra Leandro touches the topic of the need for artists to be acquainted

[38] Camera-less photography, also known as "drawing of Nature", "light drawing" or "cyanotype" makes its appearance with the first photographic techniques on paper. Works by Talbot and Anna Atkins which include botanical subjects are the most well-known and broadly studied within this particular subject. Despite their relevance for the topic they will not be explored in the present investigation, as more relevant contributions may be achieved with the study of other "alternative techniques" such as photomicrography, and underexplored photographic artists such as Aurélio da Paz dos Reis.

[39] See (Grogan 2002, 139, Rosenblum 1997, 9, Tuma 2004, 217, 219, Zegher 2004, 69, 74).

[40] See, for instance: (Durant 1993, Whiteway 2004)

[41] By "generalist" we mean works that are dedicated to certain styles or artistic movements, such as *Art Nouveau*, or to means of graphic representation, such as photography.

with the Natural Sciences in order to inform their work by scientific truth, as she cites António Enes who, while referring to the education system of the Academy of Fine Arts of Lisbon said, in 1874:

> What do landscape artists learn of Mineralogy or botany? The animalists of Zoology? Nothing, and if they do not go beyond slavishly copying, it is perhaps for fear of planting by the sea trees which only cover themselves with leaves on the crests of mountains, or of making the almond tree blossom in August in Portugal. António Enes, *apud* Sandra Leandro (1999, 110)

Botanical studies and observation drawing within the spectrum of artistic training are also vaguely touched subjects in art historiography of the period we focus our case studies[42] (broadly, the mid-nineteenth to early-twentieth century); extending to the mid-twentieth century in the specific case of photomicrography..[43] are peripherally mentioned as part of a narrative about a broader topic such as an artist's biography or a monograph about an artistic style, period, or movement. On the other hand, we know they are a substantial part of art collections in museological contexts, example of the Victoria and Albert Museum, the British Museum, or the Royal Academy of Arts, where they generally integrate prints and drawing collections.

If the specific topic of observation drawing is not, as we have seen, abundant in art historiography, when it comes to drawing itself, we find some references of significant importance for our study. And what may be considered a lack in quantity is, otherwise, compensated by their quality. Among the texts analysed for the present literature review, we particularly emphasise the words of Pedro Salgado on the essence of field drawing. The words of the Portuguese biologist and scientific illustrator find an even greater significance because they derive from experience, as they express an intimate and profound look into the art of drawing on site:

[42] With the exception of Charles Rennie Mackintosh's botanical drawings to which our study aims to be a broadening contribution.

[43] Zegher (2004, 69) explains that "in the productive interaction between art and science in the nineteenth century, drawing played a key role, and, as a device for thinking and recording, it was soon itself to become the subject of scrutiny and exploration."

> Sketchbook field drawings are notes, loose sketches, synthetic essays, technical experiments, improvised approaches, “em cima do joelho” [44] in the physical presence of the models, now line or now stain, only ten minutes or the rest of the afternoon... they have a special energy, a spontaneity rarely achieved in the finalized drawing with all its rigor in the studio. In short, a counterpoint to the time-consuming, disciplined, meticulous and unpolluted work that characterizes a scientific illustration. (…) Either way, we always rest our eyes on the natural, (…) we let ourselves be touched by the shapes that light offers us, by the patterns, colours and textures we are able to retain, and we find ourselves always returning to drawing. Because, without a doubt, drawing allows us to see more. (…) In that field sketchbook, also known as graphic diary among artists, reconnaissance experiments natural objects are chronologically accumulated, a seed, a tree, a beetle... Varied situations are graphically recorded. Drawing is omnipresent, from the simple sketch, gestural, to the construction of a complex image, filled with captions and notes. (Salgado 2011, 23-25)

Sarah Simblet (2010, 20) also refers to field drawings, namely botanical, as being "personal notes, freshly made studies, direct records of the appearance and nature of fascinating and very beautiful plants". In his turn Baudelaire (2009, 26) considers the "sketches of Rafael, Watteau and many others (...) very detailed notes, but (...) pure notes.” The poet of the "Flowers of evil"[45] speaks of Eugene Delacroix and his "passion for annotations through sketches [and how] he would dedicate himself to it wherever he was" (Baudelaire 1998, 78).

Similarly, curator and author Pamela Robertson also highlights the importance of botanical drawing for the enrichment of artistic vocabulary. The author does so in the 1988 catalogue published by the Hunterian Art Gallery, featuring botanical drawings by Charles Rennie Mackintosh[46]. Mackintosh’s interest towards botany reflects the encounter between the empirical and the scientific approaches towards nature throughout the Victorian period, a subject which has caught the attention of several

[44] Portuguese expression that translates literally as “made on the knee”, meaning to do something in the moment or hasty. In this sentence the author also makes a play on words, because many of these field drawings are actually made this way, with the sketchbook supported on one or two knees.

[45] “The literature of symbolism had set up its own floral mysticism in the mid-nineteenth century, having the cycle of poems -The flowers of evil by Charles Baudelaire as emblematic masterpiece” (Fahar-Becker 1997, 108).

[46] Robertson also refers to this aspect in the book “Charles Rennie Mackintosh: Art is the Flower” which also conveys an enhanced version of the contents in the 1988 catalogue (Robertson 1995).

authors (Bergdoll 2007, Blakeney 2009a, Bodt 2000, Gamwell 2002, Hamilton 1852, Tuma 2004, Walgate 2003). Furthermore, Robertson states that field drawing was an important activity for Mackintosh for the development of his qualities: an attentive observer and as draughtsman of Nature.[47] When referring to observation abilities, Pamela Robertson also meets Pedro Salgado's vision when he says "drawing allows us to see more".

Correspondingly, and focusing on botanical drawing, Simblet (2010, 6) explains:

> there is a significant difference between looking and seeing. Artists know this, but it is something we can all experience if we draw. And time spent drawing is a revelation, regardless of the results.

This idea of revelation is closely connected to the feeling of Ludwig Wittgenstein when, quoted by Elaine Scarry (2004, 264), he states that:

> when one sees something beautiful an eyelid, a cathedral, the hand wants to draw it. Like smelling, like imagining, this too is an act of interiorization, the yearning to incorporate, to make a residual image. What I want to argue is that we interiorize the flower, seize upon the flower as the proper object of the imagination, because it expresses the distinct quality of cognition at work in imagining.

Simblet (2010, 6) further explains that " if you spend just one hour drawing a plant, you will understand it far better than if you spent the same hour only looking for it". The author states that "there is something in the physical act of drawing, the coordination of the hand and eye, and the translation of sensory experience into marks and lines that reveals an entirely new way of seeing". This poses another question: Is there an underlying logic to the states of observation and concentration that are stimulated by the act of drawing plants and, if so, can it lead us towards scientific knowledge, even if we are not entirely aware of it?

Craigie Horsfield (2004, 207) expresses his thoughts about this matter by stating that:

> the attention to the phenomenal world is the attention to the understanding we share of that world. And it is a part of the genesis of language, insofar as it may be known, the world is known through relation. The matter of the plant, its substance, is conceivable insofar as we think it in relation to the plant's being and to each other. Now, to

[47] See (Gallery 1988, 5, Robertson 1995, 10).

> this extent, the plant may be understood as acting on us, but it is brought to that through our attention to it.

This is one of the key ideas to explore in our study: drawing as artistic representation, animated by a reverential attitude towards the beauty of plants, combined with the scientific gaze directed at Nature as a crossing path overlapping artistic creation and scientific knowledge. Drawing emerges and develops in an exploratory attitude. Just as shape prevails in field sketchbooks, as visual annotations, Nature itself is bursting with extraordinary forms. Moreover, plants are distinguished in Nature for the diversity of their morphological features, patterns, textures, contours and for the multitude of metamorphoses, inherent to their organic essence. These notions of morphological and physiological diversity and metamorphosis are well reflected in the words of Henri Focillon (2001, 13, 16, 18) while referring to the forms in Nature, their understanding and their transposition into art:

> Nature creates forms, imprinting Fig.s [sic] and symmetries on the objects that are part of it and on the forces it uses to bring them to life, so that one is sometimes, compelled to see in it the work of an artist God (...). The tenuous and the most impetuous waves own a form. Organic life draws spirals, orbs, meanders, stars. If I intend to study it, it is by quantification that I come to comprehend it. But from the moment in which these Fig.s [sic] intervene in the realm of art and its particular subjects, they acquire a new value, creating absolutely unique systems. (…) the models of Nature can themselves be considered as mainstay and support of metamorphoses.

Wendy Walgate (2003, 8) underlines the richness of plant forms by citing Gottfried Semper. When lecturing at the Government School of Design, London, in 1853, Semper stated that “the principle of symmetry in simple plant forms is already present in a latent form in those remarkable small worlds of snowflakes [and] flowers”, which was particularly vivid with plants of the primeval world or *urwelt*. He continued by saying:

> when I observed this variety of Nature in its simplicity, I very often thought by myself that it may be possible to reduce the creations of Man, and especially the works of architecture, to certain normal and elementary forms, which, in a comparative method of contemplating them, analogous to that of Cuvier for natural history, will enable us to find out the elementary forms and the principles of which all million appearances in art are but as much different modifications.

These shapes, present in the unique diversity and the metamorphic mechanisms of plants, as shown by previously referenced authors, embody one of the most fascinating aspects for those who dedicate themselves to their representations. Yet they also represent one of the greatest challenges for the artist who takes up the endeavour of drawing plants. As noted by Blunt and Stearn (1993, 26) "only those who have attempted to draw flowers can appreciate what restless models these can sometimes be; how quickly petals open and stems curve." Botanical illustrator Sarah Simblet (2010, 6), always draws directly from the real specimens. She assigns choosing this method to the fact that “plants are three dimensional and were once alive, even if they are no longer. They are physically present, and can move, change, and challenge the person drawing them".

One of the aspects integrated in the study of observation drawing is the role of botanical studies as part of academic education of artists. We consider botanical studies, drawing, and subsequent modelling of plants as part of artistic training, to be of major importance to our research. Understanding the role of botanical science as part of a philosophy of action in British art and design education during the Victorian Period is central to our research. Likewise, we find it is important to assess the relevance of knowing and understanding botanical elements, their physiology and morphology, as well as the impetus it would give to the link between Art and Science, when adopted and implemented as an official part of the natural curriculum of Art and Design training. With this purpose in mind, we will focus on the case of the *Government School of Design*, later the Department of Science and Art, the National Art Training School, and ultimately the Royal College of Art in London. Likewise, we will focus on the Art school of the Royal Dublin Society. The option for this institution is motivated by its prolific activity during the nineteenth century and the early twentieth century and the integration of botanical studies in its artistic curriculum, which are widely documented and would, most certainly, benefit from an in depth study.

Wendy Walgate’s work (2003, 5-17) presents Christopher Dresser, Scottish designer, visionary and botanist, precisely, in the Government School of Design in London. According to the author, Dresser enrolled as a student in 1847 and later as faculty member. The same author refers to other personalities, who, such as Dresser,

encouraged and practiced the integration of botany in the study of the arts. It is the case of Gottfried Semper, previously mentioned, and Richard Redgrave. In our own research we will explore the role of two important lecturers in botanical studies within art curriculums: John Lindley and Christopher Dresser. The latter is further explored in accordance with his views on the perception of botanical elements as well as the understanding of the vegetable laws of growth and morphology. It will have the study of his botanical diagrams, kept by the Victoria and Albert Museum as its agglutinating core. After exploring the subject of artistic training in its relation with botany, we will carry on to study botanical drawing as part of artist's everyday practice. Our study of this matter will mostly focus on Charles Rennie Mackintosh. His intense activity as a botanical artist, materialized in his field sketchbooks, attests to the qualities of artist-scientist that we aim to emphasize with the subject of our research project. It also justifies deciding on this artist to be the starting point for the analysis on botanical sketchbook field drawing, alongside his colleague and wife Margaret MacDonald, with whom he co-authored several botanical drawings.

There are also several references to botanical drawing at the *Glasgow School of Art,* integrated in publications about Charles Rennie Mackintosh: in the, previously mentioned, 1988 catalogue “Flowers Drawings”, published by the Hunterian Gallery at the University of Glasgow[48] as well as in the book “Charles Rennie Mackintosh: Art is the Flower” [49] (1995) by Pamela Robertson, curator of Mackintosh collection at the Hunterian Art Gallery. Robertson presents flower drawings from Mackintosh’s sketchbooks exhibited at the Hunterian Art Gallery in 1988 and enhances her study with the artist’s still life compositions of flowers. The author also refers to the use of floral elements in Mackintosh’s work as a designer.[50] The book contains a chapter entitled "Botanical Artist" in which Robertson traces Mackintosh’s artistic route with allusion to some of the transformations undergone by his field sketches, while also presenting the

[48] The Hunterian Gallery owns 5 of Mackintosh’s sketchbooks that include 20 botanical drawings. (Gallery 1988, 5)

[49] The expression “Art is the Flower” is part of a speech entitled “Seemliness” given by Mackintosh in 1902. In this speech he states that “art is the flower, life is the green leaf”. According to Grogan (2002, 141), this is an “allegory for art, the highest of man’s achievements”. On this subject see also (Gallery 1988, 12, Robertson 1995, 6, 87)

[50] See (Robertson 1995, 59 - 84; 85-104)

context of the journeys in which they were produced (Robertson 1995, 59-84). The author refers to the then-recent discovery of one of Mackintosh's sketchbooks at the National Library of Ireland. In 2002, in the book "Beginnings: Charles Rennie Mackintosh's Early Sketches", Elaine Grogan (Grogan 2002) also dedicates a chapter to this sketchbook of botanical drawings (named the *Dublin Botanical Sketchbook*). From all of Mackintosh's known sketchbooks, this is the only one which is exclusively devoted to plants. Grogan and Robertson present the hypothesis that this is one of the sketchbooks the artist himself had thought lost (Grogan 2002, 137-165, Robertson 1995, 16-17).

As previously mentioned, although botanical studies are an important element both in Robertson and Grogan's works, they do not carry out a profound comparative study directed at the iconography of plants contained in all of Mackintosh's known sketchbooks. There are three fundamental works that focus on Mackintosh's botanical subjects. The first one is a catalogue that accompanied the exhibition of several of his botanical drawings, held in 1988 at the Hunterian Art Gallery of the University of Glasgow (Gallery 1988). This catalogue was followed by a broader study of Mackintosh's botanical motifs, by Pamela Robertson, curator of the Mackintosh collection at the Hunterian Museum and Art Gallery (Robertson 1995). Finally, Elaine Grogan (Grogan 2002) dedicated a chapter to the "Dublin botanical sketchbook" in a study on the artist's earlier drawing work.

Previous studies give us a very comprehensive portrait of Mackintosh's botanical aptitudes and provide us with the paths of his travels, while presenting us with his plant drawings in an explicit way. Nonetheless the analysis of his botanical work can still gain from a more comparative and integrative perspective, focused on their interdisciplinary qualities. Also, the art of Margaret Macdonald, his wife and colleague, is very often, somewhat, obscured by Mackintosh's notorious artistic creations. Margaret accompanied her husband in most of his documented travels (Mackintosh 1988) and the initials of her name are often included in his botanical drawings. Being an artist herself, the love for nature and flowers was a common passion for both and is clearly expressed in her own work. We intend to present our study with a totalising and inclusive dimension starting from the theme itself and exploring the graphic variants of its

botanical iconography, to the identification (of the yet non-identified species), listings, and mapping, when possible, of the species portrayed. This study closes our literature review in what concerns the contribution of botanical studies and botanical drawing to the construction of botanical iconography guided by a dialogue between Art and Science. Something we also sought in regard to photography.

Generic texts on photography, as well as more theme-focused literature often cover botanical images, however, there are few studies on which botanical photography is the main topic. An example is the edition "Martin Gerlach's "A World of Forms from Nature" where Astrid Mahler presents the portfolio by Martin Gerlach published between 1902 and 1904 in secessionist Vienna. The book conveys the main images published at the time, where the author combines both conventional and amplified photographs of animals and plants.[51] As for Aurélio da Paz dos Reis, our case study in terms of conventional photography, as he was mostly regarded for his work as documentarist and filmmaker[52]. Although his facet as floriculturist is mentioned mostly in works focusing on his work in film. Aurélio "the photographer" is found often in the shadow of Aurélio "the filmmaker" or "the documentarist". We aim to bring his photography, and more specifically his botany-related photography out of the shadow. To shed light into the contributions of his work for the botanical image in a very unique context of Porto, Portugal late nineteenth – early twentieth centuries. With Aurélio, we take a first step into botanical photography. And from there venture into the microscopic realm, exploring photomicrography.

Magnification allows to extend the range of forms, patterns and volumes of the plant which are visible to the human eye. It does not extend the truth, or the real existence of the plant, because its reality does not depend on our ability to apprehend it. It does, however, make possible for us to extend the reach of our own vision of the plant and, thus, our understanding of it. We believe this to be a truly fascinating aspect to integrate in the iconographic study of flora.

[51] See, for example (Maingot 1950).
[52] See, for instance, (Serén and Siza 2001, Santos 1990).

Although we often find references to the scientific practice and the history of microscopy in history or art history books, they are significantly less in regard to photomicrography[53] in the specific area of art history research. Photomicrography has been mostly studied on a technical perspective. A literary rarefaction most probably due to the specificity of the technique and to the fact that even nowadays it is still quite an uncommon artistic practice if seen within the broad spectrum of Visual Arts. Nonetheless, it is referenced by authors, such as Monique Sicard (2006, 85) who mentions it in the context of the nineteenth century, stating that at the time "one would not oppose the emerging photomicrography capabilities to those imperfections of drawing [scientific illustration]: while allowing access to details, it also facilitates a recognition of the whole".

Associated with photomicrography, appears once again the work of Fox Talbot. Frizot (1998, 275) explains that, eventually, Talbot adapted the solar microscope to his photogenic drawings in order to obtain images of plant sections and crystals in polarized light. The author also mentions the sense of fascination brought about by Talbot's images, which were considered to be "difficult to draw even under the microscope" (1998, 27). Armstrong (2004, 93) also alludes to Talbot's photomicrographs, and considers them to be "reminiscent of the cross-sections in botanical drawings and prints and proof of the founding intersection between botany and photography ".

Even though not abundant, references to photomicrography are more frequent than those about photographic magnification from negative film. German photographer Karl Blossfeldt is a common reference that emerging from the literature on the subject. Adam (2008, 15-20) stresses his "non-artistic" intentionality and the didactic use Blossfeldt made of his amplified images of plants. Adam also highlights the scientific character of Blossfeldt's method, which included the rigorous cataloguing of the species. The same author alludes to the connection between the artist and the Berlin Botanic Garden from where he got most of his plants.

[53] Originated in the alliance between photography and microscopy, in order to produce photographic records of the microscopic scale.

Amy Kulper (2012, 2) refers to the way Walter Benjamin viewed Blossfeldt's plant images and how he "speculates upon a generative immanent Nature as a stylistic source. It is as if to see these specimens microscopically enlarged is to witness nature coming into being, and to be privy to the stylistic secrets of its formation." Benjamin further develops this concept in his text "The work of art in the age of its technological reproducibility, and other writings on media" (Benjamin 2008, 272-273). While discussing flowers in photography he reflects on the manner in which:

> these photographs reveal an unsuspected horde of analogies and forms in the existence of plants. Only the photograph is capable of this. For a bracing enlargement is necessary before these forms can shed the veil that our stolidity throws over them.

Alluding to the photographic work of Blossfeldt, the author leaves us with a thought which clearly reflects the underlying concept of the research we aim to carry out:

it must be food for thought in even the soberest [sic] observer that the enlargement of what is large, the plant, or its buds, or the leaf, for example, leads us into a whole different realm of forms than does the enlargement of what is small, the plant cell under the microscope, say. (…) We, the observers, wander amid these giant plants like Lilliputians. It is left, though, to fraternal great spirits, sun-soaked eyes, like those of Goethe and Herder, to suck the last sweetness from these calyxes" (Benjamin 2008, 272-273)

1. ART, SCIENCE AND THE STUDY OF NATURE IN BRITISH ART: FROM RUSKIN TO THE PRE-RAPHAELITES

In 1917, Kenyon Cox referred to "a new and detailed investigation of the appearance of nature" as one of the accomplishments of nineteenth century art (Cox 1917, 315). It was a time for many *first times*. New discoveries or "simply" the first time known elements and processes of nature (light, wind, geological formations, were represented and registered. This is common to Art and Science: to document what is observed, to register and visually transcribe one's impressions of what we observe. The nineteenth century brought with it a new and enlarged dimension of this endeavour: the accurate knowledge and understanding of what is being observed, not only above but also beneath the surface.

Still according to Cox, by 1880 the days of new learning for naturalism were over. A cumulative result of experiments based on the attentive study of Nature, resulting either in unconventional compositions or no composition at all. Nonetheless, he speaks as if what had to be learned from Nature, its elements and the main processes it encompasses was near to completion (Cox 1917, 319), mainly of an overall understanding of Nature as a whole as well as the learning of the artists' own mechanisms to apprehend Nature and its phenomena. Cox discourse is a fairly dramatic one, as if announcing the end of Naturalism. However, we argue that a portion of Naturalism has its place in the foundations of the artistic endeavours in British Art in this period and it was not extinguished *per se,* but absorbed, assimilated. As if scattered and adapted by different artists and movements, becoming more of an essential premise inherent to how each artist regards, feels, interprets and visually conveys the image of natural elements and phenomena. In other words, while interpretation and aesthetic, creative treatment differ from artist to artist, the resultant variety is founded in a common base: the inquisitiveness, the appreciation and wonder before the greatness of Nature, and the conscience that greatness may be found in the most minute of its elements as well as the largest, and in the coexistence of both.

In this section, firstly we address the role of John Ruskin (1819-1900), for the reach of his thoughts and own artistic practice on the link between Art, Nature and

Science, his views on Botany and its importance to artistic practice, focusing mainly on drawing. Secondly, we explore the botanical universe of the Pre-Raphaelites, for the role as advocates of Ruskin's views on connecting to Nature and transposing it into pictorial art, and their own respect and admiration for its vegetable structures, their aesthetic qualities and their truth: William Holman Hunt (1827-1910), John Everett Millais (1829-1896) and Dante Gabriel Rossetti (1828-1882), as the founders of the Pre-Raphaelite Brotherhood, as well as John William Waterhouse (1849 – 1917), a later follower of the movement. Here we examine the presence of botanical specimens depicted in a selection of paintings by each artist, and systemize the information gathered, based mainly on observation.

1.1. **Poetry, Art and Science combined: John Ruskin's views on botany as applied to Art**

Considered the best and most analytical mind of late 1800s Europe in regard to art (Thomson 1879, 225), John Ruskin was majorly acclaimed in his time for his facet as an art critic. He was a gifted man with many talents and interests; to a great extent nurtured by his love for nature[54]. His poetic soul and sensitivity, coupled with a great propensity for Visual Arts, particularly drawing and watercolour _, and combined with an attentive eye and a highly inquisitive mind lead him to develop a very particular way of thinking. Seemingly paradoxical, at times, Ruskin's way of observing, of seeking knowledge and of interpreting the natural world was a result of his multifaceted personality, the diversity of his passions and the depth of his beliefs. One could say Ruskin was, simultaneously, a believer and a *dis*believer of Science. He was undoubtedly an admirer of scientific knowledge and greatly appreciated the way scientific accomplishments helped shape the knowledge of nature, its processes and mechanisms. However, at the same time, there were facets of Science he found confusing, unnecessary and inaccessible. One of them, was scientific language and terminology, for example. He argued that botanical terminology was difficult and confusing and believed its sole purpose was to "enable one botanist to describe to another a plant which the other has not seen" (Ruskin 1874, 31)[55]; going so far as to state that botany was "oppressed by nomenclature" (Ruskin 1843, 65). Natural Sciences should be made as accessible as possible, which entailed the use of simple and perceptible terms.[56] Ruskin's lectures on Botany to his pupils at Oxford were the true example of what he defended. He devised his very own terminology while referring to specific parts or groups of parts in plants. This consisted on replacing botanical terms likely to cause confusion with English words that could more easily be remembered and understood by association.

[54] His connection to nature was deeply rooted in his childhood, very much influenced by his mother's love for plants and gardening (Estes 1908, XIV).

[55] His idealistic mind envisioned a time when all plants would become known to every botanist in the world and when unknown plants would be a rarity, making the use of botanical nomenclature obsolete. (Ruskin 1874).

[56] "Nor need you care for methods of classification any more than the origin of classes. Leave the physiologists to invent names, and dispute over them; your business is to know the creature, not the name of it momentarily fashionable in scientific circles" (Ruskin 1872, 179).

The purpose was to lead pupils to intuitively visualize what was being described; while also conveying the true meaning and function of those specific parts within the morphology and physiology of the plant.[57] The 1874 lecture "Proserpina: studies of wayside flowers" presents some examples of this *student-friendly* method of teaching the structure of plants, as listed in table 1.

Table 1. Examples of "Ruskinian" nomenclature correspondent to scientific nomenclature of plant parts (based on the 1874 lecture "Proserpina").

Botanical term	**"Ruskinian" term**
Pistil	Pillar
Style	Shaft
Stigma	Volute
Ovary	Treasury

He was also doubtful in regard to the capacity of scientists to preserve and develop a poetic sensitiveness, almost innocence, towards nature and its phenomena, to let themselves be touched and even overwhelmed by beauty and not to become/remain somewhat captives of pure logic. Nonetheless he *did* acknowledge their work and appreciated their role in the rendition of the mysteries of nature to those who did not have the means to reach them otherwise. According to Ruskin, by making use of pure logic and inquisitive analysis while addressing natural elements and phenomena, the scientists of his time generally possessed, a myopic view. As if "losing the romantic mind of the impressionable traveller", a scientist was solely capable of addressing Nature as it presented itself, rationally and cognitively; thus, failing to contemplate its inherent abstractness all-encompassing of poetic and artistic possibilities. To a great extent, this would stop them from reaching or even desiring to reach a more profound understanding of nature's "nobler" qualities (Ruskin 1891, 89). Ruskin compared this to observing the elements of Nature as belonging to a dissected model, either within the grander scale of a landscape or the smaller scale of a plant or a rock. Would he think this way had he lived in a later time? Probably he would have not. We must not forget that

[57] The study of the morphology and physiology of plants: their organs and structure, as well as the laws that govern their development and growth, respectively. The seed being not an egg but a treasure, Ruskin called the ovary the "treasury", for instance. (Ruskin 1874, 31).

the dialogue between Art and Science has come a long way since then. Even though science communication had already taken very important steps towards engaging a broader public, artists and art students included, the connection was still much more limited than we find it in present days.

According to Ruskin, the mission of Naturalists (and all scientists, for that matter) was to inform and be loyal to the truth of their observations.[58] Artists, on other hand, had an added purpose: to translate the values of Nature and convey the image of its poetry *and* of its *truth* as *one and the same*. An intermediary who combined the knowledge of nature and of its underlying scientific laws, with imagination and sensitivity when faced with the aesthetic qualities and the myriad of ongoing transformations that occur in the natural world. The value of veracity while representing nature and its elements was so important to Ruskin that he would go so far as to advise draughtsmen not to draw what they loved, or at least, to not let their love for a subject be the reason to draw it, as this would affect their perceptive powers and compromise their depiction of the truth (Ruskin 1857, 149).

In the chapter dedicated to "Sciences of organic forms" in "The Eagles Nest", he states:

> You must always draw for the sake of your subject, never for the sake of your picture. (…) what you wish to see in reality that you should make an effort to show in pictures and statues; what you do not wish to see in reality, you should not try to draw. (Ruskin 1872, 161)

Initially, this may sound as somewhat of a paradox. On the one hand he believed the poetry and the love for ideal beauty in nature resided in its truth. Nothing was to be added to it in order to retrieve it, as it was inherent and ever present. Conversely, poetry and ideal love are qualities that are intrinsic to the feelings of admiration for nature. That love, however, shouldn't compromise the artist's perception while seeing and graphically representing what is observed. That ideal love and visual poetry should then be as much present in the work of art representing nature in the same measure as it was presented in Nature itself and directly perceived by human vision, no more, no less.

[58] As Pedro Salgado states, a scientific illustration is meant to be an explanation (Salgado 2011, 55).

But, were artistic endeavours completely separate from scientific ones? His argument leads us to think that he *did* acknowledge a gap, a clear distinction between the poetic and artistic and the purely scientific. Both valid, but each with its own unique identity and scope, coexisting but not overlapping. A common requirement, however, for both scientists and artists was to care for nature. To appreciate it and to seek to go beyond its surface. Ruskin strongly believed that "those who do not care for nature cannot see her" (Ruskin and Porter 1900, 22). So, if scientific nomenclature was considered accessorial; often times confusing and even misleading; and if pure science carried with it the "danger" of not apprehending the more subjective values of nature, such as beauty and emotion, what was, for Ruskin, the most important thing to seek and to transmit while learning and teaching botany in the context of the Arts? All in all, while he identifies the artist-scientist fissure, he also embraced science and its accomplishments very passionately. By doing so, he opened the door for science and art, knowledge, poetry and beauty to coexist and contribute for a full appreciation of Nature.

We notice, in Ruskin, a profound desire for scientific empiricism to touch what is there of abstract, of poetic and beautiful in Nature. The fact that he *did* sought scientific knowledge very intensely to assist him in his own enquiries into Nature; alongside his admiration for Goethe[59], the importance he attributed to his findings on plant morphology; as well as his own theoretical and practical endeavours in the territories of Botanical studies, portray him as also an inquisitive man who desired very deeply to understand what the world was made of and how it worked. To obtain such knowledge

[59] The mix of scientific inquisitiveness and poetic feel, that so well characterizes Ruskin, is very well expressed in the way he apprehends and interprets the findings of Goethe: "Some fifty years ago, the poet Goethe discovered that all parts of plants had a kind of common nature, and would change into each other. Now this was a true discovery and a notable one; and you will find that, in fact, all plants are composed of essentially two parts – the leaf and the root, one loving the light, the other darkness; one liking to be clean, the other to be dirty; one liking to grow for the most part up, the other for the most part down; and each having faculties and purposes of its own. But the pure one, which loves the light, has, above all things, the purpose of being married to another leaf, and having child-leaves, and children's children of leaves, to make the earth fair forever. And when the leaves marry they put on wedding robes, and one more glorious than Solomon in all his glory, and they have feasts of honey and we call them flowers" (Ruskin 1871, 7).

and to be able to pass it on to others, was a noble mission that artists should most definitely pursue.

Making use of their true vocation grounded in "intenseness of observation and facility of imitation" artists were in the best position to fulfil *their own* mission as "informants of the Sciences" (Ruskin 1891, 16):

> Suppose that each recess of every mountain chain of Europe had been penetrated and its rocks drawn with such accuracy that the geologists diagram was no longer necessary, suppose that every tree of the forest had been drawn in its noblest aspect, every beast of the field in its savage life, that all these gatherings were already in our national galleries, and that the painters of the present day were labouring happily and earnestly, to multiply them, and put such means of knowledge more and more within reach of the common people, would not that be a more honourable life for them, than gaining precarious bread by "bright effects"? (Ruskin 1891, 19-20)

On the whole, we argue that Ruskin mostly appreciated science for its role in making Nature perceptible and unveiling its mechanisms. In all clarity, he did not defend that artists should be scientists. In the specific case of plants, artists were not supposed to be botanists, nor did they need to be fluent in technical terminology, nor particularly knowledgeable and scientific methods, as scientists would. They should, however, have the sufficient grasp of science in order to understand, translate, interpret and convey the values of botany to others who did not[60]. They should do so by embracing Nature's objectivity as well as its subjectivity.

This brings us to two very important points of "Ruskinian" thinking. Firstly, knowledge can be acquired in a virtually universal way; so, there is, to a certain degree, a unified underlying truth within reach of every man and woman who endeavour to pursue it. Secondly, the way that knowledge is used is, in principle, ultimately unique (Ruskin 1891, 35). It originates from a singular, individual look towards nature and its elements, while also contributing to the construction of a plural diversity, a global iconography. The vision of an extremely interconnected natural world, where one

[60] This informative mission did not, according to Ruskin, exclusively apply to botany. It was transversal to virtually any aspect with the potential to document human and non-human existence, from history to natural sciences (Ruskin 1891, 19-20).

element influences another and so forth. Metamorphoses as opposed to inertia; life as opposed to stillness; diversity as opposed to sameness.

In the preface to the second edition of Modern Painters, vol. I, Ruskin says:

> Every kind of knowledge may be sought from ignoble ends; and in those who so possess it, it is ignoble knowledge; while the very same knowledge is in another mind an attainment of the highest dignity, and conveying the greatest blessing. This is the difference between the mere botanist's knowledge of plants, and the great poet's or painter's knowledge of them. The one notes their distinctions for the sake of swelling his herbarium; the other that he may render them vehicles of expression and emotion" (Ruskin 1857a, XXXII).

This demonstrates, once again, that, according to Ruskin, artists and poets alike had a similar way of viewing nature guided by emotion, whilst botanists would approach it with the unique purpose of extracting knowledge from it. Art and poetry would, in this case aim to express its values with the same sensitiveness they perceived them themselves. Hence, to art and poetry, the knowledge obtained was, therefore, not the end but the means to something greater than *knowledge for the sake of knowledge*. His goal, as well as the goal of other artists and other poets was to take knowledge one step further, and, through it, bring to surface the countless incredible features of nature. This would imply an open mind, free from scientific rigidness or constraints, and, at the same time, a kind of innocence that would let sensitivity, emotion and imagination simply run free. It all beginning with perception.

Regardless of each artist's individuality, in order to excel in art, and most particularly in drawing, Ruskin found it essential to refine their powers of perception. Hence, to support and promote artistic training, schools and masters should primarily focus on two main goals. Firstly, they should teach pupils to observe attentively and profoundly, with patience and an open spirit, thus ensuring that they saw truly. Secondly, and fostered by a keen perception, pupils were to be taught to draw delicately[61], thus ensuring they could truthfully represent what they observed. This system was adopted by those Ruskin considered to be the great schools of art in the

[61] For Ruskin, all great art was delicate (Ruskin 1857b, XI).

United Kingdom, and should be embraced by those who wished to become great artists, as others had done before them (Ruskin 1857b, XI).

Ruskin advised his pupils to study Titian and to analyse his mastery in harmoniously representing vegetable structures (Ruskin 1857b, 174). He further suggested the study of Da Vinci's and Rembrandt's drawings; and strongly advocated that Dürer's drawings were to be studied as profoundly as one would study nature itself (Ruskin 1857b, 99-103). The realistic, and thorough virtuosity in depicting the subject in light and shade with the finest detail, the *Dureresque* effect, seen in doc.1, is one of the Flemish artist's masterpieces. We find it in some of Ruskin's own graphic work.

"Ferns on a rock" (1875, doc.2) is a clear example of his taste and aptitude to convey nature as realistically as possible. The whole composition is imbued with minutia and detail. The treatment given to the shape and the surface of the rock, the detailed depiction of the ferns holding on to its rough and uneven surface; the detail of the grasses growing by its side; the variations of colour; and the games of light and shadow that highlight the volume of each detail, shape, colour and texture are commendable examples of the *Dureresque* effect, Ruskin so greatly admired. Furthermore, his representation of an Alpine rose amongst a Mountain rock (c. 1844, doc.3) is yet another example of Ruskin's keenness for expressing the truth of nature. The way vegetable and geological are depicted here is outstanding. The whole composition, especially the left-hand side of it, as he goes further into the woods resonates his will to draw the vital forces of nature. Here the connection between vegetable and geological is remarkably portrayed. Every element occupying its rightful place but also touching the other, resonating with the principles of unity inherent to nature itself. It is a portrait of natural relations, coexistence and harmony. The fact that it is an open composition, leads the observer to instinctively envision the continuance of the scene, as if a moment captured by a photograph. Even without the minuteness of "Ferns on a rock", it reminds us that there are many sides to the truth in nature, be it the detailed depiction of its elements or the visualisation of it's the life that governs it; both at the centre of ideal artistic endeavours. Ruskin knew and explored these facets very well, and sought to perfect his knowledge and skills throughout his career. Both are the result of the emotion of an artist-poet, coupled with the mind of a seeker.

He started his studies on Botany with the highly regarded "Curtis' Botanical Magazine", published since 1795 (Ruskin 1874, 5). In 1842 he began studying botany from the Alps. His enquiries into this natural science continued throughout his career. By the late 1860s, he had agreed with the "Blackwood Magazine" to publish a book, with his own drawings, meant to illustrate every English and Scottish flower known at the time. He began the work and gathered three notebooks that documented not only information of the species themselves but also, and very importantly, the whole process of research and analysis inherent to this kind of work; a "history of efforts and plants" (Ruskin 1874, 12). However, even though the work was initiated, due to a major divergence of opinions between Ruskin and the magazine in regard to Turner's work, the ambitious project was eventually abandoned.[62]

The 1874 lecture "Proserpina: studies of wayside flowers" was, in a certain way, a taster of what the aforementioned book would have been. In fact, one of the most characteristic aspects of Ruskin's approach to botanical studies was the importance he attributed to *understanding*; comprehending the vegetable world itself, including but going beyond its visual features, delving into its deep and complex structures and behaviours; as well as understanding the ways to reach that knowledge, by experimenting it himself. This included observing live specimens and cuttings, many from his own garden (Ruskin 1874, 13), drawing their features in various scales and dispositions, and seeking for information to respond to his enquiries in various

[62] This, however, did not preclude to develop his understanding of botany, on the contrary.

publications[63]. It is well worth emphasising the name of John Lindley[64], from whom he states to have learned almost everything he knew about botany.

In 1870, before the University of Oxford, Ruskin stated that botanical education needed first and foremost to address the "biography" of plants; to know "how and where they live and die, their tempers, benevolences, malignities [sic], distresses, and virtues" (Ruskin 1870, 262). The main focus should be on understanding the processes of metamorphosis, the overall movement and interchangeability of the Natural world. To look at the visual features of plants not simply as characteristics and elements to identify, but as the result of something greater; a living complex mechanism, much of which remained unknown to the date. In other words, what mattered the most was not so much the "whats" but much more the "whys" and "hows" in Nature. Artists should seek to comprehend it, it's laws, structure and forms, not by becoming zoologists, botanists, geologists or physicists, themselves, in all sense of the words, but by turning to those who were for assistance if and when needed. Not to know what they knew, *per se*, but for helping them with the construction of their own artistically adapted scientific knowledge of the natural world.

A keen sense of perception coupled with patience and perseverance were an artist's greatest allies for understanding plants and flowers. Moreover, before being a painter, a sculptor or a designer, they should be draughtsmen and draughtswomen. Sight, memory and artistic ability should be developed as much as possible through observation drawing. In fact, Ruskin himself said that he much preferred to draw a plant

[63] He often turned to his books on botany to satisfy his curiosity and eagerness to learn as well as to search for answers he struggled to find on his own. Some he agreed and rejoiced with, others he questioned and disagreed with in certain points, acknowledging their usefulness, nonetheless. Among his botanical preferred works, and aside from "Curtis's Botanical Magazine", as previously mentioned, were publications such as "Structural and Systematic Botany", Balfour's "Manual of Botany" Lindley's "Introduction to Botany", Dresser's "Rudiments of Botany", Figuier's "Histoire des plantes", "London's Encyclopaedia of plants", and Gray's "System of Botany". The latter being "the most technical book" on botany he possessed (Ruskin 1874).

[64] John Lindley (1799-1865) was a renowned botanist and horticulturist, responsible for the planning and plantation of Bedford Park (Conway 1882, 218). He was also known as 'the man who saved Kew' due to his efforts to revitalize the Royal Botanic Gardens in the late 1830s – early 1840s. On this matter see (Yeomans 2013). As a lecturer he also taught at the London University until he retired in 1860 (1860a). He was also one of the pioneer lecturers of Botany in the London Schools of Art and Design. Lindley's role in the connection between art and science is developed further on the topic of "Botanical studies in the instruction of Victorian designers, from drawing plants and flowers to technical design".

than to write about it. Drawing kept him focused, immersed in one thing only: his subject. Like surrendering to one unique moment, allowing no distractions and capturing every detail time and perception allowed him an exercise that combined rush (against time) attentiveness (to detail), and a steady and fast hand.

1.1.1. On drawing plants and flowers

Ruskin advised his students to, from as early as possible, get "any cheap work on Botany", such as Baxter's British Flowering plants", and copy even the simplest outlines, changing the pencil as they progressed. Firstly, using soft graphite and closely following the trace of the pencil with a focused eye. After finishing the freehand outline, they should instinctively correct anything which might seem disproportioned or wrong, by close comparison between the preparatory drawing and the original. Finally they were to make the same drawing using tracing paper over the book, so as to compare the freehand with the traced copy and assess any faults, analyse them and correct them (Ruskin 1857b, 14). After outline drawing, shading should be practiced with the same attentive eye and agile hand. The technique of shading depended on the combination between lightness, as well as steadiness of hand and keenness and accuracy of sight. Doc.4, shows one of Ruskin's drawings from the collection of the Ruskin Library and Research Centre. Here he partially depicts the elegant and delicate campion plant (*Silene juncea*). Comparing it to the plate of the same species published in vol. 5 of *Flora Graeca* (1825), the similarities are irrefutable. Ruskin's drawing is clearly a copy of the secondary stems and flowers illustrated in the 1825 plate. Aside from the red-purple colouring and the vertical inverted orientation, the differences are negligible. He copied the print with absolute precision; an admirable task given the level of detail. It reveals either very close observation combined with very careful and precise freehand drawing; or it may indicate that he copied it directly from the print using trace paper, as he instructed his students to do. Either way, it is a clear example of observation combined with patience and ability.

After using copies, the apprentice draughtsman should then turn to nature itself. Firstly, practicing from still specimens (e.g. leaves, twigs, flowers, fruits). Using cuttings positioned in various ways and giving them different treatments (from outline to

shading) was the optimum starting point (Ruskin 1857b, 76-86). Secondly, drawing from living nature. This, on the other hand, was much more challenging. Nature does not relax, the earth does not stop moving, light does not freeze throughout the day, and plants do not stagnate their daily cycles to be observed, analysed, drawn. If the aim is an accurate depiction, the artist must be prepared for the simple fact that nature's vital energy and movement are not put on hold for them. Hence, the artist should rely on perception and memory, retain key features that are common to the species and not solely the specimen they have on sight, while making choices on what features to represent (Ruskin 1857b, 119). An understanding of the plant's morphology and physiology would assist the choice, as well as what aspects to leave for a later stage or simply to omit:

> For all his own purposes merely graphic, we say, if the artist's eye is fine and faithful, the fewer points of science he has in his head, the better. But for purposes more than graphic, in other order that he can receive the science from them without letting himself become uncandid and narrow in observation, it is very desirable that he should be acquainted with a little of the alphabet of structure, just as much as may quicken and certify his observation, without prejudicing it. Cautiously, therefore, and receiving it as a perilous indulgence, he may venture to learn, perhaps, as much astronomy as may prevent his carelessly putting the new moon wrong side upwards; and as much botany as will prevent him from confusing, which I am sorry to say Turner did, too often, Scotch firs with stone pines. (Ruskin 1872, 131-132)

Here, shading would be particularly stimulating. It required persistence, memory and practice. It was a game of constructing harmonies; the prize being to recreate, as faithfully as possible, the subtleties of colour, light and volume in nature, and how they come together to create the mutable subjects of human perception. In the first place, he advised to search for spaces with gradations of colour in nature, the sky being "the largest and most beautiful", and to intensely explore their variations of light and colour. Nature was an overwhelming promise of variety and Ruskin aimed to seize it and share it with others (Ruskin 1857b, 18).

In addition, he considered that the greatest distinction between great and inferior men, be it in life itself or in art, resided in *knowing where things are going*. Keeping this in mind, in regard to drawing plants from nature, it was most valuable to know the inherent growth processes and directions they would take; not solely the plant

itself (up and down directions), but also its parts individually, as well as the effects of light on their multiple surfaces.[65] Not only to understand those tendencies and even anticipate them, but also to be able to represent life's movement and differentiate/capture it in the various stages of its development as they happen.[66] In other words, the ultimate goal was to treat nature and its elements and features with the same dynamic it is impregnated with; seizing the movement, the action, the growth, the "vital facts of form" (Ruskin 1857b, 130). In the vegetable world, that dynamic is truthfully everywhere, in every moment, and in everything:

> Try always, whenever you look at the form, to see the lines in it which have had power over its past fate and will have power over its futurity. Those are its awful lines. See that you seize on those, whatever else you miss. (Ruskin 1857b, 122)

Artists were also advised to attentively look at the plant's different angles while drawing it. Observing and drawing side and top views would allow them to reach the maximum understanding of the subject's anatomy, how its parts relate to one another and the overall construction and development of the structure.[67] They were also instructed to draw each part and organ individually, in miniature and in full-size (Ruskin 1857b, 86-88). He took his own advice and produced several scientific-like drawings, in accordance with the principles of botanical illustration. Most of them represent different views of flowers and their parts[68].

We may group Ruskin's dissected flowers from the Lancaster University collections into three groups. The first is dedicated to growth, showing different stages of development, usually from the bud to the flower in full bloom. The second group generally dedicated to the configuration and anatomy of the flower. The third group dedicated to details of parts of flowers, for the most part, petals. Most of these are more schematic, others are simpler and more "conventional" depictions. As we will see, many are accompanied by annotations and a few are captioned; the latter suggesting that they

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[65] A teaching common to Christopher Dresser, as we will see further ahead.

[66] We may, to some extent, draw a parallel with the investigations into pre-cinema principles and apparatuses, such as Muybridge's, Charles-Émile Reynaud's or the Lumiére brothers'; as if capturing frames of the natural growth of plants, an unrushed, free, stop motion-like drawing.

[67] Another aspect common to Christopher Dresser's teachings.

[68] As would be expected, given flower's visual potential and appeal.

probably were also used in lectures, alongside the group of sequentially numbered diagrams that belong to the same collection.

Doc.5 shows one of Ruskin's these compositions on flower growth. It was published in "Proserpina" (1874) and illustrates four different stages of development of the Primrose flower, which he found lovely and very well worth drawing. Docs. 6 and 7 are similar botanical studies belonging to the Ruskin Library and Research Centre, and are two of the examples of Ruskin's coloured botanical drawings. The illustration of the Common Ragwort is particularly interesting, as he concentrates mainly on illustrating the shape of the "graceful calyx". In the inventory entry he researched for this plant, Professor David Ingram[69] mentions it as "an example of Ruskin's close observation of even the commonest plant"[70]. The tall calyx is, in fact, the most detailed of all the flower parts depicted here. The ink and wash technique gives it a delicate, almost ethereal appearance which coexists with the superlative precision of the most minute details; a feature we find in many of Ruskin's botanical compositions from the Lancaster University collection.

Similarly, Ruskin's studies of petals clearly reveal his attentiveness to detail. Either represented as simple outlines and mainly focused on shape (e.g. studies of Francescas in doc.8), or more realistically and comprehensively treated, petals were, surely, of great interest to him. Among his studies of petals, doc.9, illustrating what seems to be the petal of a carnation, is a perfect example of the way he subtlety makes use of colour and combines it with his treatment of lines and shading, to create lightness and volume at the same time. A set of features equally present in the delicate illustration of the Geranium "Kashmir white" shown in doc.10, and, although not as realistic-looking, the study of what seems to be the petal of a Magnolia tree (shown in doc.11). The latter is particularly relevant especially for the variety of views used to illustrate the

[69] David Ingram is Honorary Professor in the Lancaster Environment Centre, Lancaster University and Honorary Professor, Edinburgh University, ESRC Genomics Forum. He has a great interest in Ruskin's Botanical work and is responsible for several entries in the catalogue of his works at the Ruskin Library and Research Centre. Since 2006 his work includes the study of botany and horticulture in nineteenth century art, working with the Lancaster Environment Centre and Ruskin Library, Lancaster University, The Ruskin Foundation/Brantwood Trust, the Lakeland Arts Trust and the Bowes Museum.

[70] In catalogue entry for the drawing 1996P1451, Ruskin Library and Research Centre, Lancaster University.

petal as seen through different angles. On the whole, petals clearly occupy one of the privileged places among Ruskin's interest in the morphology and visual appeal of plants. Moreover, aside from the abovementioned illustrations exclusively dedicated to them, we also find petals as part of more complex compositions, namely illustrations decomposing the flower and its parts.

Although they are not botanical illustrations in the purest sense of the term, a significant number of Ruskin's drawings do aim to be visual explanations and not only "free" representations of plants. The variety of key elements represented, the different angles he chose to create their visualization, the accuracy of the drawing, and the technical annotations that recurrently accompany the illustrations, are clearly scientific added attributes. Docs.12 to 26 present an excerpt of what we may consider Ruskin's most technical drawings of plants, and the ones closest to actual botanical illustrations, mostly dedicated to flowers. They are overall schematics of flowers and their parts, accompanied by notes by the author. Doc. 12 is a study of a Gypsywort (*Lycopus europaeus*) flower. The flower is represented in different angles and views. In its inventory entry, Professor David Ingram refers that the instructions contained in this study were most probably directed to an engraver and the drawing was meant to be published, most likely in Proserpina. Docs.13 and 14 show two studies of flowers and their parts. The first (doc. 13) is identified by Ruskin as the flower of the honeysuckle. The drawing pays special attention to the corolla, the calyx, the flower buds and the petals, and is accompanied by several notes regarding each. The second (doc. 14) is the drawing of a flowering structure which, although unidentified by Ruskin seems to be a passiflora. This drawing is particularly interesting as he draws different flowering stages parallel to each other. On one side the flower in its last stage of bloom, and on the other side of the stem, the flower bud in its initial stage of development. On the whole, these diagrammatic illustrations combine freehand drawing with scientific intention, and are, thus, very clearly within the territory of dialogue between scientific and artistic practice.

The scientific features of Ruskin's drawings are clearly present in two other groups of botanical drawings. The first combines side and top views with their geometric counterparts. Doc. 15 shows the side view and a cross section of the calyx and pistil of a bell heather flower, with notes mostly related to its variations of colour. Doc. 16

illustrates two geometric schematics of the “perfect type of sedum flower”. The drawing shows a layered captioned side view, a captioned longitudinal section and the geometric top view study of radial symmetry, similar schematics can easily be found in technical illustrated publications on botany, many of which Ruskin was very familiar with. Doc.17 is a preparatory drawing for volume V of “Modern Painters”. It combines a freehand drawing of the arrangement of an oak branch with its geometric correspondent in the shape of a pentagonal inverted pyramid. These drawings demonstrate Ruskin’s mathematical interest in flowers and also what scientific features he most valued while studying them; in this case, clearly geometrical coherence and symmetry. The next type of scientific-like drawings was clearly meant to explore the visual features of flowers as seen through different angles and in detail.

In this second “technical” group Ruskin generally presents the species in both top and side views, illustrating details of key parts of the plant, in this case, mainly petals and buds, and, in some cases, makes use of colour to fully convey the flower’s appearance. Although not entirely scientific drawings, and clearly more focused on the flowering parts of plants, they do clearly demonstrate Ruskin’s familiarity with the rules of botanical illustration and his aptitude to make use of those rules to represent the features he found most relevant while studying the morphology of plants. Doc.18 depicts the stem and flower of a sea lavender. Despite its seemingly rough finish the drawings are very complete in regard to the dissection of the plant. The branched stalk is represented as a side view and its correspondent cross section, while the flower is represented in two side views and a longitudinal section. Altogether, Ruskin was successful in mainly two aspects: clarifying the construction of the vegetable structure, as well as the way each part connects with the others; and conveying the shape, the volumes and the textures of both stalk and flower. Docs.19 to 21 show ink and pencil drawings which are clearly schematic dissections of three types of flower. The first represents a side view, a top view and a back view of a silver weed flower. The following two drawings illustrate, very accurately and comprehensively, the structure of an Iris and of an unidentified flower. Both compositions deconstruct the flower into its main parts, in general as well as in detail views. Although they are somewhat rough drawings, it is possible to observe the thoughtfulness and time Ruskin has put into these drawings.

It is also easy to visualize the practical work behind them. It would have required working with collected cuttings, dissecting their parts and closely examining them within the whole of the vegetable structure as well as one by one, in order to obtain both general and detail illustrations of structures and individual parts.

In scientific botanical illustration, colour is also a significantly important feature to include in order to portray the species as accurately as possible. Accordingly, Ruskin also used colour in his schematic illustrations. Sometimes fully applying it to all the parts of the plant, (such as in the study of the fringed gentian seen in doc.22). Other times applying colour solely to sample sections and leaving the remaining only outlined; a technique commonly seen in botanical illustration, as well. Doc.23 illustrates the latter. It is the study of a Common Self-Heal (*Prunella vulgaris*). Only the flowers and the calyx are coloured, with various gradations of blue and green, respectively. The calyx seemed to have caught most of Ruskin's attention as he drew it in three different views. In fact, the prunella, as a whole, was clearly among of Ruskin's preferences, as in the collection of the Ruskin Library and Research Centre there are three more drawings of it: the two aforementioned outline studies and what is one of his few illustrations of the entire aboveground structure of a plant, from the base of the stalk to the apex (Doc.23 on the left). Ruskin's work on schematic illustrations of plants is also contemplated in a set of sequentially numbered botanical diagrams used in his lectures at Oxford.

Ruskin's lecture diagrams are not all clearly schematics. In fact, only a few would actually be considered diagrams in the rigorous sense of the word. Hence this nomenclature derives mostly from their educational purpose as visual explanations. Doc.24 is the most technical of Ruskin's diagrams from the Ruskin Library and Research Centre. It illustrates parallel and alternate patterns of growth in plants. The first two drawings demonstrate the development of alternate leaves on a stem and the top view configuration of a flower with odd number of petals. As opposed to the even numbered petals, and the parallel positioned leaves of the second set of drawings. This diagram is also clearly representative of the symmetry inherent to vegetable structures; one of the features Ruskin most valued in plant morphology. A similar purpose is evident in doc.25. Here, Ruskin presents four variations of leaf buds from clearly different species. Aside from the more common alternate and parallel types of disposition of the first two,

Ruskin also depicted whorls of leaf buds, highlighting the variety of growth configurations existent in different vegetable structures. Docs. 26 to 28 are, likewise, representations of stems and leaves. Curiously, these diagrams are, for the most part, dedicated to stems and leaves and not so much to the intrinsic complexity of flowers. Regardless, it is clear that both were exceedingly admired by Ruskin.

1.1.2. The unique appeal of the flower and the leaf

In 1872 Ruskin wrote that "the simplest forms of nature are strangely animated by the sense of the divine presence; the trees and flowers seem all, in a sort, children of God" (Ruskin and Tuthill 1872, 395). He considered flowers to be the ultimate example of something which occupied the exact place it was meant to; a place determined by divine intervention (Ruskin and Porter 1900, 298), and the ultimate example of nature's capacity to create harmonies. His views on the blooming of flowers and their role within the complexity and overall beauty of plants are expressions of a deeply driven and poetic soul, as he interpreted the moment of flowering as the "inner rapture of the spirit of the plant", the ultimate culmination of life.

Under this light, the flower was the highest achievement of a plant, the noblest result of the complex and beautiful process of gathering dead organic matter, to assimilate it, and reshape into the forms of its own growing structure, pigmented with the most delightful colours. Ruskin found the construction of this natural ensemble, and the ongoing metamorphosis which occurred, so consistently, in the vegetable world, as something no less than extraordinary. He admired not only the singular existence of a plant in itself, but also the ways its parts interconnected with one another as it grew, as well as the natural mechanisms which allowed them to interrelate with other specimens. Something comparable to "the joy of love in human creatures, and having the same object in the continuance of the race" (Ruskin 1869, 66). His private garden in Brantwood was a privileged realm where he paced himself observing and registering and searching for answers to his enquiries. One of the features that most captured his attention and inspired his curiosity was colour. He was especially astounded by the purity and unmatched radiance achieved by nature's colours, and the way they were

either united or separated, and by the fact that there was no space in nature deprived of colour.[71]

The poppy and the rose represented two astounding examples of the richness of colour in nature. Ruskin's description of the poppy, in Proserpina (1874), is one of his most poetic and emotional pieces of writing on botany. Combined with exquisite forms, he sees the poppy as a delicate but persistent force, striving to survive; evolving, until it touches perfectness in every aspect. He describes the blooming of the poppy as liberation from imprisonment and delves into its inner layers, the way it is formed and the way it looks before and after blooming, its fragile existence until it perishes. We find the text so significant that it deserves a full transcription:

> I have, in my hand, a small poppy which I gathered on whit Sunday on the Palace of Caesars. It is an intensely simple, intensely floral, flower. All silk and flame: a scarlet cup, perfectly edged all round, seen among the wild grass far away, like a burning coal fallen from heaven's altars. You cannot have a more complete, a more stainless, type of flower absolute; inside and outside all flower. No sparing of colour anywhere, no outside coarseness, no interior secrecies; open as the sunshine that creates it; fine finished on both sides, down to the extremist point of insertion on its narrow stalk; and robbed in the purple of the Caesars. Gather a green poppy bud, but just where it shows the scarlet line at its side; break it open and unpack the poppy. The whole flower is there complete in size and colour, its stamens full-grown, but all packed so closely that the fine silk of the petals is crushed into a million of shapeless wrinkles. When the flower opens, it seems a deliverance from torture: the two imprisoning green leaves are shaken to the ground; the aggrieved corolla smooths itself in the sun, and comforts itself as it can; but remains visibly crushed and hurt to the end of its days. (Ruskin 1874, 52-58).

As for the rose, he explains how its "victorious beauty" derives solely on richness of the colour gradations found both its leaves and flower (Ruskin 1857b, 219). There is only one drawing exclusively depicting roses among his botanical studies at the Ruskin Library and Research Centre collection. It is a copy of a rose bunch featured on the dress of "La Primavera" by Botticelli. Curiously, the composition is identical, whilst the colours

[71] "There is no climate, no place, and scarcely an hour in which nature does not exhibit colour which no mortal effort can imitate or approach" (Ruskin 1843, 118).

are altered: the green of the stems is maintained but in more vivid tones, as Botticelli's pink rose flowers are copied in varying shades of blue (doc.29).

Ruskin's freehand drawings of flowers are a perfect example of the communion between his poetic love and his scientific interest towards nature. Although his production goes far beyond these examples, the Ruskin Library and Research Centre holds some of his best original work on the subject. Doc.30 shows the example of a simple pencil shaded detail. The delightful white flower of the *daboecia cantabrica* is here amplified several times its real size. Other works such as the *Narcissus bulbocodium*[72] (doc. 31), present fully and faithfully coloured specimens, possibly drawn directly from planted flowers or fresh cuttings. Others emphasise the truthful minutia of flowers and theirs parts, such as the two sepia drawings of the candytuft flower and its seeds or the convoluted lines and shapes of the perennial cornflower (docs.32 and 33). All throughout the History of Art the flower is a gatherer of consensus in what concerns the aesthetic appeal of plants. But aesthetic appeal, intrinsic beauty and visual interest are not exclusive to the blooming elements of plants. Leaves are another example, and Ruskin was clearly aware of them and committed to direct the interest of others to their, sometimes subtle but wondrous, visual allure.

He was also a great admirer of leaves, and highlighted two universal facts about them, which are extremely interesting and appealing, and ultimately influential of our visual perception while observing and drawing. Firstly, and as one of the main tendencies of their lines, leaves grow in accordance to the laws of radiation. This tendency results on a mathematical and beautiful divergence of growth that is reflected on the shape of the leaf, as it develops. Secondly, these divergent growth directions of each line does not occur randomly. Instead it lies on a system, where each vein follows its own specific direction, originating elaborate and diverse patterns of lines or paths. This gives the leaf a fingerprint-like identity (Ruskin 1857b, 157). He compared these venation patterns, formed as leaves expand outwards from the midrib with the arrangement of the ceiling in a gothic cathedral. Doc.34 shows the detail of two leaves seen from below and the gothic rib-vaulted ceiling of the Monastery of "Santa Maria da

[72] Captioned by Ruskin as "Portuguese Narcissus".

Vitória", Batalha, Portugal. In both cases, Ruskin points out that the configuration of such structural arrangements has specific geometric functions (Ruskin 1874, 81-82).[73] The venation corresponding to the vault's ribs and the petiole corresponding the compound pier. [74]

His study of the water lily leaf (doc.35), illustrates these intricate venation patterns very clearly. The lines are drawn with great precision and symmetry, comparable to the muscles in the human body. There is a great level of detail, not only observable in the leaf itself, but also in the amplified reproduction of the terminations of its venation on the outer margin. There is no way of knowing with all certainty whether the unfinished aspect of the drawing was intentional or not, however, this feature, common to botanical illustration, is often times present in Ruskin's Botanical drawings. This is his most detailed and accurate botanical study of a leaf. Docs.36 and 37 present similar leaf studies of the Cyclamen (Primrose family) and a Jupiter's Distaff (*Salvia glutinosa*), respectively. The first associated with the study of a flower from the same species and the latter with the study of a leaf bud, probably of the same species as the leaf as well. Four other drawings complete the individual studies of leaves contained in Ruskin's botanical drawings at the Ruskin Library and Research Centre. The first presents two simple outline drawings. One representing a palmate (on the right) and the other a pedate (on the left) leaf (doc. 38). The venation pattern is simplified to the main lines developing from the top of the leaf-stalk. The second, (doc.39) presents another example of a palmate leaf.[75] In this case the venation structure was drawn with great precision, and aimed, according to the inscription, to depict the vital energy of the leaf as it grows from the rib through its veins. Lastly, on a more curious note, Ruskin drew three leaflets of a rose leaf with the marks of bee bites (doc.40).

The patterns created by the venation of leaves, unveiled by its variable translucent qualities and accentuated by the use of a backlight, were among the features Ruskin most admired in plants. Doc.41 shows various photographs of leaves, where we

[73] Something that can be observed in other supporting structures such as the disposition of beams under a wooden floor or a roof or the girders on a bridge.
[74] See the anatomy of the leaf in figure 25.
[75] See figure 27.

can observe different light effects of texture, colour, light and pattern. In fact, the overall effects of light on leaves, either individually or within the structure of the plant.[76] The shadows cast by other leaves, the reflection of light from the surface of the leaf, variable according to its surface texture, or the darker spectrum of other leaves when observed through the translucent medium of another leaf. His two studies of light and shadow with bay leaves (doc.42) is well illustrative of his interest for these light variations and the way they affect the visual perception of their surface, its textures and volumes.[77] The latter, was, for Ruskin, one of the most interesting visual effects to be found while observing leaves, but one highly neglected by landscape artists before and during his time. Leaves are composed by an intricate mix of elements of form, simultaneously in front of our eyes but impossible to perceive in its totality[78].

Ruskin believed that all natural objects were imprinted with this mystery; a virtually unfathomable facet that lured human curiosity and challenged perception. On the other hand, a portion of it which could actually be at reach of human observation powers. This, however revealed to be a difficult task at times, as it demanded the observer to find order amid complexity. It required extreme care and technique to become fathomable and reproducible (Ruskin 1857b, 89-90). One of his studies of the Rhododendron flower illustrates this concept very well. The pencil drawing depicting the flower and highlighting the spotted pattern of its petals, is accompanied by the inscription: "Spots on Rhododendron petal – Brentwood main garden"[79] (doc.43 second top right). This is part of a series of 6 studies meant to illustrate the principle of order in pardonable disorder", using the rhododendron flower (doc.44) as an example.

Still on the principles of radiation, which he considered essential to the beauty of virtually every vegetable form, Ruskin turns his attention to trees, where radiation could be most visually impactful (Ruskin 1857b, 277). His 1861 lecture diagram of trees (doc.45) seems to have been produced with the intent of illustrating that concept. Aside

[76] Ruskin nurtured a special admiration for olive tree leaves, whose blossoms he found delightful (Ruskin 1874, 162).
[77] Another aspect also explored by Christopher Dresser, as we will see further ahead.
[78] Over time, science and technology have broadened the spectrum of what exactly may and may not be perceived but also reproduced, registered, and shared about the vegetable kingdom.
[79] Brantwood, where Ruskin had his house and garden.

from more “conventional” depictions of trees, the diagram contains two somewhat odd-looking drawings illustrating a cup-shaped tree crown. The first drawing illustrates the whole mass of the crown terminating in a perfectly circular edge; the second is a section of it. An idealized shape most probably to convey the concept of radiation and its presence in the structure of trees. Moreover, aside from leaves and trees, many flowers are also constructed according to the laws of radiation. Some partially, others very extensively throughout their entire structure. The convolvulus is one of the examples mentioned by Ruskin (Ruskin 1857b, 277), but in his drawings of flowers, we find many more, as we have previously seen. Table 2 presents a list of 27 species present in the collection of the Ruskin Library and Research Centre.

Table 2. List of plants depicted by John Ruskin, Ruskin Library and Research Centre, Lancaster University.

Common name	Botanical name/genus	Botanical Family
Alpine Rose	Rhododendron ferrugineum	Ericaceae
Bay laurel	Laurus nobilis	Lauraceae
Bell heather flower	Erica cinerea	Ericaceae
Campian plant	Silene Juncea	Caryophyllaceae
Candytuft	Iberis umbellata L.	Brassicaceae
Carnation	Dianthus	Dianthus
Common Ragwort	Jacobaea vulgaris	Asteraceae
Common Self-Heal	Prunella vulgaris	Lamiaceae
Cornflower	Centaurea cyanus	Asteraceae
Cyclamen	Cyclamen	Primulaceae
Daboecia Cantabrica	Daboecia Cantabrica	Ericaceae
Daffodil	Narcissus	Amaryllidaceae
Fern	Polypodiopsida (class)	Polypodiopsida (class)
Francesca	Francesca Dispersa	
Francesca	FrancescaTerrestris	
Gypsywort	Lycopus europaeus	Lamiaceae
Honeysuckle	*Lonicera*	Caprifoliaceae
Horse Chestnut	Aesculus hippocastanum	Sapindaceae
Iris	Iris (genus)	Iridaceae
Jupiter’s Distaff	Salvia glutinosa	Lamiaceae
Magnolia [?]	Magnoliaceae	Magnoliaceae
Passion Fruit	Passiflora	Passifloraceae
Primrose	Primula Vulgaris	Primulaceae
Quatrefoil fringed gentian	Gentianopsis crinita	Gentianaceae
Rhododendron	Rhododendron	Ericaceae
Sea Lavender	Limonium	Plumbaginaceae
Silverweed	Argentina anserina	Rosaceae

1.1.3. Ruskin and the Pre-Raphaelites

In his references to Turner and the way he sought, perceived and expressed the values of the natural world, Ruskin uses the word "sympathy" to describe an all-encompassing almost transcendental way of emotionally connecting to nature, entering a meditative state. He saw Turner as the great master of absorbing and assimilating the aesthetic values, the power and the greatness of Nature in such a way that the painter would be a translator of something beautiful and transcendentally bigger than him/herself. He also saw something of this meditative, introspective way of being one with the natural world in the self-denominated Pre-Raphaelite Brotherhood.

In his pamphlet "Pre-Raphaelitism"[80], first published in 1851[81], Ruskin sets out on the quest to "salvage" the name of the Pre-Raphaelites from the, often harsh, criticism of many of their contemporaries.[82] The goal was not to acclaim the perfection of their artistic views, endeavours or accomplishments, but to highlight their merits, for the most part, as followers of his advice to young artists to:

> go to nature in all singleness of heart, and walk with her laboriously and trustingly, having no other thought, but how best to penetrate her meaning; reflecting nothing, selecting nothing, and scorning nothing. (Ruskin 1843, 418, 1851, 1-2).

Ruskin further stated that the true greatness of a painter lied on an "intense sense of fact" coupled with an admirable ability to appropriate oneself of what is observed, "losing hold of nothing, on his forgetting himself, and forgetting nothing else;

[80] This work is a mixt of his well-known appreciation for Turner and his connection to nature as a man of great sensitivity and high powers of perception. According to Ruskin, Turner was the example to follow.

[81] Three years after the Pre-Raphaelite brotherhood had been founded (1848).

[82] Interestingly, a review published in the *Economist*'s issue, 23 of August 1851, argues that Ruskin's pamphlet on Pre-Raphaelitism is written in a rather exaggerated tone; as Ruskin sets out to defend the Pre-Raphaelites against a scrutiny from the press which the (unknown) author admittedly fails to acknowledge. The author further questions if Ruskin's argument does not imply that Turner himself was a Pre-Raphaelite, as the text is highly focused on the way he addressed and treated Nature in his pictorial work (Ruskin 1851). In our opinion, this is a very legitimate consideration. One that Ruskin, even if unconscientiously, could have had on his mind as well, by addressing Turner's work as the role model to follow, when discussing the work of the Pre-Raphaelites; seemingly putting him in the position of a precocious, unnamed, Pre-Raphaelite.

and to convey it truthfully. Thus, it began with an ideal state of mind, grounded on a deep feeling of caring for nature; with no distractions and with extreme focus; a communion so great that subject, moment/time and artist were in perfect symbiosis. This was the greatness of the "sympathy" he majestically saw in Turner and also recognized in the conceptions and the pictorial work of Raphael himself and in the Pre-Raphaelites (Ruskin 1891, 77). While acknowledging the Pre-Raphaelites under this light, Ruskin was also giving credit to their vocation as painters. According to him, it was founded on intense sensitivity and power of perception, combined with an acute ability to imitate what was observed (Ruskin 1891, 16). What we see is universal. Learning and perfecting our way of observing has also, to a certain extent, some degree of universality, but the way each of us is touched, interprets, reacts to and applies what we observe is, even if influenced by others, always a personal choice. Ruskin saw it in the Pre-Raphaelites. On the one hand, the universal gaze inherent to the profound love and understanding of nature. On the other hand, an intimate, very personal way of interpreting and translating its values into art. Unity and diversity in one. As he himself was influenced and enriched by others, such as Christopher Dresser or John Lindley, Ruskin was a great influencer of others of and beyond his time. Directly or indirectly he remains as a key communicator who remains as a link between many scenarios and figures of British Art. Among them are the Pre-Raphaelites. The following chapter explores the presence of botanical elements on Pre-Raphaelite art, focusing on the work of William Holman Hunt, John Everett Millais, Dante Gabriel Rossetti and John William Waterhouse.

1.2. **An insight into botanical elements in Pre-Raphaelite paintings and drawings**

This chapter takes Ruskin's teachings as a starting point. Firstly, it is grounded on Ruskin's positive opinion of the Pre-Raphaelite's obedience to what he believed to be the look and practice of a true artist when depicting Nature, respecting, understanding and respecting the truth and inherent aesthetic qualities of the botanical universe before them. Secondly, grounded on Ruskin's premise that one of the great missions of an artist is to be an informant of Nature and Science, it explores the existence and formal representation of botanical elements in Pre-Raphaelite paintings and drawings. The main goals of this contextualizing chapter are to locate and identify and present the species depicted in a selection of pre-Raphaelite pictorial works; to synthetically analyse the formal style in which they are visually depicted; and to assess the existence of a dialogue between artistic intent and an underlying scientific knowledge and understanding of botanical elements and mechanisms, by the four artists: William Holman Hunt (1827-1910), John Everett Millais (1829-1896), Dante Gabriel Rossetti (1828-1882) and John William Waterhouse (1849 – 1917).

The Pre-Raphaelite Brotherhood was established in London in the year 1848. Its founders were William Holman Hunt, John Everett Millais, and Dante Gabriel Rossetti. As the pioneers of the artistic revolution that occurred in mid-1800s Britain, "they were to throw all traditions to the winds and begin art all over again" (Cox 1917, 315). By the late nineteenth century, the founding group was to influence another phase of the movement. One of those later Pre-Raphaelites was John William Waterhouse. In this chapter we look into the work of Hunt, Rossetti, Millais and Waterhouse, and the ways botanical elements come into place in their unique but intrinsically connected pictorial universes. It is impossible to deeply analyse each work of the four artists within the context of this study. Nonetheless, a close observation and analysis of botanical elements within the pictorial work of each can shed significant light into what those elements *are*, *and* how they complement each other within a group that, although the focus of controversy, had such meaningful influence in Victorian art, as Ruskin himself so vehemently emphasised. On the whole, we analysed a total of 6 paintings by Hunt, 4 by Millais, 24 by Rossetti and 33 by Waterhouse (plus his sketchbook drawings). In a

total of 66 paintings studied, we identify 80 botanical specimens, the majority flowering plants, some of which, such as the rose, the poppy, the daffodil or the lily, for example, feature in various compositions.

1.2.1. William Holman Hunt: Nature just as it is

William Holman Hunt[83] was the great naturalist of the group. Highly acclaimed especially for his landscapes of the British countryside, he was clearly an attentive observer of everything around him, of anything eligible to be transferred into his painting. He was also extremely keen and gifted on depicting nature, either animal, vegetable, geological or climatological, as accurately as he found possible. His painting "The scapegoat" (doc. 46), for instance gathers all these facets. The stare of the animal, the minute treatment of detail, make it a true leap of reality into canvas. Coherently with his overall pictorial representations of Nature, Hunt treats botanical elements with the eye of a naturalist.Table 3 lists the botanical species in six of Hunt's paintings.

Table 3. Botanical elements in the work of William Holman Hunt

Title	Date	Common name	Botanical Name / genus	Botanical Family
The Hireling Shepherd	1851	Bindweed	Convolvulus arvensis	Convolvulaceae
The Hireling Shepherd	1851	High mellow	Malva sylvestris	Malvaceae
The Hireling Shepherd	1851	Marigold	Calendula officinalis	Asteraceae
The Hireling Shepherd	1851	Poppy	Papaver (genus)	Papaveraceae
The Hireling Shepherd	1851	Wheat grass	Triticum aestivum	Poaceae
The light of the world	1852	English Ivy	Hedera helix	Araliaceae
The light of the world	1852	Hemlock water dropwort [?]	Oenanthe crocata	Oenanthe crocata
The light of the world	1852	Rubus plant	Rubus (genus)	Rosaceae
The light of the world	1852	Sheep's sorrel [?]	Rumex acetosella	Polygonaceae
Our English Coasts	1852	Valerian [?]	Eupatorium cannabinum	Asteraceae
Our English Coasts	1853	Rose campion [?]	Lychnis coronaria	Caryophyllaceae
Our English Coasts	1854	Sheep's sorrel [?]	Rumex acetosella	Polygonaceae
Isabella and the pot of basil	1867	Basil	Ocimum basilicum	Lamiaceae
Isabella and the pot of basil	1867	Camellia	Camellia	Theaceae
Amaryllis	1867	Chicory	Cichorium intybus	Asteraceae
Amaryllis	1867	Indian Cress	Tropaeolum majus	Tropaeolaceae

[83] Do not mistake for the English watercolourist William Henry Hunt (1790–1864).

The birthday	1868	Rose	Rosa	Rosaceae
Amaryllis	1884	Rose	Rosa	Rosaceae

A spontaneous but truly attentive look towards the slightest detail results in an immediate sense of reality and material presence. Proximity and familiarity to the observer are highly achieved in Hunt's paintings featuring plants, as in the majority of his work he represents the vegetable world just as it is, no more, no less. We argue he did not necessarily aim to represent beauty, he "simply" transferred it, when existent, into his canvas, just as advocated by Ruskin as well. On the whole, Hunt united the essence of naturalism with the technical mastery so avidly defended and sought by the Pre-Raphaelites. As a result, he portrays the British flora just as it appears to his eyes or as it would appear in the natural state required for his more symbolic or idealistic compositions. The withered plants (sheep's sorrel, Hemlock water dropwort, rubus plant) and the English ivy seen in "The light of the world" (doc.47) are an excellent example of the latter. It is not our purpose here to refer to their symbolic meaning, but simply to emphasise the level of accuracy and detail with which they are depicted, and, although accurate identification is not always easy especially due to large similarities between different plants, especially more common ones, the detail is, nevertheless, present and imposing.

Even though there seems to be a growing attention to detail as Hunt's work evolves, it is safe to say his approach to the vegetable realm did not undergo significant changes in terms of representing the truth of Nature. His landscapes are sprinkled with the existing flora in the moment they were observed by Hunt. growing on mountains and plains. Consequently, we argue that botanical variety in Hunt's work is, for the most part, a result of the botanical variety he found in Nature itself; an encounter rather than staging or stylization. The existing elements being carefully treated with the accurateness possible from the viewpoint of the painter, just as it happens with, from atmospheric perspective to the growing botanical specimens that inhabit the depicted sceneries. Resonating Ruskin's thinking, it is clear that he paid close attention to the ever-present movement in nature and by doing so seemed to be conscientious of where things were going, representing them in the current state, moment, and ultimately, as they live. The 1851 rural scene "The Hireling Shepherd" (doc.48) is a clear testimony of this. The couple is literally surrounded by the intricate movement of the landscape.

Aside from the exquisitely modelled trees aligned alongside the stream and surrounding the cornfield in the background, the artist finely depicts the wild flowers that inhabit those grounds, such as the Bindweed, climbing the trunk of a tree. In the foreground, and closest to the observer two specimens of wild flowers. Hunt successfully combines the freedom of his stroke with the accurate representation of the flora before him. The plant on the right, possibly a marigold, is harder to identify, as yellow wildflowers are very common in British, and, in general, European spring-summer landscapes. The plant on the left is a high mellow, being on the foreground it deserved close attention to detail. Hunt took the time to model and paint it accurately. Shapes, anatomy and a rich pallet of colour variations, applied precisely to the various parts of the plant are joined together to represent a notable portrait of the plant; a common feature in his landscapes. In "Our English coasts" (doc. 49), he represents a niche of vegetation in the foreground. Although the species are not the easiest to discern, they seem to include a rose campion, a hemp agrimony, a valerian plant and a sheep's sorrel[84], which are common British wild plants. In fact, wild flowers are the most common in all Pre-Raphaelite art.

In Hunt's work flowers not only appear as elements of the landscape but also as adornments or botanical "annotations" amidst various sceneries. In "Amaryllis" (doc. 50), against a deep but fairly limited natural background, wild and garden flower cuttings are highlighted as adornments in her hat, as her figure occupies most of the foreground space. Wildflowers alternate between chicory, indian cress, and white and red roses, heralding the warm seasons and the richness of the natural elements that originate from them. In interior sceneries, for example, they appear as natural notes staged with the composition of a scene. From the simplest of forms: a cutting with two red roses hanging from Edith's hand[85], in "The birthday" (1868, doc.51.), for example; or the three varieties, each occupied a well-defined space such as the potted Basil plant and what seem to be a red and a yellow camellia, lying by Isabella's feet in "Isabella and the pot of basil" (doc. 52).

[84] The latter also seen in the above-mentioned painting "The light of the world".
[85] The model in "The birthday" is Edith, the sister of Hunt's wife, Fanny. She became his second wife, in 1873, after Fanny's death.

1.2.2. John Everett Millais: detail, colour and diversity

"Sensitivity to colour and the eye of an eagle"; these were two qualities Ruskin considered essential in any artist who wished to convey a truthful image of Nature. Among the Pre-Raphaelites, he saw these qualities mostly in John Everett Millais (Ruskin 1891, 37) (Cox 1917). As we go deeper into the Pre-Raphaelite botanical universe, one thing becomes increasingly clear: even if not necessarily the central topic, plants and flowers are essential elements of virtually every painting they are present in. Millais' work is one of the greatest examples of this. Table 4 lists the botanical species in 4 of Millais' paintings.

Table 4. Botanical elements in the work of John Everett Millais.

Title	Date	Common name	Botanical Name / genus	Botanical Family
Ophelia	1852	Baby blue eyes [?]	Nemophila menziesii	Boraginaceae
Ophelia	1852	Blue bugloss [?]	Echium vulgare	Boraginaceae
A Huguenot on St. Bartholomew's day	1852	Bluebell	Hyacinthoides non-scripta	Asparagaceae
The Blind Girl	1856	Campanula	Campanula	Campanulaceae
Ophelia	1852	Carnation	Dianthus (genus)	Caryophyllaceae
Ophelia	1852	Common hawkweed [?]	Hieracium lachenalii	Asteraceae
Ophelia	1852	Common Milkwort [?]	Polygala vulgaris	Polygalaceae
Cymon and Iphigenia	1848	Common polypody	Polypodium vulgare	Polypodiaceae
Ophelia	1852	Daisy	Bellis (genus)	Asteraceae
Ophelia	1852	Dame's-violet [?]	Hesperis matronalis	Brassicaceae
Ophelia	1852	Dog rose	Rosa canina	Rosaceae
A Huguenot on St. Bartholomew's day	1852	English Ivy	Hedera (genus)	Araliaceae
Ophelia	1852	Fuller's Teasel	Dipsacus fullonum	Caprifoliaceae
A Huguenot on St. Bartholomew's day	1852	Indian Cress	Tropaeolum majus	Tropaeolaceae
Ophelia	1852	Iris	Iris (genus)	Iridaceae
Ophelia	1852	Marsh grass	Spartina (genus)	Poaceae
Ophelia	1852	Marsh marigold	Caltha palustris	Ranunculaceae
Ophelia	1852	Pansy	Viola x wittrockiana	Violaceae
Cymon and Iphigenia	1848	Polypody fern	Polypodium vulgare	Polypodiaceae
Ophelia	1852	Poppy	Papaver (genus)	Papaveraceae
Ophelia	1852	Purple loosestrife	Lythrum salicaria	Lythraceae
Ophelia	1852	Rose	Rosa	Rosaceae
Ophelia	1852	Water crowfoot	Ranunculus aquatilis	Ranunculaceae
Ophelia	1852	Water forget-me-not	Myosotis scorpioides	Boraginaceae
Ophelia	1852	Willow	Salix.sp	Salicaceae

Ophelia	1852	Wood forget-me-not	Myosotis scorpioides	Boraginaceae

In the painting "Cymon and Iphigenia" (1848, doc.53) plants are determinant to compose the scenery. They are also crucial sources of intensity and diversity of colour, and variety of patterns and shapes. In this particular composition, they are the quietness alongside the mayhem. Millais presents the vegetation in the foreground in a mixt of well-defined perceptible vegetable structures and gradually fading shapes. The fern on the bottom right, for instance, is executed to perfection, the lines, the position of each leaflet, the directions of growth are all coherently represented. The lower vegetation, on the other hand, is depicted with less detail, but with the same accurateness in terms of structure and overall morphology. As the scene develops into the background, shapes and colour gradually assume the form of homogenous masses which dissolve into each other, creating a misty atmospheric effect, in contrast with the realistic treatment of the foreground vegetation (e.g. the common polypody fern on the bottom right), and exquisitely accomplished in the depiction of the dog. The natural elements, namely animal and vegetable, being the ultimate representatives of naturalism as opposed to the human mix of reality and exaggerated expressive treatment. Two coexisting pictorial treatments, one founded on accuracy and detail in the foreground, especially present in the dog and the plants; the other based on atmospheric perspective and the consequent gradual dissolution of forms**.**

Another example is Millais's treatment of vegetable elements in the painting "A Huguenot in St. Bartholomew's Day" (1852, doc.54). It is a definite testimony of the painter's mastery in replicating nature, and particularly botanical elements, in all accuracy and detail. His "eagle eye" at work and his talented and steady hand coupled to represent the finest shapes, textures, light and colour effects of the vegetable elements surrounding the couple. An English Ivy covers the upper part of the wall, giving the lovers the perfect background contrast to highlight their faces and expressions. The Ivy is masterfully represented, from the naked roots holding on to the wall, to the leafy structure above. The treatment of light - shade effects on the overall appearance of each leaf, as well as their resultant colour variations, clearly suggest that this was the result of patient study and observation. In lighter shades of green, by the lover's feet, is a

Nasturtium or Indian cress. Millais' attention to colour, light and shape is what most makes the Nasturtium distinguishable and easy to identify. The uniquely shaped and positioned leaves are the first element to make it unique. And, if the artist had, by any chance, omitted the flower, the identification of the plant would not have been compromised, due to the truthfulness of the non-flowering elements (e.g. stems, leafs, venation) both in terms of colour and shape. The same veracity is applied to the flower, with the necessary accuracy of colour gradations and form. Both treatments imply, once again, close observation, attentive study and a fair amount of understanding of not only the plant's morphology but also its physiology.

Lastly, the delicate shapes and fine structure of a white Campanula only just made it to fit into the scenery. Its flowers dangling by the natural effects of gravity, sharing its space with short-grasses and framed by a mossy wall, this species reappears in the painting "The blind girl" (1856, doc.55) where it is portrayed against the light background of a springtime meadow. The scene is covered with numerous shades of green in a landscape bathed with a warm yellow.

Let us now pay close attention to Millais' most acclaimed work: "Ophelia" (1852, doc.56). Nature alone sets the scenery, as the feeble female figure of Ophelia lies on the surface of the water. Here, the role of natural elements, and especially plants and flowers is so determinant that to envision the composition without them is in itself as nothing less than inconceivable, as they have such relevant role in the composition of Shakespeare's play itself, as well:

GERTRUDE
One woe doth tread upon another's heel,
So fast they follow — Your sister's drowned, Laertes.
LAERTES
Drowned? Oh, where?
GERTRUDE
There is a willow grows aslant a brook
That shows his hoar leaves in the glassy stream.
There with fantastic garlands did she come
Of crowflowers, nettles, daisies, and long purples,
That liberal shepherds give a grosser name,
But our cold maids do "dead men's fingers" call them.
There, on the pendant boughs her coronet weeds

Clambering to hang, an envious sliver broke,
When down her weedy trophies and herself
Fell in the weeping brook. Her clothes spread wide,
And mermaid-like a while they bore her up,
Which time she chanted snatches of old lauds
As one incapable of her own distress,
Or like a creature native and indued
Unto that element. But long it could not be
Till that her garments, heavy with their drink,
Pulled the poor wretch from her melodious lay
To muddy death.

William Shakespeare, Hamlet, act 4, scene 7 (1905, 370-373)

This is one of the examples where every single feature of the painting comes together as a whole to successfully deliver a message that goes much beyond "simple" visual perception. The elements portrayed, and the way they are treated in terms of composition, form, colour and light, all seem to occupy their rightful place, and to have been represented in the right state to conjointly tell Ophelia's story, as she falls into the stream and drowns.

Instead of making annotations of the natural landscape to posteriorly create the painting in the studio, Millais started and finished the landscape on site and added the figure of Ophelia in a later stage, in his studio.[86] This was a common practice among the Pre-Raphaelites, differentiating them from many others of their time, in Britain, where the academicism of indoor painting was still significantly expressive. The full *plain air* tendency required patience, a keen eye for detail and a fair amount of time spent in the presence of nature. It also entailed a great degree of self-confidence. If looked at closely, Millais' Ophelia portrays not only the Shakespearean story but also the multifaceted and unique character of "the Brotherhood". It combines the views and teachings of Ruskin, the poet, artist and critic, with the scientifically inquisitive mind of Victorian artists and the impressionist principles of capturing the most fleeting moments of light. This was no

[86] Ophelia's image was painted in studio having Elizabeth Siddall as his model.

easy task for Millais who chose the banks of the Hogsmill river (Surrey) where he went back to for a period of 5 months. He is said to have worked on the natural scenery for an average of 11 hours a day, resting only one day each week and, often times, facing harsh winds (Secher 2014).

"Ophelia" is extremely profuse in botanical elements. From cuttings gently placed and staged on the female figure and on the translucent surface of the water, to trees, shrubs and marsh flowers, growing on the river banks, the diversity is immense. Even without identifying the plants, the numerous colours sprinkling the green backgrounds alone are a testimony of such variety. Between low and high vegetation, flowering and non-flowering plants, Millais painted over thirty species in Ophelia. Doc.55 Identifies twenty of those species, for the most part wildflowers commonly seen in British grounds during spring and summer. In some cases, such as the rose, the forget-me-nots, the fuller's teasel or the pansy, for instance, identification is immediate. In other cases, although precise in colour gradations and tones, there is insufficient line and shape detail to allow a precise identification, making the task highly challenging. Most certainly an artistic option rather than lack of precision and attention to detail, Millais has proven to master in other details and in the overall thorough treatment of the entire scene. Detail is clearly applied in larger scale vegetation, such as the water marsh or the trunk and branches of the willow tree[87].

In parallel, his fidelity to smaller-scale and more profuse vegetation mostly results from his exceptional ability to treat light and colour, modelling even the slightest volumes to create shape, texture and veracity**,** and faithfully materialising his own perceptions onto the surface of the canvas. On the whole, Millais's fidelity to the truth of this chosen natural scenery in such a complex and profuse composition is truly admirable, contributing greatly for what is one of the greatest accomplishments of its time in British Art. Another aspect of Millais's Ophelia is the treatment of botanical

[87] "The man who can perceive the difference between rudeness and tenderness in humanity, perceives, also, more difference between the branches of an Oak and the willow than anyone else would, and, therefore, necessarily the most striking character of the drawings themselves is the speciality of what they represent. The thorough stiffness of what is stiff, and grace of what is graceful, beyond all this, this condition of the mind of the painter himself is easily enough discoverable by comparison of a large number of the drawings" (Ruskin 1891, 55).

elements, deeply associated with *the feminine*, which seems to go beyond the obvious depiction of the woman itself. The delicate nature of the picked flowers or the flower necklace Ophelia is wearing are examples of that close association between flowers and the feminine. A feature profoundly present in the work Dante Gabriel Rossetti as well.

1.2.3. Dante Gabriel Rossetti: flowers in the feminine

Either adorning his model's hair, resting on top of furniture or composing backgrounds, or growing from the ground in flower beds, in Rossetti's work plants and flowers inhabit a universe profoundly inspired and nurtured by the feminine. Table 5 lists botanical species depicted in a 24 paintings by Dante Gabriel Rossetti.

Table 5. Botanical elements in the work of Dante Gabriel Rossetti

Title	Date	Common name	Botanical Name / genus	Botanical Family
The Blue Bower	1865	Bachelor's button	Centaurea cyanus	Asteraceae
Regina Cordium	1867	Bearded Iris	Prunus avium	Rosaceae
Salutation of Beatrice	1882	Bluebell	Hyacinthoides non-scripta	Asparagaceae
Salutation of Beatrice	1882	Buttercup	Ranunculus	Ranunculaceae
Salutation of Beatrice	1882	Camellia	Camellia	Theaceae
The blessed Damozel	1878	Canary bird rose	Rosa xanthina	Rosaceae
The Blue Bower	1865	Cathedral bells	Cobaea scandens	Polemoniaceae
Mary Magdalene	1877	Christmas rose	Helleborus niger	Ranunculaceae
Blanzifiore	1873	Common snowdrop	Galanthus nivalis	Amaryllidaceae
Veronica Veronese	1872	Daffodil	Narcissus	Amaryllidaceae
The bride	1866	Day lily	Hemerocallis	Asphodelaceae
Hanging the Mistletoe	1860	European mistletoe	Viscum album	Santalaceae
Lady Lilith	1868	Foxglove	Digitalis purpurea	Plantaginaceae
Salutation of Beatrice	1882	Giant Himalayan Lily	Cardiocrinum giganteum	Liliaceae
Marigolds	1873	Giant marsh marigold	Caltha polypetala Hochst. ex Lorent	Ranunculaceae
Hanging the Mistletoe	1860	Highclere holly	Ilex x altaclerencis	Aquifoliaceae
The daydream	1880	Honeysuckle	Lonicera	Caprifoliaceae
Venus Verticordia	1864	Honeysuckle	Lonicera	Caprifoliaceae
Proserpina	1874	Ivy	Hedera (genus)	Araliaceae
The lovin cup	1867	Ivy	Hedera (genus)	Araliaceae
The blessed Damozel	1878	Lily	Lilium sp.	Liliaceae
Bocca Baciata	1859	Marigold	Calendula officinalis	Asteraceae
Beata Beatrix	1870	Opium poppy	Papaver somniferum	Papaveraceae
Girl in a lattice	1862	Pansy	Viola (genus)	Violaceae
Study for Water Willow	1871	Pansy	Viola (genus)	Violaceae
The Blue Bower	1865	Passion Flower	Passiflora	Passifloraceae

The bride	1866	Pomegranate	Punica granatum	Lythraceae
Proserpina	1874	Pomegranate (fruit)	Punica granatum	Lythraceae
Blanzifiore	1873	Primose	Primula vulgaris	Primulaceae
Bocca Baciata	1860	Rose	Rosa	Rosaceae
Lady Lilith	1868	Rose	Rosa	Rosaceae
Lady Lilith	1868	Rose	Rosa	Rosaceae
Regina Cordium	1868	Rose	Rosa	Rosaceae
The bride	1866	Rose	Rosa	Rosaceae
Venus Verticordia	1864	Rose	Rosa	Rosaceae
Study for "The daydream"	1878	Schruby Bindweed	Convolvulus cneorum	Convolvulaceae
Fair Rosamund		Sweet Briar Rose	Rosa rubiginosa	Rosaceae
Regina Cordium	1866	Sweet cherry	Prunus avium	Rosaceae
The daydream	1880	Sycamore	Acer pseudoplatanus	Sapindaceae

In “Venus verticordia”, for instance, (1864, doc.57) the female figure is surrounded by roses staged in order to frame the central figure. On the bottom a honeysuckle where we can see leaves and different stages of flowering, from infant flower buds, the first stages of flowering and finally the mature blossoms. Every element is represented to perfection, from the colour gradations in all the blooming stages represented, to the shape and structure of the flower, from petal to filaments and anthers, accurate and meticulously depicted.

The same species also appears in “The daydream”, dated 1880 (doc.58). the feminine figure rests her hand on an opened book holding a cutting of the fragrant flower of a honeysuckle. Curiously, in the 1878 study for “The daydream” (doc.59) Rossetti draws a convolvulus flower in her hand and not the honeysuckle present in the final work. The convolvulus, attached to the curvilinear stem is drawn in detail. Every visible part of the white flower is represented minutely and faithfully, as he uses line, light and shadow to create a three-dimensional effect of the flower, stem and leaf. Beneath the flower a loose leaf, judging by the shape, one of the leafs of the tree she sits on, not the pomegranate tree that finally appears in the finished painting. In the finished work, presently on display at the Victoria and Albert Museum, the feminine

figure sits on a pomegranate tree with early blossoms which generally occur after reaching maturity, between spring and fall.[88]

The pomegranate is another featured species in Rossetti's work. It was most certainly one of Rossetti's favourite plants to depict, probably for the wide range of unique aesthetic features. In "The bride" (doc.60), painted fourteen years earlier (1866) the feminine figure on the left holds the cutting of a pomegranate tree branch supporting four flowers in different stages of blooming.

In "Proserpine" (1874, doc.61) the feminine figure is holding a pomegranate fruit. The general scene, the reference to the pomegranate, the colour palette and even the body language of the feminine figure in "The day dream" clearly resonate this work, painted six years earlier. The ivy, which appears on the background of Proserpine is also present in the 1867 work "The loving cup" (doc.62). In Proserpine the background seems to be an exterior scene where the ivy could naturally appear. Conversely, the context for an ivy is a rather odd one, as we can partially see the limits of a doorway and its casted shadow on the inside, an uncommon location for wild ivy. The plant itself, however, is perfectly designed, with structural and colour accuracy. Wild plants such as the ivy and wildflowers are abundantly common in the work of the Pre-Raphaelites. Rossetti is no exception. Common and much appreciated British wildflowers are often present in his work. "The Salutation of Beatrice" (1882, doc.63) presents tall flowering species such as the camellia and the giant Himalayan lily expanding well above the ground, aligned with a lower foreground of flower beds profusely inhabited with two of the most beloved wildflowers in British spring and summer: bluebells and buttercups. The family of the buttercup is also represented by the giant marsh marigolds Rossetti placed in the vase featured in the appropriately entitled 1873 work "Marigolds" (doc.64).

We have seen that several examples of flowers repeatedly appear in Rossetti's work, but that he was an admirer and creator of diversity as well. The painting "Hanging the Mistletoe", for example (1860, doc.65), shows two botanical specimens with

[88] Rossetti's use of flower cuttings is much more common than actual grown shrubs or trees such as this one.

meticulously modelled berries and shiny leaves: the Highclere holly and the European mistletoe. While the painting “Lady Lilith” (1868, doc.66) exhibits the perfection of an apparently freshly picked light pink Foxglove. Here Rossetti’s stroke is not an extremely detailed one. Nonetheless, he does represent the main differentiating features of the plant accurately enough for it to be easily distinguishable: especially the fully matured flowers at the base and the buds in various stages of bloom towards the tip (or apex) of the plant. The painting also exhibits an intricate pattern of roses framing the figure of the woman. This type of floral patterned border becomes a characteristic feature in Rossetti’s work and is especially notable in his female individual portraits.

In “Regina Cordium” (1866, doc.67), for example, Rossetti fills the background with the buds and foliage of a sweet cherry tree. It is interesting to notice that, although clearly intended to create a repetitive pattern, and some degree of stylization is partially applied to the branches, overall, the foliage and buds are realistically treated, as opposed to a stylized general visual effect we find in more design-oriented artists of that time (e.g. the botany-inspired wallpaper patterns of William Morris). On the whole, the branches are somewhat schematic, whilst the leaves and buds are quite realistic. In addition to the cherry tree background, we find two other species featured in the composition: the single cutting of a bearded Iris flower is gently held in her hand, as a flowering rosebush closing the lower area of the composition exhibiting various views and stages of bloom, from buds to mature roses.

In the 1859 work “Bocca Baciata” (doc.68), the figure of Fanny Cornforth appears isolated against a dark background covered with yellow - orange flowers. Although the whole area of the background lacks sufficient light and detail to state with full certainty, if the flower she holds is the same as the ones on the foreground, and it certainly appears to be so, then they are both representations of the common marigold; a very popular wildflower also much appreciated in British gardens. This aesthetic option of placing the feminine figure against a dark background adorned with flowers is also present in a later portrait: “Mary Magdalene” (1877, doc.69). In this case the background pattern being composed of Christmas rose flowers with foliage. Despite the obscured context the detail of the flowers and foliage is much more expressive than in the background of “Bocca Bacciata”.

In the painting “The Blue Bower” (1865, doc.70) this feature is not only present but is truly superlative as it powerfully draws the eye of the observer to the depicted passiflora (or passion flower). The passion flower has a complex and uncommon structure, which Rossetti was able to represent rigorously, with a level of detail and morphological accuracy nothing less than extraordinary. This suggests he spent a significant amount of time observing it and working on its rigorous detail, in terms not only of structure but also very clearly in the treatment of colour. It is one of those cases where every single aspect was done right, being a true achievement in portraying nature as it is. Aside from the passion flower, Rossetti completed the profuse blue background with Japanese-like white coloured blossoms, and added two other botanical species: on the right, the foliage and a single flower of cathedral bells, perfectly shaped and positioned. On the bottom left an ensemble of loose picked chicory flowers rested on the green surface. As a note of bright colour, she wears a rose in her red hair. Also one of the features we encounter often in Rossetti’s feminine portraits, such as the Fair Rosamund (1861, doc.71), or Blanzifiore (1873, doc.72), for example.

In “Blanzifiore”, another, one of the portraits of Jane Morris, she holds three delicate snowdrop flowers, while three common primrose flowers contrast with her dark hair. The snowdrops are exquisitely depicted. The overture of the petals, the fine shapes of the stems and calyx and the way they bend downwards by the effects of gravity. Another beloved wildflower also found abundantly in British gardens is the pansy. This is a hybrid species developed as a garden flower in England during the 1830s and currently also seen in wild landscapes. The bright vivid colours and graceful shape of its delicate flowers come together to make this one of the most visually appealing of British wildflowers. Rossetti also shared this admiration for the pansy and depicted it both in drawing and painting. In the study (1871) for the painting “Water willow” (1871, doc.73) instead of the leafy branches that appear in the finished painting, a single pansy flower is held by the feminine figure. Although it lacks the actual colours, the shading contrast between the groups of brighter and darker petals is indicative that this is most probably the purple-white variation. In “Girl at a lattice” (1862, doc.74) another variant is depicted: a bunch of yellow-orange coloured pansies are placed in a vase under the soft gaze of the girl.

In The Blessed Damozel (1878, doc.75) Rossetti depicts flowers surrounding the main feminine figure: the canary rose bush in full bloom, as the feminine figure holds a cutting of the canary bird rose in one hand and the cutting of a stem with three lily flowers. The canary bird rose had already appeared in the 1877 painting “A sea spell”, (doc.76) adorning her hair as a crown of flowers. Rossetti might have been painting both sometime between 1875 and 1877. The lily also makes its appearance in the aforementioned painting “The beloved” (also known as “The bride”), although here Rossetti represents another species, the day lily.

In “Veronica Veronese” (1872, doc.77) Rossetti places cuttings of daffodils resting on top of an open book on the table and the vase beside the woman. Here flowers are treated as adornments of interior spaces, lending their forms and colours to enrich the scene. The composition itself and the way flowers are thoughtfully positioned is significantly similar to the 1868 painting “The blue silk dress” (doc.78), another of his portraits of Jane Morris. Here he painted a vase with white rose cuttings in water. It is also one of the few examples of carnations in Rossetti’s work. Here they appear both adorning her blue dress and again on the opened book, resonating the “The Daydream”.

Lastly, we turn to one, if not the most known and admired of Rossetti’s portraits of his wife Elizabeth Siddal: “Beata Beatrix” (1870, doc.79). The painting is a symbolic portrayal the Lizzie, her death, their love, and his sorrow before such sad and devastating event. The only botanical element here is an opium poppy, knowingly associated with laudanum, an opium derivative, popularised as a painkiller in Victorian Britain, with which Lizzie took her own life. Here Rossetti chooses to treat the poppy in the same ethereal manner he composes all the remaining elements. He was, undoubtedly, a master in portraying reality as well as dream, impression and expression, it would all hinge on an artistic choice, and Rossetti clearly possessed the talent, the rigour, the emotion and the mind to achieve either one. Something similar is observable in the work of John William Waterhouse, a later follower of the Pre-Raphaelite movement.

1.2.4. John William Waterhouse: truth and dream combined

Before addressing the botanical elements present in Waterhouse's painting, we will first make an incursion into his drawings of plants in four sketchbooks, currently under the care of the Victoria and Albert Museum. Table 6 lists the drawings of plants and flowers contained in the four sketchbooks kept by the V&A museum.

Table 6. List of Botany-related sketchbook drawings by John William Waterhouse, Victoria and Albert Museum.

Sketchbook	Date	Museum nº	Location (V&A Museum)	Drawings of plants & flowers
1	n.d. (1891 or prior*)	E. 1 – 1949	Prints and Drawings Study Room: Level C, case 91, shelf C, box 33	• Trees and low vegetation
2	n.d. (1891 or prior**)	E. 2 – 1949	Prints and Drawings Study Room: Level C, case 91, shelf C, box 34	• 2 sketches of the same undetermined flowers • Simplified flowers • 2 independent detailed drawings of a Rubus [genus] plant, (includes annotations on colour and close-up drawing of stem with thorns) • Rough drawing of foliage and stems (possibly also Rubus plant) • 7 studies of wild rose flowers and foliage (various views; includes partial/unfinished drawings; no annotations) • Studies of trees (includes trunks, branches and crowns)
3	1912-1914	E.1112-1963	Prints and Drawings Study Room: Level F, Case 93, shelf D, box 14	• Branch of an apple tree with foliage and fruits • Madonna lily • Undetermined foliage (annotation: "Pear") • Studies of trees • Simplified undetermined flowers (markings, e.g. study for the

Sketchbook	Date	Museum nº	Location (V&A Museum)	Drawings of plants & flowers
				painting "Enchanted Garden", 1917)
4	n.d.	E.3 – 1949	Prints and Drawings Study Room: Level C, case 91, shelf C, box 35	• Studies of trees (includes trunks, branches, foliage and crowns) • Study of mushroom
*** Contains study of an eagle, as well as composition studies for the painting "Ulysses and the Sirens" (1891)** **** Contains study for "Circe Offering the Cup to Odysseus" (1891)**				

The first conclusion we reach is that, curiously, although plants, especially flowering species, are a dominant element among his paintings, we do not find many examples of sketchbook botanical drawings in Waterhouse's preparatory work on paper. The exception, nevertheless, lies in his multiple drawings of trees. John Ruskin stated that the softness and the textures of the tree can be better drawn if one knows the laws that rule their development. He associated this to a unique way of seeing in which the artist sought to understand botanical subjects with "delicate expressions of form and growth only imitable by very careful drawing" (Ruskin 1857b, 176). Ruskin further referred to the drawing of the extremities of trees and attached leaves. How, while observed against the background of the sky, the outlines of the thinner branches and tiniest leaves lose materiality due to brightness created by light. Photography, by then, was incapable of overcoming this effect, however, drawing with enough time to apprehend even the finest lines, would give the artist the power to truthfully and accurately depict these delicate features. In his own words "if you once succeed in drawing a few sprays rightly, you will find the result much more lovely and interesting than any photograph" (Ruskin 1857b, 88). Nonetheless, Ruskin recognized the immense difficulty in drawing a tree in all accuracy. For that matter he advised to "try to discover some mode of execution which will more or less imitate, by its own variety and mystery, the variety and mystery of Nature, without absolute delineation of detail; something he sought to practice himself. As a persistent and clearly passionate draughtsman of trees, Waterhouse left us numerous sheets with sketches of trees which resonate Ruskin's

words. Doc. 80 shows nine of his studies of trees from his sketchbooks kept by the Victoria and Albert Museum.

Although we find several drawings of trees as a whole, he had a clear predilection for drawing tree trunks and naked branches. He clearly admired the textures and variations of patterns in tree trunks and barks (e.g. doc.80.C, on the top right), as well as the lines of their morphology as they develop into various ramifications of branches. His annotations, however, were almost exclusively in regard to colour, as jottings such as “warm green”, “dark green amber”, “reddish glow”, “brown green shadows” often strategically appear captioning the aforementioned drawings. (see docs. 81 and 82). Doc. 80.I, on the bottom right shows yet another example. Here, in the artist’s annotations, we find the name “Tunbridge wells”, a place located in the west side of the region of Kent, a much appreciated area in England, especially for its natural landscapes.

Aside from trees only a few of Waterhouse’s drawings at the V&A feature plants and flowers sufficiently detailed to be identified, as in most of his preparatory composition sketches flowers appear only as simple markings without morphological detail (e.g. doc. 83). Doc. 84 shows the painting “The Enchanted Garden” (1916-1917) and a preliminary study for this composition, contained in one of Waterhouse’s sketchbooks at the Victoria and Albert Museum. What in the final painting resulted in carefully depicted examples of roses, poppies and a madonna lily, are simply visual jottings in the study, marking the position of each floral element within the composition. As for his more thorough studies of plants and flowers, they appear isolated and fairly scattered among his many preparatory sketches for painting compositions. As previously mentioned, Waterhouse’s more detailed drawings of identifiable plants are very few and mainly distributed between two of the abovementioned sketchbooks. The first sketchbook is undated. However, as it contains what seems to be a very preliminary study for the 1891 painting “Circe Offering the Cup to Odysseus”, it is probably dated around this time[89] (doc.85) . Although proportions and general structural elements are apparently faithful to reality, in general, Waterhouse’s sketches of plants and flowers do

[89] Although this point of reference is useful for setting non-rigid chronological, the actual chronological range of the sketchbook drawings is harder to define, as the same one could have been used over diverse periods of time, continuously or intermittently.

not seem to have been produced with the primary intent of reproducing nature faithfully. Did he not have the talent or ability to do so? We can safely state that was absolutely not the reason, as we will see in his paintings further ahead. It was simply a choice, a way to work, ultimately a method and a taste. The aforementioned sketchbook, however, contains Waterhouse's most detailed and profusely treated drawings of plants. They vary from rough, unfinished-like sketches of undetermined flower cuttings (doc.86) to considerably more accurate and copious botanical structures. The latter contain, broadly, three sets of drawings. The first two seen in doc.87 represent different cuttings of what seem to be plants from the rubus genus (e.g. roses, blackberries, raspberries). In both drawings Waterhouse depicts solely the non-flowering parts of the plants, concentrating mainly on the stems and leaves. Although without representing much detail, he depicts enough features to allow us to determine at least the family (Rosaceae) and genus (Rubus). He also follows a coherent repetition and symmetrical pattern characteristic to the growth of vegetable structures (e.g. the position of the leafs and thorns) developing alternately along the stem. His annotations, however, are exclusively dedicated to colour variations, "Lg" and "Dg" meaning "light green" and "dark green", for example. Similar annotations are also found in the second drawing, where he simply draws various examples of thorny stems with leaves. In both sketches, the venation of the leaves is merely hinted, as it is fairly clear his interest was directed primarily to the surface colour tones and gradations. This suggests these were essentially studies and notes on colour for the preparation of his paintings and not necessarily a scientific approach to nature and its botanical elements. The third set contains 7 studies of different views of a wild rose with flower and foliage. Doc.88 shows the folios of the sketchbook as well as details of the different drawings of the wild rose. This is the most "scientific" of Waterhouse's drawings of plants within the four sketchbooks consulted. He made several studies of lateral and top views and also different stages of blooming, from bud to fully matured flowers. Most sketches are partially finished, with the exception of the bottom left sketch which seems to be a synthesis of all the others, presenting a full cutting with leaves and two flowers seen from top and lateral views.

In another sketchbook, dated 1912 – 1914 and, again, amongst many studies of composition the human figure, we find, apart from the common trees and undetermined drawings of branches and foliage (e.g. doc.89 bottom right), two individual sketches of plants (doc.89). The first is a shaded study of a Madonna lily cutting (doc. 89 top centre). He depicts accurately the shape of the flower and its parts. At first glance it may be mistaken for a hyacinth, however, and though not drawn with full rigour, the anthers surrounding a protruding pistil in the centre make it easier to differentiate. It is not a minute drawing (as we can observe in comparison to a botanical illustration, as shown in doc.89, top right, but a speedy one, where the main features were probably drawn and shaded in one phase. The same sketchbook also contains the drawing of an apple tree branch with foliage and fruits (doc.89, top left). Once again, this is yet another study highly focused on light-shade and colour, as annotations are exclusively in regard to these features (e.g. “All a warm transparent green”, “Blue green”, “Blue light edges”).

His interest in colour is, for that matter, present all throughout his sketchbooks, whether drawing the layers of a landscape elevation (doc.90) , a flower or a tree. Colour was what he seems to have most sought and recorded in his “botany-themed” drawings, and despite their seemingly simple and, at times, rough appearance they are, if we deeply think of it, instruments to guide us into this artist’s unique way of seeing and registering what his vision recorded. In Waterhouse, we can clearly see drawing was mostly used as study. His sketchbook drawings are generally speedy, visual annotations, markings, notes to himself. Whether loose ideas or trains of thoughts, they suggest a man who drew as fast as he could see and think. His paintings, on the other hand, many of which originate from those first sketches are noticeably works of patience, acute observation, an enormous apprehension of reality combined with dream.

As many others of his time, including the three founders of Pre-Raphaelitism, most of Waterhouse’s scenes take place either in Nature itself or in the presence of its elements. Among the most present of those elements were plants. In the present context it is impossible to closely examine every single one of the vast universe of Waterhouse’s painting. Nonetheless, a close study of a selection of 27 paintings provides a faithful portrait of how and what botanical elements were not only present but

privileged in his final works. Table 7 lists botanical species depicted in the aforementioned paintings by John William Waterhouse.

Table 7. Botanical elements in the work of John William Waterhouse

Title	Date	Common name	Botanical Name / genus	Botanical Family
Boreas	1903	Daffodil	Narcissus	Amaryllidaceae
Dolce far niente	1880	Daffodil	Narcissus	Amaryllidaceae
Echo and Narcissus	1903	Daffodil	Narcissus	Amaryllidaceae
Narcissus	1912	Daffodil	Narcissus	Amaryllidaceae
Ophelia	1889	Daisy	Bellis (genus)	Asteraceae
Ophelia	1894	Daisy	Bellis (genus)	Asteraceae
Magic Circle	1886	Devil's Scabious [?]	Succisa pratensis	Caprifoliaceae
The Lady Clare	1900	Foxglove	Digitalis purpurea	Plantaginaceae
Hylas and the Nymphs	1896	Frogbit	Hydrocharis morsus-ranae	Hydrocharitaceae
Ophelia	1894	Frogbit	Hydrocharis morsus-ranae	Hydrocharitaceae
Gossip	1885	Geranium	Geranium (genus)	Geraniaceae
Magic Circle	1886	Hogweed [?]	Heracleum (genus)	Apiaceae
Ophelia	1889	Hogweed [?]	Heracleum (genus)	Apiaceae
Flora	1890	Iris	Iris (genus)	Iridaceae
Hylas and the Nymphs	1896	Iris	Iris (genus)	Iridaceae
Lamia	1909	Iris	Iris (genus)	Iridaceae
Narcissus	1912	Iris	Iris (genus)	Iridaceae
Flora	1890	Lily	Lilium sp.	Liliaceae
The Annunciation	1914	Lily	Lilium sp.	Liliaceae
Magic Circle	1886	Marsh grass	Spartina (genus)	Poaceae
The Lady of Shalott	1888	Marsh grass	Spartina (genus)	Poaceae
Ariadne	1898	Poppy	Papaver (genus)	Papaveraceae
Enchanted Garden	1917	Poppy	Papaver (genus)	Papaveraceae
Ophelia	1894	Poppy	Papaver (genus)	Papaveraceae
Psyche opening the golden box	1909	Poppy	Papaver (genus)	Papaveraceae
Saint Cecilia	1895	Poppy	Papaver (genus)	Papaveraceae
The Annunciation	1914	Poppy	Papaver (genus)	Papaveraceae
The Shrine	1895	Rose	Rosa	Rosaceae
Diogenes	1882	Rose	Rosa	Rosaceae
The soul of a rose	1908	Rose	Rosa	Rosaceae
Gather ye rose buds while ye may	1908	Rose	Rosa	Rosaceae
Sweet summer	1912	Rose	Rosa	Rosaceae
Ariadne	1898	Rose	Rosa	Rosaceae
Enchanted Garden	1917	Rose	Rosa	Rosaceae
Magic Circle	1886	Rose	Rosa	Rosaceae
Saint Cecilia	1895	Rose	Rosa	Rosaceae
The Annunciation	1914	Rose	Rosa	Rosaceae

The Lady Clare	1900	Rose	Rosa	Rosaceae
Hylas and the Nymphs	1896	Waterlily	Nymphaea	Nymphaeaceae
Lamia	1909	Waterlily	Nymphaea	Nymphaeaceae
Narcissus	1912	Waterlily	Nymphaea	Nymphaeaceae
Ophelia	1894	Waterlily	Nymphaea	Nymphaeaceae
The Lady of Shalott	1888	Waterlily	Nymphaea	Nymphaeaceae
Windswept	1902	Wildflowers (various)		
Gather ye rose buds while ye may	1909	Wildflowers (various)		
A song of springtime	1913	Wildflowers (various)		
Ophelia	1910	Wildflowers (various)		

Wild flowers are a universal botanical subject in either of the work of the three founding Pre-Raphaelites, as well as in Waterhouse, a later advocate of the movement. The love and aesthetic appreciation for the outdoors, and the preference (even audacity) for leaving the walls of a studio and paint in the virtually boundless spaces of Nature, put an immense botanical universe before their eyes. Waterhouse borrowed form, light and colour from plants and flowers and gave it the power to perpetuate in time. The depiction of plants in his work varies from simplified splashes of colour to finely modelled features of pictorial compositions. His many scenes amidst colourful countryside landscapes testify to his great appreciation for Spring and Summer, the seasons of flowering plants. Doc.91 shows four of his paintings depicting young women picking flowers, all produced after the turn of the nineteenth century. Gently carried on their robes or adorning their hair we distinguish poppies, daisies, roses and daffodils.

Daffodils are one of his most appreciated flowers. They are a common presence in British spring and summer landscapes until this day. In the 1880 painting "Dolce Far Niente" (doc.92) Waterhouse places cuttings of yellow daffodils spread over the top of the side table. They reappear in works such as Boreas (1903, doc.93.) as adornments in her hair and sprinkles of yellow colour on the green landscape. In "Narcissus" (1912, doc.94) he represents a feminine figure gathering the pale yellow flower[90] in the characteristic English countryside. In Echo and Narcissus (1903, doc.95), they appear subtlety beside "Narcissus" by the water, in a representation of the famous myth. In this same scene the daffodil is part of a scenery with trees, grass and two other highlighted

[90] Daffodils are part of the genus narcissus.

flowers which appear also in other of Waterhouse's compositions: the iris and the water lily. The latter is also seen in paintings such as his 1894 Ophelia.

Unlike Millais, who portrays Ophelia at the moment of her death, Waterhouse places the tragic Shakespearean character peacefully siting by the water (doc.96) , and equally surrounded by nature. Marsh plants such as the water lily, the frogbit and marsh grasses coexist with a wild rose growing on the banks of the water surface. A red poppy adorning her red hair and a bouquet of freshly hand-picked daisies laying on her lap. The daisy is also a constant floral presence in Waterhouse's work. Among others, it appears in yet another of the artist's portraits of Ophelia (doc.97). In this case, there is no water on sight. The feminine figure is laying on a green bed of grasses surrounded by wild flowers of many colours, as if resting in a warm summer day. Around her a typical English country landscape, a bucolic meadow sprinkled with trees and flowers. The subtle but varied colour palette of the scene itself shows the variety of flowers surrounding Ophelia'a rested body. She holds what seems to be a bunch of yellow flowers, difficult to identify, perhaps daffodils. Scattered daisies and what seems like a scabious flower lay on her white dress, as a hogweed (or perhaps pignut or hamlock water-dropwort, three very similar species) elevates its white flowered tips above her body and all other plants nearby. A similar plant to the hogweed, here in a darker arid scenery, is also present in "The magic Circle" (1886, doc.98).

One of the masteries of Waterhouse is the way he depicts forms and volumes of plants enough to make them recognizable, but yet often applying strong and thick brushstrokes. An up-close look at "The lady of Shalott" at Tate Britain (doc.99), for example, clearly testifies to this. If observed from a distance, the water grasses growing beside the boat and the water lily leaves floating in the water, on the foreground, are perfect in shape, volume and colour. If looked at more closely, we notice it is not necessarily minutia and detail, but mainly the way colour is used to model volumes, light-shadow effects, and forms, that create the realistic effect in many of Waterhouse's paintings.

In "Hylas and the nymphs" (1896, doc.100), his stroke delineates a profuse universe of colour on the banks and on the translucent surface of the water. Among the notes of colour, we can distinguish the frogbit, the white and the yellow lily and the iris,

one lilac, another yellow. With its many variations of colour and peculiar flowers, the iris is also among the preferred flowers of the Pre-Raphaelites. Waterhouse paints it in many of his compositions. We see it in "Lamia" (1909, doc.101), likewise by the water and likewise in the presence of water lilies, in a scenario enclosed by a line of trees. In "Flora" (1890, doc.102), it appears adorning a Mediterranean-like idyllic scenery next to a bunch of freshly picked white lilies, some of which have fallen to the floor. The white lily, is yet another of the Pre-Raphaelite's favourites, as we have seen in Rossetti, for example. In "The annunciation" (1914, doc.103) Waterhouse places a bunch of white lilies in the hands of the angel. He is extending his hand as he approaches Mary, as an offer. Around them, a grassy green surface is covered with poppies and a rose bush. This is a union we often observe in his compositions. The poppy and the rose appear together in works such as "Saint Cecilia" (1895, doc.104), "Ariadne" (1898, doc.105), and "The Enchanted Garden" (1917, doc.84). In the latter, among the warm colours of the roses and poppies, we can also distinguish what seems to be a madonna lily, similar to the one drawn in his aforementioned sketchbook dated 1912-1914. In line with the work of Rossetti, the rose plays a determinant role in Waterhouse's painting. Doc.106 shows five of the immense number of paintings featuring the rose, the very popular and universally admired flower. Although only a very small sample of the iconography of this plant in his work, it demonstrates how this botanical species can be common without falling into repetition, as it is extraordinarily varied in context, colour and form.

On the whole, we most often see Waterhouse's flowers and plants portrayed naturally as they would have been seen in nature, which adds to the premise that he would paint most often in the outdoors, on site. He also has a clear preference for depicting flowers as part of diversified floral landscapes, and more rarely as individual floral elements, as we can observe, for example with the poppies in "Psyche opening the golden box" (1903, doc.107), the vivid red geranium in "Gossip" (1885, doc.108), or the elegant foxglove in "The Lady Clare" (1900, doc.109).

2. CASE STUDIES: FROM LOOK TO LINE - BOTANICAL STUDIES IN ARTISTIC TRAINING AND PRACTICE

> I believe that the sight is a more important thing than the drawing; and I would rather teach drawing to my pupils may learn to love Nature, than teach the looking at Nature that they may learn to draw.
>
> (Ruskin 1857b, XIV)

The study of botanical sketchbook drawings which are not scientific illustrations in all their dew rigor, is a promising field of study while addressing the interconnections between Art and Science. At this meeting point, the artist and the scientist shared a common interest and admiration for nature. During the Victorian period and the early years of the twentieth century, this happened under the visual standpoint that scientific advances helped to see and understand more deeply and clearly Nature, its mechanisms, and, in due course, the laws, principles and resulting visual features underlying the existence and development of vegetable life. A new perceivable world was unfolding, where concepts of grandeur and sublime were extended to the scale of the most minute of details. Where the structural complexity and beauty of plants were reason enough to captivate the attention of artists and appear abundantly on the pages of their sketchbooks. The essence of these drawings places them in a frontier territory where technical and artistic images of botany intersect. We encounter a sense of union and complementarity in artists whose admiration for the elements of Nature becomes a fundamental source for graphic expression and communication. But, how exactly does this symbiotic process occur? Does it begin with a somewhat science-imbued study of botany which may be found in a common ground to both artists and scientists? Plus, regardless of intent, can they be relevant to both fields?

While referring to the practice of observation drawing in nature, John Ruskin calls attention to the way the sheets of the sketchbook will compile seemingly random drawings of elements in the natural landscape but also that these preliminary sketches can one day be transferred and worked on in a work of art. In Ruskin's words:

> Fancy how his paper will be covered with stray symbols and blots, and undecipherable short-hand: as for his sitting down to "draw from Nature," there was not one of the things which he wished to represent that stayed for so much as five seconds together: but none of them escaped, for all that they are sealed up in that strange storehouse of his;

> he may take one of them out, perhaps, this day twenty years, and paint it in his dark room, far away. (Ruskin 1891).

From look to line, in the following chapters we focus primarily on the depiction of plants and flowers, primarily through drawing. Firstly, we concentrate on the role of botanical studies for the training in Victorian Art Schools. We particularly highlight its most relevant figures and methods, within this context for the development of a botany-inspired practice, from drawing to modelling, and focusing primarily on design training.[91]

Finally, we explore the botanical sketchbook drawings of plants and flowers by Scottish designers Charles Rennie and Margaret MacDonald Mackintosh, and assess their contributions to the dialogue between arts and sciences and the construction of a comprehensive study of botanical iconography.

[91] It is important to clarify that the teaching of botany to art students knew different variations, according to the specific purpose of the courses. Hence, Fine Arts Students were taught firstly to draw from copies and Nature and would then proceed to sculpture and painting. Whilst industrial art students (future designers/ornamentists trained in the Schools of Design) were to learn also drawing, and proceeded to reinterpret the values and laws of Nature to technical design. Function, practicality and adaptation to the industry being one of their most important guidelines. We will return to these concepts while discussing Christopher Dresser's teachings on Botany, in the chapter that follows. Let us also recall that the debate on the equality between Fine and Decorative arts was one of the basis for the Arts & Crafts and the Aesthetic movements (1860s - 1880s). The discussion of which fuelled the gradual acknowledgement of Design as an important artistic variant, determinant for the construction of the artistic panorama as well as the industry, especially in the second half of the 1800s in the UK.

2.1. **Botanical studies in the instruction of Victorian designers: from drawing plants and flowers to technical design**

The works analysed in the previous chapter are dated between the years 1851 and 1917. This period corresponds to one of the most prolific periods in the History of British Art, starting with the Great Exhibition at the Crystal Palace, London, which is in the origin of the present Victoria and Albert Museum. Furthermore, also during this period, the Government School of Design, London, and the Department of Practical Art (later National Art Training School and Royal College of Art, and Department of Science and Art) invested greatly in the inclusion and development of botanical studies as part of the curriculum of Art and Design training. Alongside painting, Design was also a growing discipline which would benefit, to a great extent, from the inclusion of the study of plants in the training and practice of Victorian design students. In his address "On the necessity of Principles in Teaching Design" at the Opening of the Session of the Department of Science and Art, October, 1853, Richard Redgrave, by then Superintendent of the department, stated:

> By the removal of the School of Art from Somerset House to this building[92], there are means provided for carrying out here a complete and systematic course, both for the acquisition of technical skill and execution, and for obtaining a knowledge of the principles which should guide the application of such skill, when acquired, in the practice of Design. (Redgrave 1854, 11)[93]

Drawing was in the in the foundation of both theory and practice implemented by the Department of Science and Art to train design students and lead them to acquire the technical skills, execution and knowledge Redgrave mentioned in his address.

The development of this topic was mainly based on sources kept in three London archives: The V&A archive; the National Art Library and the archives of the Royal Botanic Gardens, Kew. The starting point was a comprehensive analysis of official records

[92] Referring to the move of the Government School of Design from Somerset House to Marlborough house.

[93] We clarify that, in this same text, Redgrave refers to "designers"(Redgrave 1854), which confirms that, in addition to "industrial artist" and "ornamentist" the term was already in use in the mid-1800s (Redgrave 1854, 13). By 1853-1854, the course of design offered by the Department of Science and Art was entitled: "Course for designers, ornamentists, and those intending to be industrial artists" (1854a, 45)

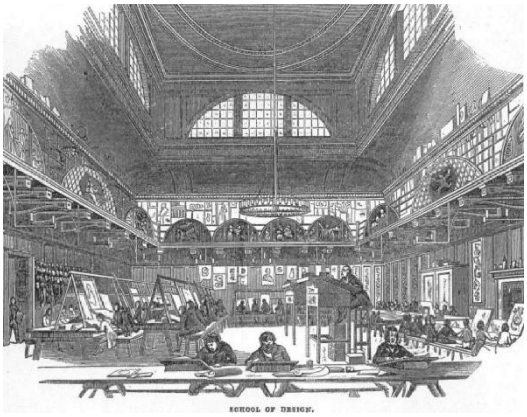
documenting the activity of the Department of Science and Art (including its institutional predecessors: the Government School of Design and the Department of Practical Art), as well as the South Kensington Museum, between the years of 1835 and 1899[94]. These were complemented with other miscellaneous documents relating to the abovementioned institutions (including its institutional predecessors (e.g. addresses, lectures, manuals and prospectus and minutes. The documents related to the South Kensington Museum were also of great value to the present topic and were, particularly the Diaries of Henry Cole (1851-1869), architectural plans and engravings, correspondence, the South Kensington Museum Daybook (between 1857 and 1858), records of the Educational Division, and the mentions on the Reports of the Department of Science and Art. Equally important were the records kept by the Royal Botanic Gardens, Kew; especially those pertaining to the connection between the Botanic Gardens, the Department of Science and Art and the South Kensington Museum. Parallel to the primary sources described, we also consulted other documents, such as periodical publications and monographs, in order to cover as many sources of information as possible, considering the time and specific scope of the theme.

In order to offer a clearer context of the institutional development of the Department of Science and Art, from its origins in the first half of the 1800s to the turn of the nineteenth century (1835-1899), table 8 presents a broad timeline of the institutional development of the DSA, as well as a selection of events considered meaningful to understand the structure and dynamics of the Department, especially in regard to botanical studies within the courses of Art and Design. Many of the events listed are mentioned throughout the text that follows.

Table 8. Chronologic overview of the evolution of the Science and Art Department and the South Kensington Museum, including relevant facts on botanical studies as part of Art and Design training (1835-1999).

Year	Event
1835	A Select Committee of the House of Commons was appointed to inquire on the possibilities of delivering training of Arts and Design in Britain.

[94] This includes the periods that preceded the establishment of the Department of Science and Art (1852), as its origins go back to the Government School of Design and later the Department of Practical Art, the two direct predecessors of that Department.

Year	Event
1837	Opening of the Government School of Design, established at Somerset House, London  Figure 14. The Government School of Design, in Somerset House, Engraving published in The Illustrated London News, 1843.
1843	William Dyce retires from the presidency of the Government School of Design.
1847	Christopher Dresser begins his studies at the Government School of Design at Somerset House (later to be transferred to Marlborough House).
1851	London holds the Great Exhibition of 1851, which is in the origin of the great increment of investment in the Arts, culminating in the opening of the South Kensington Museum (currently the Victoria and Albert Museum) in 1857.
1852	The Council of the Government School of Design is abolished and the Department of Practical Art is established, with Henry Cole as General Superintendent and Richard Redgrave as Art adviser.
1852	The Department of Practical Art, including the Museum of Manufactures and the School of Design, moves from Somerset House to Marlborough House.
1852	Christopher Dresser is awarded a scholarship at the Metropolitan School of Art, London.
1852	Christopher Dresser is Awarded a Scholarship of £15·00.
1852	The Department of Practical Art becomes the Department of Science and Art; The Museum of Manufactures is renamed the Museum of Ornamental Art. The Government School of Design is renamed School of Ornamental Art.
1853	Henry Cole and Richard Redgrave visit the Royal Dublin Society.
1853	Christopher Dresser is reappointed to the Metropolitan School of Art, London.
1853	Prizes in money are awarded for botanical studies in Male and Female School of Design, London.
1853	Christopher Dresser wins 3 medals and 3 prizes, and is re-appointed for a scholarship.
1854	Christopher Dresser receives a promotion and an increased scholarship (£25).
1854	John Lindley delivers lectures on Botany directed to Art and Design students.

Year	Event
1854	Botanical Diagrams are purchased by the Department of Science and Art, for the use of the School of Art.
1854	Diagrams and copies - plates featuring studies of flowers and ornaments are approved by the Department of Science and Art for use of Schools of Art.
1855	Christopher Dresser is accredited to provincial schools as a "competent person for botanical lectures".
1856	New designation for the Department comprising the School of Design to "Department of Science and Art", from then under the administration of the Privy Council Committee on Education.
1856	The Department of Science and Art and the School of Art move from Marlborough House to South Kensington. The school is renamed National Art Training School.
1857	Opening of the South Kensington Museum (despite a pre-existent project for this museum since 1836, that lead directly to the creation of the Government School of Design in the following year).
1870	The Board of the South Kensington Museum decided on 8 July 1870 that, as soon as the building was sufficiently completed, the Animal Products and Food Collections at the V&A were to be transferred to Bethnal Green. - probably opened officially in 1872. The New branch received plants from the Royal Botanic Gardens, Kew.
1896	The National Art Training School becomes The Royal College of Art.
1899	The South Kensington Museum becomes the Victoria and Albert Museum.

Going through all the documents that provide the basis for the present chapter it becomes clear that drawing was most certainly among the priorities of the Government School of Design, London, as well as the artistic educational policies of the Department of Science and Art. Furthermore, it is also clear that the realization of adequate and successful methods of artistic education involving drawing and, specifically relevant to our study, the role of botanical studies as an integrant part of artistic apprenticeship underwent a gradual evolution from the 1830s onward, and was particularly expressive in the second half of the nineteenth century. Furthermore, in 1872[95], John Ruskin advised artists and art students to seek the expertise of their Botany

[95] By this time, botanical studies had been officially part of the curriculum of art and design for over twenty years. We recall that this was something that Ruskin, himself, considered of extreme value.

professors and to frequent botanic gardens, so as to acquire the necessary knowledge of botany to excel in depicting plants, always having drawing as their starting point:

> It has become a habit with drawing masters to confuse this particular science of anatomy with their own art of drawing, though they confuse no other science with that art. Admit that, in order to draw a tree, you should have knowledge of botany. Do you expect me to teach you botany here? Whatever I want you to know of it I shall send you to your professor of Botany, and to the Botanic Gardens, to learn. I may, perhaps give you a rough sketch of the lines if timber in a bough, but nothing more. (Ruskin 1872, 158).

As we will demonstrate, the actions of the Government School of Design and the Department of Science and Art, resonate Ruskin's words and wishes for the establishment of a close connection between botany and art within the curriculum of art education throughout the Victorian era.

2.1.1. Understanding nature as a pathway to creative excellence: the system of art instruction implemented by the Government School of Design and the Department of Science and Art (1837 – 1910)

The system of art instruction implemented across the United Kingdom by the Department of Science and Art, and its predecessors, played a most important role in the development of British Design during the 1800s.[96] Note that, by establishing the Government School of Design in 1837 in London, as well as the provincial schools[97] across de United Kingdom, the British government created an enormous advantage for

[96] The history of the Department of Science and Art started with the Government School of Design, founded in Somerset House, London, 1 June 1837; after a Select Committee was appointed, in 1835, to 'inquire the best means of extending a knowledge of the Arts and of the principles of design among the people of the country' (Cole 1853, 193, Physick 1982, 13). In the year following the Great Exhibition of 1851, the Department of Practical Art was established with the support of King Albert and Queen Victoria (Redgrave 1887, 221), (1864, 3), Museum (2016). Along with the Museum of Manufactures and the Government School of Design, from then on renamed School of Ornamental Art, the Department of Practical Art and moved to Marlborough House. In 1856 the Department and the School, by then renamed Department of Science and Art and National Art Training School, respectively, moved to South Kensington, where they were united with the South Kensington Museum (currently the Victoria and Albert Museum) opened to the public in the following year. By 1896, the National Art Training School was renamed "Royal College of Art", today one of London's most prestigious artistic higher education Institutions in the United Kingdom, and by 1899, the South Kensington Museum became the Victoria and Albert Museum. See, for example, (Cole 1853, 23, Conway 1882, 34-35, Redgrave 1887, 224).

[97] The Schools spread across the kingdom. See, for example, (Cole 1853, 19, 1854a, 34, 1855, 209).

itself. In the words of Moncure James Conway, in 1882 artists could then be trained so as to 'draw such patterns as should render it no longer necessary for English manufacturers to go to Lyons and Paris for such'.[98] Given that Britain was a recognized consumer of French design patterns, it would be expected that it turned to French art instruction as a potential source of know-how for its art education system. This leads us to ponder on another question. If Botany was included in French art education, would the then-newly-established British 'Advanced Schools of Technical Art-Education' or 'Schools of Design'[99], benefit from the contact with French schools in regard to botanical studies? Evidence suggests that contact was, in fact established and the British leaders of art education did seek to get acquainted with foreign practices, namely in the French art education system.

The information gathered clearly demonstrates the interest of the Council of the Government School of Design in getting acquainted with the curriculum of French schools of art. What is more, the first annual report of the Department of Science and Art documents the supply of coloured examples of flowers imported from France to the Government School of Design. The cost of these examples was, however, too high, which, to a great extent, limited the distribution to the Schools of Art. In 1853, the DSA resolved this issue by taking advantage of the developments in chromo-lithography and arranged the production of similar examples in England, with "three of the most eminent lithographers". The result was successful as it allowed more Schools of Art to acquire those examples (1854a, XV). Records also demonstrate that the use of botanical specimens for art education in France caught the attention of the British who contacted with French schools. On this matter, the documents consulted account for two very relevant official visits made to Art schools in Paris, on behalf of the Government School of Design. Both visits occurred in early stages of the school's activity and, thus, a propitious time to learn from the experience of others, something that the following accounts attest to.

[98](Conway 1882, 23).
[99] (Cole 1853, 19).

The first visit, by William Dyce, the first Director of the Government School of Design, occurred in 1841. When describing the course of instruction offered by the Female School, Dyce explained that the first section consisted 'of outline drawing of ornament, of flowers, and of the figure; the second, of shadowed drawing from lithographs, &c.; and the third, from the round, from *natural flowers*, and from the living model'. This record is highly noteworthy, given the similarities with the stages of instruction later on implemented in the United Kingdom which, in more advanced stages, included the work with real plants.[100] The second visit happened in September 1844, by Henry James Townsend, Esq., a then-recently appointed Master of the Government School of Design London. His report states that 'he proceeded to Paris in order to prosecute such general observations as might tend to increase the utility of subsequent official labors [sic]'. (…) 'The points of enquiry proposed were, first, The System of Education adopted in the Pursuit of Art; secondly, The Works and Methods of the Modellers in Paris". Townsend refers to the existence of a 'large oval chamber' which he compares to the 'large room in Somerset House'; and describes it as being 'crowded with glazed frames, containing the examples of flowers, ornament, & co.' More importantly, he mentions fresh flowers being "constantly supplied, when they can be easily procured, for the purposes of study' (Design 1846, 76). In addition to confirming that work with real-life plants was part of art and design training in Paris, these documents also allude to the partnership established between the school of art and other institutions [101]in order to ensure a continuous supply of plants as resources for art classes. This is something that became a regular practice in the UK, as well as during the second half of the nineteenth century, predominantly in London and Dublin, as we will discuss further ahead.

On the whole, these enquiries into French art education demonstrate that those responsible for developing the system of art instruction in Britain were interested in acknowledging the practice of others and even taking some degree of guidance from

[100] (Design 1849, 145) The organization of the Courses of Art Instruction is developed further in this chapter.

[101] There is no clear mention to the name of the supplier. Likely, a public garden, given the mention to the frequent supply of flowers, which would imply an ongoing collaboration between the two.

them. Additionally, both accounts, and more explicitly the latter, confirm that the use of plants and flowers as elements for art and design study was an interesting enough aspect to be found worthy of mention by the authors. Although they fail to provide complete certainty, these records point to the possibility that, while grounding its system of art education, Britain looked to French art instruction, including its use of Botany, as a good example to follow. Regardless of the level of external influences, the British system of art instruction was based on a set of principles and guidelines which were applied to general instruction and also to specific training in Design. Within the latter, drawing, and ultimately designing, from plants and flowers occupied a most important place, firmly supported on the attentive study and understanding of nature.[102]

Accordingly, guidelines and general principles were created and conveyed to students and masters of the schools of Design, in order to train design students and 'qualify artizans' [sic] (Redgrave 1853, 41). Included, were the elements and features future ornamentists/designers[103] should look for in Nature, particularly in the vegetable kingdom, in order to apply both its scientific and aesthetic values to the practice of Design. In other words, they should seek to acknowledge how understanding nature could become a pathway to excel in Design. He should, rather, operate a transmutation of Nature's aesthetic qualities or 'peculiar beauties'[104] by adapting them to objects of Design. This meant to 'conventionalize' those elements, particularly flowers and foliage, by displaying them 'flat and according to a symmetrical arrangement (Redgrave 1890, 135). As a result, those objects would embody a selection of 'whatever is beautiful, and

[102] From 1853 onward, the system of Art Instruction _based on William Dyce's system, was maintained and reinforced under the leadership of Henry Cole and Richard Redgrave. As part of the art educational strategy of the Department, a manual was assembled and distributed to assist 'masters and mistresses' who had not learned drawing. In addition, a body of qualified lecturers was assembled, to provide the best art educational practice possible to the central school, in London, as well as the provincial schools. In 1860 the School of Art at South Kensington was said to have a greater staff of professors and tutors than any school in the kingdom; which was considered a general benefit, as the masters of all the schools were trained at South Kensington (1860b, 226).

[103]The terms "ornamentist" and "industrial artist" were more commonly used in the 1800s to refer to those currently mostly known as "designers". See, for example, 1853, 113), Redgrave (1853, 62), 1854b, 31), 1860e, 12, 1890, 60).

[104] General Principles of Decorative Design (1853, 6).

graceful, irrespective of her [nature's] individual embodiment of these qualities[105] into ornament by subordinating the details of the general idea'.[106] A knowledge of the laws of the natural world was essential for that transposition of natural elements and qualities of Nature onto design to occur. This meant that the student should first learn the elements and laws of the vegetable kingdom, through various methods, so as to master their deconstruction, interpretation and ultimately application to Design work. Being one of the most important means to achieve and develop those skills, observation drawing was a fundamental part of the ground stages of the instruction of future designers. When taught properly, the practice of drawing helped them to see 'truly and rightly, all objects'. As explained by Richard Redgrave:

> Now, as far as for knowledge consists in a perception of the nature, qualities, and properties of things, I have shown that drawing must be considered a valuable part of the science of education. But drawing has yet another great use, as a means of explanation, as a language, by the aid of which men may explain and describe, far more readily than is possible by words, the forms and other properties of objects (…) Thus then drawing becomes, so to speak, a language of accurate description, a universal medium of explanation, and moreover may be, to men of other professions as well as to the artist, a means of treasuring and collecting stores of truths; and the surgeon and engineer, the botanist, the zoologist, the entomologist, and indeed many other professions, may, equally with the artist or the architect, write down in such a shorthand the interesting facts of their profession; while the manufacturer, the tradesman, and the artisan can by its means keep a common-place book of valuable hints and recollections. (Redgrave 1853, 43-46)

Doc. 110 is an excerpt of the abovementioned address by Richard Redgrave where he specifically refers to the importance of drawing as both visual representation of the natural world and an immediate explanation of the morphology of plants and flowers, perceivable to those not acquainted with botanical scientific terms. Drawing would be an irreplaceable ally of observation and a tool at the service of perception and understanding. An understanding that would be a growing requirement within the system of art instruction implemented by the Department, as we will demonstrate

[105] See Richard Redgrave's address on Design included in the 'Principles of Practical Art', (1853, 113).
[106] See the 'remarks by Dr. Waagen, Mr. Dyce, Mr. Pugin and Mr. Redgrave' on examples of false principles in decoration, (1853, 13).

further ahead. All in all, records confirm the great will of the Department of Science and Art to encourage an adequate scientific knowledge of botany among the skills required for a designer. This led to the inclusion of botanical lectures specifically adapted to the study of Design, within the national curriculum. In order to be successful, such endeavour would require the collaboration of professors who gathered a very specific set of scientific, artistic and communicational skills.

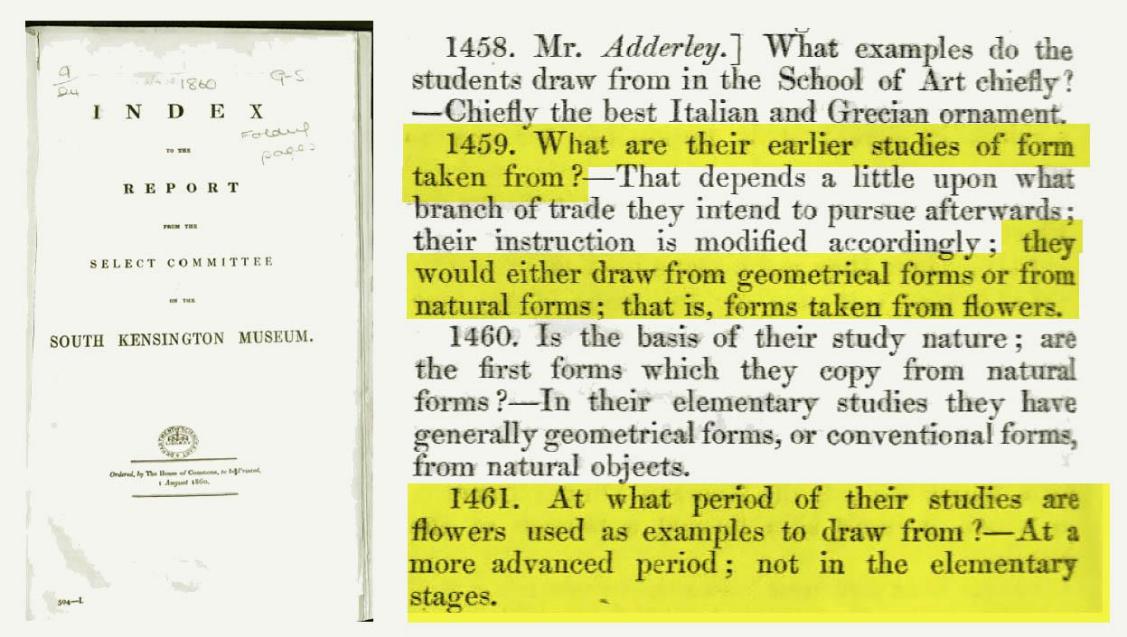
2.1.2. From drawing plants and flowers to technical design: botanical studies in the course of instruction for design students

According to John Ruskin, all drawing manuals produced and used in the mi-1800s in the United Kingdom had either one of two purposes. The first was to provide the student with an extremely high dexterity to sketch with graphite and watercolour in order to be able to produce quality imitations of "second-rate artists". This applied to the cases where drawing was taught and practiced as "an accomplishment". The second was, according to Ruskin, much more specific. It was one of the underlying purposes of the courses taught at the Government School of Design at Marlborough House: "to give him [the student] such accurate command of mathematical forms as may afterwards enable him to design rapidly and cheaply for manufactures" (Ruskin 1857b, IX-X). Also specifically directed to design students, he claims it was still, by that time difficult to assess if whether or not the methods implemented to the training in drawing were, in all accuracy, suitable and successful. This was most probably due to some unclarity between what was art and the creative process as applied to manufacture and the end-product of manufacture itself, which was linked to the more practical side of the industry (Ruskin 1857b). Ruskin establishes here a very relevant point. On the one hand, being a fairly "new" discipline at the time, Design would require a significant temporal distance, in order to assess, with all rigour, the educational artistic practices implemented by the schools throughout an extended period of time[107], not only by the work of alumni, but

[107] Although, we must add that, by then, 20 years had passed between the foundation of the Government School of Design in London and Ruskin's letter on "The Elements of Design". We also recall that very expressive changes occurred when Henry Cole and Richard Redgrave undertook the roles of superintendent and Director of the School, and initiated a period of search and change within the theory and practice of artistic education in the UK.

also by the qualitative correspondence between designs and the productive capacity and quality of the industry. Hence, the aim should be to offer the best artistic education considered possible at the time, while envisioning the success of its future outcomes. Close and attentive observation and drawing of natural elements being one of the founding pillars of art instruction. While presenting his annual report, in 1857, the Secretary of the Department of Science and Art stated:

> The study of the of sciences of observation[108] would naturally aid and be aided by instruction in drawing, and would implant that love of nature which is required to insure the success of the intermediate schools and separate scientific institutions throughout the country. If these views are correct, it will be for your Lordships to consider whether it would not be desirable to induce an increased study of the sciences of observation in the Training Colleges.[109]



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TO THE

REPORT

FROM THE

SELECT COMMITTEE

ON THE

SOUTH KENSINGTON MUSEUM.

1458. Mr. *Adderley.*] What examples do the students draw from in the School of Art chiefly?—Chiefly the best Italian and Grecian ornament.

1459. What are their earlier studies of form taken from?—That depends a little upon what branch of trade they intend to pursue afterwards; their instruction is modified accordingly; they would either draw from geometrical forms or from natural forms; that is, forms taken from flowers.

1460. Is the basis of their study nature; are the first forms which they copy from natural forms?—In their elementary studies they have generally geometrical forms, or conventional forms, from natural objects.

1461. At what period of their studies are flowers used as examples to draw from?—At a more advanced period; not in the elementary stages.

Figure 15. Excerpt of the "Index to the report from the Select Committee on the South Kensington Museum", referring to the then-current practices on the study of form and drawing from plants and flowers at the National Art Training School, London: House of Commons.

Alongside general instruction, the schools of art under the Department of Science and Art also offered a 'Course for designers, ornamentists, and those intending

[108] By sciences of observation, the author refers to sciences such as zoology, botany and physiology. See (1857a, XXXI).

[109] (1857a, XXXI).

to be industrial artists'[110], later renamed 'Course of Design'[111]. In 1860, the study of nature in the School of Art was one of the many subjects addressed by the select committee, which had gathered to enquire on the activity and mission of the South Kensington Museum, as shown in figure 15.

Congruently with the answers provided to the Select Committee on the South Kensington Museum, in 1860, we can see that drawing from plants and flowers was one of the founding pillars for mastering design within the Art School at South Kensington. Doc.111 shows an examination paper for freehand drawing of a flower, dated 1853. It confirms that plants were one of the subjects to be drawn by Design students from the early stages of their instruction, as freehand and memory drawing (outline and shaded) were among the ground-classes within the course for Designers. Moreover, doc.112 (A and B) lists the structure of the courses for training in Design in 1854 and 1887 respectively, as presented in the annual reports of the Science and Art Department. In 1854, stages 7, 10, 13, and 20 were clearly connected with botany, whether through drawing of "flowers, foliage and objects of natural history' from copies" in stage 7, drawing of "foliage, flowers &c. from nature" in stage 10, Painting from flat examples, including flowers, in stage 13, or "modelling of fruits, flowers, foliage or objects of natural history from nature" in stage 20. Plus, in other stages, such as stage 8, 14 and 22, although plants and flowers are not explicitly mentioned the references to "natural objects" or "from nature" may implicitly include botanical subjects.[112]

In addition, a more detailed description of stage 22, in the following year (Doc.112-B), further specifies that the training of Elementary design included "Studies treating natural objects ornamentally" and "Ornamental arrangements to fill given spaces, in monochrome", both included the "Ornamental analysis of nature" and the close work with wild flowers The aim was to understand and replicate on paper the laws of their growth as well as their ornamental details and arrangements. Over 30 years later, the main structure was maintained. Although the structure presented in 1887

[110] See Richard Redgrave's address on the 'General Principles, Courses of Instruction, &C., in Art: On the Necessity of Principles in Teaching Design', in (1854a, 45).
[111] (1887, 12).
[112] The full course was arranged in 23 stages.

(Doc.112-C) is not as exhaustive as the one in 1855, we can observe that "Studies from Plants and Flowers" continued to occupy a significant part within the course of Design. Ultimately, the aim was to acquire "the power to proceed to the round" from copying from flat examples." That is to say to proceed to outline and shaded drawing of "foliage and flowers, & co. from nature"[113], which was introduced almost half-way through the course. Hence, the practice of drawing plants and flowers was a way to acquire technical skills, as well as a tool to get to know nature in depth and, ultimately, to knowledgeably apply its features and principles to Design.

As explained by Richard Redgrave, the course was not set to teach students how to "treat Nature" but rather to study it 'more lovingly', to examine it 'more patiently', as he, a skilled and attentive draughtsman of plants and flowers himself (doc.113) sought to put into practice. By the same token, when studying the vegetable kingdom, students should observe the following:

> The structure of the plant or flower is first carefully dissected and analysed-the component parts examined and sketched, the law of its growth ascertained, and the harmonious relations of its tints and colours carefully noted: nor are the graceful accidents of its growth-for accidents they are-neglected; and the designer having by these means obtained a complete knowledge of his subject, is enabled to arrive at the simplest mode of displaying it characteristically, and would be as little likely to put four leaves to his rose as to design one from the embalmed contents of a hortus siccus. Such studies, such investigation of the details of Nature, will enable him to give the fullest character of the flower or plant by the simplest elements of form and colour.[114]

Consistently, 'the method adopted to provide general instruction to all in drawing, &co.', which was in core of the principles underlying the Schools of Design, allowed for 'the training in form, in proportion, in beauty of contour and in colour' (Redgrave 1853, 42-45). Training visual perception through the study of nature would, ideally, result in 'accuracy and precision of hand in the delineation of superficial form, or of the patience in minute details of execution, which are indispensable to ornamentists' (1854b, XXI-XXIII). and only obtainable if the designer was, first and

[113] (Redgrave 1890, 162).

[114] See Richard Redgrave's address on the 'General Principles, Courses of Instruction, &C., in Art: On the Necessity of Principles in Teaching Design' in (1854a, 19).

foremost, a 'practised draughtsman' (Redgrave 1853, 42-45). Subsequently, and after learning painting and modelling 'flowers, fruits foliage and objects of natural history', also from nature', students reached the final stages of their training.[115] Firstly, with Elementary Design in stage 22, students were taught to analyse foliage and flowers, namely, their structure as well as the laws of growth and symmetry, 'with a view to the new ornamental forms to be derived from them'. Secondly, still in stage 22, they learned the "geometrical and other laws which govern the agreeable distribution of ornamental details, either as to form, colour, quantity, or symmetrical combinations"[116]. Lastly, students would reach the stage of 'Technical Studies', thus concluding their training. Here they had the chance to put into practice all the knowledge and skills acquired and developed. Among the classes, 'lectures, by a competent professor' were 'frequently given to the pupils on artistic botany'[117], as well as scientific Botany, and students were evaluated on both artistic and scientific aspects, as transcribed bellow from the "Notice of the Course of Examination for Candidates for Certificates in Art (second Session, 1856)"[118]:

Nº 226 – Examination Paper, Nº 5

Botany – Group 1

Name and describe the primary divisions of the vegetable kingdom, explaining wherein they differ from each other in germination, growth, &c.

Name and describe the various parts distinguished in a flower.

Describe the principle arrangements of leaves, and hence of buds, branches, &c.

[115] For a detailed arrangement of the courses in the schools of design see, for instance, (1854a, 25-29, 1855, 45-46, 1887, 11-12).
[116] (1855, 165)
[117] See (Burchett 1858, 19, 1861c, 108).
[118] (1857a, 197)

All in all, the arrangement and complexity of this courses required a wide variety of teaching strategies as well as material and human resources. One of the Department's major responsibilities was to provide and optimize those means.

2.1.3. Lecturers & Lectures

Teaching Botany, with a specific focus on the union between Science and Design, required that lecturers were interested and knowledgeable in both areas. But, more importantly, to successfully perform the role, they should keep in mind that the future Designer was not expected to become a specialist on Botany, but, to some extent, a material translator of its laws. To that effect, students should acquire sufficient knowledge of the science of Botany, so as to effectively interpret and transpose the features and laws of the vegetable kingdom into a personal way of practicing Design. For this reason, the knowledge, preparedness and communication skills of the lecturer were of the upmost importance, as conveyed by *The Art-Journal* in 1860:

> No man of the smallest pretension to a love of polite study will underrate the value of correct classification, nor can too much honour be awarded to the successful physiologist; but, after all, these are branches which belong almost exclusively to sectional knowledge, and are interesting only to the few, while what we may be allowed, for want of a more definite terminology, to call the artistic phase of botany, not only would embrace both classification and structure, but would also be all-important to every youth who expected to be engaged in almost any branch of industry. (…) [The professor of Botany as applied to the Arts would, ideally,] redeem this science from dry abstract knowing, which, however delightful, is yet barren of general utility; and who will be able to unfold and imbue the student with a love for those true developments of ornamental form, composition, construction, and harmonious colouring, of which botany is the great unerring teacher (1860a).

In a nutshell, the main goal of the botanical lecturer should be to lead the students on a quest for achieving a harmonious and well-grounded combination of the principles of Nature with the principles of Design.[119] This could only be accomplished if based on true knowledge of Botany and persistent training in representing and

[119] As acknowledged by the Department of Science and Art itself. See, for instance, (1861b, 108).

reinterpreting its features, hence the investment on botanical lectures especially directed to the study of Art and Design. Table 9 lists 21 accounts of botanical lectures delivered to art and design students[120] in London, Dublin and Glasgow, between 1845 and 1887.

Table 9. Documented lectures on Botany at the Schools of Art of the Department of Science and Art, United Kingdom (1845 – 1887).

Year	Topic (and number of lectures when specified)	Lecturer	Venue
1845	Botany	Prof. Balfour	Glasgow School of Art
1852	The Symmetry of Vegetation: An Outline of the Principles to Be Observed in the Delineation of Plants (3 lectures)	Prof. Lindley	Marlborough House, London
1854	On form and colour in the Vegetable Kingdom (5 lectures)	Prof. Lindley	Marlborough House, London
1854	Botany (6 lectures)	Prof. Lindley	National Art Training School, London
1855	On Botany, considered in its relations to the Industrial Arts (6 lectures)	Prof. Allman	Museum of Irish History, Dublin
1855	Botany (2 lectures)	Prof. Dresser	National Art Training School, London
1855	On form and colour in the Vegetable Kingdom	Prof. Lindley	School of Science, London
1857	Systematical [sic] Botany	Prof. Lindley	South Kensington Museum, London
1858	On Botany applied to Fine and Industrial Art (1 lecture)	Prof. Dresser	South Kensington Museum, London
1860	On Botany as applied to Fine and Ornamental Arts (14 lectures)	Prof. Dresser	South Kensington Museum, London
1861	Botany (1 lecture)	Dr. Lankester	South Kensington Museum, London

[120] When that association is not explicit, it is possible to deduct the link with the arts, through their respective venues, e.g. National Art Training School, London; South Kensington Museum, London; Female School of Art, London; Metropolitan School of Art, Dublin.

1861	Structural & Physiological Botany (22 lectures)	Prof. Harvey	Royal Dublin Society, Dublin
1861	Economic Botany (6 lectures)	Prof. Harvey	Museum of Irish History, Dublin
1861	Botany	Prof. Harvey	Royal Dublin Society, Dublin
1861	Botany	Prof. Harvey	Botanic Gardens, Dublin
1863	Plants as furnishing ornamental forms	Prof. Dresser	Female School of Art, London
1869	Botany	Prof. Balfour	Edinburg Museum of Science and Art
1884	Botany in its relation to art	Prof. Cunningham	Botanic Gardens, Dublin
1884	Botany in its relation to art	Prof. McNab	Botanic Gardens, Dublin
1886	Botany	Prof. McNab	Metropolitan School of Art, Dublin
1887	Botany as relating to art	Prof. Fraser	Botanic Gardens, Dublin

It is clear that bringing the above-mentioned principles of drawing from the vegetable kingdom into practice was, certainly, among the cares and efforts of the Department of Science and Art and its predecessors, from the 1840s onward. We also observe that during the two following decades this practice was expressly intensified in London and in Dublin. More succinctly in some cases and more thoroughly in others, records convey important data about the content of those lectures, who delivered them and where. This information was gathered from official documents of the Government School of Design, the Department and Science and Art, the Diaries of Henry Cole and the South Kensington Museum, all kept at the Victoria and Albert Museum archive, Blythe House, London. In addition, the records kept by the Christopher Dresser Society also contain mentions to a large number of lectures by Christopher Dresser, during his active years, as a designer and a professor. All in all, the first three decades of the second half of the nineteenth century were especially prolific in regards to the teaching of botanical studies in the context of art education. Topics from colour in the vegetable kingdom, to the morphology and physiology of plants, to the principles of Botany as applied to fine

and industrial art, were conveyed in Schools of Art, Botanic Gardens and Museums, by well trained and knowledgeable lecturers such as John Lindley, John Balfour and Christopher Dresser.

The earliest references found, in regard to lectures on Botany applied to the Arts, report back to 1845 and a 'gratuitous course of lectures on Botany, in the Glasgow School, which have been eagerly attended by the students, who, at the end of the course, made a present to the Professor [Balfour[121]], with an expression of their grateful thanks' (Design 1846, 274). Although not completely explicit, it is highly likely that it refers to the Glasgow Government School of Design, founded in that exact year (Art). Firstly, because these minutes specifically document the activity of the Government School of Design. Secondly, because this same document occasionally refers to the Glasgow Government School of Design simply as the 'Glasgow School' (e.g. when mentioning its foundation) (Design 1846, 40). Besides, Professor Balfour is mentioned again in 1870, when delivering Botanical 'evening lectures specially adapted to the instruction of artizans [sic] in the principles of science' and a special course on Botany 'at the request of a number of artizans [sic] who attended the lectures' at the Edinburgh Museum of Science and Art.[122] All in all, although not abundant, these accounts help us understand how Botany came to enter the universe of British public art instruction[123] as well as the practice of Victorian Design. Yet, given the broad nature of the majority of sources consulted[124], allusions to such lectures all throughout the Kingdom are relatively scarce. We notice, however, two significant exceptions: records on the teaching of Botany to Art and Design students are noticeably best documented in the cases of London and Dublin (as we can see also from the table above).

No explicit references were found in regard to botanical classes at the London Art Schools prior to the move of the Government School of Design from Somerset House

[121] Most probably Professor John Hutton Balfour. He was Scottish botanist, who taught at the University of Edinburgh and the University of Glasgow, as well as Keeper of the Royal Botanic Garden Edinburgh. See (2015).

[122] The report mentions Professor Balfour's lectures for the period between 1867 and 1869. See (1870a, XXV).

[123] The Government Schools of Design as official public art education appeared in the late 1830s, hence these may still be considered pioneering practices.

[124] Previously presented in this chapter.

to Marlborough House (1852).[125] Nonetheless, the study and copying of plants was clearly encouraged and practiced within the school prior to 1852. The minutes of the proceedings of the Council of the Government School of Design for the years 1844 - 1846 do mention the evaluation of 'outline pencil drawings of flowers, produced during the vacation by students in the Schools at Somerset House'. They also refer to plants, flowers and foliage *from nature* among the works of students awarded with prizes in 1845. This is also supported by the fact that, as we will discuss further ahead, the first correspondence between Kew and the Department of Science and Art, regarding the supply of flowers to the Government School of Design dates back to 1848 (doc.118).

On the whole, this suggests that *some* training with plants and flowers (weather from the flat or the round,) was offered by the School of Design while at Somerset House. As there is no mention of Botany in the lists of classes offered by the School at the time,[126] we argue that the aforementioned training was, most probably, based on occasional lectures or as part of general classes (e.g. 'Elementary and Outline Drawing; Shading from the Flat; Drawing from the Round; Modelling from Casts, from Nature and Original Designs'). On the other hand, the first explicit references to botanical lectures applied to art in London place them at the School of Ornamental Art[127], Marlborough House, in 1852.[128] By this time the lecturer was the above-mentioned John Lindley, one of the most relevant contributors to the union between Botany and Art in the second half of the nineteenth century. He was very highly regarded by both his peers and the artistic world; an acknowledgement expressed very profoundly by John Ruskin, for example, who states owing to Lindley almost all he learned about plant structure (Ruskin 1874, 37). As both a knowledgeable botanist and a prodigious botanical illustrator[129],

[125] We recall that in 1852 the Government School of Design in London moved from Somerset House to Marlborough House. By then the Department of Practical Art was created. According to The Art-Journal, it was to be renamed 'The School of Ornamental Art'. See (1852, 196, 1864, 4, 12, Redgrave 1887, 221, Physick 1982, 9, Museum and Burton 1999, 27-28, Museum 2016).

[126] These classes are presented in a table showing the 'Attendance in the Schools at Somerset House during August 1844 and at Spitalfields during September 1844'. See (Design 1846, 40).

[127] Formerly Government School of Design and then-future National Art Training School, having moved to South Kensington in 1856.

[128] On this matter see (Design 1846, 45, 60, Cole 1852).

[129] Yeomans (2013) refers to Lindley's artistic work, highlighting the illustrations he created for his published works on Botany, e.g. 'Rosarum monographica'; or a botanical history of Roses'.

Lindley seemed to fit impeccably in the role of lecturer at the School of Ornamental Art, since its very beginning, at Marlborough House.

Altogether, the contents of Lindley's lectures demonstrate that, to understand the morphology of plants, in a way that it could be insightfully deconstructed, truthfully portrayed, and creatively transposed to Design, attention should be focused primarily in those inherent and 'omnipresent' manifestations of symmetry in the vegetable kingdom.[130] One of the fundamental principles conveyed by the schools of Design was that the 'ornamentist' should not be solely a direct imitator of Nature. In fact, it was Henry Cole's opinion, and the firm belief of the Department of Science and Art that, by then, British manufactures were going on the wrong path, by producing motifs directly imitated from Nature, but disregarding, the principles of symmetry[131] and harmony inherent to nature itself, and seen, for example, in Tunisian textile patterns. For Cole, the latter was a true example of manufactures, as opposed to the design of 87 objects displayed in London under the title "False Principles of Decoration" (Livingstone 2001, 380). In his teachings, Lindley would become one of the greatest promoters of the symmetrical[132] the way of producing designs in accordance with the symmetry and repetitive patterns observable in nature itself. That could be achieved through the study of Botany specifically applied to the arts. As he explained:

> The botanist imagines that he beholds the living plants themselves, and the mere artist recognises in every detail forms of such exquisite grace as could, by no known means, have been obtained except by the most skilful application of the laws of symmetry (Lindley 1854, 38).

On December 6th 1857, Lindley delivered a lecture on 'Systematic botany' at the then-newly opened South Kensington Museum.[133] This is the last reference to his

[130] In his lectures, Lindley explored thoroughly the laws of vegetable symmetry and balance inherent to plant growth and how they manifest, e.g. in buds, leaves, roots, stems, branches, and finally flowers. He based his statements on the premise that 'symmetry in plants arises out of their peculiar nature. It is dependent upon a highly complicated internal structure, which is, in itself, essentially symmetrical.' See (Lindley 1854, 9).

[131] As we will see further ahead, when discussing the teachings of John Lindley and Christopher Dresser as lectures on Botany applied to Design, at the Department of Science and Art.

[132] As well as Christopher Dresser, his successor at the Department of Science and Art, as we will see in the chapter that follows.

[133] By then the Department of Practical Art had become the Department of Science and Art which included the National Art Training School, in South Kensington. See (1864, 125, Redgrave 1887, 221, Physick 1982, 16).

lectures at the Schools of Art that we have found in the course of this study.[134] It was most probably an occasional lecture, since in 25 August 1855 the Department of Practical Art had considered it 'unnecessary to present session to continue lectures on botany [by John Lindley].[135] Lindley's role during the early years of the 1850s was of the upmost importance. It reveals a pioneering practice in the teaching of botany to future designers and, thus, a significant contribution to Victorian industrial art and manufacture. Altogether, Lindley's contribution, as a lecturer seemed to have become less regular from the mid-1850s onward. Nonetheless, his legacy remained, and others continued the task of linking science and art through a Botany and Design. Among them, the names of John Ruskin, and of Christopher Dresser, for example, are particularly relevant.[136]

Evidence indicates that the Department of Science and Art was notably committed to establishing a continuous collaboration with Christopher Dresser as a fully accredited and knowledgeable lecturer on Botany in the Department's schools of art, mainly in London. Notice that his name was among the 'list of candidates for Masterships in Training, Scholars, and Pupil-Teachers receiving pay from the Department at Christmas 1854' (1854a, 317); and that, later on, on March 1855, he was 'accredited to provincial schools as a competent person for botanical lectures'. Finally, in that same year, the Department decided to cease Lindley's lectures (on 25 August 1855) Dresser was appointed to teach Botany at the National Art Training School (1864, 99). Thereafter, he became one of the most active and distinguished people of the Department in regard to the alliance between Science and Art; a role he was widely acknowledged for as being 'thoroughly acquainted with the wants of the Art-student, [and] having spent nearly eight years of his own life in the study of the Ornamental Arts'.[137] Based in London, Dresser worked mainly at the National Art Training School[138]

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[134] Although no documents were found to confirm it, it is possible that he continued lecturing, occasionally, to art students, even after his retirement.

[135] Professor Lindley is also mentioned as one of the donors of plant specimens to the Department of Science and Art, having offered 39 plants and cuttings. See (1856, 142).

[136] The work of both Lindley and Dresser in the London schools of art was determinant for the teaching of Botany within the arts; which justifies the special attention this chapter pays to both lecturers.

[137] (1860e, 11).

[138] Both in Marlborough House and South Kensington.

and the Female School of Art, both as lecturer and class director.[139] Here he thoroughly explored the morphology of plants and how the *ornamentist* should apply this knowledge to Design.

Although more widely documented in regard to the capital, botanical lectures at the Schools of Art and Design were not exclusive to London.[140] There are also records referring to other British locations, such as Manchester or Dublin, for instance; the latter being the most referenced and well documented within the consulted archives. Had it not been for the fact that the annual reports of the Department of Science and Art included a section dedicated to the Royal Dublin Society, it would have been much more difficult to find relevant information in regard to Botanical lectures to Art and Design students in Dublin, in a research mainly based on London archives. The above-mentioned lectures were distributed between 4 venues: the theatre of the Royal Dublin Society, the Museum of Irish Industry, the Metropolitan School of Art and the Dublin Botanic Gardens. These references provide sufficient information to support that some of the lectures documented were either directed to or attended by students from the Dublin School of Art. Although we find the Dublin records highly significant, especially if we consider the scarceness of analogous ones on a national level, the primary sources consulted do not provide as substantial information as the London records. Nevertheless, altogether, they constitute the most complete source of information regarding Botanical lectures in Victorian training on Art and Design, within the sources investigated in this research.[141] Correspondingly, the establishment, in the 1850s, of a course of instruction to train designers, which was strongly grounded on the

[139] Besides the references in the Précis of the Minutes of the Science and Art Department (1864), see, also (1863, 58). The latter on a course opened at the Female School of Art in London, under the direction of Christopher Dresser assisted by Messrs, Lyon and Allen. It included lectures on the history of ornament, as well as on 'plants as furnishing ornamental forms'. Also, according to the *Art-Journal* (1861): 'The Female School of Art is the only one in the kingdom, not excluding even that at South Kensington, where the principles of design are taught as well in theory as in practice. We may mention also that lectures, by a competent professor, are frequently given to the pupils on artistic botany. The importance of this feature, and the necessity for students in design to have a knowledge of the laws of plant growth, will be appreciated by all'. (1861c).

[140] It is important to underline that, as home to the head office of the Department of Science and Art and having more facilitated access to resources, what happened in London is comprehensively documented. Furthermore, the fact that most of the documents found report back to activities which took place in London widely supports this premise.

[141] A thorough investigation *in loco*, would probably retrieve more substantial data.

understanding of Nature, confirmed the will of the Department to pursue a system of teaching Design where 'students should be taught the laws of ornament from leaves, flowers, and plants'. The devised system of instruction would gradually take them from drawing from flat examples and copies, to drawing from life specimens and ultimately deconstructing, reinterpreting and transferring the aesthetic and ornamental features of plants and their structures to elements of design[142]. Knowledge and skills were, hence, conveyed and practiced through the adoption of various theoretical-practical methods, such as the use of flat copies or casts of plants, as well as botanical diagrams and real life specimens.

2.1.4. The use of copies and botanical diagrams

For drawing from foliage, plants, fruits and flowers, as well as for learning botany, material resources varied according to each stage[143]. In the earlier stages, primarily based on freehand and memory drawing (outline and shaded), students drew from the flat; resorting mainly to printed copies and casts.[144] Several copies of plants, flowers and fruits are listed in the annual reports of the Department of Art and Science as being 'purchased, recommended and approved examples for use in the Schools of the Department'. Interestingly, as shown in figure 16, some went to the extent of specifying the botanical and/or common names of the plants, e.g. calia, honeysuckle or woodbine, bindweed, passion flower, pelargonium, petunia, nasturtium, camellia, wall flower, althoea frutex, torrenia asiatica; oleander.[145] This reveals a significant level of planning and criterion, which is also found in the use of botanical diagrams in the schools of Art, whether to illustrate lectures on Botany or to serve as examples to be studied and copied.

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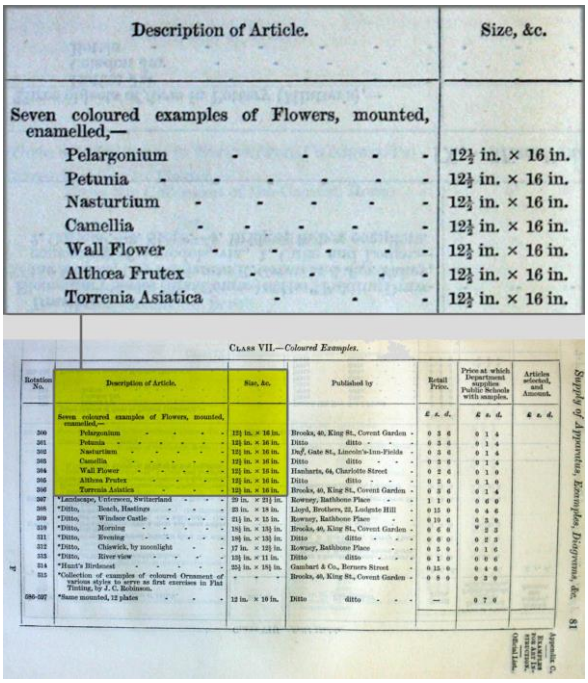
[142] (1894, XXXII).

[143] Especially by the end of the Design Courses, students learned the principles of Botany through class-lectures.

[144] In a brief reference to the use of flat examples in the Schools of Art, Stuart Macdonald (2004, 191) explains that these were usually 'washable and mounted on millboard, often from front and back, measuring about ten inches by eight inches. Flowers, the favourite examples of the "ladies" classes, such as "the wallflower" and the "Passion flower" (…) were printed nearly two feet high'.

[145] (1855, 81).



Description of Article.	Size, &c.
Seven coloured examples of Flowers, mounted, enamelled,—	
Pelargonium	12½ in. × 16 in.
Petunia	12½ in. × 16 in.
Nasturtium	12½ in. × 16 in.
Camellia	12½ in. × 16 in.
Wall Flower	12½ in. × 16 in.
Althœa Frutex	12½ in. × 16 in.
Torrenia Asiatica	12½ in. × 16 in.

CLASS VII.—*Coloured Examples.*

Rotation No.	Description of Article.	Size, &c.	Published by	Retail Price.	Price at which Department supplies Public Schools with samples.	Articles selected, and Amount.
				£ s. d.	£ s. d.	£ s. d.
	Seven coloured examples of Flowers, mounted, enamelled,—					
200	Pelargonium	12½ in. × 16 in.	Brooks, 40, King St., Covent Garden	0 3 6	0 1 4	
201	Petunia	12½ in. × 16 in.	Ditto ditto	0 3 6	0 1 4	
202	Nasturtium	12½ in. × 16 in.	Dorf, Gate St., Lincoln's-Inn-Fields	0 3 6	0 1 4	
203	Camellia	12½ in. × 16 in.	Ditto ditto	0 3 6	0 1 4	
204	Wall Flower	12½ in. × 16 in.	Hanhartz, 64, Charlotte Street	0 2 6	0 1 0	
205	Althœa Frutex	12½ in. × 16 in.	Ditto ditto	0 2 6	0 1 0	
206	Torrenia Asiatica	12½ in. × 16 in.	Brooks, 40, King St., Covent Garden	0 3 6	0 1 4	
207	*Landscape, Unterwern, Switzerland	29 in. × 21½ in.	Rowney, Rathbone Place	1 1 0	0 6 0	
208	*Ditto, Beach, Hastings	23 in. × 18 in.	Lloyd, Brothers, 22, Lodgate Hill	0 15 0	0 4 6	
209	*Ditto, Windsor Castle	21½ in. × 15 in.	Rowney, Rathbone Place	0 10 6	0 3 0	
210	*Ditto, Morning	19½ in. × 13½ in.	Brooks, 40, King St., Covent Garden	0 6 6	0 2 2	
211	*Ditto, Evening	19½ in. × 13½ in.	Ditto ditto	0 6 6	0 2 2	
212	*Ditto, Chiswick, by moonlight	17 in. × 12½ in.	Rowney, Rathbone Place	0 5 0	0 1 6	
213	*Ditto, River view	13½ in. × 11 in.	Ditto ditto	0 3 0	0 0 6	
214	*Hunt's Birdcnest	25½ in. × 19½ in.	Gambart & Co., Berners Street	0 15 0	0 4 6	
215	*Collection of examples of coloured Ornament of various styles to serve as first exercises in Flat Tinting, by J. C. Robinson.		Brooks, 40, King St., Covent Garden	0 8 0	0 2 0	
200-207	*Same mounted, 12 plates	12 in. × 10 in.	Ditto ditto	—	0 7 6	

Figure 16. List of examples approved by the Department of Science and Art for the use in Art and Design training. From "First report of the Department of Science and Art, presented to both Houses of Parliament by command of Her Majesty", 1854, p.81.

Two main factors seem to have influenced the introduction and continuous use of botanical diagrams by the Schools of Art. One was the impulse given to the development in printing, which made possible to reproduce diagrams in a larger scale, with fewer costs of production and, consequently, lower end-prices. Robert Hunt wrote a very pertinent article on this matter in *The Art-Journal*, in 1854, where he stated:

> The impulse which has been given to industrial instruction, particularly in the National and British schools, has led to the production of scientific diagrams, at an exceedingly cheap rate, by the means of block printing, and who have lately seen some specimens of botanical diagrams, produced by Mr. Griffin, of Finsbury, by the process of cylinder-printing, remarkable for their correctness in drawing and in colour. A large sheet containing as many as twelve or fourteen colours can thus be produced for about sixpence [sic]. The educational means afforded to us are being increased with remarkable rapidity. We must hope that the result will be the gradual introduction of more correct knowledge than that at present possessed by the masses, and the diffusion of a higher order of taste.[146]

[146] (Hunt 1854, 3).

The other main factor was the commitment of the Department of Science and Art in reinforcing the teaching of Botany in its art schools. Firstly, by encouraging the communion between art and botanical subjects in art training, through drawing, painting, modelling and design.[147] Secondly, by endowing the courses with knowledgeable and accredited people to lecture in Botany. And thirdly, by suitably supporting both masters and students, providing them with good quality and variety of didactical resources, such as flat copies, casts and botanical diagrams.

On November 1852, in the course of the botanical lectures delivered by botanist John Lindley to the students of practical art at Marlborough House, he enquired on the possibility of using 'devises of botanists, not intended for decoration, but for the representation of ideal truth' to assist the work of manufacturers'. He further stated:

> Botanists are accustomed for the purposes of abstract science, to project the parts of plants, and especially of flowers or fruit, upon plane surfaces, preserving all the organs in their due position with respect to each other, but neglecting form and other minor attributes. Such projections they call diagrams.[148]

Even though implicitly, Lindley's words suggest that, by November 1852, botanical diagrams were neither well-known nor accessible to manufacturers in the United Kingdom. By association, this would initially lead us to think they were also disregarded within the instruction of Art and Design.[149] Yet, as we will see, documental evidence demonstrates otherwise.

Early allusions to botanical diagrams within the context of art instruction demonstrate that diagrams were already in use at the Government School of Design, prior to the move from Somerset House to Marlborough House. Firstly, in 1842-43, in "The introduction to the drawing book of the School of design" William Dyce referred to **'**the power of representing objects in the form of diagrams" and praised them as an art didactic resource especially aimed to assist students in drawing. In Dyce's own words,

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[147] For example, in 1854, the description of a lesson for Masters in training at Marlborough House, mentions to the use of diagrams for the drawing exercise of a chestnut leaf (1857c, 26).

[148] See (Lindley 1854, 48-49, Art).

[149] There is an allusion to 'Botanical Diagrams by Sir S. Harris, F.R.S.' as part of the 'preparation of Scientific Diagrams and Apparatus suited to elementary schools' ordered by the Department of Science and Art in 15 November 1853. However, there is no mention of their use in art schools. See (1854a, 33).

they were valuable instruments to develop the skills to draw "with precision and readiness every variety of superficial form in outline' and, therefore, were 'a prominent object in the education of ornamentists [sic]'. [150] Hence, Dyce's statements strongly confirm that art and design students were acquainted with diagrams at that time and that the Government School of Design was evidently invested in exploring the art educational potential of scientific diagrams within the curriculum of artistic education. This would implicitly include botanical diagrams. Secondly, according to Henry Cole, the practice of suggesting and purchasing 'improved diagrams and examples' as 'aids for teaching Science and Art' was instituted in 1852 by the Department of Science and Art (Cole 1857, 19); right at the time Lindley encouraged their use in art instruction. In view of this, it is evident that botanical diagrams were, in fact, used since the early years of the Government School of Design, leastways as copies and examples to draw from. Nevertheless, their use as fully recognized resources to illustrate botanical lectures in art courses, dates from 1852 onward. It is also likely that Lindley was one of the first to implement them in this manner, in the early 1850s, while a lecturer of Botany at Marlborough House, London.[151]

Although, as we have seen, explicit references to diagrams illustrating lectures on botany are not abundant on the subject, by 1854 onward, the use of botanical diagrams in the instruction of art and design was clearly encouraged by the Department of Science and Art (as shown in figure 17, which mentions the approval of copies and diagrams containing studies of flowers and Ornaments to be used in the schools of art). Moreover, records of the Educational Division of the South Kensington Museum between 1862 and 1869 also include allusion to botanical diagrams, either on display in the corridors, or as additions to the educational collections.[152] These were, therefore, also widely accessible to the masters and students at the art school in South Kensington.

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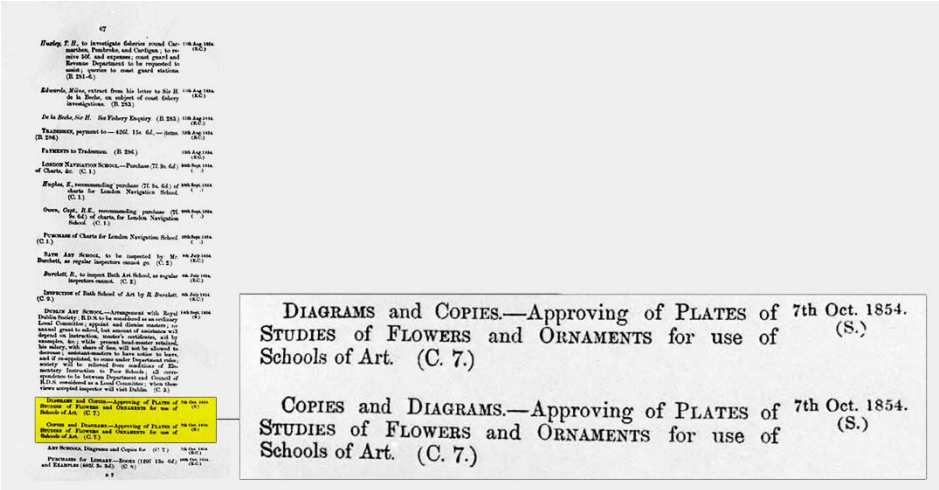
[150] See (1854b, VIII).

[151] Other references to botanical diagrams are, likewise, unclear as to their use in art schools. Either because they are not specific as to the type of schools they were intended for or because they specify schools other than Art Schools, e.g. Kings College, or yet have too broad a description for that to be determined, e.g. 'supplied to National and other Public Schools and Institutions', 'Diagrams of plants used for useful purposes' or 'diagrams illustrating easy methods for teaching Botany in schools'. See, for instance, (1854a, 33-34, 1855, 14-15).

[152] (1869, 294).

The above-mentioned diagrams may be the same ones Henry Cole refers to, in his Diary of 21 January, 1869 (Cole 1869), as having been "settled by Dr. Hooker and Dr. Oliver".



DIAGRAMS and COPIES.—Approving of PLATES of STUDIES of FLOWERS and ORNAMENTS for use of Schools of Art. (C. 7.) 7th Oct. 1854. (S.)

COPIES and DIAGRAMS.—Approving of PLATES of STUDIES of FLOWERS and ORNAMENTS for use of Schools of Art. (C. 7.) 7th Oct. 1854. (S.)

Figure 17. Diagrams and Copies approved by the Department of Science and Art, for use of the schools of art, in 1854. From "Précis of the minutes of the Science and Art Department, arranged in chronological order from 16th Feb. 1852 to 1st July 1863. edited by Department of Science and Art. London, p.67.

The following year, a set of 70 botanical diagrams by the same 'Prefessor [sic] Oliver, of Kew'[153] was prepared for the Department of Science and Art. Each diagram was described as being 'mounted a dried specimen of a typical plant of the class to which the letter-press and coloured engravings relate'.[154]

It is highly likely that diagrams were introduced as part of a more 'scientific' approach to botanical studies within the course of art and design instruction, i.e. in the most advanced phases of training. Doc. 114 shows an overview of stage 22a and 22b of

[153] Although only the surname is mentioned, the dates and the allusion of his connection to Kew gardens suggest this would be Professor Daniel Oliver (1830 - 1916). He was keeper of the herbarium of the Royal Botanic Gardens, Kew; fellow of the Royal Society, the Edinburgh Botanical Society, and the Linnean Society. In 1916, upon the news of his death, the journal "Nature" published his obituary, where his contributions to the study and teaching of botany were highly praised: "His reputation as a keen and critical worker, gained in the North of England, was already such as to prompt Sir William Hooker [the Director of the Royal Botanic Gardens, Kew] to invite him to assist his son in the heavy task of arranging and distributing the botanical collections accumulated by the East India Company and to induce him in 1858 to become an assistant in the herbarium at Kew. On settling there Oliver instituted in 1859 a course of lectures on botany, which he continued to conduct until 1874, for the benefit of the young gardeners. He proved so excellent a teacher that in 1861 he was appointed to the botanical chair which had been occupied by Lindley at University College, London" (1916, 331).

[154] (1870b, 184). On the purchase of a set of these diagrams by the South Kensington Museum, see also (1871, 438).

the Course of Studies at the Central School Art, London. It specifies flowers where analysed in regard to their growth and ornamental details and then transposed into ornament. Nonetheless, this study and drawing of plants was not exclusive to the use of copies and diagrams, on the contrary. Especially on the last phases of training, study and observation would take most advantage of real specimens. What is more, this required contact of students with real plants on a regular basis, which, in turn, called for either visits to local gardens (e.g. botanical gardens); the delivery of plants to the schools; or even the establishment of small gardens, in proximity of the schools of art, to allow access to fresh plants and flowers for the use of masters and students.

2.1.5. Organic workshops for the designer: the link between botanic gardens and the schools of Art and Design in London and Dublin

In one of his many addresses on design, Richard Redgrave explained the courses in public art schools were arranged in the 'spirit of a loving study of nature, coupled with a due appreciation for art' (Redgrave 1890, 22). Here the pupil alternated the study of ornament from examples with the study of 'natural foliage, fruit, and flowers placed before him'. The student then proceeded to 'investigate the laws of growth and development'; and 'finally, as a step to invention', he was 'instructed how to arrange according to like geometrical laws and principles the unnumbered beautiful forms and varied colours with which nature supplies him'. The constant need for contact with real botanical specimens, as part of the method of artistic education within the Department of Science and Art, lead us to look into how the schools of art had regular access to real life plants and flowers throughout the school year. This matter is primarily documented, once again, in regard to the London and Dublin schools of art and design.

The fourth annual report of the Department of Science and Art, contains a site plan of the South Kensington Museum (shown in doc. 115). It includes the buildings of the museum and National Art Training School, as well as their surroundings, and is dated 1857. Located west of the old Lecture Theatre and North of the schools, can be read 'BOTANIC GARDEN FOR TRAINING CLASS'. This shows that, by this time, the Art School in South Kensington, actually had, or was planned to have, at one time, its own botanic garden, especially intended for the training of students. Moreover, a birds-eye view of

the same area [docs.116) included in a guide of the South Kensington Museum, originally published in 1860, shows a garden occupying that same space, adjacent to the lecture theatre. Even though elements are numbered in the picture, the guide lacks a caption, so, although all points to this, it is uncertain that it was, in fact, the same garden identified in the 1857 plan. In addition, Henry Cole mentions in his diary from 1859, that Professor Lindley was called to the Department of Science and Art in for the transplant of the "sunk garden". With no further data there is no way of knowing if this "sunk garden" could be related to the Botanic Garden in the above-mentioned plan (Cole 1859). Nevertheless, the fact that no further documents were found that corroborate its presence, and that it is absent from the plans that followed (doc. 117)[155], indicate that this garden's existence was a brief one. Hence, to be able to work with real botanical specimens, the schools of art would have to get them from elsewhere. The most apt to supply specimens on a regular basis would, naturally, be botanical gardens.

Collaboration with botanic gardens, as part of the curriculum of art education, was materialized in three main types arrangements. Firstly, by allowing free entrance to art students, who wished to visit botanical gardens. For instance, in 1845, the students at the Manchester School were encouraged to draw at the Natural History Museum, and negotiations were initiated in order to allow them free entrance in the Botanical Garden. (Design 1846, 296). This was a common practice in Dublin throughout the second half of the nineteenth century, where the Botanic Gardens of the Royal Dublin Society allowed free admission to all the students from the medical schools as well as from the School of Art.[156] Secondly, by granting access to masters of the schools of art in order for them to deliver lectures on site. Again, records best document the cases of London and Dublin. And thirdly, by regularly supplying plants and flowers from the gardens to the schools of art.

One of the earliest references found regarding a partnership between London botanic gardens and art schools, dates back to 1850 and was an unsuccessful attempt

[155] Namely those authored by Captain Fawke (e.g. (Fawke 1860), or others held by Victoria and Albert Museum, some of them incorporated in official documents of the Department of Science and Art and the South Kensington Museum, e.g. (Museum 1860, 1869)).

[156] See, for instance (1856, 141, Art 1860, 187, 1868a, 302).

for collaboration between the North London School of Drawing and Modelling and the botanic garden at Regent's Park (1850, 329), and reads as follows:

> An application has been made to the Royal Botanic Society, Regent's Park, for the occasional loan of plants for use in the school [North London School of Drawing and Modelling]; as most desirable objects of study. But a refusal has been given, on the plea of inconvenience.

Even though the North London School of Drawing and Modelling was unsuccessful in establishing what could have been a prolific partnership with Regent's Park, London was, in general, a case of success in this matter. This was mostly due to a long-lasting and fruitful cooperation established between the Department of Science and Art and the Royal Botanic Gardens, Kew. It comes as no surprise that the collections at Kew would be of interest to the School of Art if it desired to promote the use of real plants as part the students' training. As highlight by Edward Forbes (1851, II) while referring to the value of 'vegetable works' in the Great Exhibition' of 1851 :

> the vast assemblage within the precincts of the Royal Gardens, at Kew, presents an opportunity for botanical study, such as can be met with nowhere else; whilst among the many and extensive herbaria of dried specimens belonging to lovers of botany and scientific societies in Britain, that of the illustrious botanist who presides, to the great benefit of the public, over the Gardens at Kew, is probably unequalled in the world, although it be a private collection.

Although there are few records to confirm it, evidence points to the fact that at the time of the Great Exhibition (London, 1851), the aforementioned cooperation had already been established. The archives of the Royal Botanic Gardens, Kew, hold various documents in regard to it. For the most part, they comprise correspondence between the director and curators of the Royal Botanic Gardens and the Department of Science and Art. Altogether, these sources are extremely relevant to the topic in hand, as they document an ongoing supply of plants from the Royal Botanic Gardens at Kew to the Department of Science and Art, primarily its main School of Art in London, for a period of over sixty years. These documents are archived as belonging to the years 1855 to 1912. However, among them, there is a letter, shown in doc.118, dated 1848, which indicates that this collaboration started with the Government School of Design while it

was at Somerset House, and the Department of Science and Art was still the Department of Practical Art[157].

Over the following years, the Royal Botanic Gardens at Kew supplied the Government School of Design with plants from their collections, on a regular basis, throughout the school year: from early October to late July (Art 1863, 1874b, 1891, 1893). This continued, accompanying the evolution of the Department and the School: initially in Somerset House (1837), then at Marlborough House, as School of Ornamental Art (1852) and also denominated Central School of Art (1854a); subsequently as part of the South Kensington Museum, denominated National Art Training School (1856). The complex included the branch of the Female School of Art, an 37 Gower Street (also known as Metropolitan School of Art for Female Students (1854a, XLII); and, finally, as the Royal College of Art, from 1886 onward, still at South Kensington.

In 1855, a letter was sent by the Department of Science and Art, thanking the director of the Royal Botanic Gardens for showing the site to 'Mr. Slocombe'[158], as they were 'much in want of some plants as for our classes during the present winter; and he may by seeing your collection be probably able to point out to you things which during the present session' (doc.119). Initially, botanical specimens and cuttings were exclusively sent to the Government School of Design/National Art Training School. When the School was already in South Kensington a request was sent to the Royal Botanic Gardens so as to extend the supply of plants to the 'Art School, Gower Street'. The reply letter shown in doc. 120, refers to the Female School of Design[159], 'a branch of the School of Art & Design at Kensington Grove', which was, by that time 'extensively supplied with flowers from the Royal Botanic Gardens, Kew'. William Hooker, the then-director of the Royal Botanical Gardens, explained that it would be impossible to supply

[157] In 1853, the Department of Practical Art became the Department of Science and Art. On the activity and transition of the Department of Practical Art, see, for instance (1852, 196, 1853, Cole 1853, Redgrave 1853, 1854, Physick 1982, 9, Museum and Burton 1999, 27).

[158] G.P. Slocombe was a lecturer at the Department of Science and Art, teaching 'Ornamental Design' alongside R. Burchett. See (1857b). Richard Burchett was also Head-master of the Government School of Design, renamed National Art Training School while at South Kensington, from 1856 onward, see (1864, 125).

[159] It 'was established by government, in the year 1842, at Somerset House, but, from want of accommodation, was removed to adjacent premises in the Strand, and, for a similar reason, ten years after, transferred to Gower Street. It is now located in Queen Square'.(1861c).

'the branches are well as the head of department' without extra funds. He further stated that this arrangement occupied a great deal of time of the workers at Kew, who received the requests after the flowers had been approved by the head of the Royal Botanic Gardens, as they were not cultivated[160] there 'for such purposes' (Art 1858c). Even so, despite Hooker's initial reservations, in the two weeks that followed, two letters were received at Kew, confirming the abovementioned request was accepted by the Royal Botanic Gardens (docs.121 and 122). Both requested the director to 'give directions that the usual weekly supply of flowers' be sent to the schools, the first specifying the Female School at Gower Street' and the second specifying the 'Training School' at South Kensington (Art 1858b, a). Also, in the letter dated 15 October 1858, William Hooker requested that 'the objects [plant cuttings and botanical specimens] wished' would be determined beforehand, so as to assure the correct specimens and cuttings were delivered, as 'already there have been expressions of disappointment at not satisfying the requirements of applicants' (Art 1858c). This leads us to ponder on what such requirements would be and if whether or not plants were pre-chosen by the schools.

The documents found are insufficient to prove with absolute certainty that specific species or genus of plants were usually identified in the requests by the schools of art and, if so, with what criteria. Nonetheless, there are at least five documents at the Royal Botanic Gardens, Kew, which contain relevant information on this matter; whether more objectively, by providing lists with botanical or common names, or more broadly, by specifying the type of plant or elements of plants required (docs.123 to 127). Table 10 lists all the plants identified in the requests from the Department of Science and Art to the Royal Botanic Gardens, Kew, gathered from sources dated between 1867 and 1885.

Table 10. Plants requested by the Department of Science and Art to the Royal Botanic Gardens, Kew, gathered from the correspondence held by the archives of the Royal Botanic Gardens.

Botanical name* (genus/species)	Common name	Date
Juncus sp.	Rushes	

[160] A letter dated 28 November 1863 suggests that flowers were supplied to the Schools of art were grown in the greenhouse at the Royal Botanic Gardens, Kew (Art 1863).

Botanical name* (genus/species)	Common name	Date
Orixa japonica	Japanese orixa	20 March 1867
Potentilla anserina	Silverweed	
Orixa japonica	Japanese orixa	
[?] littoralis	[?]	
Pinus luchuensis [?]	Luchu (?) pine	
Danae racemosa	Poet's laurel, [Alexandrian laurel	5 March 1870
Not specified	Not specified (foliage of large growth)	25 July 1874
Not specified	Not specified (foliage of large growth)	27 July 1875
Calla aethiopica [Zantedeschia aethiopica - (L.)]	Arum lily, Calla lily, White calla lily	18 December 1885
Calla maculata [Zantedeschia albomaculata]	Spotted Calla Lily	
Not specified	Orange and Lemon trees small seedings	
Euonymus argentea	Spindle	
Not specified* * [Pseudosasa japonica – Bamboo metake]	Bamboo Metake	
Aralia sieboldii	Japanese aralia	
Dracaena [genus]	Dragon tree	
Lycesteria formosa	Himalayan honeysuckle	
Phoenix reclinata	Senegal date Palm	
Chamaerops L. [genus]	Palm [?]	
Habrothamnus elegans [Cestrum elegans]	Purple cestrum	
Habrothamnus newelli [Gard] [hybrid between Cestrum fasciculatum and Cestrum elegans][161]	n.a.	
Lapageria rosea	Chilean bellflower (pink)	
Lapageria alba	Chilean bellflower (white)	
Calia Scandensa [?]	Calia [?]	
Asplenium scolopendrium	hart's tongue fern	

[161] See (Department of Environment 2017).

Botanical name* (genus/species)	Common name	Date
Pteris [genus]	Pteris fern	
Tulipa L. [genus]	Tulip	
Narcissus L. [genus]	Narcissus	
Iris L. [genus]	Iris	
Gladiolus L. [genus]	Gladiolus	
Lillium L. [genus]	Lily	
Banksia serrata	Saw banksia, Red honeysuckle, Saw-tooth banksia	
Luculia gratissima	Luculi swa	
Lophospermum atrosanguineum (Rhodochiton volubilis – alternative name)	Purple bell vine	
Hechtia argentea	Bromeliad	
Cotyledon gibbiflora	Echeveria	
Cotyledon undulata	Silver crown	
Yucca aloifolia	Spanish bayonet, Dagger plant	
Dasylirion acrotiche [?]	Great desert spoon, green sotol	

Obs.

- [?] – refers to cases where handwritten names are not deciphered with certainty.

Whenever the name of the species is not specified, only the Genus is presented in the table above.

- Some names in the table, although accurate, are differently spelled from the original documents (Docs. 123-127)

The use of botanical taxonomic information strongly indicates that the requesters had a scientific background, or at least an above average knowledge of botany. It was the case of Christopher Dresser who, as previously mentioned, was one of the lecturers on botany at the National Art Training School[162]. Doc.123 shows a list of cuttings of flowering and non-flowering plants requested in the name of Christopher Dresser to the Royal Botanic Gardens, Kew, in 20 March 1867 (Art 1867b). It is interesting to notice the inclusion of Japanese species, such as the *Orixa japonica* or the

[162] The chapter that follows focuses on the work of Christopher Dresser as a lecturer on Botany at the Department of Science and Art and, particularly, explores his botanical diagrams, presently held in the collections of the Victoria and Albert Museum.

Pinus luchuensis, also unsurprising, given Dresser's, as well as the general Victorian's, interest in Japan[163]. Another letter, dated 1870 (doc.124) requests that a 'piece of Poets [sic] Laurel[164] [*Danae racemosa*] (the narrow and sharp-leaved variety)', be sent to the Science and Art Department (Art 1870). And both in 1874 and 1875, the National Art Training School at South Kensington specifically requests the Royal Botanic Gardens, Kew, to supply the school with 'some foliage of large growth' in the coming school year (doc. 125 and 126).[165] But the most extensive list found is from 1885, where a total of 32 different plants (doc.127) are requested to be supplied by the Royal Botanic Gardens to the National Art Training School. The list includes a wide range of flowering and non-flowering plants, some of which not endogenous to England nor Europe, many of them identified by their respective botanical name of genus or species. The regular deliveries of plants, whether cuttings or entire botanical specimens demanded a significant level of logistics arrangements on both parts, starting with pre-selection of plants, which would imply a previous knowledge of the collections at Kew, hence the accounts of visits to the Botanic Gardens by members of the Department of Science and Art (e.g. G.P. Slocombe, Mr. Sparks, the latter responsible for the list of 32 specimens/cuttings requested on 7 December 1885); and also adequate transport.[166]

Generally, and for an extended period of time, one weekly supply was delivered: a box containing cuttings and another containing live botanical specimens (Art 1867c, 1884, 1885b)[167]. Yet, in 1910, new arrangements were made so as to accommodate the request of the Board of Education to increase the supply of plants from once to twice a week. The full content of the letter can be seen in (doc.128). It refers to the cooperation that had 'existed for some years whereby the Authorities of the Kew Royal Botanic Gardens send a weekly box of flowers to the Royal College of Art for the use of Students.' It, further, explains that 'owing to some changes in the arrangements of some other gardens from which additional plants have hitherto been secured for the College, it now

[163] On Dresser and his interest in Japan, see, for instance, (Dresser 1877, 1879b, 1879a, 1882, Dresser 1972).
[164] Also known as alexandrian laurel.
[165] (Art 1874b, 1875a).
[166] Transport between the botanic gardens and the schools was made by a carrier (Art 1884, 1885a).
[167] Although not clarified here, botanical specimens were probably complete rooted plants, as opposed to cuttings.

becomes necessary for the Board to obtain a further supply of flowers from elsewhere' (Art 1910); then enquiring on the possibility of receiving two weekly supplies from Kew instead of one. Two days later a positive response to this request was sent from the Royal Botanic Gardens to the Board of Education (doc.129). Furthermore, on occasion, the schools requested to receive larger quantities of plants, and, to the extent of our knowledge, the Botanic Gardens always made the necessary arrangements to meet those requirements (Art 1868b, 1874a).

Despite a few hitches along the way, namely an occasional discontentment about the state of conservation of the cuttings delivered to the Royal College of Art [168], the collaboration between the two institutions proved to be of great value to the training in Art and Design in London. The appreciation of this long-term collaboration is noticeably expressed in an invitation sent on behalf of the Royal College of Art to the College exhibition in 1910, addressed to the Director of the Royal Botanic Gardens, Kew (doc.130). It conveys the gratitude of the school towards the Royal Botanic Gardens, whose supply of plants is acknowledged as being of 'very great benefit' especially to the Design section throughout the years. The documents referenced here are, in our opinion, the most relevant of the whole ensemble of correspondence found at the archives of the Royal Botanic Gardens, Kew, regarding the aforementioned collaboration between the Botanic Gardens and the Department of Science and Art[169], between the years 1848 and 1910. Although it is the best documented, as previously mentioned, this was not an isolated case. A similar collaboration was maintained between the Botanic

[168] See (Art 1900). It was very important that the school received fresh flowers, as withering cuttings would not make justice to the plant's real structure and appearance. On this matter we recall the words of John Ruskin when he stated: "But it is difficult to give the accuracy of attention necessary to see their [of flowers] beauty without drawing them; and still more difficult to draw them in any approximation to the truth before they change. This is, indeed the fatallest [sic] obstacle to all good botanical work. Flowers and leaves, and especially the last, can only be rightly drawn as they grow. And even then, in their loveliest spring action, they grow as you draw them, and will not stay quite the same creatures for half an hour" (Ruskin 1874, 51).

[169] Namely the London Schools of Art and Design.

Garden and the School of Art in Dublin, both under the administration of the Royal Dublin Society _throughout the second half of the nineteenth century.[170]

The Royal Dublin Society, founded in 1731, aimed to promote Arts and Sciences (i.e. the Fine Arts, botany, and natural history) in Ireland. Among others, it incorporated the Dublin Schools of Art (established in 1749 and then-called, "Drawing Schools"), as well as the Botanic Gardens at Glasnevin. The study of plants and flowers occupied a significant part of the training at the Dublin School of Art, considered one of the best in the United Kingdom.[171] Moreover, reports of the Royal Dublin Society and of the Scientific Superintendent of the Royal Botanic Gardens, Glasnevin[172], during the second half of the nineteenth century contain copious references to the close collaboration between the Dublin School of Art and the Botanic Gardens. Similarly to the Royal Botanic Gardens, Kew, throughout the second half of the nineteenth century, the Botanic Gardens, Glasnevin, supplied the Dublin Art School _from the mid-1880s onward appears denominated 'Dublin Metropolitan School of Art) (Art 1885c, 287), with plants and flowers, twice a week. In addition, plants and flowers were also supplied to the Government Normal Lace School, the Queen's College, the Queen's Institute, the Royal College of Science, the Royal College of Surgeons and the Dublin medical schools (e.g. Peter Street School of Medicine).[173] The overall purposes were to illustrate lectures on Botany at several venues across Dublin (i.e. the theatre at the Royal Dublin Society, the Museum of Irish Industry); to be used in laboratorial work, as well as to be used by the students at the School of Art. The sources consulted lack specific information regarding the actual species of plants supplied. Notwithstanding, given the strong presence of these references within the official reports of the Royal Dublin Society, it becomes clear

[170] Interestingly, Henry Cole and Richard Redgrave visited the Royal Dublin Society, in September 1853, to inspect "what the Society had to offer: its Museum of Irish Industry (a science school), its natural history museum, library, and botanic garden" (Turpin 1989, 251). In addition, the Royal Botanic Gardens, Kew, are listed among the donors to the Royal Dublin Society (Art 1866, 272); indicating a close interest and between the two cities' schools of Art and Botanic Gardens and, with it, the possibility of mutual influences in their practices.

[171] On the history and activity of the Royal Dublin Society see, for instance, (Art 1875b).

[172] Comprised in the annual reports of the Department of Science and Art.

[173] The Annual Reports of the Department of Science and Art, contain numerous references to this partnership. See, for instance, (1856, 141, Art 1860, 187, 1861b, 178, 1862, 159, 1863, 220, 1864, 214, 1866, 272, 1867a, 271, 302, 1869, 435, 1871, 497, 1872, 485, 1874c, 497, 1876, 489, 257, 1885c, 287)

that the dialogue between the Botanical Gardens and the School of Art was a significantly important aspect of the Society's activity.

According to the fourth annual report of the Department of Science and Art, during 1856 alone, a total of 1600 plants were sent to the School of Art and a total of 1200 to the Model Lace School.[174] The sources consulted do not specify which species were supplied in Dublin. They, however, show an increment of the supplies from the 1860s onward, when plants and flowers were said to be sent almost daily to the Society for the use of the students of the School of Art (1870a, 503). Near the term of the nineteenth century, the supplies of specimens "to illustrate lectures, and for private classes", as well as the "number of students frequenting the botanical arrangements" were said to have increased year after year; and the Botanic Gardens were much recognized by their efforts to always comply with the demands, having only faced difficulties "in cases where special plants not cultivated in quantity in the gardens were required" (Art 1887, 306). Furthermore, several accounts corroborate the satisfaction regarding the collaboration between the Botanic Gardens and the School of Art. For, instance, in his report for the year 1884, the Scientific Superintendent of the Royal Botanic Gardens, Glasnevin stated that the supply of specimens left "nothing to be desired" and thanked the Curator for "the prompt and liberal manner" in which all his demands had been supplied. (Art 1885c, 287).

To sum up, a significantly varied range of documents found in archives mainly connected to the Science and Art Department, the South Kensington Museum and the Royal Botanic Gardens, Kew, have effectively provided a clear insight into the role of Botanical Studies within the training of Victorian artists and, most particularly, designers in the context of the London and Dublin schools of art and design. The study and practice with flowers was introduced early on, in the initial phases of training, where drawing was the main tool to depict nature, initially from flat copies and casts. Subsequently, a further scientific approach on botanical studies was administrated, through theoretical-practical lectures delivered by knowledgeable specialised professors of botany, such as John Lindley and Christopher Dresser. As previously mentioned, botanical diagrams

[174] See (1857a, 109).

were among the main resources used to convey scientific knowledge on the morphology and physiology of plants, and to study their aesthetic features and potential. In addition to copies, casts and botanical diagrams, the study and copy from real botanical specimens was an extremely valuable method, used, for the most part, during the later stages of Design training.

An intensive use of real specimens during these stages implied a continuous access to fresh plants and flowers by masters and students, made possible mainly through partnerships established between the schools of art and local Botanic Gardens. The most well documented cases are: the long-lasting agreements between the Department of Science and Art and the Botanic Gardens. The first involved the Royal Botanic Gardens, Kew and the Government School of Design, (and carried on with its descendent institutions in Marlborough House and lastly in South Kensington, within the Department of Science and Art). The second was established by the Dublin Botanic Gardens and the Dublin School of Art, both part of the Royal Dublin Society. The aforementioned collaborations allowed access to plants and flowers throughout the school year and were materialized in three different ways: The Botanic Gardens granted free admission to Art and Design students, allowed masters to deliver lectures *on* site, and regularly supplied the schools of Art and Design with fresh plants and flowers to be used in artistic training. The exposed confirms the interest and diligence of the Department of Science and Art to ensure the overall quality of botanical training as applied to Art and Design, maintained by both material resources and knowledgeable professors. As previously stated, one of the most valuable collaborators in this enterprise was botanist and designer Christopher Dresser. The extent of his contributions warrants a closer look into his teachings on the dialogue between design and botanical studies, with particular focus on the botanical diagrams Dresser created and extensively used to illustrate his lectures in the Science and Art Department.

2.2. **Science, an art matter: botanical lectures and diagrams of Christopher Dresser at the Department of Science and Art, London**

> It has been said that there is nothing sudden or abrupt in nature; but a gradual blending of kingdom into kingdom, of member into member, and a gradual transition from simplicity to complexity. Christopher Dresser, The Art-Journal, 1858, 38.

The previous chapter explored the role of botanical studies within the policy and practice of the Government School of Design, London, the Department of Science and Art, as well as its Schools of Art and Design in London and in Dublin, with special focus on observation drawing. Our study comprised both the theoretical framework of the approach to botanical studies, as well as its practical side. The latter was mainly centred on strategies, as well as material and human resources provided by the Art and Design Schools of the Department in order to integrate botanical studies in their curriculums. As lecturer in the Department of Science and Art, during the decades of 1850 and 1860, Christopher Dresser was instrumental for the success of this endeavour. In this chapter we study the role of Christopher Dresser in implementing a botany-inspired and informed training within the training of designers. The chapter begins with the study of what Dresser denominated Rustic and Suggestive botany. Two concepts which are in the foundations of his theory and practice in regard to the dialogue between the artistic and the scientific approach to botany and botanical elements and features, specifically in the point of view of Design. The chapter develops and ends with an articulated analysis of two documental sources: the set of sixty-two botanical diagrams Dresser created to illustrate his lectures at the DSA, and eleven articles he published in 1857 and 1858 in *The Art-Journal*, entitled “Botany: as adapted to the arts and manufacture”.

Highly regarded as the first modern industrial designer (Joll 1990), Christopher Dresser (Doc.131) is one of the most relevant names associated with botanical studies as part of the curriculum of Arts and Design training during the Victorian period. Dresser’s own training, intimately linked to the Department of Science and Art,

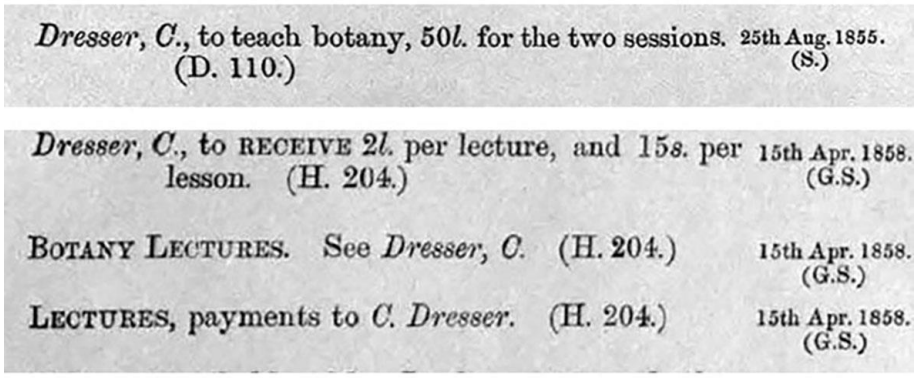
culminated with a PhD in Botany, awarded by Jena University, Germany[175] (Dresser 1972) for his contributions to that field. He first entered the Government School of Design as a student, where he was remembered as "hard-working energetic (…) clever, copying the plants, flowers, &c." supplied by the Royal Botanic Gardens, Kew, being prodigious in making copies, studies in pencil or chalks on tinted paper (Student 1907, 155). Further along his academic training, the quality of his work won him several prizes, among which a third prize in the Exhibition of Students' works at Gore House, May, 1854, as well as the Department's Design prizes for Advanced Studies (1853), where he was awarded for his work regarding stages 23 c. and f.[176] of the Course for Designers, Ornamentists, and those intending to be industrial artists" while at the Normal School (1854a, 204-205).

By the end of 1854, Dresser's name appears among the candidates for "masterships in training, scholars and pupil-teachers receiving pay from the Department of Science and Art"[177], with an annual allowance of £20 (doc.132) (1854a, 347). As mentioned in the previous chapter, in 3 March 1855, he was appointed by the Department of Science and Art as a competent person for botanical lectures" (1864, 88), a role he occupied throughout the decades of 1850 and 1860, both as lecturer of Botany and Master of the Botanical Drawing classes at the South Kensington Museum (figure 18).

[175] The University of Jena was the leading centre of scientific botany in Europe (Durant 1993, 7), with illustrious masters such as Herr Schleiden, chair of Botany at the time of Christopher Dresser's PhD (1860c, 30).

[176] In 1853, stage 23 c and f corresponded to subdivisions Technical studies: "Ornamental surface design" and "Lithography", respectively (1854a, 31).

[177] In 1853, a new class was created at Marlborough House destined to certify students who wished to become masters at the Schools od Art of the Department of Science and Art. The course, included a technical artistic component as well as training in teaching. After completion, if found competent, local committees would nominate the masters for their schools of art across the United Kingdom. By the time of its foundation, attendance of this course and consequently the emergence of a growing number of trained and certified masters was considered crucial for the success of the system of Art Education across the British territory. (1854a, LVII).



Dresser, C., to teach botany, 50*l.* for the two sessions. (D. 110.) — 25th Aug. 1855. (S.)

Dresser, C., to RECEIVE 2*l.* per lecture, and 15*s.* per lesson. (H. 204.) — 15th Apr. 1858. (G.S.)

BOTANY LECTURES. See *Dresser, C.* (H. 204.) — 15th Apr. 1858. (G.S.)

LECTURES, payments to *C. Dresser.* (H. 204.) — 15th Apr. 1858. (G.S.)

Figure 18. Excerpts of the Précis of the minutes of the Science and Art Department (6th Feb. 1852 - 1st July 1863) referring to Christopher Dresser as lecturer on Botany, pp. 99 and 213.

In 1860, prior to the cessation of his role at the Department of Science and Art, he applied for the position of Chair of Botany at University College in London. In a letter dated 25 September 1860, Dresser thanks the director of the Royal Botanic Gardens, Kew for his "kind testimonial" to assist his application (doc.133). The application was unsuccessful, as Dresser remained in his role at the Department of Science and Art until 1868.[178] These circumstances lead him to an auspicious carrier combining design and Botany (Durant 1993, 7). Dresser's lectures took place in in several venues, mostly across London. In 1860, while still a lecturer in Botany at the Department of Science and Art and at the South Kensington Museum, he was also appointed for an analogous office at the St. Mary's School of Medicine[179], Edgware Road (1860d, 158), as well as the Crystal Palace Schools. During the years that followed he is known to have delivered various lectures and courses both inside and outside the United Kingdom. The London Hospital Medical and Surgical College, Botany at), The Ladies Treasury, the Birmingham and Midland Institute, the Tudor Hall Ladies' College (Manchester), the Halifax Literary & Philosophical Society (Leeds), and at the Pennsylvania Museum and School of Industrial Art are examples of venues where Dresser delivered courses, workshops and lectures.[180]

[178] A photocopy of four manuscript pages held by the archives of The Christopher Dresser Society document the cessation of Dresser's role by the end of the school year of 1868.

[179] The Harry Lyons Archive at the Christopher Dresser Society holds handwritten notes of his work as Lecturer on Botany at St Mary's Medical School (currently part of Imperial College London).

[180] These lectures are mostly documented between the years 1855 and 1877 in the Harry Lyons Archive at the Christopher Dresser Society, and in the annual Reports of the Science and Art Department.

Alongside a scientific-lead approach to Botany in its connection with design, Dresser lectured in related topics, such as "Ornamental Manufacture, more particularly of Glass and Crokeryware", for example (1861a). Some of his courses and lectures, such as "Nature Printing", were explicitly designed for female students (1861a). Nonetheless, the majority of Dresser's teachings did revolve around the link between Botany and Design and was directed at Art and Design students in general. It was his belief that, by that time (the mid-1800s), the knowledge of Botany, although significant among the arts, was still insufficiently applied to ornament. He felt that this "neglect" was, nonetheless, "pardonable, for how were the two sciences to become mingled" when neither the ornamentist nor the botanist had the necessary time or tools to learn about each other's domains? (Dresser 1857a, 17), a gap he was determined to address and ultimately fill.

Although many mysteries remained undisclosed about the Natural Sciences, something was most definitely changing by the time Dresser became a lecturer at the Department of Science and Art. Scientific knowledge was, by then, progressively reaching a broader public, including the artistic community. As sciences advanced, the laws of nature would become more definite and accessible and more easily understood. In Dresser's words:

> There is now so much truth revealed, so much light enjoyed on this science, that it has laid open to us its fundamental principles, and displayed before us its beauties so simply and pleasingly that it is now little more than a work of mere pleasure to gather those gems that shall appropriately deck the ornamentist's choicest works. It is needless on our part to show you that nature's gay flowers have in all ages been used by the aspiring ornamentist, and that they have ever been the basis on which the science of ornament has stood. (Dresser 1857a, 17).

Dresser became an actor of this great change, taking upon himself to be one of the lead communicators of science within his own fields of interest and expertise. His teachings on Botany and its place within the arts, most particularly Design, were

disseminated through various media; from books, to journal articles and lectures.[181] The present research focuses primarily on the two latter.

During the years 1857 and 1858, *The Art-Journal* published a series of eleven articles authored by Christopher Dresser and entitled "Botany: as adapted to the arts and manufacture". Doc.134 shows the first page of part II of the series. The text is illustrated by numerous drawings, some of which are very similar and even identical to the ones found in the diagrams he used for his lectures at the DSA. Dresser's main goal was to convey his knowledge of the structure of plants as well as the processes underlying their development, with the ultimate purpose of applying it to the theory and practice of Design. Morphology and physiology united in the understanding of the vegetable world would be the best path. The main goal was to prepare his students to master the art of translating the language of nature into the language of design. To appropriate themselves with the shapes and behaviours of plants in a symbiotic process that would culminate in design shapes and compositions. In his own words, to "reveal the peculiar adaptability of certain forms and lessons to particular cases or manufactures" (Dresser 1857a, 17).

The study of the above-mentioned articles is not only interesting to learn about Dresser's scientific knowledge of Botany and its applications to design. It is also a valuable source of information about his thoughts on the usefulness of possessing a substantial understanding of the vegetable kingdom for the training and work practice of designers. Moreover, a comparison between the topics, sequence and illustrations on the aforementioned articles and Dresser's botanical diagrams for the Department of Science and Art, is extremely helpful to reach a significantly clear understanding of what

[181] Several of Dresser's books, especially written to the non-specialist public, which included arts and design students, remain to this day among the most relevant references regarding the link between Botany and Design. Dresser authored various book publications on the subject which have greatly influenced Art and Design theory and practice throughout the second half of the nineteenth century, and beyond. The most relevant were produced mainly between the late 1850s and the mid-1870s: "The Rudiments of Botany, structural and physiological: being an introduction to the study of the vegetable kingdom, and comprising the advantages of a full glossary of technical terms" (1859); "Unity in variety, as deduced from the vegetable kingdom: being an attempt at developing that oneness which is discoverable in the habits, mode of growth, and principle of construction of all plants" (1860); Popular manual of botany : being a development of the rudiments of the botanical science: without technical terms" (1860); Studies in design (1876) (Dresser 1859, 1860a, Dresser 1860b, Dresser 1876).

his lectures actually consisted of, what topics where explored and the relevance of each for the overall structure of the course on Botany adapted to Design. This would be transversal to the course of instruction for designers and part of a method comprising the study of theoretical botany and design, as well as direct work with real specimens and design practice.

Concomitantly, records at the Harry Lyons archive at the Christopher Dresser Society documenting the summer course Dresser delivered at the Crystal Palace School of Art, Science, and Literature, in 1861, inform us that the course included "dissection of flowers with demonstrations on the commons round London.' In addition, let us recall the letter, dated March 1867 (doc.123), requesting a series of listed cuttings of flowering and non-flowering plants by the Department of Science and Art, on behalf of Christopher Dresser, for use in his lectures at the Schools of Art. These two records decisively confirm the use of live specimens of plants and flowers was a common practice in his botanical teachings. Overall, the purpose was to train the eye, to become a critical observer and interpreter of plants, to perceive their complexity, understand their composition and behaviours, scrutinize how distinct features influence visual perception and, finally, to deconstruct and appropriate those values into individual creative practices. A gradual and intricate process which started with direct observation and drawing[182]. Before going into the actual diagrams, it is important to focus our attention on a fundamental concept which is extensively explored by Dresser in his earlier articles and remained, most likely, within the core of his lectures at the School of Art: the concept of "Rustic Botany".

2.2.1. The appeal and perception of Rustic Botany: form, colour and texture

Dresser advised his readers and, in all likelihood, his students, to take morning walks and inspect the woods, so they could observe the true character of Nature and learn from it (Dresser 1857a, 17). They should seek to find it its purest state, affected

[182] The Christopher Dresser Society holds the copy of a review on "The Rudiments of Botany", published in "The Athenaeum" No 4674, Nov 5, 1859 where Dresser is referred to as "Lecturer on Botany, and Master of Botanical Drawing Classes in the Department of Science and Art of the Privy Council for Education".

exclusively by natural conditions, and observe "the general effect of growing vegetation":

> behold the living forest, with its towering trees; find out the craggy wild, and there behold the old and well-nigh worn-out oaks, as they, tottering, bend over the awful chasm; the ferns, as they spring from the naked rock; the ivy, winding itself around the old decayed trunk; and the young trees, as they spring up amidst the boughs of the mother plants: in beholding this scene you see displayed rustic nature. (Dresser 1858d, 333)

It may be ascertained that Dresser's teachings commenced with the ability to observe. All in all, in his view, the designer should be first and foremost an attentive observer of Nature and take an interest in understanding its parts, organic mechanisms and behaviours.

The way vegetable structures develop and adapt in Nature influences their form, colour and texture. In turn, form, colour and texture, whether individually or combined, influence the visual effect of plants and flowers, which influences human perception, and ultimately visual representations and adaptations of those same vegetable parts and structures. Here, aside from biology itself, the laws of physics play a fundamental role. According to Dresser's theories on Rustic Botany, the variations of features and particular conditions found in nature directly influence the way its elements are perceived by the human eye, both up close ("close effect") and from a distance ("distant effect"). As previously mentioned, among these features and conditions Dresser highlights form, colour and texture *(Dresser 1858d, 333)*. On the whole, form influences both the distant and the close affect in different ways, from general to specific. If observed from a distance only the contours of vegetable structures can be distinguished. This is named the *distant effect,* reminiscent of optical – artistic principles we can observe in Da Vinci's atmospheric perspective *(sfumato) or* Seurat's *Pointillism*, for example. Gradually, proximity begins to unveil lines, segments, patterns, details of individual parts as well as their unions with other elements and respective positioning within the whole structure; leading up to details only observable up-close or through human aided vision (e.g. through a magnifying lens or microscope). Whether separately or combined, the variations of shapes found in vegetable structures can be virtually infinite. Consequently, the potential of plants as sources of graphic vocabulary is equally

rich and varied, making their contribution to the construction of a varied and extensive design grammar remarkably significant. An overall contribution due also to other features such as texture and colour.

The multiple texture variations present in plants and their parts are equally determinant for visual perception. This is surely understood if we first consider the laws of physics, particularly in regards to light and optics. Different surface textures can reflect, disperse or absorb light. If a surface is glossy and soft it will reflect light, creating an effect Dresser refers to as a "sparkling vitality", conveying brightness and lightness. Because it highly stimulates the retina and subsequently the nervous system, reflected light is more likely to be perceived as energy, excitement, warmth and even movement *(Dresser 1858d, 333)*. On the other hand, a mate surface or a "plumose, velvety" texture, by respectively dispersing or absorbing light, will be responsible for a softer effect, suggestive of subtle games of light and shadow, more homogenous, contained and less energetic than reflected light, thus creating a subtle intimist sensation (Dresser 1858d, 333).[183] In addition, by influencing the way light waves move (being reflected, absorbed or diffracted according to different materials) and, therefore, the range of our visible spectrum in regard to a given plant and its parts, the diverse textures found in a plant are also determinant for the human visual perception of colour.

According to Dresser, "by varied dispositions of quantity, and diverse degrees of intensity", colour materially influences the general appearance of plants and flowers. He further states that "as a general principle, colour is used to assist form, and also by its enchantments to add to the beauty of the organism" (Dresser 1858d, 333). The particular textures found in a reflecting surface directly influence which wave lengths within our visible spectrum are reflected by that surface, and this, in turn, influences our visual perception and the colours we actually see, both at a distance and up-close. Dresser exemplifies this principle with the leaves of the holly bush (doc.135):

[183] The way surface textures of vegetable elements affect and condition human perception was also of great interest to John Ruskin. He made a point of conveying his views on this matter, particularly when referring to the drawing of leaves, as these are amongst the richest and most varied vegetable structures in the natural world (Ruskin 1857b, 89).

> (…) although each leaf of the Hollybush is of a full rich green, this tree has a remarkably blue appearance. So prominent is this, that in the forest the extent of this effect is most astonishing, and is even conspicuous at a great distance. The cause of this effect is the leaf reflects the blue colour of the atmosphere by its glossy surface. (Dresser 1858d, 333)

The secondary colour green comes close to monopolizing the major part of most of currently known plants. The levels of intensity of green, as well as its tonalities, are remarkably varied and can be perceived differently depending on many factors; one being the distance between the plant and the observer. Colour perception is also influenced by the texture of the surface, as previously mentioned, and even by shape and contour. To exemplify, the colour green in a flat somewhat translucent leaf is not perceived in the same manner as the same tone of green in a round mate textured stalk, and even between the base and the apex of a stem, for example. In addition, if observed from a long distance, green is often times gradually perceived as blue (Dresser 1858d, 333). On the other hand, primary colours (blue, red, and yellow), alongside a vast range of secondary colours, occur primarily in flowers, being one of the main reasons for a superior aesthetic interest in flowering plants. That variety further extended by the action of a large spectrum of natural factors which determinately influence the perception of colour, e.g. atmospheric conditions, the time of the day or the passing of the seasons.

Alongside the above-mentioned factors which affect plant physiology and morphology, Dresser highlights the unpredictability of natural elements, which often cause plants to grow abnormally, thus, altering what would be their normal, “ideal” appearance, in a very unique way. Geographic location, climatological circumstances, such as the direction and intensity of wind or the changing of the seasons, as well as geological factors like the chemistry of the soil and the amount and quality of its nutrients, have a major impact in the distribution, general development and overall appearance of plants. Also, plant diseases, as well as the presence of insects which destroy buds, leaves, stems or flowers, are biological factors that can change the development and, consequently, the appearance of plants, to varying degrees. Most importantly, and regardless of their origin, all of these factors are testament of nature’s unique capacity to adapt to circumstances, thus, broadening the variety of unique

shapes that result from it. Dresser referred to this as the *freeness of nature,* on which the concept of Rustic Botany is ultimately grounded (Dresser 1858d, 335). This brings us to another concept conveyed by Dresser: the principle of "suggestive Botany" where science and art interplay in the construction of a botanically-inspired design grammar. Through meticulous observation and study, designers could develop the tools to dismantle the causes and effects which conditioned perception. By doing so, they would, ideally, acquire a level of coherence that would allow them to apply scientific principles even to the most stylized and deconstructed representations of plants and flowers.

2.2.2. Suggestive Botany and Design

The main impetus for Dresser's commitment in transmitting an accurate and profound knowledge of Botany to his students was to aid them "to produce like beauty with Nature, by revealing as fully as possible the principles on which she constructs her beautiful compositions" (Dresser 1858b, 38). In other words, the Designer should borrow Nature's "beautiful hints of form, colour, and effect, and appropriate them by his intellectual skill to his particular necessities". This principle is referred to by Dresser as "adaptation to purpose" (Dresser 1857f, 335). This was one of the core lessons to learn from nature: adaptation is key. Something designers could utterly learn from, and ultimately apply to their work. Going to Nature, observing closely, studying, acknowledging and understanding the main principles that govern the natural world was the backbone of a most promising connection between Botany and Design, which Dresser was determined to explore and to share. This was, according to him, the best path to follow in order to better serve manufactures, supplying them with objects, forms and patterns directly transferred and interpreted from Nature. We can find these in Dresser's own work (patterns, objects and decoration), e.g. "Principles of decorative design" (1873); Studies in design (1876); "Modern Ornamentation, being a series of original designs for the patterns of textile fabrics, for the ornamentation of manufactures in wood, metal, etc." (1886) (Dresser 1873, 1876, 1886, Dresser 1972).; or for the work of others, for example, the diagrams he created for Owen Jones' "The grammar of ornament", 1856.

Accordingly, one of the most fundamental aspects of Dresser's approach to Botany as a source for the practice of design lies in the fact that, according to him, Nature, and particularly vegetable structures, are relief decorations in themselves. He explained that, as living organisms composed of a system of fluids which requires thickness, rotundity and magnitude, growing structures innately possess a three-dimensional existence which is naturally in harmony with its surroundings (Dresser 1857b, 55). Likewise, the capacity of adapting to the most varied contexts and circumstances gives plants the necessary means to construct their own forms as they grow and develop, and thus have an active influence in their very own appearance. As if *self-sculpting* their own materiality, plants have the capacity of, in all truth, becoming unique organisms while still being governed by common universal laws. This makes each specimen, at the same time part of given group but also an inimitable example of a living structure. Therefore, by resulting from the combination of general physiological principles with specific external circumstances, plants are organisms where both general and specific, rule and exception coexist. This complementarity is observable in both their detailed and general visual appearance, and was one of the aspects of the vegetable kingdom Dresser was most passionate about. This was one of the main reasons why, throughout his teachings, he advised designers to "do what nature did", to be respectful of general principles but keep in mind the constant need to adapt. Ideally this would become one of the guiding lines of their creative paths.

The starting point was to consider the purpose of the design work, "the principle of adaptation to purpose", as observed in Nature itself (Dresser 1857b, 55). Once determined the purpose, it was important to know the materials it would be produced with and how the production process would develop. From this point on and while creating the design concept, lead every aspect of the creative and manufacturing process towards expressing the purpose and accomplishing an overall aesthetic harmony with the surrounding context and objects. Very importantly, during the entire process, designers should never neglect to take into account any circumstances which may influence the development of the piece, but rather incorporate them as part of the design itself, just as plants adapt to surrounding environment and circumstances. According to Dresser this was one of the most valuable lessons to be learned from

Nature (Dresser 1857b, 55). Another key aspect when creating design directly inspired in botanical subjects, was the orientation of the ornament or design (either flat or round).

Defining a horizontal or a vertical orientation for a design object, pattern or composition during the earliest stages of creation, informed the designer of what elements/parts/organs of plants would best suit it and what views/representations he/she would need to observe and study for the project (e.g. front views, top views). Firstly, to visualize it in nature, secondly, to understand why it develops in a given way and not another, and thirdly to appropriate and adapt the principles of its development and appearance by stylizing it into a design. Altogether, a previous knowledge and understanding of the composition of plants and flowers, as well as the way each of their views are more or less appropriate for vertical or horizontal designs would make the process less time consuming, and the work solid and coherently constructed.

Like starting a work with the domain of the tools needed to perform it beforehand, the knowledge of Botany was instrumental to interpret the structure and mechanisms of plants and to apply its visual universe and scientific principles to the creative art of design. One of those scientific principles, ever so present in plants and ever so valued in design was symmetry. Dresser revered the principles of vegetable symmetry not necessarily in the sense of a strict rigidity where all parts are evenly and distributed, but of an overall unity and coherence. The principles of symmetry were, therefore, one of the foundations for the symbiosis between scientific principles which govern the vegetable world and artistic and practical principles which govern the practice of design.

Dresser explained to his pupils that, in plants, the principle of symmetry is mainly based on the similarity of the elements of its structure. For example, a plant whose structure is fully symmetrical (e.g. identical position and form of buds, leaves, petals, etc.) is more likely to inspire both vertical and horizontal surfaces, because both lateral and top views will show the symmetrical arrangement and forms of its elements, allowing designs based on them to be composed of equally symmetrical and harmonious elements and patterns. On the other hand, plants whose parts are only alike and not identical should only be used for vertical designs, as their top views are most probably

not symmetrical (Dresser 1857b, 55). Nevertheless, they can still be part of symmetrical compositions if combined and accordingly adapted and stylized to create symmetrical visual compositions. The example of the unequal flowers of the Candytuft arranged in a circle and converging to a centre, as seen in doc.136 is used by Dresser to convey this point (Dresser 1857b, 55). Conclusively, as previously mentioned, a core aspect of his teachings was based on the fact that vegetable structures are exposed to external natural influences which, alongside internal and innate biological factors, condition their development. To know how these external factors operate and how they affect the visual aspect of plants and flowers, it is first necessary to understand the "normal positions of the various organs and their natural habits" (Dresser 1857a, 17), that is to say the *natural* state, structure, behaviour and visual appearance of what would be the perfect plant and/or flower. Once this is accomplished, any disturbances or abnormal features in development and appearance should become recognizable to a well-trained designer's eye.

This does not mean that only perfectly formed plants should be regarded as adequate models and sources of inspiration and vocabulary for designs. In fact, as, in principle, each part naturally adapts to particular circumstances, although the plant's structure may be altered in different degrees, if it maintains symmetry, unity and coherent adaptation to purpose, the beauty of the whole will be maintained, even if with very singular, exceptional features. The use of real botanical specimens, either cuttings or observed in nature,[184] to illustrate and exemplify the structure and visual features of plants and flowers, was determinant to convey Dresser's message, as looking at unique real specimens will allow to move away from the general and towards the specific.

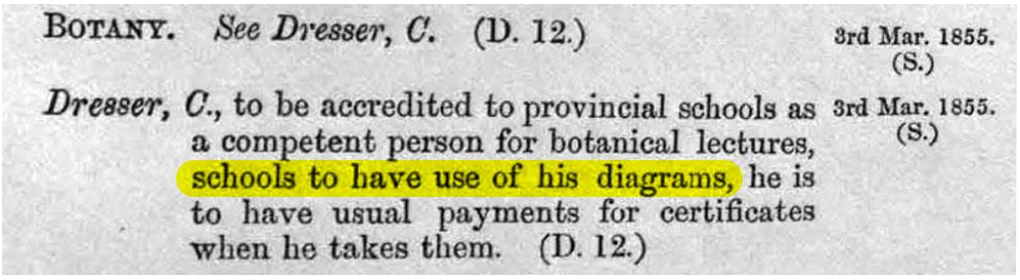
For over 60 years the Royal Botanic Gardens, Kew were responsible for the regular supply of plants to the Schools of Art of the Department of Science and Art. A portion of those specimens were requisitioned and used by Christopher Dresser, as previously referred. Doc.137 shows the record of the donation of an Epitatctis

[184] See chapter IV.1. Botanical studies in the instruction of Victorian designers, from drawing plants and flowers to technical design.

grandiflora by Christopher Dresser to the Royal Botanic gardens, Kew, in 1867. This document is yet another to attest the central role Dresser played within the dialogue with the Botanic Gardens, Kew, not only as a lecturer on Botany at the Department of Science and Art, but on a personal level, as a contributor to enrich the collections of the Royal Botanic Gardens. Nonetheless, real specimens were not the only resources employed by Dresser to illustrate and make demonstrations during his lectures. Botanical diagrams, were also of great importance, and are equally part of today's Dresser's material legacy to the history of design and testament of how close the connection between Art and Science can be.

2.2.3. Christopher Dresser's botanical diagrams for the Department of Science and Art

The year 1855 marked the starting point of a very active and promising activity for Christopher Dresser within the Department of Science and Art. According to the précis of the minutes of the Science and Art Department for 1855, on 3 March of that same year, by then with only 20 years of age, he was officially accredited as a competent lecturer on Botany for the provincial schools of the department. Figure 19 shows the abovementioned extract, where it is also deliberated his botanical diagrams were to be made available for the use of the schools of the Department and that he should receive "usual payment for certificates when he takes them" (1864, 86).



BOTANY. *See Dresser, C.* (D. 12.) — 3rd Mar. 1855. (S.)

Dresser, C., to be accredited to provincial schools as a competent person for botanical lectures, schools to have use of his diagrams, he is to have usual payments for certificates when he takes them. (D. 12.) — 3rd Mar. 1855. (S.)

Figure 19. Excerpt of the Précis of the minutes of the Science and Art Department (16th Feb. 1852 – 1st July 1863) referring to the use of Christopher Dresser's Diagrams by the Schools, p. 86).

This confirms the existence of a series of botanical diagrams authored by Dresser previous to his official appointment as lecturer on Botany. It also informs us that those diagrams were initially meant to travel from school to school according to necessity. In addition, and although no document was found to indisputably confirm this assumption,

we argue that since Dresser was based in London, it is unlikely that his diagrams were used in schools outside the capital, except sporadically when or if need arose. Nonetheless, they were certainly considered of great relevance and quality to officially be used throughout the schools of the Department of Science and Art. Although it is not clearly specified in this document that this set of diagrams, and the one presently kept by the V&A[185] are one and the same, the likelihood is extremely high. This affirmation is based on the fact that they are dated by the museum as belonging to the years 1854-1856; right about the same time of Dresser's accreditation as lecturer at the Department of Science and Art. Firstly, we must not forget that he had trained to become a master at the Department. What is more, his official appointment for the role of lecturer on Botany had to be previously arranged between the parts. Which, in turn, would justify an early planning of the course structure and respective preparation of materials for use in his lectures until the beginning of the school year. Secondly, the set of diagrams kept by the Victoria and Albert Museum present the seal of the Department of Science and Art, as well as the stamp "SUPPLIED FOR THE PUBLIC SERVICE" (doc. 138).

The set is composed of 62 botanical diagrams plus accompanying explanatory texts and three Indexes of botanical terms to be used alongside the diagrams (museum numbers 3925 to 3996). The inventory description states they were used to illustrate Dresser's lectures on botany at Marlborough House[186], 1854-1856. As no mention was found in regard to any reproductions of this original set, all points to them being the only existing collection. Most of the diagrams are annotated in ink and pencil on buff paper, measuring, on average, 550 mm x 705 mm, with a few exceptions varying in format and size. Tables 11 to 13 show the transcripts of the botanical terms referring to parts and organs of plants contained in all indexes (Docs. 139 to 141) complemented by their respective botanical definition.

Table 11 Transcript of organs and parts of plants contained in Index nº1 of Christopher Dresser's Botanical Diagrams (1854-1856) and respective scientific definition (the majority

[185] Christopher Dresser's Botanical Diagrams are currently kept by the Archives of the Victoria and Albert Museum at The Prints and Drawings Study Room, level D, case LD, shelfs 11 and 26.

[186] Although not stated in the inventory, they were likely to continue being used following the move of the Department of Science and Art and the Schools of Art from Marlborough House to South Kensington, in 1856, where it integrated the South Kensington Museum, inaugurated in 1857. See, for example, (Cole 1853, 23, Conway 1882, 34-35, Redgrave 1887, 224).

according to the “The Cambridge illustrated glossary of botanical terms” (Hickey and King 2010)

INDEX 1	
Transcript	Description
Cotyledon (C)	One of the first leaves of the embryo of a seed plant, typically one in monocotyledons, two in dicotyledons, and two or more in Gymnosperms.
Caulicle (C^e)	A small stalk or stem, especially the rudimentary stalk of a seed embryo (in “Advanced English Dictionary)
Collar (C^r)	The neck or line of junction between the root of a plant and its stem.
Embryo (E)	A young plant developed sexually or asexually from the ovum.
Hillum (H)	The scar left on a seed where it was previously attached to the funicle.
Plumule (P)	The young shoot as it emerges from the seed on germination, usually after the appearance of the radicle.
Radicle (R)	The young root as it emerges from the seed, normally the first organ to appear on germination.
Root leaves (RL)	
Stipule (S)	A leafy outgrowth, often one of a pair arising at the base of the petiole.
Sheath (S^h)	A tubular covering
Testa (T)	The seed coat, a hard covering that has developed from integument of an ovule after fertilisation.

Table 12 Transcript of organs and parts of plants contained in Index nº2 of Christopher Dresser's Botanical Diagrams (1854-1856) and respective scientific definition (the majority taken according to the “The Cambridge illustrated glossary of botanical terms” (Hickey and King 2010)).

INDEX 2	
Transcript	Description
Bract (B)	A very reduced leaf, especially the small or scale-like leaves associated with a flower or flower cluster.
Lamina (L)	The expanded part of a leaf or frond.
Leaflet (L^f)	A leaf-like segment of a compound flower.
Node (N)	The point on a stem where one or more leaves are borne.

Petiole (P)	A leaf-stalk [the elongated base of the leaf that connects it to its parent stem].
Stipule (S)	A leafy outgrowth, often one of a pair arising at the end of the petiole.
Scale (S^c)	A reduced leaf, usually membranous, and often found covering buds, bulbs and corns.
Tendril (T)	A tiny thread-like structure produced from a stem or leaf that enables a plant to hold its position securely.
Exogen (EX)	Originating from the outside of the plant.
Endogen (EN)	Originating or developing from inside the plant.
Acrogen (AC)	A flowerless plant e.g. a fern, in which growth occurs only at the apex [the tip] of the stem.
Thalogen (TH)	Young shoot or branch.
Male (♂)	
Female (♀)	
Hermafrodite (⚥)	

Table 13 Transcript of organs and parts of plants contained in Index nº3 of Christopher Dresser's Botanical Diagrams (1854-1856) and respective scientific definition (the majority taken according to the "The Cambridge illustrated glossary of botanical terms" (Hickey and King 2010)).

INDEX 3	
Transcript	Description
Anther (A)	The part of the stamen that produces pollen.
Bract (B)	A very reduced leaf, especially the small or scale-like leaves associated with a flower or flower cluster.
Calyx (c)	The outer perianth*, composed of free or united sepals.
Corolla (C^a)	The inner perianth*, composed of free or united sepals.
Coronet (C^t)	Coronet is another term for "Corona" commonly used in the nineteenth century.[187] A structure occurring between (and sometimes united with) the stamens and the corolla, as the cup-shaped or trumpet-shaped outgrowth in the genus

[187] See, for instance (Lindley 1865, 183).

	Narcissus, the horned *Asclepias curassavica*, and the ring of filaments of the *Passiflora (Passion flower).*
Disk (D)	A development of the receptacle within the perianth, often bearing nectar glands; the central part of the capitulum** in members of the Compositae; the basal plate or reduced stem at the base of the bulb.
Filament (F)	A fine, elongated, thread-like structure, especially the stalk of an anther.
Ovary (O)	The lower part of a carpel*** (or carpels) which contains the ovules.
Petal (P)	A single segment of the corolla.
Peduncle (P^d)	The stalk of an inflorescence.
Pistil (P^l)	A single carpel in an apocarpous flower, or the gynoecium in a syncarpous flower.
Receptacle (R)	(thalamus, torus) The end of the stem which bears the flower parts.
Stamen (S)	One of the male sex organs, usually consisting of anther, connective and filament.
Stigma (S^a)	The apex (of the style, usually enlarged, on which the pollen grains alight and germinate.
Spathe (S^p)	A large bract subtending and often enclosing a flower or an inflorescence.
Style (S^t)	The often-elongated apical part of a carpel or gynoecium**** that bears the stigma at its tips.
Spadix (S^x)	A spike with a fleshy axis, as in “Araceae”. (38)
Sepal (S^e)	A single segment of the calyx.

*Perianth: a collective term to for the outer non-reproductive parts of a flower, often differentiated into calyx and corolla.

** Capitulum: A head of sessile or almost sessile flowers surrounded by an involucre, the inflorescence especially characteristic of the Compositae and Dipsacaceae.

*** Carpel: one of the units forming the gynoecium, usually consisting of ovary, style and stigma.

**** Gynoecium: the female sex organs (carpels) collectively. In some cases, consists of a single carpel.

The fact that all diagrams are sequentially numbered in ink[188] indicates they were meant to be used in an order predefined by Dresser. This, in turn, is determinant to ascertain the sequence of the topics taught in his lectures. In addition, the number of diagrams on each topic, their respective degree of detail, i.e. the features depicted as well as the degree of complexity and graphic treatment (e.g. outlined, outlined and shaded, fully or partially coloured, captioned, etc.) also informs us about which topics/features may have been considered more or less relevant for Dresser and, thus, most thoroughly explored in his lectures. Table 14 lists the diagrams grouped by aggregating topic[189] in a total of 8 categories (Introduction to the general structure of a plant; seeds and germination; roots and underground stems; stems and plant tissue; buds; leaves and tendrils; the flower and its parts; the reproductive system of plants). A comprehensive look through all categories and respective descriptions evidences two main aspects. Firstly, Dresser explores plants in the context of their life cycle. After introducing the object by presenting the general structure of a plant, with a large diagram showing a plant as it is viewed laterally. Both the ascending and descending axes are identified, as well as the basic parts that compose it (doc. 142 shows the entire composition of this introductory diagram). Secondly, he explores the appearance of plants through the study of their physiology and morphology, and associates it to Design principles.

[188] Although none of the drawings display a date and no document was found to confirm this argument, it is possible and even probable that not all the diagrams that compose the current group were part of that initial set. The diagrams numbered 58 to 63, which are the last of the group, may have been produced on a later stage to complement the primary set, as they would be more conveniently placed within the sequence of their respective topics. Namely diagrams 58, 59 and 62 ("The arrangement of flowers", "Compound flower" and "Flowers of grasses", respectively) would be fitting the group dedicated to "The flower and its parts"; as the last of the group, 63 (untitled) shows the partial view of a stem with two pairs of opposite unions of leaves, which would include it in the topic of "Unions of leaves and stems". Table 4 places them arranged in regard to topic and, hence, places them within the aforementioned topic groups.

[189] This group association is not present in any of the documents consulted, but rather resulted from their analysis during the course of this research study, as well as the cross-referencing with Dresser's articles in *The Art-Journal*.

Table 14. Groups of botanical diagrams by Christopher Dresser for the Department of Science and Art (1854-1856). Victoria and Albert Museum, London.

Christopher Dresser – Botanical Diagrams*

Department of Science and Art | 1854 - 1856

INTRODUCTION- THE STRUCTURE OF A PLANT (1x)

SEEDS & GERMINATION
Various forms of seeds (2x)
Sections of seeds (1x)
Germination of the Broad Bean (2x)
Germination of the Indian Corn (3x)
Raised and not raised cotyledons (2x)

ROOTS & UNDERGROUND STEMS
Roots (1x)
Underground stems (1x)

STEMS & TISSUE
Sections of stems: Endogenous, ExogenousAcrogen (2x)
Forms of stems (2x)
Tissue of plants (1x)

LEAF BUDS
Opposite, alternate buds (2x)
Spiral form whorls(1x)
Position of buds in the proliferous fern and bryophylum (2x)
Development of the horse chestnut bud (4x)
Development of the lilac leaf bud (3x)
Ash tree bud with seeds (1x)
Variation of leaf buds (1x)

LEAVES & TENDRILS
Endogenous and exogenous of acrogenous leaves (1x)
Failure in the development of leaves (1x)
Forms of the patiole (1x)
Variations of leaves from the base to the apex (1x)
Unions of leaves with stems (3x)
Unions of leaves with stems (Pericladium) (1x)
Tendrils (1x)

THE FLOWER AND ITS PARTS (1)
The flower and its main parts (4x)
Arrangement of flowers (1x)
Petal of the Pink (1x)
Nectaries (1x)
Filaments of stamens inserted (1x)
Sections of flowers (1x)
Variations of flowers (1x)
Flowers of grasses (1x)

THE FLOWER AND ITS PARTS (2) - REPRODUCTIVE SYSTEM
The calyx and the perianth (1x)
Pollen grains (1x)
Pistils (1x)
Ovaries (4x)
Ovules ((2x)
Embryo (1x)

*Victoria and Albert Museum, The prints and drawings study room

Symmetry (*the symmetry of the whole)* is one of the essential principles conveyed by Dresser in regard to the morphology of plants. He states that "All plants are either symmetrical in their parts or in the disposition of the parts" and calls attention to the fact that "plants and other bodies upon our globe are alike subject to universal laws, forces, and attractions". The abovementioned statements are among the 5 handwritten texts that accompany the set of Dresser's diagrams (docs.143 and 144). On the structure of plants and how they should be observed by linking scientific knowledge and artistic intent, he explains:

> A plant is regarded by the botanist as composed of a central rod, or stem, which he names the axis, and lateral organs of diverse characters, as leaves, &c., which proceed from it. For artistic purposes, we deem it expedient to view these structures from two points, or in two lights, first, as looking at the side of the plant (the ordinary view that we have of trees), when it is to us a vertical composition; and second, as looking on the top of the object (the view which we generally have of small plants, as the houseleek, daisy, &c.), when it is to us a circular composition. These observations will lead us to a great principle in the vegetable world: the centralisation of power, or the erection of a force in a centrifugal manner from a fixed point, which gives a marvellous oneness to the structures of this kingdom [this he called "unity in variety"]. (Dresser 1857a, 17)

After conveying the concepts of Rustic and suggestive Botany and, subsequently introducing and illustrating the basic parts and features of a plant, both under and above ground, Dresser proceeded to the actual beginning of plant life: the seed and the process of germination. From then on, he dissected the various elements and features of plant morphology and physiology, from general to particular, illustrating his teachings with botanical diagrams and schematics.

Seeds and germination

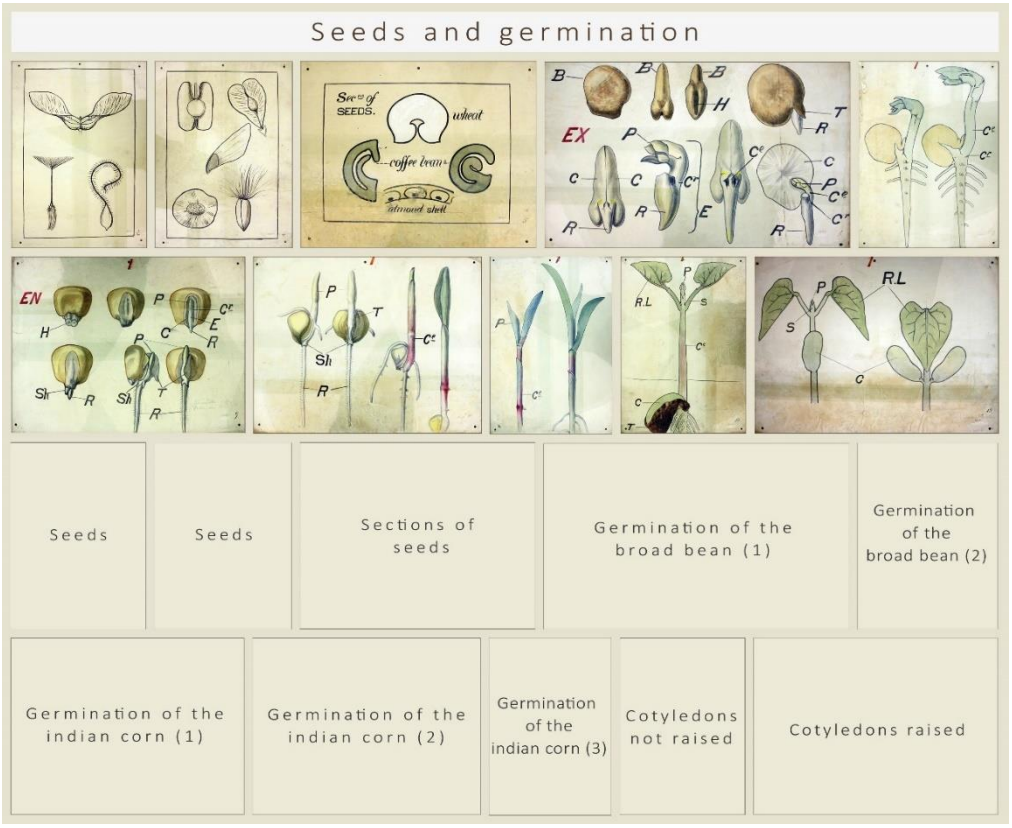


Figure 20. Christopher Dresser, group of botanical diagrams on the topics of seeds and germination, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room (museum numbers 3927 to 3936).

The seed and its germination, mark the first glimpse of vital energy and development of plant life, the motor that carries out the transition from underground to aboveground, from unseen to seen. It is the starting point for all the changes the plant goes through as it approaches maturity and reaches the end of its lifecycle. From the first effect, which is the rupture of the seed's integument with the protrusion of the infant root, the plant goes on to develop fully, varying according to different species, but, in all cases, leading up to the development of an ascending axis. Figure 20 (above) shows the ten diagrams dedicated to the study of seeds and germination. Diagrams 3927, 3928 and 3929 (docs.145 to 147) were used to illustrate the forms of different kinds of seeds. The first two are very simple representations of eight different types of seeds. The third represents three different outlined drawings of sections of seeds, namely wheat, coffee bean and almond shell, and are the only coloured illustrations of

this introductory group. We can see that the drawings of seeds are simple black contoured drawings, suggesting that form was the most relevant aspect to address.

Diagrams 3930 to 3936 (docs. 148 to 154) represent the process of germination in different plants. To provide a clearer understanding of the process of germination in its varied phases, three examples are used: the germination of the broad bean (*faba vulgaris) in* diagrams 3930 and 3031 (docs.148 and 149), the germination of the Indian Corn, in diagrams 3932 to 3939 (docs.150 to 152), and the illustration of the appearance and raising of the first leaves from an embryo *(cotyledons)* in diagrams 3935 and 3936 (docs.153 and 154). The germination of the broad bean is illustrated in a total of 6 stages, starting from the simplest form of the seed, showing the hilum to the development of the radicle, the rise of the cotyledons and the appearance of the collar, the growth of the plumule and the caulicle which are illustrated raised to form the ascending part of the plant. All stages are represented through different lateral points of view so as to fully illustrate the relation between the different elements and their respective orientation and positions throughout the process of germination.

Dresser's comments on the germination diagrams were very likely to resonate what he wrote about it in *The Art-Journal*. The process is thoroughly explained in part IV of "Botany: As adapted to the arts and manufacture", where he also publishes two drawings (doc.155) very similar to the ones found in the above-mentioned diagrams, namely the germination of the broad bean and the Indian corn. He explains how the future axis of the plant originates from the small rod in the centre of the seed, once it develops upwards; how the elongation of its apex (the tip) will develop into the stem "protruding into the air, and developing leaves, first of a rudimentary character, but successively more and more complex, till [sic] we have ultimately the perfect leaf" (Dresser 1857d, 109). Finally, the root which will constitute the descending axis develops from the centre of the structure. This is the general rule, nonetheless, examples are shown to explain the actual development of the seed and the process of germination. Hence, not only the morphology is meant to be perceived but also the physiology, how it develops. Starting from a fairly rudimentary shape to gradually achieve the perfect leaf and stem, which Dresser calls its "ultimate form". The same is observed with the diagrams representing 9 distinct phases of germination of the Indian Corn.

On the whole, the main purpose of exploring germination was to understand the "varied effects produced during its different stages" (Dresser 1857d, 109). Evidencing the great variety of shapes, textures and colour ranges a unique plant can present as it metamorphoses from the seed until it reaches full maturity and eventually perishes, potentiates an equally extensive and varied graphic source for designers.

Roots and underground stems

Figure 21. Christopher Dresser, group of botanical diagrams on the topics of roots and underground stems, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room (museum numbers 3937 to 3938).

Diagrams 3937 and 3938 (docs.156 and 157, figure 21) are dedicated to the underground bodies of plants, namely roots and underground stems. The two outlined and coloured drawings present six examples of roots and five examples of underground stems. The laws that govern the growth of roots are not necessarily the same as the ones that govern the growth of the ascending parts of plants. Mostly because they develop in a medium where, with adverse and resisting circumstances are more likely occur, roots and underground stems are very much prone to adaptation. This irrevocably results in a great variety of unique shapes[190]. Nonetheless, and although roots and underground stems do have some potential to influence ornamental motifs, Dresser considered them of little significance for designers, as compared to the overall structure of plants (Dresser 1858a, 295). All in all, their rudimentary and somewhat bulky and disordered appearance contrasts with a generally lighter, more elegant and symmetric aspect of over ground parts of plants, leaving them to occupy a rather secondary part as a source for design vocabulary. From underground bodies Dresser moves on to the parts and organs that compose the ascending structure of plants. Here, from stems, buds and leaves to flowers, inner structures and outer appearance tend to assume a noticeably

[190] Mainly due to the accumulation of matter in roots, which changes their aspect over time. In part IX of "Botany: as adapted to the arts and manufacture" Dresser uses two examples to clarify this process: the carrot (Daucus carota), present in diagram 3937 and the Turnip (Brassica Napus) seen in the same diagram and also used to illustrate the aforementioned article (doc.156): "in the well-known root of the carrot, the entire central descending axis is thickened by such aggregations; its ramifications, however, remain in their fibrous, unaltered state: also, the root of the Turnip (Brassica napus) is enlarged by a similar addition of matter, but here it only takes place at the upper portion of the root, the lower preserving its normal condition" (Dresser 1857e, 249).

more complex and profuse character, thereupon widening the range of discernible visual features that can potentially be rendered into design.

Stems and tissue of plants

Figure 22. Christopher Dresser, group of botanical diagrams on the topics of stems and plant tissue, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room (museum numbers 3927 to 3936).

Generally, when we think about a stem, one of the images that typically comes to mind is the lateral view of a plant. However, Dresser's drawings on the topic (with the exception of the specific subject of the unions of leaves and stems[191]) present, mainly, the configuration of stems as top views (Cross-sections and axonometric projections), and, hence more suitable for horizontal compositions. Diagrams 3939 and 3942 (docs.158 and 159), the first two of a group of four specifically dedicated to stems, represent full or partial cross-sections of stems. Dresser certainly used the aid of a microscope to produce these drawings with significant detail. Furthermore, and although no document clearly attests to this, since real specimens were widely used as one of the didactic resources in lectures at the Art Schools of the Department of Science and Art, it is highly possible, and would have been very enriching, that direct observation of plant sections through the microscope be part of a more practical component of

[191] To be addressed further ahead.

Dresser's lectures[192]. Microscopic sections are particularly befitting the observation and study of repetitive patterns. Something that is clearly present in Dresser's drawings of stems and again when he treats the reproductive system of plants[193]. Therefore, this indicates that close observation and understanding of lines and pattern would be one of the main aspects designers should focus on while studying sections of plant stems. This principle applies to virtually any type of section showing tissue of different parts of plants.

On a more scientific point of view, diagram 3940 (doc.159) represents three sections of tree stems (trunks) differentiated by three categories [exogenous (-EX), endogenous (EN-) and acrogens (AC-)], according to their internal structure and how they grow (mainly the direction of growth), which directly influence their exterior appearance, regardless of the dimensions of the plant in question[194]. Dresser explains that only exogenous trunks are conical, as the two latter are cylindrical. The conical shape of exogenous trunks (such as the Oak or the Beech) develops between the base and the apex. Its inner layers grow in concentric circles (commonly known as tree-rings), and the mass of the trunk is externally covered by a separate element with variable thickness and structure, the bark. They are considered exogenous because to renew itself the plant adds layers outwards covering its old exterior surface. As for endogenous trunks, such as the trunk of the Palm tree, their cylindrical shape develops homogeneously outwards from the centre. In this case, it is a single unified body of biomass, as it does not have a separate bark but have a homogeneous inner structure which also develops outwards. Finally, acrogenous stems also develop in a cylindrical

[192] The use of magic lantern slides was also likely to have been used in the lectures, see, for instance, Laurent Mannoni's "The great art of light and shadow: archaeology of the cinema" (Mannoni and Crangle 2000a). It is also likely that a camera lucida was used to draw plants, in real scale, as well as attached to a microscope. The camera lucida is an optical apparatus with a prism and lens used to aid the drawing of a subject placed directly in front of the observer. The observer will see the subject as if projected onto the surface it will be drawn on, thus aiding accuracy. According to the author D.G. Mann, his 1978 PhD thesis on a specific type of algae (Studies in the Nitzschiaceae (Bacillariophyta) was illustrated with his own drawings using a Zeiss Camera lucida attached to a microscope. 8). This account can be found in the website of The Royal Botanic Gardens of Edinburgh (Mann 2018). Also on the camera lucida see (Barthes and Howard 1981).

[193] Corresponding to the closing topic of Dresser's course of lectures.

[194] Although these categories are common to small and in big plants, they are more obvious if observed in tree trunks than in more minute stem structures.

shape. Dresser explains that sections of acrogenous stems present “a large central mass of pith-like matter, and a series of woody bundles, which, however, are not numerous, and assume given zigzag forms, the whole being covered by a somewhat barky matter” (Dresser 1857e, 250).

Drawing 3943 (doc.160) is another example of the extensive range of intertwining lines and patterns can be found in plants at a microscopic scale. It shows a stratigraphic depiction of what seems to be the vertical section of a stem alongside three other detail views of vegetable tissue. These diagrams show that pattern and line are emphasized in the microscopic scale. Moreover, the graphic appeal of stems is also found in real scale views. And in this case, form assumes the leading role. Whether seen as top contoured section views or simple lateral views, the outer shapes and contours of stems are extensive and varied. Diagrams 3941 and 3942 (docs.161 and 162.) show three extruded views and 14 top contoured views of differently shaped stems which can easily be transferred to designs, whether by simplifying them to their underlying geometric shapes, by appropriating them realistically or by stylizing their lines to add complexity and profusion. These are also two qualities commonly found in the subject Dresser treated following the structure and shapes of stems: the configuration and development of buds.

Leaf buds

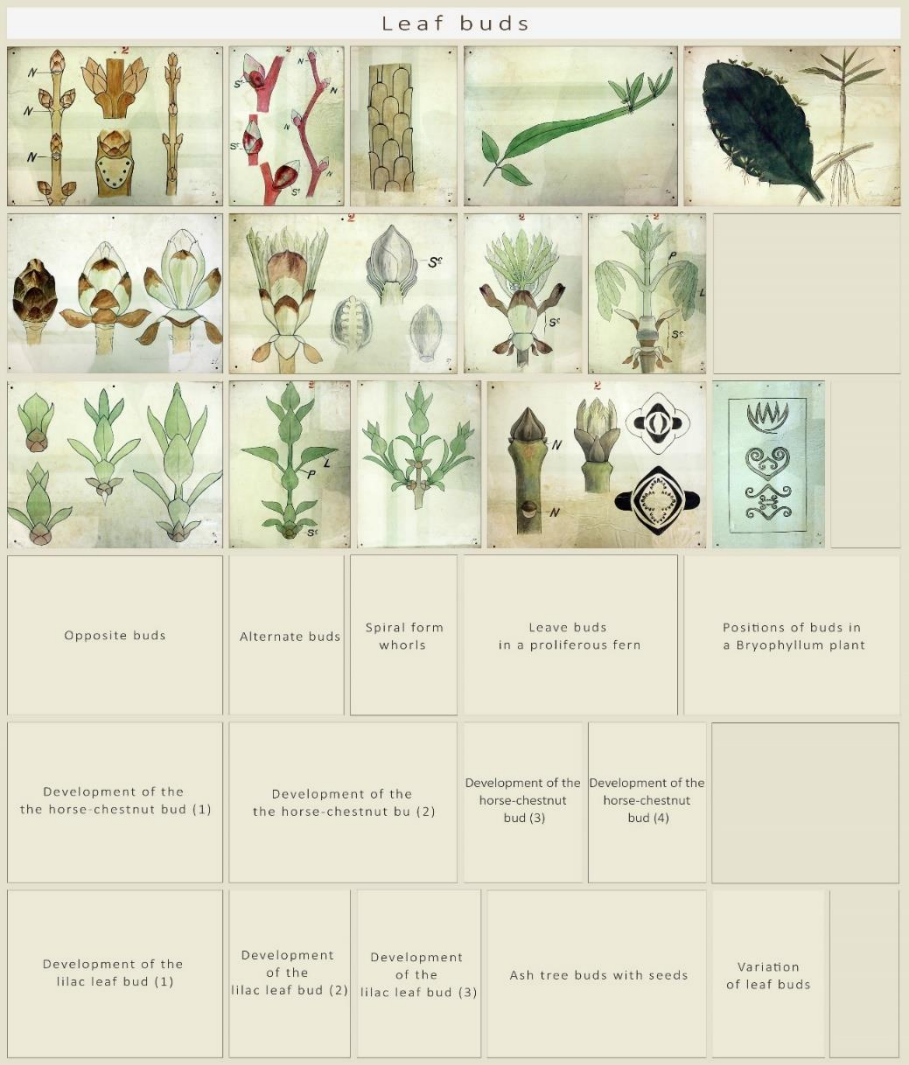


Figure 23. Christopher Dresser, group of botanical diagrams on the topic of buds and their development, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room (museum numbers 3944 to 3957).

A bud is, as explained by Dresser, “a shortened axis or branch” developing from a stem. They are usually covered with scale-like bodies and present very simple forms of leaves with varying dispositions and aligned very closely together (Dresser 1857e, 250) . The immediate variations in regard to buds are found in the way they are positioned and distributed. The first three diagrams of buds are constructed to show and distinguish their position along the stem and to demonstrate their abidance to the universal principle of symmetry applied to the vegetable kingdom. The two initial drawings show opposite and alternate buds, respectively (docs.163 and 164) The depiction of opposite buds (doc.163) features two general lateral views where it is made

clear how they are positioned along the stem up to the apex. It is interesting to notice that the way they are positioned and distributed vertically along the stem will directly affect the top view of the plant. One pair of opposite buds is in a straight line with the second pair that follows, and the same happens with the pair that immediately follows it in the stem, always alternating. We can compare this arrangement to that of the usual arrangement of individual seats in a theatre. Another analogy can be made if we compare the top view of the stem to the cardinal points. In this case, if the first pair of buds is positioned S-N the following is positioned W-E followed by another pair S-N, all the way to the apex (the tip of the plant). This arrangement is extremely relevant also for the top view of the plant as it will result in a homogenous composition resembling a round flower elliptically shaped.[195]

Coherence and symmetry reside mostly on the fact that the remaining the elements, namely the scales clothing the buds and leaves which repeat the same arrangement pattern as the buds. So, if a pair of buds is opposite the scales and leaves that constitute it will be also opposite, and so forth. This detail is also shown in diagram 3944. A similar development pattern occurs with alternate buds, as seen in the second diagram (doc.164), as well with the profuse patterns of buds formed in spiral whorls and positioned very closely together (as seen in diagram 3946 (doc.165). Nonetheless, besides the abovementioned examples which are the most common to find in Nature, Dresser also illustrates more peculiar examples which only occur in specific species of plants and present equally peculiar features. The first example, diagram 3947 (doc.166), illustrates the position and development of leaf buds in a proliferous[196] fern where two

[195] This principle is clarified by Dresser through the examples of the horse chestnut and the lilac, where he focuses on the visual features of the buds but also deconstructs the main stages of their development:

"if we examine the bud of the Horse-chestnut tree we find that there is a pair of these scale-like leaves, one of which is at the back, the other at the front; then a pair, one of which is at the right, the other at the left, and so on, from the base to the apex of the structure, each successive pair being at right angles to the pairs both immediately below and above it, as will be at once seen from our horizontal views of the to the pairs both immediately below and above it, as will be at once seen from our horizontal views of the Lilac bud the structure of which is precisely similar to that of the Horse-chestnut: this fact being so extremely obvious, needs no further comments" Dresser (1857e, 250).

[196] Proliferous plants can produce buds in uncommon places, such as leaves or flowers, for example.

buds are growing from the midrib[197] of an already mature frond[198]. The second example, diagram 3948 (doc.167), depicts a plant from the Bryophyllum genus. Dresser's drawing represents the peculiar looking Bryophyllum leaf with its buds developing along the edges of the lamina, in small intervals, and a detailed drawing of the whole body of a bud from root to apex. Doc.168 shows the detail of a Bryophyllum bud where the aerial root[199], also highlighted in the diagram, is clearly visible. After an attentive examination of the positioning of buds and how it influences the overall appearance of the plant, he goes on to explore the actual development stages of buds.

Dresser compares the growth of buds to the "drawing out of a telescope" as a germinal axis that elongates gradually until it reaches maturity. He admired the way the curves of the "scale-like" leaves that compose buds develop, each at its own rhythm, in harmonious contrasts and elegant curves. He further emphasises how the construction of such ensembles can be appealing to designers/ornamentists and the benefit that may come from its close observation and understanding (Dresser 1857e, 250). In order to convey this process and the overall visual configuration resultant from each stage of development of buds, Dresser created a set of seven diagrams, distributed in two groups. Each group exemplifies the development of buds in a specific plant. Firstly, the horse chestnut and secondly the lilac. These are notably highlighted examples in Dresser's teachings as we find them both in the diagrams and the article he writes about the topic for *The Art-Journal*. A clear resemblance, if not actual reproduction, is found between some of the drawings that illustrate *The Art-Journal* (doc.169) and the ones comprised in these two groups of diagrams. Diagrams 3949 to 3952 (docs.170 to 173) illustrate four distinct development stages of the horse-chestnut bud, while diagrams 3953 to 3955 (docs.174 to 176) represent the lilac bud going through three distinct phases of development. The two examples are structurally similar but differ in certain relevant aspects, which will directly influence the perception and understanding of their respective development processes.

[197] Midrib is the central most protuberant vein of the leaf.
[198] Frond is the common name for fern leaves.
[199] Aerial roots develop above ground.

One of those aspects is the transition between the scales and the development of the leaves they cover. It varies from being quite sudden in the horse-chestnut to being very gradual in the lilac. In the lilac bud this aspect is very important. By assisting a more accurate perception and distinction of each stage of development on the lilac bud, it poses less of a challenge to the observing eye of designers who wish to fully comprehend this process and take advantage of the visual details and structural compositions they may potentiate (Dresser 1857e, 250). In addition, the pattern of repetition observable in the overall development of plants is another visual feature greatly appealing to the schematism inherent to the work of designers. This particular characteristic is highly perceptible in buds. As they go on to develop into branches and/or leaves. The construction of the plant structure will replicate the exact same initial pattern initiated with the angle and position of the points of union of the bud, the leaf-stalk, and the branch with their respective parent stems.

Dresser concludes this topic by exploring the variations found in sections of leaf buds. Two diagrams are dedicated to these variable shapes. The first, diagram 3956 (doc.177), illustrates the bud of an ash tree, both an external lateral view and two cross sections displaying the inner arrangement of the bud with seeds. He uses similar drawings to illustrate "Botany: as adapted to the arts and manufacture- part V" (doc.178) (Dresser 1857e, 252).[200] The second, diagram 3956 (doc.179) shows three sections of buds whose lines are clearly suggestive of design elements. From leaf buds Dresser proceeds to explore the structure and arrangement of leaves as well as the peculiar appearance of tendrils.

[200] The seed and the bud are extremely similar, differing in terms of nutriment: as the seed will develop the root and has the power of seeking its own nourishment, while the bud is the receiver of nutriment that is given by the stem it is attached to The cycle continues as the plants that renew their buds nourish themselves as the old leaves fall and are absorbed by the root (Dresser 1857e, 252).

Leaves and tendrils

Figure 24. Christopher Dresser, group of botanical diagrams on the topics of leaves and tendrils, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room (museum numbers .3958 to 3965 and 3986)

Dresser considered leaves to be one of the most influential of vegetable for design, as they taught the lesson "simplicity is elegance" (Dresser 1857a, 18). On the whole, the position and aspect of leaves within the plant structure is of great relevance for Dresser. The curves of the various parts of leaves are another feature of interest for the study of Botany's influence on Design and, thus worthy of Dresser's full attention. Figure 24 shows the group of diagrams dedicated to leaves and tendrils.

Whether presented by the petiole, or the mid-rib or the margins of leaves (see the schematics of the anatomy of the leaf (figure 25), curves originate, to a great extent, due to the fact that plants need to grow freely and simultaneously to adapt to their medium and physical context. One influencing and being influenced by the other and all being subject to external factors, such as the ground it stands on, climatological conditions, external objects, coexistence with other plants, light and even gravity itself. Interestingly, the two latter somehow oppose each other, as light (namely sun light) naturally calls plant organs to grow upwards, whereas gravity will naturally attract its

parts downwards, potentially causing those organs, depending on their weight, to bend down. Understanding these mechanisms will ultimately allow the designer to rigorously apply the laws of plant growth and morphology to their creations, hence accomplishing the desired coherence they naturally observe in Nature. Moreover, when detached from the stem the petiole leaves behind a mark, a unique fingerprint which Dresser refers to as a "scar" on the surface of the stem, replicating the form of its base. Moreover, he calls attention to the importance of the small pattern of dots left in the aforementioned scar, to the study of designers, especially their form and number (Dresser 1857f, 341).

The complexity and visual appeal of leaves is also enhanced by the effects deriving from other features. Surface textures, the form of edges (e.g. indentations) or the size of the leaf (large, small, wide, narrow, long, short, etc.) are some of the most relevant examples. They contribute greatly to the visual perception of the observer (Dresser 1858d, 333) and thus, any creative work directly influenced or derived from these parts of plants. Likewise, and although not always easily perceived, patterns found in venation and nerves of leaves help us understand how they are composed internally.

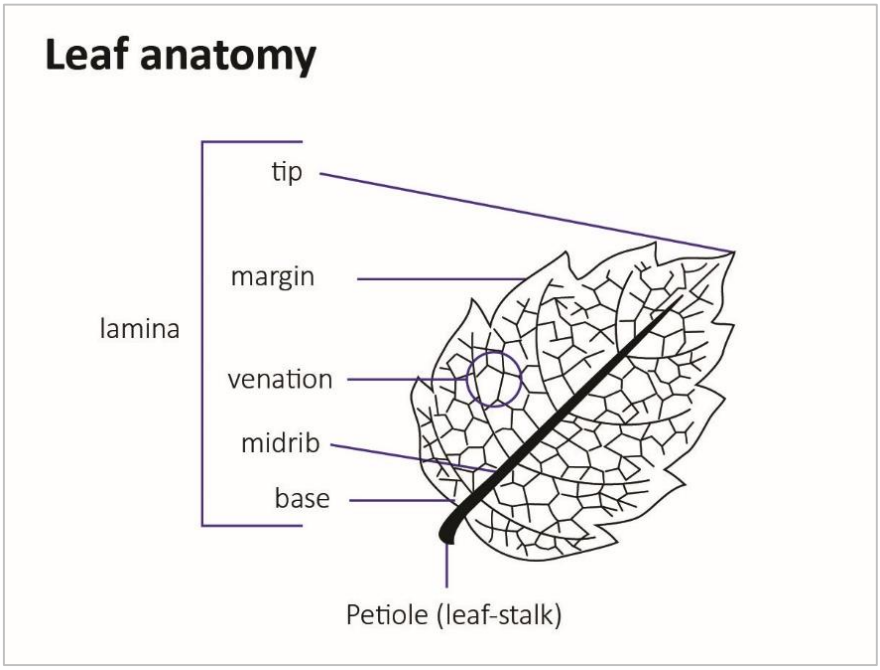


Figure 25. Basic leaf anatomy. Agnieszka Kwiecień. CC BY 3.0 via Wikimedia Commons, (adapted, Sandra Santos).

Dresser explained that these variations of leaves are divided in three groups: exogenous, endogenous and acrogen, the illustrations of each can be observed in figure 26 . from

the book “A class-book of botany: Designed for colleges, academies, and other seminaries where the science is taught”(Wood 1845, 86).

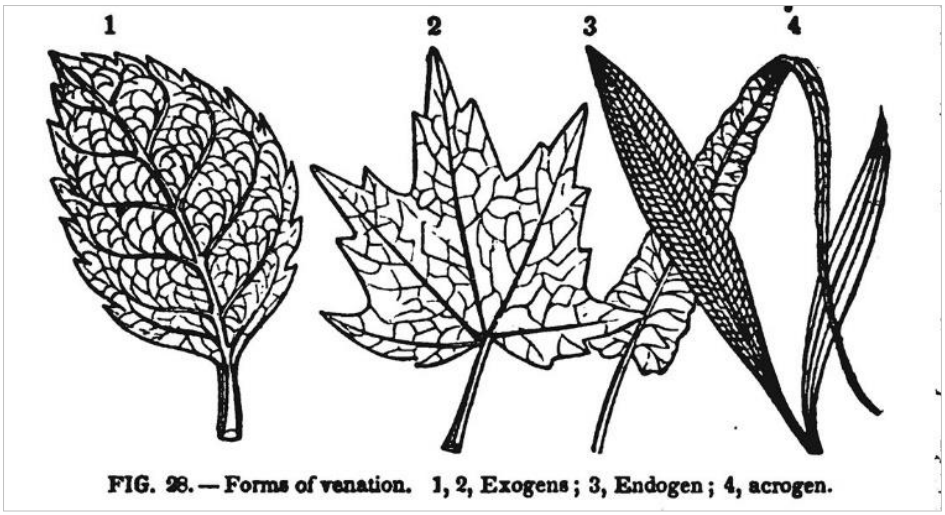


Figure 26. The venation of exogenous, endogenous and acrogens leaves. In Wood, A. 1845. *A class-book of botany: Designed for colleges, academies, and other seminaries where the science is taught*: Crocker & Brewster, p.86.

Firstly, reticulate venation, which is the most common type, presents a web-like pattern spread across the whole body of the leaf. Exogenous stems, which originate from seeds with two lobes, develop leaves with reticulated external veins divided into two or three branches. Secondly, external parallel veins form a pattern of longitudinal lines from the base to the apex of the leaf. They are characteristic of endogenous stems, which originate from a single lobe seed. Thirdly, a forked patterned venation, where each rib is divided into two branches which, on their turn, divide into another two, and so forth, falls under the category of acrogens (Dresser 1857f, 340, Wood 1845, 85-86).

Dresser further explains that way the leaf is divided if teared (straight, zigzag or in oblique lines) will confirm if it is exogenous or endogenous or acrogens, respectively. Dresser was likely to have recreated this experiment in his lectures, as he had real

specimens at his disposal for direct observation, supplied by the Royal Botanic Gardens, Kew[201]. These variations are also illustrated in Figure 27 , where we can see a more complete listing of these variations of venation patterns, namely: pinnate, reticulate, parallel, palmate, fan.

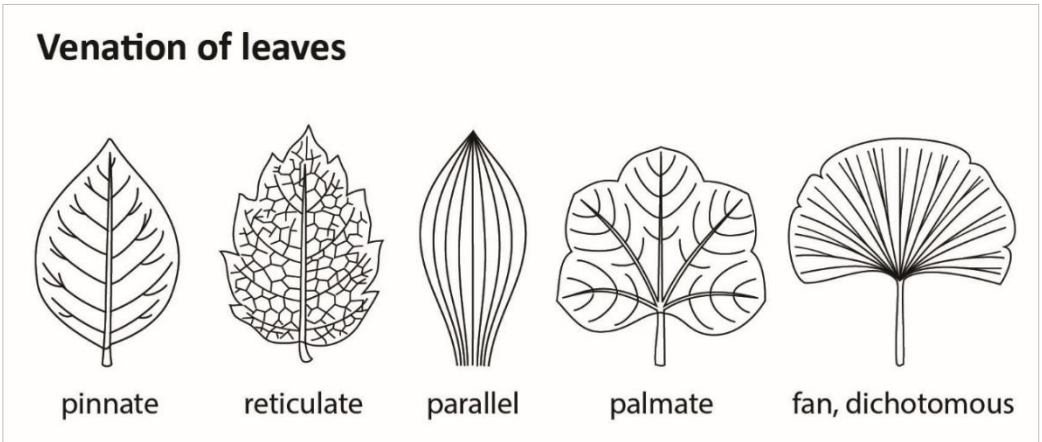


Figure 27. Venation of leaves: pinnate, reticulate, parallel, palmate, fan. Agnieszka Kwiecień. CC BY 3.0 via Wikimedia Commons, (adapted, Sandra Santos).

Doc.180 shows a composite of macro photographs showing different patterns of leaves belonging to specimens kept inside the Palm House at the Royal Botanic Gardens[202], Kew, London. These four examples alone illustrate how varied, rich and appealing, leaf patterns may be and how they can easily relate to design patterns, forms and compositions. Although variably discernible, depending on the species, the thickness, the tones and intensity of colour, or the maturity of the leaf, for example, the visual diversity found in these patterns seems virtually unfathomable. This being one of the many features that make leaves one of the most graphically promising parts of plants for a Victorian designer, especially if trained by Christopher Dresser. There are, in total, eight diagrams dedicated to the leaf (including its of union with the parent stem, plus a unique drawing illustrating variations of tendrils. The first leaf-related diagram (3958) (doc.181) depicts leaves in accordance with their origin or direction of growth: endogenous (growing by adding matter in the centre of the leaf structure); exogenous (growing by addition of tissue from the edges outwards) and acrogens (growing from

[201] See previous chapter: "Botanical studies in the instruction of Victorian designers, from drawing plants and flowers to technical design".

[202] The iconic Victorian greenhouse at the Royal Botanic Garden, Kew, designed to recreate and sustain the micro-environment of a tropical rain forest in 1844-1848.

the tip/summit of the leaf, upwards). Alongside the aforementioned variations of leaves, Dresser also includes the drawing of a mushroom as representative of a thalogen, a vegetable organism solely composed of a thalos, a unique body of organic mass where neither leaves, nor stem, nor roots are differentiated, as seen in algae, lichens and mushrooms.

Diagram 3959 (doc.182) depicts visible abnormalities which may occur in the growth of leaves. Plants' organs and genetic mechanisms do not always develop perfectly and flawless. Overall, both internal and external factors may lead a plant to develop abnormally. This is true in regard to all parts/organs of plants, including leaves. Nonetheless, Nature has its own way of compensating those abnormalities in order to preserve biological structural coherence. This allows plants to adapt to circumstances while still conserving what we could consider a *circumstantial symmetry*. This occurs because, in essence, vegetable parts of the same plant follow a common pattern of growth both in normal and abnormal circumstances. An extremely relevant feature, especially because it conveys the capacity of plants to react to abnormal circumstances and still succeed to maintain order, coherence, and unity. It confirms Nature's capacity to guide its inner mechanisms when faced with the need for adaptation given specific internal or external exceptional conditions. A similar capacity also expected of the designer who adopts the vegetable world as one of his privileged sources of learning and inspiration. Moreover, even if the results of adaptation and abnormal development, whether seamless or noticeable, commonly effect the visual appearance of plants and their parts, those features may still be as appealing to the designer as those of a "normal/perfect" specimen. The third, diagram 3960 (doc.183) addresses the petiole. Also denominated leaf-stalk, the petiole is the connecting element between the body of the leaf and its parent stem. Originating from leaf buds and, thus, following their primary placement along the stem, the petiole and adjacent leafs, are one of the most influential building blocks of plants' elemental symmetry. The varying forms and the overall external appearance of the petiole was highly noted within Dresser's design principles. Interestingly, the drawings in this diagram also present the two broad categories in which, botanically, leaves are grouped as: simple and compound leaves.

Simple leaves, such as the leaves of the lilac or the vine, and the drawing on the left in diagram 3960 (doc. 183), are formed of one unique piece, whereas compound leaves, such as the horse-chestnut leaf, the rose tree and the Laburnum (as well as the central drawing in diagram 3960) are formed of more than one unit (small leaves named leaflets) (Dresser 1857f, 240). Since leaflets can be arranged in diverse ways within the structure of the leaf, compound flowers can assume very distinct appearances, thus extending the array of shapes and compositions eligible to be translated from nature and rendered in design decorative elements and patterns. They can radiate from a common centre at the summit of the leaf stalk, such as the horse-chestnut[203] leaves. They can also be arranged in rings around the axis (verticillatelly[204]), as observed in the Lime-tree (*Polygonum cuspidatum*) (doc.184.); or be distributed along the stalk, as seen in the rose bush and the *Robinia* genus. (Dresser 1857f, 240). Here both repetition and symmetry play essential parts for the whole aspect and coherence of the composition, a very important feature for design.

Diagram 3661 (doc.185) presents four top views of leafs belonging to the same plant. The aim is to illustrate the way each "layer" is configured as the plant gradually develops from the base (here identified as nº 1), where leafs are more profusely distributed and the body of the plant is fuller, to the apex (here identified as nº4), where matter appears less abundant and, overall likely to be more delicate and fragile. Once again, this illustrates Dresser's explanation that plants are constructed based on a symmetrical series of similar elements which are linearly repeated in either parallel or alternating planes. Each leaf and each pair of leaves occupies a unique position and is separated from the groups above and below with mathematical precision (Dresser 1857a, 18). Viewing both top and lateral views of this stratigraphic-like configuration will provide the observer with the overall understanding of the principle of unity and symmetry in plants Dresser so clearly and vehemently conveyed throughout his career as a botanist, a lecturer and a designer. He further states that:

[203] The leaf of the horse-chestnut which is composed of seven concentric segments represented both in Dresser's diagrams and articles.

[204] Verticillate is a formation composed of a whorl of leaves around a stem.

> These observations reveal to us nature's most characteristic and simple circular compositions, and show forth a series of members, originating in one point, and extending on one plane; and a series of parts, originating in various points and arranged round an extended centre. (…) the axis is the centre of power[205]. And as this axis is in all eases the centre, and the lateral organs proceed from it, there is at once displayed a marvellous unity in the entire products of the more highly organised tribes of the vegetable kingdom, for all, when viewed from above, are circular compositions.(Dresser 1857a, 18)

As previously mentioned, the central topic of diagram 3960 is the petiole through which the leaf is connected to the stem. This specific aspect in plants was extensively explored by Dresser in his articles in *The Art-Journal* and in four botanical diagrams for the Science and Art Department, which close the series dedicated to leaves. He aimed to prepare designers to be able to recreate the pleasing and harmonious unions of lines many plants so perfectly accomplish in those points of union between leaves and stems. Here designers could attentively examine the different circumstances which influenced these unions, the natural tools and physiological mechanisms they devise in order to perform their practical role within the plant's anatomy and simultaneously contribute to the overall harmony of the vegetable structure.

Doc.186 shows one of the text presentations used in his lectures pertaining to the union of leaves and stems, and reads:

> Leaves starting from the same point of the same stem, and developed in opposite directions, have their apex equidistant from the stem by which they have been produced.
>
> Also the periphery of a circle, the centre of which coincides with the centre of the stem, will touch the extremity of all leaves placed around such stem, spiraly [sic], alternately, or in alternate pairs, if they are equidistant from each other, thereby indicating the force by which they have been developed was similar.
>
> (Text in Christopher Dresser's Diagrams, Victoria and Albert Museum, The Prints and Drawings Study Room, Museum numbers 3995, 3996).

Whichever form they assume, the points of union between leaves and stems, seem to be significantly important to convey the principles of symmetry, unity and mathematical coherence Dresser so clearly valued in plants. He produced three

[205] Dresser frequently refers to the axis as centre of power and vital force (Dresser 1857a, 19).

diagrams featuring lateral views and cross sections to explore the topic, as well as an article within *The Art-Journal,* with very similar illustrations. Diagrams 3962 and 3963 (doc.187) illustrate five examples of the union of leaves with stems where the role of the stipules and the petiole (leaf-stalk) are also emphasised.

Still on the union of leaves and stems, diagram 3964 (doc. 188) presents two lateral views of the Pericladium, "a dilated sheathing base of some petioles, especially among umbellifers" (Moore 1866, 864). Although the depicted plants are not explicitly identified in Dresser's diagrams, part VI of "Botany: as adapted to the arts and manufacture" contains two identical compositions representing the union of leaves and stem in two species: the strawberry angelica (A) and the cow parsnip (Heracleum sphondylium) (C) (Doc.188 A, C) corresponding to the top left drawing in diagram 3963 (doc.187) and the drawings in diagram 3964 (doc.188), respectively[206] (Dresser 1857f, 341). Dresser explained that in various cases, particularly when the petiole is absent and the body of the leaf is significantly heavy, instead of a specific noticeable point of union, the base of the leaf is prolonged in the shape of a membrane wrapping itself around a small area of the stem.

The development of these appendages, (identified in diagrams 3962 and 3963 with the letter "S" and in diagram 3964) allows the plant to reinforce the support of its heavier leafs. In addition, and whatever patterns, textures and forms they may present (e.g. leaf-like, spiny, tendril-like), the stipule and the pericladium also contribute greatly to the general appearance of the plant, by bestowing it with an added homogeneous and unified appearance. These elements are one of the numerous physiological mechanisms to represent the "strong tendency manifested on the part of nature to hide the actual point of union of contiguous organs" (Dresser 1857f, 341). They exemplify the harmonious fusion, organic fluidity and subtleness intrinsic to the morphology of plants, and so greatly appreciated by Dresser. Correspondingly, the appropriation of those principals and resulting visual features into Design was equally likely to endow its forms and compositions with similar organic attributes.

[206] Doc.188 shows a composite of the abovementioned diagrams and article illustrations.

Dresser stated that to be perfect "all compositions should contain the right line, the angle, and the curve". The latter being considered "the most refined, and therefore most agreeable, the origin of which is the most difficult to detect" (Dresser 1857c, 87). This certainly did not make designers' work easy, but Botany would prove to be a valuable help. The tendril was, most certainly one of the plant organs designers should study to understand and transpose the nature, shape, and development of curvilinear forms.

There is yet another aspect emphasised by Dresser in regard to the supporting structure of plants. That of the curvature of stems. As previously noted, gravity is a determinant factor on the way plants develop. It is, therefore, clear it is also one of the most influential factors on the development of curves within the structure of plants. One of the manuscript documents which accompanies Dresser's diagrams (doc.189) explains:

> The curves of the plants are never arcs, but are of an exceedingly subtle ratio. The degree of curvature of the stems &c varies with every alteration of their consistency or thickness, the length remaining unaltered. The curve of the stem is dependent upon the angle it forms with the earth's surface, as well as its form, thickness, and consistency. (Christopher Dresser, explanatory text to accompany set of botanical diagrams, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room, museum number3993-3994.)

Dresser further explains that stems occasionally seem pendent instead of vertical/erect. This happens when they are not strong enough to support their appendages upright. Stems like these will, then, appear flexible and feeble instead of strong and robust as their supporting function would demand in most cases (Dresser 1858c, 239). Nonetheless, what may result from a somewhat fragile feature in nature can still produce positively appealing forms to a designer's eye. Hence, the potential of such botanical structures to inform designers is certainly not to be neglected, especially if they seek curvilinear forms as well as to convey dynamism and movement. Likewise, and quite noteworthy, tendrils[207] are extremely fertile in curvilinear forms. These

[207] "Tendrils are filiform bodies, which are mostly to be met with on plants having feeble or climbing stems, and by their twining spirally around contiguous objects tend to support the otherwise falling plant"(Willshire 1840, 21).

thread-like structures develop from the stem or leaves and enable the plant to reinforce its position by revolving around parts of external supporting adjacent bodies or objects, as commonly observed in climbing trees. These appendages may originate from various parts of the plants, e.g. stem, leaves, nodes, inflorescences. Moreover, tendrils mostly occur in climbing plants, such as the Bindweed (Genus *Convolvulus,*) the grapevine (Genus *Vitis*), the passion fruit vine (Genus *Passiflora*, doc.190) or the sweet pea plant (Lathyrus odoratus), for example (doc.190). Their main function is to secure the position of plants with a fragile supporting structure, either by adherence to rock surfaces, or grabbing on to other structures, including stronger vegetable bodies. John Lindley explains that "Sometimes all the flowers of the inflorescence are abortive, and the ramifications, or the axis itself, assume a twisted or spiral direction; when this happens, a tendril is formed; Ex. the Vine"(Lindley 1841, 40).

Dresser stated "It is held by the highest authorities the curve is the most refined, and therefore most agreeable, the origin of which is the most difficult to detect" (Dresser 1857c, 87). The light and flexile shapes of tendrils easily fit these criteria. Moreover, the fact that it needs to adapt to the plant's specific context and the external bodies it wraps itself around for support, make the shapes assumed by tendrils extremely flexible and diverse, adding to their unique character. This "ever-varying" curvilinear character was, for Dresser, "one great cause for their beauty" (Dresser 1857c, 87) and, although not extensively, tendrils are well represented in his diagrams. In diagram 3965 (doc.191) Dresser depicts three examples.

The first example (on the left) is a branched (or forked) tendril terminating in two perfectly shaped and symmetrical volutes[208], developing from the apex of a thin stem. This is most probably the tendril of the Bauhinia racemosa (doc.192) Dresser refers to in *The Art-Journal.* He describes "a tendril of an interesting character which divides into two arms, each of which forms a regular volute by its precise spiral curvature" (Dresser 1857c, 87). He admired its highly interesting character, especially due to the way its phases of development resonate the plants vital energy cycle: from growing until it reaches its maximum and subsequently, to gradual diminishing and going back to the

[208] Evocative of the shapes of ionic capitals or baroque decorations.

point where these organs go on to reassume the simplest version of their form (Dresser 1857c, 87).

The second and third tendrils represented in the same diagram develop from nodes on the structure of the stem. One terminates in a single volute and the other presents a main sinuous axis branching out into several alternate secondary tendrils. W.H. Willshire, (1840, 21) points out that the position of each tendril within the structure of the plant indicates what parts of the plant they are an abortion of, as they develop in the place of those parts instead. Tendrils can then develop in place of a flower or a leaf which failed to develop properly, for example (as observed on the right side figures of diagram 3965). Although only representative of a much wider diversity existent in Nature, these three examples in Dresser's diagram clearly illustrate the potential of tendrils to create an enormous variety of curvilinear lines and shapes derived from nature. From the most perfectly shaped curves to apparent randomly developed spiral-like forms, they are one of the many elements that attest the extent of Nature's physiological adaptation mechanisms in constructing the morphology of a plant. Those variations can be equally appealing when reinterpreted and its stylized features conveyed through design compositions. On the whole, in what concerns their influence on design, variety is one of the most significant features to be found in plants and theirs parts; from the above mentioned roots, stems, buds, leaves, tendrils and bracts, to the overwhelming diversity found in flowers.

This enormous diversity is one of the main contributors to the often difficult task of clearly identifying yet another subtle part of flowering plants: the bract. It is a leaf-like appendage which, in flowering plants, may develop, for example, between a branch and the base of a flower it holds. Dresser explained that the "bract varies in so many particulars that it is extremely difficult to define it, or its habits" as well as to differentiate it from a common leaf (Dresser 1857f, 342). Hence, bracts vary in colour, position within the structure of the plant, size and shape. In flowering plants, it is common to find them bellow the body of the flower, and in some cases they can even be mistaken for petals (Dresser 1857f, 342). However peculiar and generally difficult to identify, the fact that it varies so much is likely to put bracts under the closer attention of designers because variety increases the spectrum of ornamental potential. Diagram

3967 (doc.193) illustrates them while varying between male and female flowers . This diagram alone is well demonstrative of how varied the positioning and appearance of bracts can be. The outstanding richness and variety of the flower, however, surpasses all others. It was, according to Dresser, the superlative of botanical beauty and complexity.

The flower

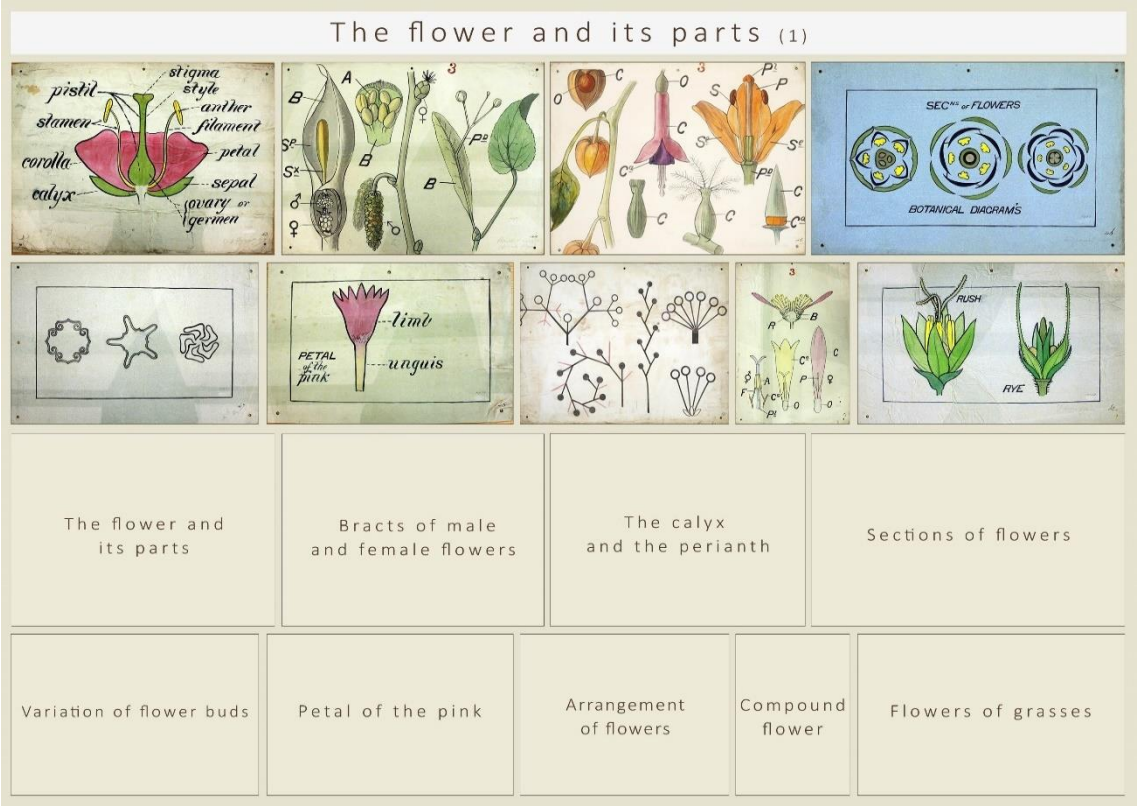


Figure 28. Christopher Dresser, group of botanical diagrams on the topic of the flower and its parts, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room (museum numbers 3966, 3967, 3969 to 3971, 3974 to 3989, 397, 3981, 3982 and 3984).

Dresser's diagrams of the flower and its parts are the ones closest to botanical illustrations within the whole set. Through nine diagrams, he represented its parts and how they are arranged as a whole, from general to particular (figure 28). Here he depicts not only different views (e.g. lateral views, top views) but also the layering of the plant, detailed views of key parts and organs, sections and schematised illustrations. The structural arrangements, textures, patterns, and colours in flowers present numerous variations which directly affect their aesthetics and the way they are perceived by human vision. As one of the most visually appealing structures of all vegetable kingdom, flowers possess the highest potential for inspiring ornamental subjects and compositions. It is safe to say they are considered the ultimate muses of botany-enamoured designers. Dresser described them as "natural ornaments sprinkled over the field of nature, (…) powderings (insulated small ornaments which are repeated)". He gives the example of the Primrose (*primula vulgaris*) (docs.194 and 195). If set against a grassy background and observed from a distance, the leaves seem to fuse with the

background, becoming almost indistinguishable from it. Whereas its ”star-like” flowers, of a predominant pale green – yellow, are highlighted amidst the green symbiotic setting, creating the effect of sprinkled colour over a homogenous backdrop (Dresser 1858c, 237).

According to Dresser, our visual perception of flowers depends of three main factors (either individually or combined): form, texture and colour. In turn, the way form, texture and colour affect our perception is greatly influenced by each part of the flower and the patterns of repetition they follow[209] (the number of petals or stamens on a given species, for example)[210]. Moreover, each assemblage of parts affects not only its elements individually, but the entire morphology of the flower as a composition. Either individually or as a whole, each part and organ of the flower, as well as their respective aggregation in groups, varies in form, texture, pattern, scale and colour from one species to another. Hence these must all be taken into account while representing a particular species or specimen. All in all, repetition patterns are largely transversal to various parts and angles of representation of a flower (e.g. lateral views, bottom views, top/birds eye views). Yet, they become particularly clear and relevant in top views and transverse cross sections, where forms and patterns are extremely adaptable to horizontal ornaments and designs. Docs. 196 and 197 show variations of top views of flowers, published by Dresser in *The Art-Journal*. Another pertinent factor to consider is that all those forms will metamorphose throughout the lifecycle of the flower, and will change their own aspect, the aspect of the group, the overall appearance of the flower and ultimately, of the plant. Hence, a wide and deep knowledge of the flower and its parts throughout its developmental stages is an important gateway to a reinforced acknowledgement of its visual features, either considered in detail or as a whole, throughout its different stages of development. Consequently, this also means an equally extended source of graphic vocabulary for designers, both in quantity and quality. The aforementioned factors are not, however, the only ones to influence the general aesthetics of flowers, as Dresser emphasises.

[209] In accordance to the principle of symmetry, the repetition pattern of the flower is common to that of the whole structure of the plant.

[210] Groups of 2, 3, 4, 5 elements, etc.

He brings our attention, for instance, to the degree of visibility of each organ/part of the flowers, individually, in the way they are integrated within the parent structures, and their connection with other parts (e.g. developing separately, partially or completely aggregated). This feature is particularly interesting when observing and depicting top views and transverse sections of flowers, where close observation and understanding of the distribution of its parts and their harmonies and/or contrasts. Nonetheless, it is also worthy of note in regard to lateral views.[211] Likewise, the direction followed by floral elements as they grow from a centre point, also affects their individual appearance[212] as well as the appearance of the whole. Similarly, the way floral parts bend or arc according to their shape (wide and short or long and narrow, for example), weight and position within the flower; the way they are positioned in relation to each other (e.g. close together or separated), as well as their distribution in the floral structure (following a continuous sequence or interrupted) are important for the general and detailed aspect of the flower and, thus, should be considered when observing, studying and depicting flowers and flowering plants. (Dresser 1858c, 237).

Although Dresser also addressed morphological features resultant from abnormal variations in the development of flowers, his teachings focused mainly on what he considered to be the "perfect flower". In point of fact, only by familiarizing themselves with the "normal" or "ideal" elements and characteristics of flowers would designers be able to actually recognize abnormalities and uncommon features, when observing and studying specimens. When considered individually, "the "perfect flower" was the ultimate example of the principles of harmony and unity inherent to vegetable structures and transversely present in Dresser's texts and lectures. He aimed to reveal and illustrate the structure and behaviour of all parts of the "ideal flower", even when they may be imperceptible or even inexistent, in some cases. The main purpose was to give the designer the necessary tools to understand, deconstruct and interpret the specimens observed at any given time, and be able to adapt their forms, patterns, textures and colours to elements of Design. The perfect flower would be similar to what

[211] This is not exclusive of floral elements but is transversal to the whole structure of the plant.
[212] Be it in length or width, upwards, downwards or sideways, fully, partially or undeveloped.

Dresser illustrates in diagram 3966 (doc.198). This is the first of the series exclusively dedicated to flowers. It represents a captioned section view of the basic structure of a flower. Another schematic view can be seen in diagram 3969 (doc.199), illustrating three different types of top views of the arrangement of flowers.

Another point highlighted by Dresser relates to the particular structure of compound flowers, represented in diagram 3982 (doc.200) explores a compound flower. Compound flowers (e.g. Marigold, Sunflower, Dandelion, Chrysanthemum, Coreopsis) are composed of small flowers (called florets) which can be arranged in various ways. They are usually positioned very close together, forming a compact mass of petals. Florets can be concentric, such as in the dandelion (genus *Taraxacum,* doc.201) , where all florets are harmoniously arranged covering a dome-like base. In other cases, they can be aggregated in such a way that they form a unique tubular body. This is the case of the common Groundsel (*Senecio vulgaris)* _, or a mixture of tubular inner layers and spread outer layers of the flower. The latter is common to the sunflower (*genus Asteraceae)* and the Coreopsis genus, for example (Dresser 1858c, 237).

Dresser compares the composition of the flower to that of a branch. It originates and evolves from a bud which metamorphoses into a complex structure of floral elements (analogue to the way leaves develop from branches). This analogy is also purposeful to demonstrate one of the basic laws of plant morphology: generally the arrangement of floral elements of a flowering plant mirror the arrangement of its branches and leaves[213] (Dresser 1858, 39). This law is illustrated in diagram 3981 “The arrangement of flowers” (doc.202). The simplified graphic representation, reduced to simple geometric forms (lines and circles) and schematic compositions, can be easily associated with design patterns by itself. He further explains that, in principle, flowers of endogenous plants present threefold arrangements repeated in the various groups of elements that compose the flower, such as carpels, stamen or petals; whereas exogenous plants present flowers usually composed of groups of four, five or multiples of four or five elements. Additionally, those elements can be arranged either by

[213] The parts of flowers follow the same natural logic disposition of leaves, being arranged in a verticillate manner (in whorls) (Dresser 1857d, 111).

developing from the apex of the leaf stalk (or peduncle) as seen in doc.203 A. apparently flowering from the stem itself (doc.203 B.), or by a seeming adhesion of the corolla with the stamens (doc.203 C.)

Figure 29 shows the schematic stratigraphy seen above in diagram 3969 (doc.199) and the elements it represents. These kind of diagrams are extremely useful and effective in demonstrating the layered arrangements of flowers from a top view, as we can clearly perceive how flowers are composed from the outer edges to the centre. A similar circular composition is found while observing diagram 3970 (doc.204). It illustrates three variations of flower buds, by outlining the contours. It is highly likely that these were drawn from observing transverse sections using a magnifying device (e.g. microscope or magnifying glass). The visual information we see in this diagram follows the same reasoning of Dresser's text in *The Art-Journal* about the flower and its parts (see also figure 32). He starts by explaining the nature and characteristics of the four whorls[214] which constitute the basic structure of the flower. From outside to inside: calyx, corolla, androecium and pistil (Dresser 1858b, 38). These four layers are, in turn, subdivided into sepals, petals, stamens and carpels. (Figure 30 shows a modern diagram similar to Dresser's composition)

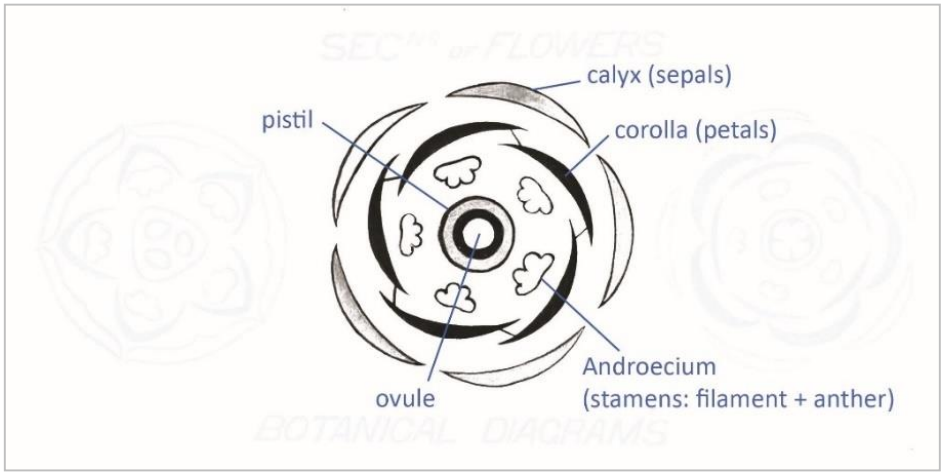


Figure 29. Botanical diagram by Christopher Dresser showing the different layers of a flower (adapted from: Christopher Dresser, 1854-1856. Victoria and Albert Museum, The Prints and

[214] Dresser clarifies that the flower follows the same natural logic disposition of leaves arranged in a verticillate manner (arranged in whorls) (Dresser 1857d, 111).

Drawings Study Room, museum number 3969). Adapted, based on Dresser's drawing, Sandra Santos.

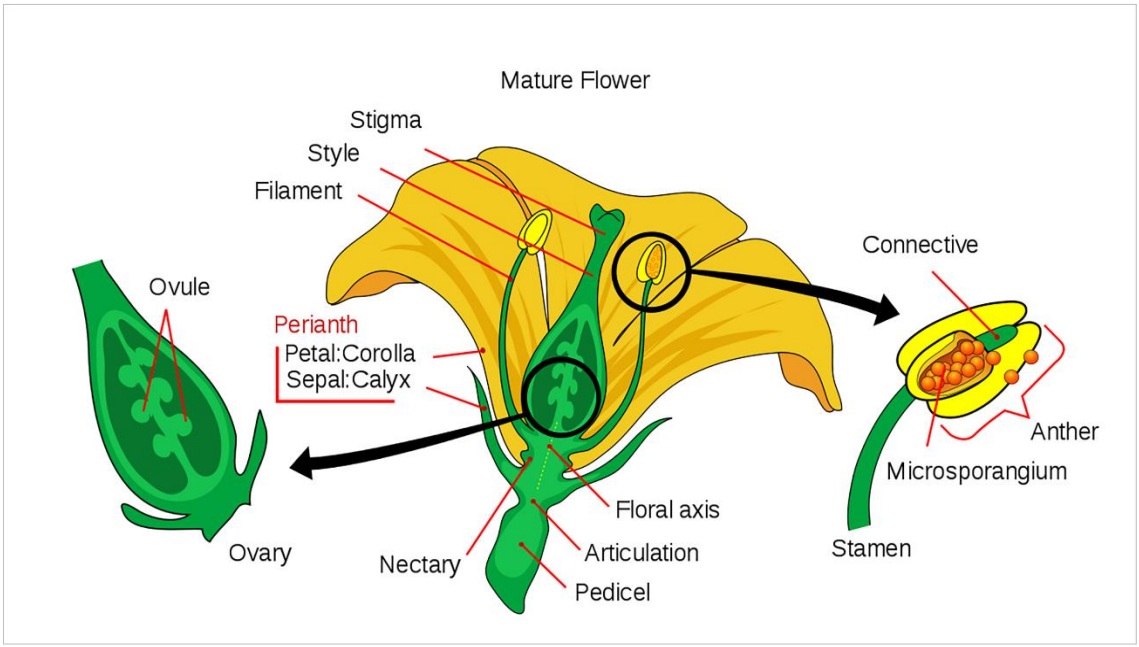


Figure 30. Diagram of a mature flower. Mariana Ruiz LadyofHats (Own work), 2007 [Public domain], via Wikimedia Commons.

The calyx is the leaf-like outer layer which develops from the tip of the stem and sustains the structure of the flower. Of a somewhat ephemeral existence,[215] It occupies the base of the flower and is composed of green leaf-shaped parts, the sepals[216]. Sepals are considered of great interest, as they can assume numerous variations which, ultimately, influence their visual composition within the whole and, consequently, the designs they may potentially inspire. Sepals can either develop only around the centre where petals grow from, or spread more widely underneath the petals. The latter generally originate wide star-shaped top-views which may vary in form according to the shape and number of sepals as well as their adhesion and disposition in relation to the centre and one another. Furthermore, the form of the calyx does not necessarily have to be symmetrical. Its function is also to directly protect the corolla and both naturally adapt to each other.

[215] The calyx may fall either before blooming, with the expansion of the flower, accompanying the death of the flower or after the seed has matured.

[216] The number of sepals that compose the calyx varies from species to species, starting from one (very rare).

The corolla is the delicate part of the flower, composed of petals which can present diverse colours, shapes, orientation[217], textures, patterns, orientation and thickness. For Dresser, the corolla is the most attractive of all parts of flowers. This is especially due to their large range of colours, which generally differ from the common tones of green most associated with the vegetable kingdom. Virtually every aspect of the corolla was attractive to Dresser; from colour and nectar acting together to attract insects so that pollination occurs, to the way petals are shaped and joined (aggregated at the base, separate from each other, or cohering (fused together). Diagram 3971 (doc.205) illustrates a detailed view of a petal of the Pink, also represented in a top view (doc.196) in *The Art-Journal* (Dresser 1858c, 237). It demonstrates the prominence of the elements of a flower in a top view and was, very likely, to be used as related to the sections of flowers and variations of flowers buds.

These various types of unions, alongside the diverse shapes, textures, thickness and colours of petals, as well as the direction in which they grow (e.g. standing erect, spreading, benched back, hood-like) "act very powerfully upon the general effect of the flower" (Dresser 1858b, 38). They are at the origin of an enormous variety of corollas and, consequently, a vast range of visual possibilities this section of the flower offers to a designer's eye. Dresser further explains that, together, the calyx and corolla "protect the inner and more delicate organs and the special duty of the corolla is to attract insects, which it accomplished by means of its gay colours and its nectarous deposits" (Dresser 1858b, 38). Diagram 3968, (doc.206), illustrates the Perianth, the segment of the flower composed by the calyx and the corolla[218]. Together, the calyx and the corolla protect the inner structure of the flower which holds the androecium and the pistil, the reproductive whorls. Although it was the most appealing to Dresser, the flower does not close the cycle of his diagrams and lectures. It is closed by the ultimate power of the plant: to originate new life.

[217] Referring to the direction followed by petals as they develop.
[218] This diagram is captioned with the botanical terms presented in Index 3.

Reproductive system

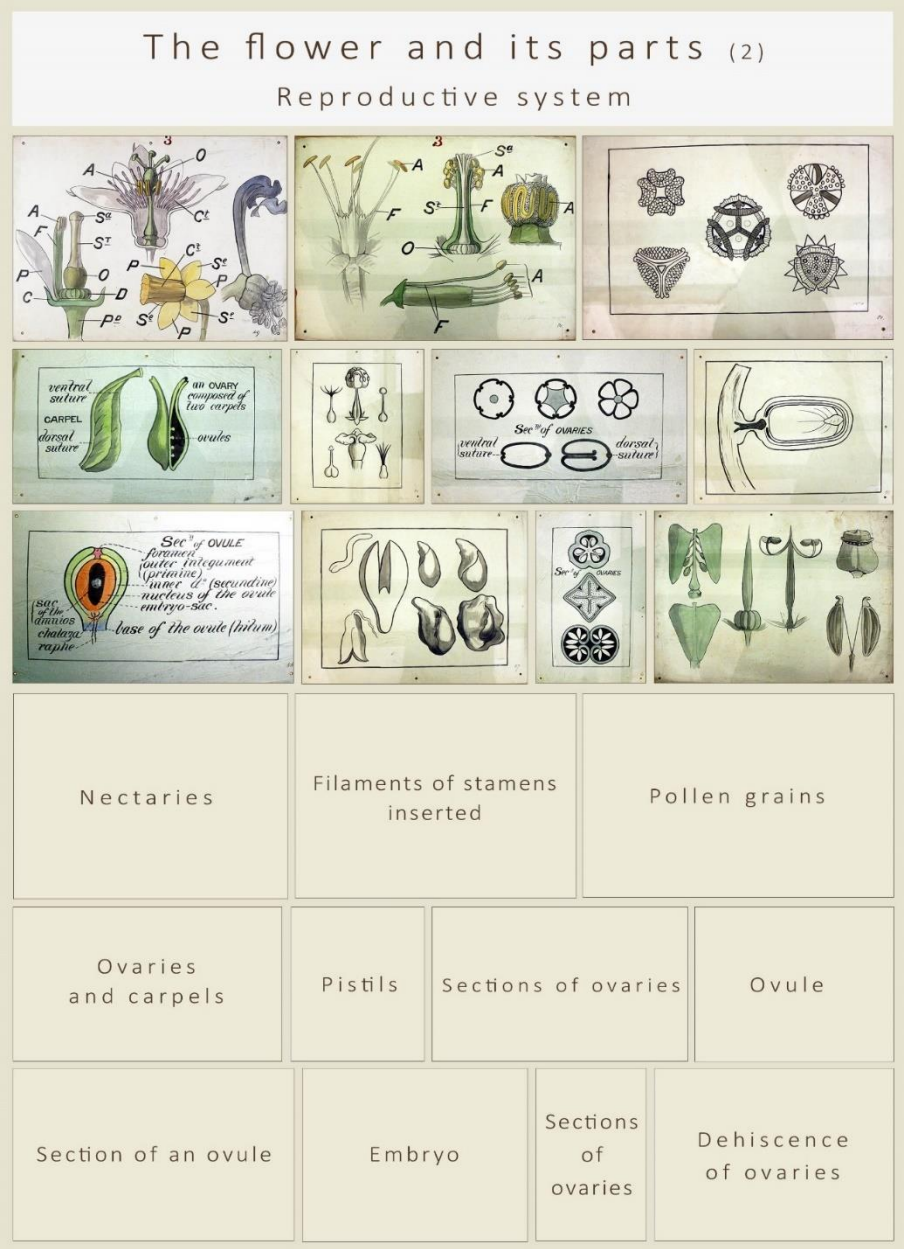


Figure 31. Christopher Dresser, group of botanical diagrams on the topic of the flower and its parts, 1854-1856. Victoria and Albert Museum, The Prints and Drawings Study Room (museum numbers 3966, 3967, 3969 to 3971, 3974 to 3989, 397, 3981, 3982 and 3984).

Dresser's diagrams demonstrate he was expressively thorough while exploring the reproductive system in flowers. He depicts the different organs and parts involved in the process of pollination, and subsequent reproduction (figure 31). Diagram 3972 (doc.207) is the first dedicated to the subject. It represents the morphology of Nectaries (or honey glands). Floral nectaries, are responsible for segregating the nectar which attracts insects so that pollination may occur (Hickey and King 2010, 27). Dresser's

diagram 3973 (doc.208), shows another partial lateral view of a flower, containing a pencilled annotation that reads “filaments of stamens inserted”. This relates to the first of the reproductive layers of the flower, the androecium, or staminal whorl (whorl of stamen, the flower’s male sex organs). Stamens are composed by a filament crowned by the anther. The range of shapes and types of aggregation in stamens extremely diverse, making them be highly interesting for the designer studying plants. Dresser explains that in some flowers, for example, all filaments are grouped together, while anthers are separated, or vice-versa. In others we find bundles of filaments topped by separated anthers. And in some cases, the whole mass of the stamens is connected through a membrane, seemingly forming one unique, generally cup-like body. He also emphasises the commonly intriguing variations found in the attachment of anthers onto filaments. It can vary from a steady fixed firm position or a softer one directly onto the apex of the filament, to being dislocated from a central point on top of the filament to a slightly lateral position (Dresser 1858b, 37-38). Nectaries and stamens are the “doorway” to the reproductive system.

The reproductive system of flowers is a blend of incredible minute and copious forms. Pollen grains, pistils, ovaries, ovules and embryo compose the compound morphological structure of “the perfect flower”. Diagram 3974 (doc.209) shows five variations of pollen grains. Identical diagrams (if not actual reproductions) were also published in The *Art-Journal* in 1858 (doc.210). All based on simple circular, elliptical, quadrangular or triangular shapes. Besides form itself, what most captures our attention in pollen grains are their perfect repetition, as well as the variety found in their cellular patterns. From net-like lines to abstract geometric shapes combined in peculiar compositions, pollen offers numerous visual possibilities likely to influence design patterns. The circular shapes, as well as the consistency and the symmetry found in their patterns make them, alongside top views of flowers, one of the most suitable floral elements for horizontal designs. In Dresser’s own words:

> These pollen grains are so extremely small that they are quite microscopic objects, and are therefore beyond the reach of common observation, yet they, nevertheless, deserve notice—not only on account of the general beauty of their forms, but also for the geometric character of their structure, which approaches more closely to the

> crystalline, as regards form, than any other part of the organised vegetable. (Dresser 1858b, 38)

Another part of flowers' reproductive system are carpels and pistils. The terms "carpel" and "pistil" are often times ambiguous, as they may refer to one and the same part or to two adjacent parts in the centre of the flower, and whose base normally contains the ovaries and ovules [219]. Figure 32 shows the distinction between the two. These floral elements are illustrated in Dresser's diagrams 3975 and 3976 (docs. 211 and 212). The first one illustrates two captioned and coloured detail views of carpels. The latter shows five variations of front views of pistils. Here, form, as they are simply outlined and only slightly shadowed would be the feature highlighted in the lectures, as well as their natural elongated configuration which makes them expressively suited to inspire vertical designs. Ovaries, which are generally found protected inside the base of the abovementioned organs, were considered highly appropriate for horizontal designs, alongside top views of flowers and pollen grains.

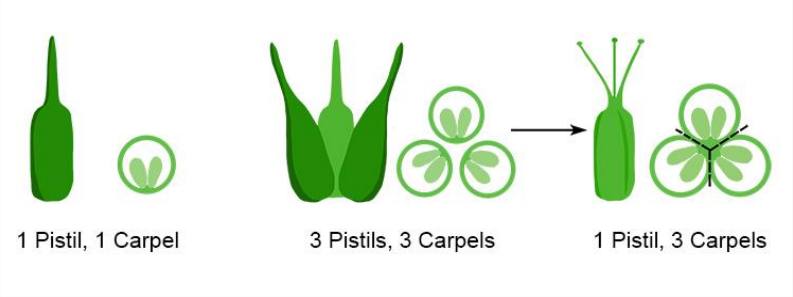


Figure 32. Schematics showing carpels and pistils. ©http://www.mammothmemory.net.

In his diagrams, Dresser seems to also explore ovaries with the main purpose of observing form and learning from the behaviour of these central organs of flowers. An entire diagram (3985, doc.213) is dedicated to the dehiscence[220] of different types of ovaries. In order to highlight the splitting process itself, two stages of three different ovaries are represented. Each illustrate a two phased process: from being encapsulated to the tearing of the ovary with the seeds visible on the inside. The variations of shapes

[219] "The Cambridge Illustrated Glossary of Botanical Terms" defines them as follows: "Carpel: One of the units forming the gynoecium, usually consisting of ovary, style and stigma. Pistil: A single carpel in an apocarpous flower, or the gynoecium in a syncarpous flower" (Hickey and King 2010, 7, 32).

[220] Dehiscence in ovaries is the process which occurs when the ovary reaches maturity and splits to release seeds. This process also occurs in regards to anthers at the moment they release pollen. (Hickey and King 2000, 12).

from one phase to the other are intricately eye-catching. It was, most likely, one of the aspects underlined by Dresser in his lectures, as well as the variations of form observable between the three ovaries presented. Much the same as the representations of carpels and pistils, these are particularly appropriate for vertical designs. Nonetheless, other views of the same organ may also be adapted to horizontal designs; something certainly conveyed by Dresser in regards to two diagrams (3977 and 3983, docs.214 and 215) showing a total of six different cross sections and two side views of ovaries. Once again, shape and repeating pattern are the most prominent features in these drawings, such as the ones shown in doc.216 These would also be the most eye-catching to the inquisitive eye of the designer. A similar cross-section of an ovary also co-illustrates part IV of Dresser's article series in *The Art-Journal* (doc. 217). While referring to design he stresses the benefits of studying the ovary throughout the different stages of development, from the primary bud to the matured fruit (Dresser 1857d, 239). In fact, this applies to virtually all the parts of the plant and their respective phases of development (Dresser 1858c, 239).

The final stage of Dresser's lectures was dedicated to the ovule and the embryo (diagrams 3978, 3979 and 3980, docs.218 to 220). The cycle, which started with the origin of the plant in the seed would be closed in this manner, the seed being freed from the ovary and the embryo originating new life. The diagrams dedicated to the ovule are illustrated as sections representing the stratigraphy of the ovary and the embryo. Firstly, by simply outlining the ovule and enclosed embryo and secondly by presenting its various regions and parts through captioning. Lastly, the embryo is illustrated in more than one stage of development; another example of the importance of conveying not only the structural information of the organ but also the processes it undergoes, which ultimately influence its configuration and, thus, its possibilities as a source for design visual grammar. As in the abovementioned sections of flowers, the last set of diagrams was likely to have been produced from observing specimens under the microscope or magnifying glass. Furthermore, although we have no knowledge of any document confirming it, since real specimens were extensively used in classes, it is plausible that a microscope and magnifying lenses were at the disposal of students in Dresser's class in

order to observe those most minute details of plants and flowers, as classes would be a mixt of lecture room, workshop and laboratory.

All in all, diagrams such as Dresser's are highly effective in deconstructing vegetable specimens, illustrating each part/organ both individually and in connection with one another. This made them an extremely useful resource for demonstrating the concepts of symmetry and unity in flowers, their mechanisms of growth and adaptation and the immensity of their visually and artistic potential. Furthermore, although fully aware and attentive to the fact that in art schools, he was not training botanists *per se*, Dresser did consider important to convey botanical accuracy and a significant degree of scientific knowledge to his students, while studying the morphology and physiology of plants. His pupils should, by the end of his lessons, be able to know and distinguish the main parts of the plant from its earliest stages of development, through maturity withering and reproduction. Developing these qualities in a designer was comparable to developing the mastery of word in a writer. Mastering any kind of knowledge and/or ability leads to a wider freedom and much higher possibilities of applying that knowledge. It is analogous to finding answers when we know what to look for and where. Hence, getting to know closely the structure of plants, their mechanisms and behaviours is an opened door to portraying them in the most varied ways while simultaneously being faithful to Nature's coherent essence. Understanding the plant from inside out would ideally allow designers to more greatly appreciate the structure and behaviour of plants from general to particular. In turn, that knowledge would become a most powerful interpretative tool in the creative process of Design. Furthermore, as Dresser clarified, it is essential to keep in mind that:

> ornaments of diverse characters are suggested by the various parts of vegetable structures, that is, that a leaf-bud presents a certain general structure characters which suggest the embodiment of similar general principles in varied detail, and which, nevertheless produce a similar effect, owing to the presence of the primary characters, which may be furnished by the structure, or the aggregation, or disposition of the parts. (…)(Dresser 1858a, 294-295)

On the whole, a thorough analysis of the articles in *The Art-Journal* reveals that they focus the majority of the topics illustrated by Dresser through his botanical

diagrams. It also indicates what would be the overall sequence of the lectures[221] and, very importantly, what aspects were considered of greatest relevance by the lecturer. The latter is an extremely important outcome of cross-analysing the articles and the diagrams. We can argue that the text somehow brings Dresser's lectures to life, as it reveals the message underlying the diagrams. To some extent, and although the wording may and probably did differ, to some extent, uniting these two sets of documents: Dresser's written words and his diagrams, makes his lessons tangible, as an extra-validation of their existence. The profounder the knowledge of the features and behaviours in plants the wider the range of their aesthetic possibilities for a designer, and the greater the power to interpret and translate them into their own unique visual vocabulary. Creative freedom and individuality were more likely to successfully coexist in such a way. By addressing the vast universe of plant morphology and physiology, as well as the intricate internal and external factors that influence our visual perception of plants, Dresser aimed to "arm" future designers/ornamentists/industrial artists with a most profound understanding of Nature, and the confidence to extrapolate and materialize its principles, effects and visual features into countless creative realisations.

[221] All diagrams are sequentially numbered.

2.3. **Botanical drawing in artists' practice: Charles Rennie Mackintosh and Margaret MacDonald**

After studying the role of botanical studies for the foundations in art and design training, in this chapter we go on to explore them in the actual day-to-day practice of artists, taking Charles Rennie Mackintosh (1868-1928) and Margaret Macdonald (1864-1933) as an example. As much has been said about the botanical universe of Charles Rennie Mackintosh, especially the numerous stylized botanical forms in his designs, in this chapter we explore his botanical drawings, some of which co-authored by Margaret Macdonald. They are predominantly kept by two archives: The National Library of Ireland, and the Hunterian Museum and Art Gallery. We continue the work that has previously been done, aiming to add to what has been studied and written by other researchers.

These drawings and watercolours are catalogued and most of the botanical specimens they contain are identified. Previous studies have mainly focused on an individualized descriptive style of the drawings themselves or have been integrated within biographical accounts on Mackintosh's interest in Botany. Nevertheless, a more reflective formal study of these drawings as a whole, will be a relevant contribution for the topic. Our approach aims to examine their artistic and their scientific features and clarify their role as potential informants for Art and for Science. With this in mind, we have analysed 70 botanical drawings and watercolours kept by the Hunterian Museum and Art Gallery, Glasgow University (HMAG) and the National Library of Ireland (NLI). One of the tasks was to compare their features to those of botanical illustration and, whenever possible, real live specimens.

Although the majority of the species were previously identified, we completed the lacking information concerning the identification of the depicted plants, by taxonomic rank (Genus and Species), recurring to databases on biodiversity, including specific botanical databases dedicated to British and Irish flora, whenever necessary (e.g. Botanical Society of Britain and Ireland; Online Atlas of British & Irish Flora; Royal Horticultural Society, UK; Royal Botanic Gardens of Kew botany collection database; National Biodiversity Network, UK; The IUCN Red List of Threatened Species; Catalogue

of life; Biodiversity Heritage Library; Smithsonian National Museum of Natural History; Southwest Environmental Information Network). Tables 15, 16 and 17 list all the botanical drawings and watercolours included in our research, kept by the National Library of Ireland (NLI) and the Hunterian Museum and Art Gallery (HMAG).

With all information gathered it was time to look closely at every drawing; to study the shapes, the composition, the way each element was treated, the attention to detail; the representation technique; and look for that visual territory of dialogue between the artist and the botanist.

2.3.1. The Dublin Sketchbooks

Table 15 lists the botanical drawings belonging to the National Library of Ireland and refers to Mackintosh's earliest years as a draughtsman. "The Dublin botanical sketchbook is the only known devoted exclusively to flowers"(Grogan 2002). It is composed of linear drawings, many with minute details, and commonly partial views emphasising the floral elements of flowering plants.

Table 15. Sketchbook botanical drawings by Charles Rennie Mackintosh at the National Library of Ireland: depicted plants.

Document	Date	Location	Common name	Botanical name	Botanical family
Sketchbook drawings: Scottish Sketchbook (1889 - 1891) [miscellaneous]	1889-1891	Unspecified	Sowthistle	Sonchus asper	Asteraceae
Sketchbook drawings: Botanical Sketchbook (1894-1895)	1894-1895	Unspecified	Orchid	Cymbidium	Orchidaceae
	1894-1895	Unspecified	Larkspur	Delphinium L.	Ranunculaceae
	1894-1895	Unspecified	Snapdragon	Antirrhinum majus L.	Plantaginaceae
	1894-1895	Unspecified	Snapdragon	Antirrhinum majus	Plantaginaceae
	1894-1895	Unspecified	Christmas Rose [Inscribed]	Helleborus niger	Ranunculaceae
	1894-1895	Glasgow, Scotland, UK	**Gooseberry** [Inscribed]	Ribes uva-crispa L.	Grossulariaceae
	1894-1895	Ascog, Argyll and Bute, Scotland, UK	Soapwort	Saponaria officinalis L.	Caryophyllaceae

	1895 [inscribed)	West Kilbride, North Ayrshire, Scotland, UK	Monkshood	Aconitum napellus	Ranunculaceae
	1894-1895	Unspecified	Monkshood	Aconitum napellus	Ranunculaceae
	1894-1895	West Kilbride, North Ayrshire, Scotland, UK	Garden Candytuft [Inscribed]	Iberis umbellata L.	Brassicaceae
	1894-1895	West Kilbride, North Ayrshire, Scotland, UK	Common Mallow	Malva sylvestris	Malvaceae
	1894-1895	Unspecified	Orange Lily [Inscribed]	Lilium bulbiferum L.	Liliaceae
	1895	West Kilbride, North Ayrshire, Scotland, UK	Canterbury Bells [Inscribed]	Campanula medium	Campanulaceae
	1895	West Kilbride, North Ayrshire, Scotland, UK	**Honesty** [Inscribed]	Lunaria Annua	Brassicaceae

The first two share one of the sheets of the sketchbook and illustrate the flowers of an orchid and a larkspur. Here it is clear Mackintosh's ability to create volumes using simple but precise lines, something that can be observed in virtually each one of the following drawings as well. Doc.221 shows three different graphic representations of the larkspur (*Delphinium L.*).

The first is a drawing of two overlapping flowers by Mackintosh, the second a conventional botanical illustration of the plant, the third is an herbarium pressed specimen and the fourth a contemporary photograph in colour. Mackintosh drew solely three outlined colourless examples of detached flowers, which, by itself is not greatly informative. However, if we compare it to the following depictions of the same plant, the notes of accuracy in Mackintosh's drawing become more present and clearer. This is a common feature within the Dublin sketchbook. Doc.222. shows the drawing of an orchid next to the larkspur along with a botanical illustration and a photograph. The lack of key distinguishable features in Mackintosh's linear drawing does not allow for a precise identification of the species, nonetheless, it does contain the necessary traces so as to identify the genus. This is a further example of a common characteristic of this group of drawings, which suggest that, although clearly drawn with attention to detail

and the steady hand of a talented draughtsman, his intent was to create botanical notes and not necessarily scientific rigour *per se*. As we will see further ahead.

Aside from the aforementioned examples, and following the same linear style, Mackintosh drew two examples of snapdragon (*Antirrhinum majus L.)* plant (doc.223). Although still simplified linear drawings, and still mostly focused on floral elements, in comparison to the previous, these offer substantially more visual information on the plant. Overall, he is largely successful in conveying the appearance of the plant; how flowers and leaves are positioned along the stem and the aspect of flowers from different points of view; a characteristic of botanical illustrations. Likewise, the drawing of the Christmas rose (*Helleborus niger*) (doc.224) presents a set of qualities not defining of but resonation botanical illustration method. The various views suggest time and attentive observation so as to describe the flower in all its facets, in terms of form and volumes. Such as the others, this drawing omits the surface details of pattern and colour essential to a finalised scientific depiction but, on the other hand, suggest the flower was intentionally dissected and staged so as to depict its main visual features, some with recognisable and relevant detail, observed in the arrangement and shape of the stamens, for example. Another analogous example, although somewhat of a rougher sketch is the gooseberry (*Ribes uva-crispa L.*) (doc.225). Here Mackintosh portrays the main flowering elements in lateral and top views, as well as an overlapping detail of the leaf, a feature common to various botanical illustrations, and the positioning of the flowers along the stem. (docs.226 to 228) all follow similar styles while representing the flowers of the Soapwort (*Saponaria officinalis L.*), the candytuft (*Iberis umbellata L.*), the potato plant flower (*solanum tuberosum*) and the canterbury bells (c*ampanula medium*), respectively.

Still mainly focused on flowers, the two drawings of the Monkshood (*Aconitum napellus*) (doc.229) also follows various principles of scientific illustration. Again, and as common in other drawings, the plant is only partially depicted and the main focus is on its flowers. These, however are very carefully drawn. The various views compose a 360º outlined portrait of the flowers, while the different depiction of the flowering stem shows the different stages of development. The Monkshood appears several times in Mackintosh's drawings and is clearly extremely appealing to his eye. Although, in terms

of composition, this drawing is fairly similar to the previous ones, it is somewhat closer to scientific principles. Similarly, the drawings of the common mallow (*malva sylvestris*) and the orange lily (*Lilium bulbiferum L.*) (docs.230 and 231) are visual annotations as well but present a different, elegant and "clean" style which makes them more readable to the observer, combining freehand drawing intuitive drawing with illustration strategies common to botanical scientific drawings (e.g. plant dissection, lateral and top views).

Mackintosh's tribute to line and form is present throughout all his drawing work with plants. In his earliest botanical drawings there is no colour applied to the plant figures. Shape prevailing over colour in an exercise of close observation. With varied degrees of minutia, solely plant contours are transposed to the surface of the paper. These highly linear drawings suggest the delicate lines of Japanese art. Figure 33 illustrates a study of Honesty (*Lunaria annua)* seeds. This a fine example of a translucent quality that Mackintosh inscribed in his flower sketches. The natural features of this plant are well deserving of such attention. Mackintosh probably sketched it while its capsules, containing seeds, were fully dried. By this period the capsule, or silicula (Botanical Society of Britain and Ireland) acquires a soft beige translucent tonality, subtly revealing the seeds and veins of its delicate structure(Figure 33.C). Figure 33.B. shows a botanical illustration of this same plant, dated 1917 (Mentz and Ostenfeld 1917); "a favourite garden plant in England, and occasionally appears in banks and hedges. Its persistence in certain localities of this kind has given the impression of its being wild" (Dunn 1905).

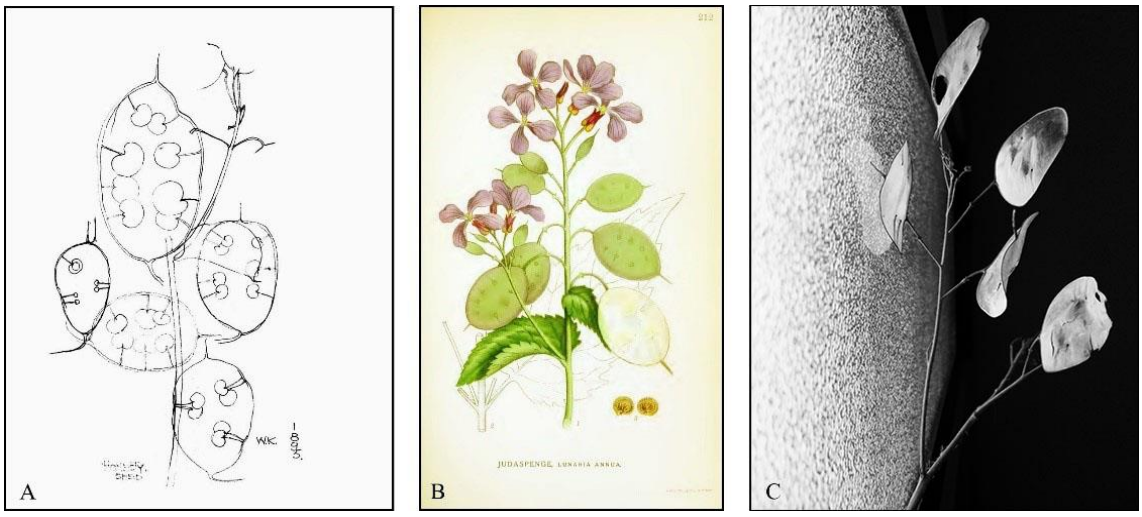


Figure 33. A. Honesty (Lunaria annua) seeds, 1895, botanical sketch by Charles Rennie Mackintosh, collection: prints & drawings, call number: PD 2010 TX 18, © National Library of Ireland. B. Honesty, 1917, botanical illustration, from Billeder af nordens flora.C. Honesty, 2014, photograph, © Sandra Santos.

While referring to the Dublin botanical sketchbook, Grogan (2002) states that "not related directly to his profession, these flower studies were essentially private and recreational". However recreational and liberated from scientifically imposed rigorousness, these drawings reflect how Mackintosh was enriching his graphic vocabulary as an artist and, at the same time, indicate his awareness towards scientific illustration.

2.3.2. The Glasgow sketchbooks and watercolours.

Table 16 lists the species depicted in sketchbooks and unbended sheets of Mackintosh's travels through the United Kingdom between 1894 and 1914, namely: The Cotswolds, Gloucestershire, Worcestershire Oxfordshire, Scotland, Kent, East Anglia, Devon, Sussex, Norfolk, Suffolk and Perthshire. Table 18 lists the watercolours produced by Charles Rennie Mackintosh, some of which co-authored by his colleague and wife, Margaret Macdonald.

Table 16. Sketchbook botanical drawings by Charles Rennie Mackintosh at the Hunterian Museum and Art Gallery, University of Glasgow: depicted plants

Document	Date	Location	Common name	Botanical name	Botanical family
Loose page drawing	1895	Unspecified	Rose	Rosa L. [Genus]	Rosaceae

The Cotswolds, Gloucestershire, Worcestershire and Oxfordshire (1894) [miscellaneous]	1895	Unspecified	Tree [undetermined]	Tree (undetermined)	Undetermined
Sketchbook drawings: Scotland and Kent (1894-1910) [miscellaneous]	1894-1895	Corrie, North Ayrshire, Scotland, UK	Bog Violet [Inscribed]	Pinguicula Vulgaris	Lentibulariaceae
	1894-1895	Corrie, North Ayrshire, Scotland, UK	Foxglove [Inscribed]	Digitalis purpurea	Plantaginaceae
	1894-1895	Walberswick, Suffolk, England, UK	Common evening primrose [Inscribed]	Oenothera biennis L.	Plantaginaceae
	1894-1895	Ascog, Argyll and Bute, Scotland, UK	Dahlia [Inscribed]	Dahlia pinnata	Asteraceae
	1894-1895	Ascog, Argyll and Bute, Scotland, UK	False Foxglove	Aureolaria flava	Orobanchaceae
	1894-1895	Ascog, Argyll and Bute, Scotland, UK	Fuchsia	Fuchsia	Aureolaria
	1894-1895	Unspecified	Tree [undetermined]	Tree [undetermined]	Undetermined
	1894-1895	Unspecified	Rose [Inscribed]	Rosa L. [Genus]	Rosaceae
	1894-1895	Langside, Glasgow City, Scotland, UK	Scabiosa [Inscribed]	Scabiosa Succisa	Dipsacaceae
	1894-1895	Langside, Glasgow City, Scotland, UK	Ligularia	Ligularia dentata	Asteraceae
	1894-1895	Langside, Glasgow City, Scotland, UK	Turtlehead	Chelone glabra	Plantaginaceae
Sketchbook drawings - East Anglia and Devon miscellaneous (1896-1902) [miscellaneous]	1896-1904	Unspecified	Bleeding-hearts	Dicentra spectabilis	Papaveraceae
Sketchbook drawings: Kent, Sussex, Norfolk, Suffolk and Perthshire (1897 - 1914) [miscellaneous]	1897-1914	Worstead, Norfolk, England, UK	oak [leaf]; [Inscribed]	Quercus L. [Genus]	Fagaceae
	1897-1914	Chiddingstone, Kent, England, UK	Lesser bindweed	convolvulus arvensis	Convolvulaceae

Of the four, the "Sketchbook of travels in Scotland and a tour of Kent", probably dated between 1894 and 1896 (Hunterian Museum and Art Gallery catalogue records), contains the most exquisite of Mackintosh's botanical simple pencil drawings. They reveal a hand of a confident and knowledgeable artist, profoundly attentive to the shapes of plants and their organic living structure. The series of drawings starts with the elongated stems of the bog violet (*pinguicula vulgaris*) (doc.232) originating from the low whorl of petals and crowned by its fragile flower. This is the first of a total of double page drawings. Others depict the full buds and flowers of the dahlia (d*ahlia pinnata*) (doc.233); the voluptuous and elegant structure of the evening primrose (*oenothera biennis L*.)(doc.234); the perfectly shaped campanulate flowers of the foxglove (*Digitalis purpurea*) and the false foxglove (Aureolaria or Agalinis) (docs.235 and 236); the peculiarly looking scabias (scabiosa Succisa) and turtlehead (Chelone glabra) (docs.237 and 238) ; and the seemingly disarranged petals of the ligularia (*ligularia dentate*) (doc.239).

All of these drawings are exquisite testimonies of Mackintosh's longing and talent for capturing the essence of natural beauty inherent to the morphology of plants; from the simplest to the most complex. These double spread depictions have a pronounced verticality and, although well-proportioned exhibit somewhat stylized features. In addition, the majority of these botanical images present partial views of plants, generally focusing on flower elements and inflorescences, often using botanical illustration techniques and composition elements: diagram-like details of flowers, but here with a subtler pencil stroke. The same stroke is found in other drawings such as the Fuchsia (*Fuchsia)* and the rose in this same sketchbook (docs.240 and 241); the bleeding-hearts *(dicentra spectabilis)* (doc.242) in the "Sketchbook of travels in East Anglia and Devon (1896-1902)" and the lesser bindweed *(convolvulus arvensis)* (doc.243) in the "Sketchbook of travels though Kent, Sussex, Norfolk, Suffolk and Perthshire (1897-1914)". These are also examples of Mackintosh's appetence for working with contours and lines, and testify to the technical development of both his observation powers, and the ability to capture Nature's character and detail.

On the whole, a significant part of Mackintosh's botanical sketches is deprived of any colour. This does not necessarily mean that colour was of little importance to him,

on the contrary. Flowering plants present us with some of the most varied and rich colour pallets in nature, and his senses were most probably touched by colour as well as shape, even in his earliest drawings. In his sketch of the, previously mentioned, orange lily (*Lilium bulbiferum L.)* (doc.231) he inscribes on the bottom, next to the stem "ALL GREEN", what may seem as a simple jotting, actually indicates a perception of colour that indicates the appearance of the flowering plant in this precise phase of its lifecycle. The orange lily is, in fact, all green on the outside before it fully blossoms, what may also be a note for a posterior depiction of this plant[222]. As linear work allowed Mackintosh to develop his graphic vocabulary, his watercolours would have certainly enhanced his perception of colour. Blunt and Stearn (1993) explain that:

> Most beginners in flower drawing are desirous of rushing into colour before they can sketch, unaware that the most gorgeous daub, however laboured, if incorrectly drawn is only a crude effort at "paper staining", as it is technically termed. The eye of a qualified critic is not to be foiled by colour. Facility in colouring is easily acquired, but a correct eye for drawing is only to be rendered by constant observation. Blunt and Stearn (1993)

In his later sketches, Mackintosh's attentive work with fine lines, developed through the years, is combined with watercolour washes, especially from 1901 onward; many co-authored by Margaret Macdonald (doc.244). Table 17 lists the botanical specimens depicted in his watercolours currently kept by the Hunterian Museum and Art Gallery. The complete group of watercolours is shown in doc.244, and the botanical species there represented are listed in appendix 1.

Table 17. Botanical watercolours by Charles Rennie Mackintosh at the Hunterian Museum and Art Gallery, University of Glasgow: depicted plants

Date	Location	Common name	Botanical name	Botanical family
1901	Unspecified	Monkshood	Aconitum napellus	Ranunculaceae
1901	Holy Isle, North Ayrshire, Scotland, UK	Sea-pink	Armeria maritima	Plumbaginaceae

[222] We see similar annotations in the sketchbooks of John William Waterhouse, associated with sketches of plants, mostly trees.

Date	Location	Common name	Botanical name	Botanical family
1901	Holy Isle, North Ayrshire, Scotland, UK	Sea pink / Thrift	Armeria maritima	Plumbaginaceae
1901	Holy Isle, North Ayrshire, Scotland, UK	Stork's Bill	Erodium cicutarium	Geraniaceae
1902	Holy Isle, North Ayrshire, Scotland, UK	Cranesbill / Herb Robert	Geranium robertianum /Geranium canariense	Geraniaceae
1904	St Mary's, Isles of Scilly, Italy	Ivy Geranium	Pelargonium peltatum (L.) L'Hér. ex Aiton	Geraniaceae
1904	St Mary's, Isles of Scilly, Italy	Carnation	Dianthus [Genus]	Caryophyllaceae
1909	Withyham, East Sussex, England, UK	Spurge	Euphorbia [Genus]	Euphorbiaceae
1909	Withyham, East Sussex, England, UK	Greater Periwinkle / Big leaf periwinkle	Vinca major L.	Apocynaceae
1909	Withyham, East Sussex, England, UK	Rhododendron	Rhododendron wardii var puralbum	Ericaceae
1910	Chiddingstone, Kent, England, UK	Common lime (leafs)	Tilia europaea	Malvaceae
1910	Chiddingstone, Kent, England, UK	Blackthorn	Prunus spinosa	Rosaceae
1910	Chiddingstone, Kent, England, UK	Cuckooflower	Cardamine pratensis L.	Brassicaceae
1910	Cowden, Kent, England, UK	Horse Chestnut	Aesculus hippocastanum	Sapindaceae
1910	Cowden, Kent, England, UK	Clematis	Clematis viticella	Ranunculaceae
1910	Chiddingstone, Kent, England, UK	Hazel	Corylus avellana L.	Betulaceae

Date	Location	Common name	Botanical name	Botanical family
1910	Chiddingstone, Kent, England, UK	Japonica / Japanese quince	Chaenomeles japonica	Rosaceae
1914	Walberswick, Suffolk, England, UK	Rock-Kress	Aubrieta deltoidea	Brassicaceae
1914	Walberswick, Suffolk, England, UK	Larkspur	Consolida ajacis L.	Ranunculaceae
1914	Walberswick, Suffolk, England, UK	Petunia	Petunia hybrida	Solanaceae
1914	Walberswick, Suffolk, England, UK	Stagthorn	Crataegus monogyna Jacq.	Rosaceae
1914	Walberswick, Suffolk, England, UK	Hoary Stock	Matthiola icana	Brassicaceae
1914	Walberswick, Suffolk, England, UK	Double Stock	Matthiola icana	Brassicaceae
1915	Walberswick, Suffolk, England, UK	Anemone	Abemone cernua	Ranunculaceae
1915	Walberswick, Suffolk, England, UK	Pasque Flower	Pulsatilla subslavica	Ranunculaceae
1915	Walberswick, Suffolk, England, UK	Strawberry-tree	Arbutus unedo L.	Ericaceae
1915	Walberswick, Suffolk, England, UK	Fritillaria	Fritillaria meleagris L.	Liliaceae
1915	Walberswick, Suffolk, England, UK	Common Gorse	Ulex europaeus	Fabaceae
1915	Walberswick, Suffolk, England, UK	Hazel tree	Corylus avellana L.	Betulaceae
1915	Walberswick, Suffolk, England, UK	Japanese Witch Hazel	Hamamelis japonica	Hamamelidaceae
1915	Walberswick, Suffolk, England, UK	Jasmine	Jasminum nudiftorum	Oleaceae
1915	Walberswick, Suffolk, England, UK	Scots Pine	Pinus sylvestris	Pinaceae
1915	Walberswick, Suffolk, England, UK	Rosemary	Rosmarinus officinalis L.	Lamiaceae
1915	Walberswick, Suffolk, England, UK	Veronica / Hebe	Hebe rakaiensis	Plantaginaceae

Date	Location	Common name	Botanical name	Botanical family
1915	Walberswick, Suffolk, England, UK	Veronica / Hebe	Hebe speciosa	Plantaginaceae
1919	Buxted, East Sussex, England, UK	Rosebay Willow-herb	Chamerion angustifolium	Onagraceae
1924	Amélie-les-Bains-Palalda, East Pyrenees, France	Mimosa	Acacia dealbata	Fabaceae
1925	Mont-Louis, East Pyrenees, France	Black pine	Pinus nigra	Pinaceae

Although without all the meticulousness of a scientific illustrator, Margaret and Charles' simple pencil drawings and watercolours present several features that connect to scientific illustration techniques. Plants, primarily flowers, provided him with an immense chromatic diversity of colour tonalities and gradations. He shows a preference for maintaining the original colour of the plants represented and, in many cases, replicates perfectly the nuances of colour we see in the real life specimens e.g. the monkshood (*Aconitum napellus*), fritillaria (*Fritillaria meleagris L.)* (docs.245 and 246). In various watercolours he would also leave uncoloured areas sideways, overlapping, underlapping or integrating the main botanical subjects (e.g. ivy geranium (*Pelargonium peltatum L. L'Hér. ex Aiton*), carnation (*Dianthus*), blackthorn (*Prunus spinosa*), japonica (*Chaenomeles japonica*), rock-kress (*Aubrieta deltoidea*), the pine cone and needles (*Pinus*) (docs.247 to 252) . This is also a common practice in botanical illustration.

2.3.3. Art? Science? Both?

While going through the botanical drawings of Charles Rennie Mackintosh we find a great variety of plant species. Figure 34 shows their distribution by taxonomic family rank. Here we observe predominance of those belonging to the *Ranunculaceae*, *Plantaginaceae*, *Brassicaceae* and *Rosaceae* families and a particular interest in flowering plants. Mackintosh also made notes on geographic location in many of his drawings. His watercolours, for example, all contain this kind of inscription. This allowed us to map the areas where most of these plants were sketched (figures 34, 35 and 36). As for those that lack any inscription concerning location, we can have an idea of their geographic distribution through the travel sketchbooks they integrate; by accessing catalogue records and previous studies (Robertson 1995, Gallery 1988, Grogan 2002).

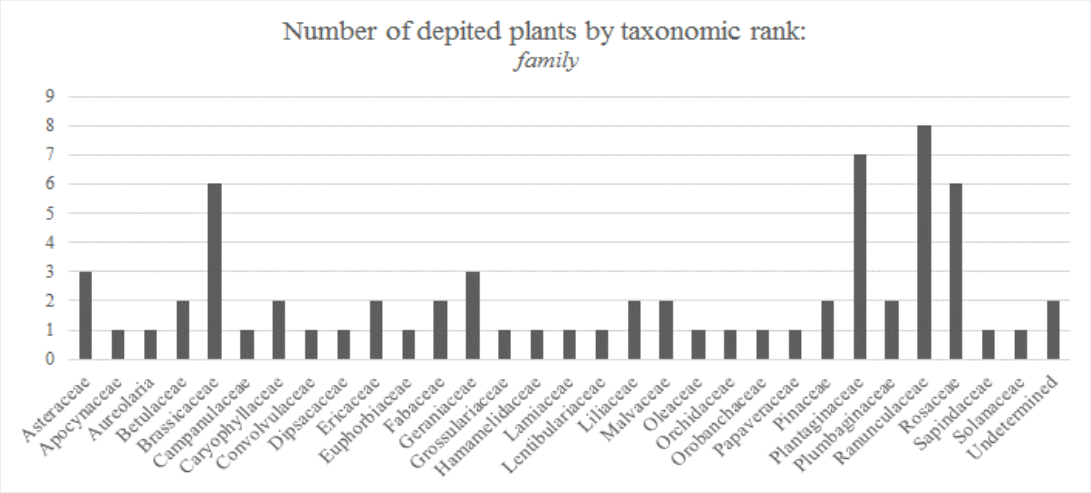


Figure 34. Graph illustrating the number of botanical species sketched by Charles Rennie Mackintosh. Collections: National Library of Ireland and Hunterian Museum and Art Gallery, University of Glasgow.

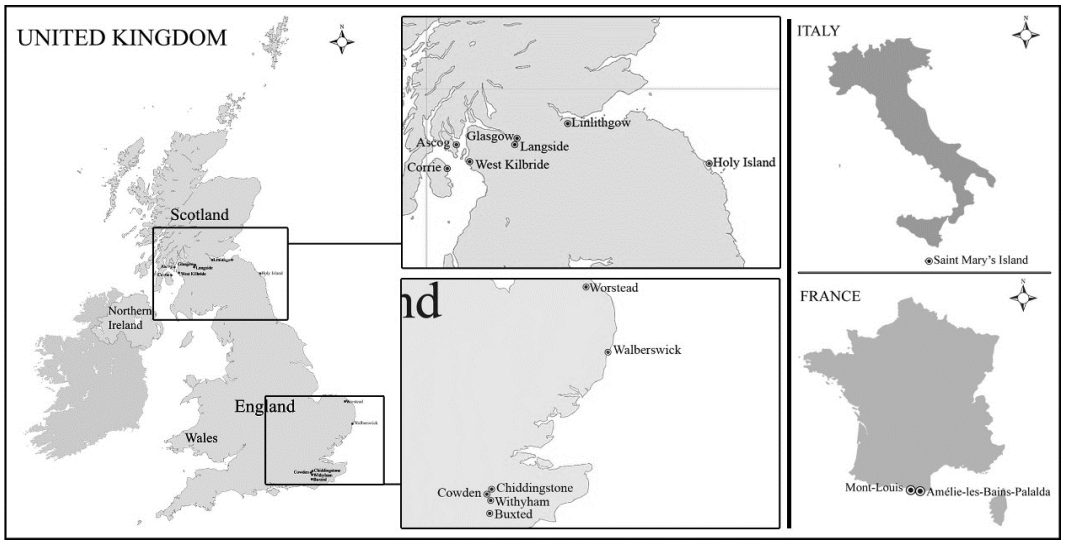


Figure 35. Charles Rennie Mackintosh's botanical drawings and watercolours: overall geographic distribution of depicted plants.

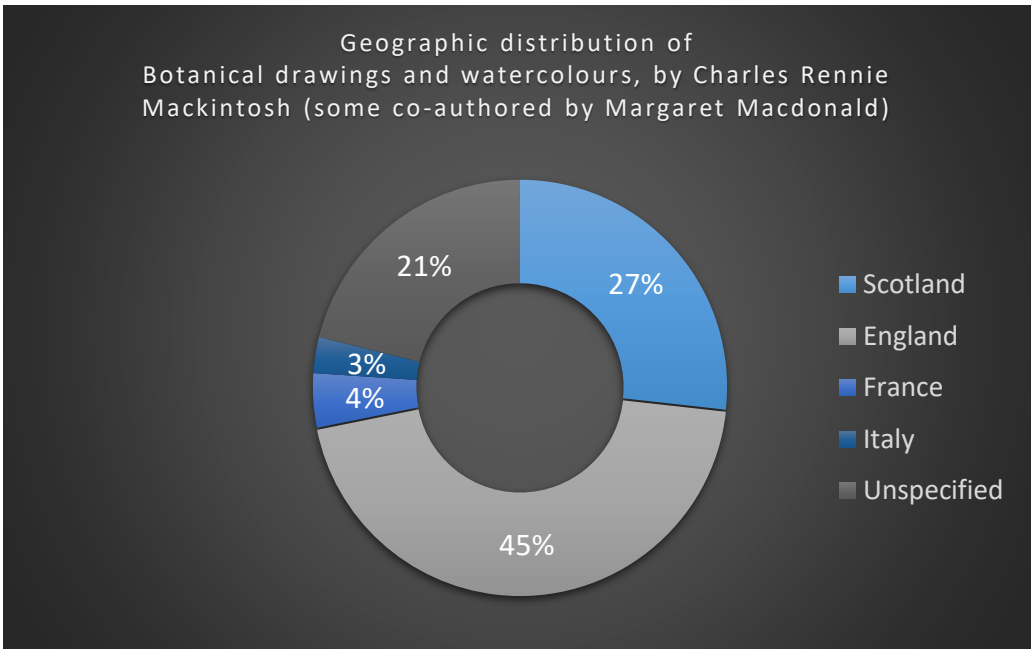


Figure 36. Graph showing the geographic distribution of the botanical drawings by Charles Rennie and Margaret MacDonald.

Most of these drawings were produced in the United Kingdom. Close to half of the identified locations (45%) correspond to Southeast England through the counties of East Sussex, Kent, Suffolk and Norfolk. 27% are located in Scotland, in the regions of Ascog, Argyll and Bute, Glasgow City, North Ayrshire and West Lothian. There are also two watercolours that were made in Saint Mary's Island in Sicily, an Ivy Geranium (*Pelargonium peltatum L. L'Hér. ex Aiton*) and white Carnations (*Dianthus*); and another

two that were made in France, in the region of the East Pyrenees, a Mimosa (*Acacia dealbata*) in Amélie-les-Bains-Palalda, and a Black pine (*Pinus nigra*) in Mont-Louis.

Biologist and scientific illustrator Pedro Salgado explains the importance of observation drawing:

> while part of the preliminary studies towards a final art of a scientific illustration is undeniable, but the potential of field sketching per se exceeds the expectations as complement of the scientific drawing, gaining a life of its own, emancipating itself as an extraordinarily motivating exploration of the unbound sketch, with a space for error, with great effectiveness in renovating the graphic vocabulary. In short, a counterpoint for the time spending, disciplined, meticulous and unpolluted work that characterises scientific illustration. (Salgado 2011)

The way Mackintosh, in later stage together with Margaret MacDonald, explored Nature and particularly the botanical *motif*, places him in a frontier territory where the artistic and the scientific may not only meet but touch and complement one another. The truth of a purely empirical approach to nature by the artist is, in fact, as valid as the truth the scientist seeks to comprehend while observing and experimenting with natural elements? The answers each one gets depends on the questions asked. The potential for understanding and appreciating nature is there for the taking and we find Mackintosh clearly searched for both. A symbiotic relation between the aesthetic inspiration and creative thinking of the artist and the curiosity, the deconstructive power of observation in the inquisitive mind of the science lover. These two universes put together make these "hybrid-like" drawings filled with possibilities.

Pamela Robertson and Elaine Grogan have opened this promising path of discovering the botanical work of Charles Rennie Mackintosh. By providing us with a detailed biographic records of the artist's life and work and by focusing attention on the botanical universe of his visual records they have set the standards high for those who wish to explore this subject. One finds that if the right questions are asked, the answers may reveal themselves to be relevant and enriching to Art and Science.

In a 2011 pamphlet on Botany and Art in conservation, we can read:

> More than 20 percent of the world's 350 000 known plant species are in danger of extinction, according to the estimates of conservationists. Thousands of these plants have never been described by science. If any are lost, they will be lost even to human memory. Botanists around the

> world are racing to make records of threatened species, the first step in any conservation effort. Working along with them are botanical artists, who provide “visual descriptions” of plants.”(Institution 2011).

While comparable to botanical illustrations, these drawings have their own place between science and art. Moreover, by offering testimony of these plants’ existence, in most cases, in a given location, over one hundred years ago, do contributes to botanical knowledge and thus for science. Providing visual records of these plants enriches artistic and scientific botanical iconography. It makes knowledge accessible to those who wish to approach it, in whichever perspective they find more relevant to a given field of study, whether it be art, science or both. Sketchbook drawings and final art can be read, admired, analysed or interpreted, and show us a reality where art can be a source of relevant scientific information and science can be beautiful and a source of inspiration.

2.3.4. Margaret and Charles: Nature through their eyes

The election of the flower as decorative motif to adorn design patterns, objects and ornaments was very common among the aesthetic tendencies, predominantly from the mid-1800s onward. We find it throughout an immense visual universe that contributed much to define the aesthetics of British design, transversal to areas such as textiles, book illustration, furniture, wallpaper and ornamental-functional objects. Adding a selection of creative works by both Charles Rennie and Margaret Macdonald Mackintosh to this comparative universe. The purpose of this exercise was to identify familiarities to the plants sketched by Mackintosh and to reflect on how the objectiveness of nature’s shapes may become creative aesthetic subjectivity. Looking at both Charles Rennie and Margaret Macdonald’s creative work, the rose emerges as the most common of floral motives, having become the symbol of the Glasgow style.

(Robertson 1995, Gallery 1988). Figures 37A and 37B show works by Margaret Macdonald and Charles Rennie Mackintosh, both with the “rose” motif.

Figure 37. A. Margaret Macdonald, Design for menu card for Miss Cranston's 'White Cockade Restaurant' 1911 (public domain). B. Charles Rennie Mackintosh, Cabinet, ca. 1902, ©Tony Hisgett. C. Rose, 2014, ©Sandra Santos.

Compositions such as the 1900 cast panels “The Wassail" (doc. 253), by Charles Rennie Mackintosh and “The May Queen” (1900, doc.254) by Margaret Macdonald are covered with stylized plant forms, long sinuous stems and floral elements that, beside the rose, resemble the sea-pink or the candytuft. In Charles Rennie’s “In Fairyland” (1897. doc.255) we find a bursting universe of flowering colour. Campanulate flowers and fine stems with heart-shaped leafs compose the bottom. Entangling stems support shapes resembling the rock kress (*Aubretia deltoidea*), and also cup-shaped flowers such as the blooming Anemone (*Anemone)* and the pasque flower (*Pulsatilla*)

Cup-shaped flowers are also a predominant motif in several of Mackintosh’s decorative murals and panels, such as the designs created for Miss Cranston’s Tea Rooms, in Glasgow (1896), or textile designs e.g. “Tulip and lattice”, stained glass patterns, furniture decorative motifs or decorative objects such as lamps. In conclusion, the botanical drawings of Charles Rennie Mackintosh, present various species of predominantly flowering plants. The majority of the drawings were produced in England and Scotland and four drawings made overseas, in France and Italy.

We find numerous features approximating Mackintosh’s botanical drawings to scientific illustration, indicating that he was knowledgeable of scientific practices of illustrating plants and put them into practice while sketching. Well at the centre of the artistic and scientific contexts of Victorian culture both Charles Rennie Mackintosh and Margaret Macdonald were profoundly influenced the organic forces of nature and the

morphology of plants. By exploring them in an interdisciplinary perspective, this study aims to contribute for the understanding of the intertwined relationship between Art and Science in botanical sketchbook drawing. Drawing, was and *is*, as demonstrated, one of the most accurate, powerful and challenging tools to create botanical images, common to science and art.

In conclusion, observation drawing allows to approach, observe and depict Nature with not many filters aside from the effects of the environment and the artist's own knowledge and perception. As we have seen, a botanical drawing may be created by an artist, with an artistic purpose, within an artistic context, as part of an artist's training and practice, and simultaneously be informed by scientific knowledge. What is more, the two dimensions, may, in fact, be complementary. This rejects the preconception that a botanical study contained in an artist's sketchbook is exclusively relevant to the history of art or that a botanical illustration may only be regarded as a scientific explanation, even though this was its original intent. Plus, we argue that the multidisciplinary potential contained in a botanical drawing such as the ones we have just explored, does not take from the original purpose it was created but rather adds the potential for another dimension. This does not mean that all botanical drawings have these features or this potential, but that acknowledging those that do, can, in fact, contribute to enlarge the multidisciplinary spectrum of possibilities of their study as well as the potential of their contributions to both Art and Science. The same applies for other mediums, aside from observation drawing. Photography, for example, although a completely different visual record, is one of those cases. Difference, nonetheless, can also promote variety and complementarity, two extremely valuable features to seek for when thinking of the botanical image as a whole.

3. CASE STUDIES: SCALE VARIATIONS IN CAPTURING THE NATURAL WORLD: BOTANY IN PHOTOGRAPHY AND PHOTOMICROGRAPHY

In this section we explore the botanical image in conventional photography and in photomicrography. Firstly, with the study of the photographic work by Aurélio da Paz dos Reis, Portuguese filmmaker, photographer and floriculturist, featuring plants and mainly flowers. Secondly, with a comprehensive study on photomicrography; its development from being exclusively associated with science, to the evolution of pictorial photomicrography, where science and art were two relevant sides of the same medium to register the minute dimensions of the vegetable world.

At first glance, the major difference between creating drawings and creating photographs is that the first relies exclusively on the executant and on the subject, whereas the second, relies on both but is dependent and is only possible to obtain through an apparatus external to both executant and subject. We could argue that the same happens with drawing, as the graphite or any other material used to draw, is a mediator between the subject, the draughtsman/draughtswoman, and the medium. However, the graphite does not come between the artist's perception and the subject, while in photography, the apparatus plays a determinant role in what of the subject is perceived and how. In many cases, such as in photomicrography, it's role is not only relevant but essential to the reach of human vision and perception.

In his letters to beginners in drawing, John Ruskin stated that if done rightly, drawing will, by far, provide an image "more lovely and interesting than any photography can be" (Ruskin 1857b, 88). Nonetheless, he did recognise photography to be a useful resource to go to when drawing directly from nature was not possible (Ruskin 1857b, 140-141). The emergence and consequent divulgation of photography brought a new way of registering and observing the world. Although it divided opinions, photography became a highly prominent tool for both artists and scientists; the way they observed, perceived and registered the world around them. Less divided torn Ruskin on this matter, Kenyon Cox (1917, 315) considered photography the most influential factor to the perceptions and representations of Nature, for the British artistic revolution which occurred during the second half of the nineteenth century.

Despite controversy and mixed opinions, some of which remain until this day, be it in real scale, macro or micro, the power of photographic images as informants of science is well-grounded and perfectly established. It took much time, though, for the same to happen with its artistic facet, as it wasn't always regarded and appreciated for its aesthetic and/or creative qualities, nor was it considered creation, but rather an objective and truthful record of reality, which had no interference from human subjective qualities of creativity or imagination.

Returning to Ruskin:

> Flowers, like everything else that is lovely in the visible world, are to be seen rightly with the eyes of which the God who made them gave us; and neither with microscopes nor spectacles… the use of the great mechanical powers may indeed sometimes be compatible with the due exercise of our own but the use of instruments for exaggerating the power of sight necessarily deprives us of the best pleasures of sight. A flower is to be watched as it grows, in its association with the earth, the air, and the dew; its leaves are to be seen as they expand in sunshine; its colors, as they embroider the field, or illuminate the forest. Dissect or modify them, and all you discover or learn at last will that Oaks, roses and daisies, are all made of fibres and bubbles, and these, again, of charcoal and water, for all their peeping and probing, nobody knows how. (Ruskin and O'Gorman 2012, 277)

For Ruskin, knowing the inner layers of plants had the purpose of discovering how they behave, grow, and not mandatorily for their visual appeal. This allure of uncovering and understanding the "whys" and "hows" in regard to the vegetable world had much influence in the discovery and development of photomicrography.

A major part of the scientific value as well as the allure of microscopy lies in the fact that, in addition to magnifying the scale of things we already see, it also allows us to visually perceive a reality otherwise inaccessible to the human eye. From the first optical photomicrographs, many of which featured botanical specimens such as diatoms to today's images obtained with high-end technology, the development of photomicrography has been a grand-scale challenge to fields such as physics or, more recently, electronics, computer-imaging and engineering. The introduction of ultra-violet light, polarised light, infrared photomicrography and scanning electron photomicrography are examples of advances within this field. As a result, exponentially higher powers of magnification and accuracy were achieved, optical limitations such as

astigmatism and chromatic aberrations were overcome, and features such as contrast and exposure were optimised. Karl Zeiss's 'automatic attachment', for instance, was a technology developed in the late 1960s with the purpose of automatically ensuring correct exposures and eliminating vibration while photographing microscopic subjects. Consequently, botanical photomicrography – alongside more recent variants, such as time-lapse microscopy and video microscopy – became one of the most accurate and 'truthful' means for registering minute details of plants that are inaccessible to human unaided vision. Botanical photomicrographs have become indispensable to the understanding of plants: what they are made of, how they grow, reproduce and decay; how they act, react and interact in particular circumstances and contexts. Consequently, botanical photomicrography has helped to shape the understanding of the natural world and to sustain the progress of science and technology through decades of evolution.

Finally, our last case study delves into the universe of photomicrography during the Victorian period and until the mid-twentieth century. It explores the evolution of photomicrography and evidences the connection between "pictorial" and "scientific" in microscopic images, with special attention to botanical subjects.

3.1. A story of three passions: Aurélio da Paz dos Reis, Portuguese floriculturist, photographer and filmmaker

In this chapter we start by presenting the photographer, his passion for flowers and introduce them as a preferred subject for his work with still images. We go on to present the shortlisted images for the present study (from a pre-selection of 173 images we short-listed 103 images to construct our analysis). Lastly we go on to the study of the images themselves, based on the subject, alluding to the compositions found in his work, as well as the botanical specimens which are possible to identify among them.

Aurélio da Paz dos Reis (1862 – 1931) is mostly known for his work as one of the pioneers of cinema in Portugal[223], but also greatly acclaimed as a photographer and acknowledged as a passionate and creative horticulturist. The drawing shown in doc.256, authored by Manuel de Monterroso, portrays him in these three facets. Aurélio is depicted operating a folding wood camera, as if photographing the two vases with flowers strategically positioned on the floor. The translated author's inscription reads:

> "AURÉLIO DA PAZ DOS REIS – (1862 – 1931). Floriculturist, intelligent and passionate amateur of photography, one of the 31 of January[224], possessed the cult of friendship, with a fine and interesting manners".

Aurélio was also the proud owner of a commercial establishment in the heart of the city: the "Flora Portuense"[225]. He opened to the public in 1893 and supplied costumers with seeds, bulbs, plants and flowers ever since. Docs.257 to 259 authored by the photographer, are interior and exterior views of the shop. Outside the sign reads "FLORA PORTUENSE. SEMENTES E FLORES" (FLORA OF OPORTO. SEEDS AND FLOWERS). The first picture portrays him inside the shop surrounded by floral decoration on the walls and furniture. The featured theme of Botany all around, from the walls, to the décor, to all sorts of glass vases carefully on display and finally the drawers which most probably held

[223] For more information on Aurélio's role in the beginnings of Portuguese cinematography and a deeper biography, see, for instance (Santos 1990, Reis 1998, Serén 1998).

[224] Referring to the first failed liberal attempt to overthrow the monarchy and implement a republican regime in Portugal, in 31 January 1891. Aurélio da Paz dos Reis took part in the attempted *Coup d'État* and became a well-known supporter, disseminator and visual chronicler of republican values (Serén and Siza 2001, 126).

[225] Translated to "The flora of Oporto".

the seeds sold in the store. Most of the plants and seeds sold here were certified specimens cultivated in his own gardens and greenhouse, located in the city, adjacent to his family house in Nova Cintra.

A multidimensional man who was an exceptional documentarist of Portugal, its people and identity; as well as a prolific creator of images of the natural world, very often amidst picturesque northern sceneries or the subtle urbanity of Oporto[226]. Moreover, in his pictorial universe, plants and flowers are not only recurrent but repeatedly feature as the main subject in photographic compositions.

Today, Aurélio's work is located in several archives and collections, but primarily found at the Centro Português de Fotografia (Portuguese Centre of Photography), and the District archive, both in Oporto. These house most of his photographic work. In addition, but much less in quantity, most of what survived of his moving images is now under the care of the Cinemateca Portuguesa (Portuguese Cinematheque) in Lisbon. Although in the scope of this investigation both archives were researched, Aurélio's photographic legacy featuring plants and flowers is mainly part of the Centro Português de Fotografia's collections. The majority are glass negatives, many of which stereoscopic plates, and compose the documental core for this study. Appendix 1 shows the complete listing of the 103 images shortlisted for this study[227].

After a close analysis we find that plants and flowers feature in three main photographic categories among Aurélio's work. These categories are determined by primary subject and composition, where plants and flowers are either one of several elements in general views, on the background and/or the foreground, or where they are the main subject in compositions with variable degrees of preparation and staging. The first category presents interior and exterior individual or group portraits of family and friends with floral surroundings. The second presents plants, mainly flowers, as the central topic of studio staged photographic compositions. And the third is comprised of images of the numerous flower exhibitions held at the Cristal Palace in Oporto. It is also

[226] Sérgio Andrade states that, at first Aurélio's avid eye was attracted to everything that moved (Andrade 2002, 43).

[227] These were shortlisted from a pre-selection of 173 images.

the most significant in terms of both quantity and emphasis given to botanical subjects, as we will see. Table 18 lists 14 different species found in Aurélio's photographs featuring plants.

Table 18. list of botanical species featured in photographs by Aurélio da Paz dos Reis.

Common name	Botanical Name / genus	Botanical Family
Arum Lily	Zantedeschia aethiopica	Araceae
Camellia	Camellia	Theaceae
Carnation	Dianthus	Caryophyllaceae
Dahlia	Dahlia Cactus	Asteraceae
Delta Maidenhair Fern	Adiantum raddianum	Pteridaceae
Gloxinia	Sinningia speciosa	Gesneriaceae
Hyacinthus	Hyacinthus	Asparagaceae
Narcissus	Narcissus	Amaryllidaceae
Pea plant	Pisum sativum L.	Fabaceae
Rose	Rosaceae	Rosaceae
Spotted Lily	Lilium	Liliaceae
Wild Pansy	Viola Tricolor	Violaceae
Wisteria	Wisteria	Fabaceae
Orchid	Orchidaceae	Orchidaceae

The first category of Aurélio's botany-related work documents excerpts of his personal life and relationships. The garden of Nova Cintra, Oporto, sets the scenery for many of his group portraits, most of them having the garden as the background. Despite the lack of colour of these photographic records, the variety of plants these pictures show let us imagine the universe of colours and forms Aurélio had presented his garden with, and which he had the privilege to observe daily. To serve both his and the family's personal fruition as well as the ongoing stock of flowers and seeds to the shop, the garden must have been significantly rich in quantity as much as variety all throughout the year. Docs.260 and 264 include group portraits. Both rehearsed and spontaneous scenes were captured by Aurélio, portraying his family enjoying the garden. Each one of these images shows a different point of view, and the variety of vegetation and floral elements in each image leads us to picture a significantly big piece of landscape adorned with shrubs, trees, as well as flowering and non-flowering plants, disposed in flower beds and vases.

One of the most impressive and idyllic example of the botanical specimens which inhabited Aurélio's garden, was a great white wisteria. We find it framing one of the group photographs taken in the garden (doc.260, on the left). The wisteria flowers and

branches, most probably cuttings from this same tree, appear in another photograph. This time the wisteria, sharing the foreground with the clay statue of a female figure doc.260 (on the right). The drapery background suggests that the latter was assembled and captured inside, either in his studio or another venue (e.g. one of the many flower exhibitions his flowers were entered). The same background is found in most of Aurélio's flower arrangements, the majority of which feature the logo of "A Flora Portuense". Observing closely some of his general views of the garden at Nova Cintra, we can actually extrapolate where many of the plants and flowers featured in his many photographs of flower arrangements were grown, either in exterior nurseries, flower beds or the greenhouse. This brings us to the second category of his photography featuring plants: flower arrangements.

Flower arrangements are very common in Aurélio's work. As previously mentioned, crossing the images of flower arrangements with the different views of his garden, most commonly present in group pictures, allows us to draw a significant number of parallels between the plants and flowers photographed in staged compositions, and the nurseries, flower beds and greenhouse they were most likely to have been grown in. On the whole, aside from the wisteria, these parallels include roses, camellias, gloxinias, hyacinthus, narcissus and the delta maidenhair fern. A few other species, such as tulips, carnations, Viola tricolor and spotted lilies, are also represented in his flower arrangements. These are not discernible within the photographs of the garden consulted for this study; nonetheless, the fact that they are accompanied by the logo of the "A Flora Portuense" indicates they must have also been grown within the premises of the property of Nova Cintra.

Roses appear in seven photographs of his flower compositions, either as a main or secondary subject. These are likely to be cuttings of the rosebush growing by the wall seen in yet another family portrait in Nova Cintra, shown in doc.261 (where we can also identify an Arum Lily, on the left). Given their aesthetic appeal, popularity, and the ability to adapt easily to various grounds, there is a high probability that roses were grown in more than one spot within the property. Doc.262 shows Aurélio's flower arrangements with roses. These are, in fact, four different compositions, but some (as colour code on the image indicates) are duplicates of the same composition but with

different treatment of light. The last one of the group is one of the rare examples where the photographer hand-coloured the glass negative. The same can be seen in one of the arrangements featuring hyacinthus and Narcissus, which seemed also to be among Aurélio's preferred flowers.

In the photograph "Hugo Virgílio at the flower beds in Nova Cintra" (doc.263, top left) we can see the young man strolling through a bed of Hyacinthus (in the foreground) and Narcissus (in the background). In the centre of the lot, the plaque referring to the "Flora Portuense" clearly identifies them as flowers destined to supply the shop and the various flower exhibitions Aurélio entered. His flower arrangements featuring the two species are likely to have been photographed in the same period, as the scenery and elements of the composition are clearly identical. As with the rose compositions, some of these are actually photographs of the same ensemble with various light treatments, while another is hand-coloured, although in a rougher manner (doc.263). The camellia. We find it adorning one of the fences of the garden, in a scene where some of the family members are picking flowers. The other is a *plain air* close-up photograph of the white camellia in bloom, probably in the garden at Nova Cintra, as well (doc.264).

Another relevant parallel between the garden domestic scenes at Nova Cintra and the photographs of flower arrangements, relates to the gloxinia (doc.265). The only surviving photograph exclusively dedicated to this flowering plant is presented in a stereoscopic negative in an advanced state of deterioration (doc.264, bottom). Nonetheless, the spectral-like photograph of the gloxinia in full bloom is one of Aurélio's most exquisite botanical images. The same species is also photographed among the vases aligned in front of one of the façades of the house, in another photograph where the family poses framed by the tall windows (doc. 264, top). The gloxinia makes its third appearance inside a greenhouse (doc. 264, centre). Although there is insufficient data to identify this as Aurélio's greenhouse, it is highly likely that it is the greenhouse at Nova Cintra. However, it may also be a friend's greenhouse, as another photograph of the collection presents the work of two gardeners inside the greenhouse of his friend António Júlio da Costa[228], on the right, is possible to distinguish a japanese Iris. Doc.266,

[228] According to the inventory information at the CPF.

this image as well as two other photographs where we can see the Japanese Iris. The two floral arrangements are accompanied by the plaque of the "Flora Portuguesa" as Aurélio would have his own culture. The same happens with the tulips present in two floral compositions in a very baroque-like appearance which close this series of staged compositions in studio (doc.267). The last of Aurélio's floral compositions feature mainly flowers (e.g. viola tricolour, carnations, spotted lily) and occasionally non flowering elements such as the delta maidenhair fern, carefully placed on paper as if drawing borders (doc. 268). Docs. 269 and 270 show two other types flower arrangements, in this case, more conventional, as also seen in the work of French photographer Adolphe Braun (1812 – 1877), for instance (doc.270). Still on arrangements, Aurélio has left a copious number of crowns of flowers, which can be seen in doc. 271.

Another flower very commonly present in Aurélio's work, and his most cherished one, was the Dahlia. His passion for dahlias was clear and growing by the turn of the nineteenth century. In 1902 he was awarded with a first prize for his very own creation: the "Dhalia Cactus", the name most likely due to its "thorny-like appearance" which, from then on appeared in many events where Aurélio showcased his work, not only as a photographer but as an acclaimed floriculturist. Docs.272 to 290 show a series of photographs representing the Dahlia Cactus, as well as others of the same genus, or as primary subject. In addition, doc. 291 features one of two works which we find to go out of Aurélio's most characteristic style. The photograph of a Dahlia Cactus next to a spider building its cobweb. It is unclear if there was an intentional main subject to this image or if both share that place by coincidence and the photographers sense of opportunity. It is, nonetheless a composition quite different to the whole of his work. The second (doc. 292) is a more elaborate and bold image for the time. Resonating the work of Bertel Bager (doc.293), for example, even slightly hinting a Karl Blossfeldt-like look (doc.294), Aurélio endeavours to photograph peapods. The image suggests a look into the aesthetic value of non-obvious elements of the vegetable kingdom, which is inherent to the work of the two above-mentioned photographers. Although staged, the composition has a differentiating character that distinguishes it from other known compositions of the same photographer. Could this have been the attempt at a parallel style? A variation of the way he looked and sought to register the vegetable realm? The

fact that there are no similar images among the collections consulted for this study leaves this question partially unanswered; however, it is a nice thought that he would have a will to explore other ways of looking and registering the botanical world. In another note, his overall interest for everything flower-related is extremely present in his photographic work and this, coupled with his journalistic view of the society he lived in made it possible for these views to be part of our present pictorial universe.

The third category of botanically-related photographic work presents the context of flower exhibitions held at the Crystal Palace in Oporto[229]. Many of these images reproduce the long-gone Cristal Palace in Oporto. These images (docs.295 to 304) are testimony of his personal interest in plants and flowers and also the documentarist side of his work as a photographer[230]. The venue received many of these events, some theme-lead, such as the chrysanthemums or the roses exhibitions, and they remain as a mark of the urban life of the city and the role plants and flowers occupied among the people of that time, either for curiosity or passion, two features Aurélio clearly had for Nature's wonders.

We find Aurélio's visual records of botanical specimens are, with rare exceptions, more conventional portraits of plants and flowers then pictorial experiments. The garden's images, as well as the photographs at the Crystal Palace reflect the alliance between the documentarist, the photographer and the horticulturist. A valuable testimony of the interest for flowers in Oporto at that time as well as the, now-long gone, venue itself. As for his floral compositions, most of them, with adornments like vases, baskets or pots are the epitome of the traditionalist studio-staged sceneries of the late 1800s and early 1900s. The most original of Aurélio's flower compositions of the sort are, nonetheless his flower borders. The majority is composed by the flowering parts of plants, including his famous Dahlia Cactus. The latter, as we have seen, is one of his featured botanical subjects, and also the result of his work as a horticulturist. The only images of *his* Dhalia kept by the CPF are cuttings, most of which as part of

[229] The Crystal palace was projected by the British architect Thomas Dillen Jones, to receive the Great International Exhibition in 1865 and demolished in 1951. Dillen Jones based his project on the Crystal Palace built in London on occasion of the Great Exhibition of 1851.

[230] A great characteristic of his film work as well.

horticultural competitions Aurélio entered. Curiously, we found no photographic records of the Dhalia Cactus in Aurélio's garden or greenhouse. Let us not forget, however, that to photograph at that time was very different than it is now. Techniques were much more complex and time-consuming; leaving fewer opportunities for numerous reproductions and also demanding a more scrutinised selection of what to photograph.

For the most part, Aurélio's photographs portray garden flowers grown by himself, as wild flowers are rarely seen in his compositions. In addition, with the exception of the plants appearing in his photographs in the garden or the greenhouse, it is also quite rare to see the whole structure of plants in Aurélio's work. Consequently, elements such as leaves or whole stems are very often absent of his botanical images, the main subject being their flowering parts, very often only the flower itself (calyx and corolla).

In conclusion, aside from providing the visual record of diverse species of plants, locating their existence in time and place, which, in itself, is a valuable contribution, we find Aurélio's photographs of plants primarily fill the role of natural ornaments both as cuttings and planted. The aesthetic features of the plant being what most attracted the photographer's attention. The care and minutia seen in the arrangement of his staged compositions shows his meticulous nature as a constructor of images. The images of the Dahlia, are, however somewhat of an exception. They join the decorative intent inherent to the way he exhibited his work, with what are probably quite unique visual records of this hybrid created by Aurélio, the horticulturist. On the whole, we argue Aurélio da Paz dos Reis' photographs of flowers gather different and complementary facets with which they contribute to the iconography of plants. They are visual testimonies of the aesthetic features of plants. Being black and white, these images mostly highlight texture and shape in plants. In addition, they also document the interest on flowers and horticulture, as well as the activities around it, of not only one individual, Aurélio, but of a society in a given time and place: Oporto in the early 1900s. Likewise, not exclusively, but especially in regard to the Dahlia, by testifying his activity as a floriculturist, they are also within the territory between artistic and documental photography, with the potential for Art and Science to touch. We argue that Aurélio's botanical photographs are, first

and foremost, relevant documents for the history of photography and of art, as well as the local social history of Portugal and Oporto. His main intent was to document interests and events, with no sort of conscious or purposeful scientific intent. This being said, they are certainly valuable to the history of botanical photography, and potentially, the scientific side of floriculture. As mentioned before, their contributions depend not only on the object and subject themselves, but also, and very importantly, the questions we address and the angles we explore them from. In conclusion, Aurélio's botanical images were clearly created with a documental – artistic intent. Nonetheless, somewhat under the surface, they do have a potential to inform science as well, we wouldn't say comprehensively, but to a certain extent, especially in regard to the flowering features of garden plants. A much clearer link between artistic and scientific (both intent and contribution) is found, however, in photomicrography.

3.2. The visible face of the invisible: science and art in photomicrography from the late Victorian period to the mid twentieth century

> Although the sense of sight enables us to see the many forms around us, there is a world as absolutely invisible to the unassisted eye as the familiar objects of life are invisible to the blind. To those who have eyesight, however, the microscope bestows as great a power of vision as the gift of sight would bestow upon the blind, for it enables them to penetrate the secrets of nature's realm, which without such assistance would for ever remain a mystery.
>
> Walter Bagshaw, in Elementary photo-micrography, 1909

In this chapter, we explore the link between Art and Science in a less conventional photographic technique: photomicrography, with special focus on botanical photomicrography. As science and technology progressed and art underwent changes regarding philosophy, aesthetic values and underlying concepts, both artistic creation and scientific knowledge were moulded, over time, by a growing human grasp of nature. Yet, it is possible that the full extension, significance and overall importance of aforesaid advances may still not be fairly comprehended by some. Nevertheless, if, in such contexts, science and art were to come together, they had the potential to create a universe of aesthetically appealing, artistically meaningful and/or symbolic images, yet not deprived of variable degrees of scientific validity. In this regard, optics has been, and continues to be, a fertile field for the establishment of a close relationship between science and art. Successive achievements throughout time made it possible for Man to have an extension of His own vision, mostly due to the development of microscopy. This allowed artists to benefit from a lengthened spectrum of visual influences, which they could apply in their graphic vocabulary; as well as for scientists to be increasingly attentive to the aesthetic qualities and artistic potential of microscopic images.

Since Galileo's advances[231] to the experiments of scientists such as William Hyde Wollaston[232] microscopy progressed enormously throughout time. By the mid eighteenth century, mineral and organic structures, such as botanical specimens, shells, or insects, were elected subjects to be observed by microscopists,[233] in continuous efforts to reach and understand the infinitely small layers of the natural world. Nevertheless, there were still important knowledge and technical gaps to fill. Namely, in regard to the composition and manufacture of lenses, while some problems still persisted in regard to the quality of the images obtained through the microscope (Carpenter 1901, 36, 39). One of these being the problems of spherical and chromatic aberrations (illustrated in doc.305) which were not entirely overcome until the 1820s.

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[231] The invention of the compound microscope is attributed to Galileo Galilei, as a result of his experiments to convert a telescope into a microscope that allowed him to distinguish "the organs of motion and of the senses in the smaller animals". (Carpenter 1901, 122) In his 1654 letter to prince Leopoldo of Tuscany, *Racconto istorico della vita di Galileo,* Italian mathematician Vincenzo Viviani gives an account of the invention of the microscope by Galileo (1564-1642): "Considerando fratanto il Sig.r Galileo che la facultà del suo nuovo strumento era sol d'appressare et aggrandire in apparenza quelli oggetti i quali senz'altro artifizio, quando possíbil fusse accostarglisi, con eguale o maggior distinzione si scorgerebbero, pensò ancora al modo di perfezionar assai più la nostra vista con fargli perfettamente discernere quelle minuzie le quali, benché situate in qualunque breve distanza dall'occhio, gli si rendono impercettibili; et allora inventò i microscopii d'un convesso e di un concavo, et insieme d'uno e di più convessi, applicandogli a scrupolosa osservazione de' minimi componenti delle materie e della mirabile struttura delle parti e membra delli insetti, nella piccolezza de' quali fece con maraviglia vedere la grandezza di Dio e le miracolose operazioni della natura." (Viviani 1654, Folio 89v).

Translated text: "Considering however, Mr. Galileo, that the power of his new instrument was solely to bring closer and seemingly magnify those objects without any artifice, leaning, if possible, so that with equal or greater distinction they would be caught in sight, he further thought of a way of perfecting our eye sight to a greater extent by making those details perfectly discerned from others even if located at any distance from the eye, making them imperceptible; and so he invented the microscopes out of a convex and a concave, or out of a set of a convex and many concaves, applying to them the scrupulous observation of the minimum components of matters and the admirable structure of parts and limbs of insects, in the tininess of which he wonderfully made the greatness of God and the miraculous works of nature be seen." (Translated by Simone Tripodi).

[232] William Hyde Wollaston (1766-1828) was a British scientist best known for discovering palladium and rhodium, and for the invention of a process "for rendering platinum malleable". Also known for his studies of the optic nerve system (Wollaston 1824) and "for his invention of the various instruments named after him-the reflecting goniometer, the cryophorus, a microscopic doublet" (Wollaston 1898, 63). His theories and experiments on the diffraction of light (Fraunhofer and Ames; Sweetman 1898), were an important contribution to the development of the interference microscope (Françon 1961, 110-120).

[233] In his 1742 book "Micrographia Nova: or a New Treatise on the Microscope and Microscopic Objects" Benjamin Martin presents a "large and particular account of all kinds of microscopic objects to be found in the human body, in quadrupeds, in fowls, fishes, insects, reptiles, etc, in plants and vegetables of every kind; in earth's minerals, and fossil substances and various other miscellaneous subjects" (Martin 1742, 1).

In the core of such progress were the experiments that culminated in the production of the fully functional achromatic microscope (Carpenter 1901, 149), shown in docs. 306 and 307. This device revolutionized visual access to cellular structures, and allowed for impressive advancements, particularly within the natural and medical sciences. From this period onward, microscopic images could be observed with a clarity and definition never seen before (Gamwell 2002, 45). This leads us to ponder on an important question: yes, science and technology made it possible for these images to be clearly observed, but by whom? Who would have access to them and by what means?

3.2.1. The microscopic realm and its observers: the popularisation of science as a growth path for photomicrography

It is implicit that microscopists and other members of the scientific community would be privileged observers of microscopic images. In the words of Walter Bagshaw:

> a very small magnification will often reveal details of construction sufficient to call forth exclamations of surprise; and, indeed, with microscopists it is a matter of common knowledge that whole insects or parts of plants viewed under a low power will excite more astonishment than the resolution of a difficult diatom under the very highest power. (Bagshaw 1902, 9)

The discovery of new forms and patterns was, then, a constant amidst microscopy enthusiasts, and it was, most certainly, intensified from the discovery of the achromatic microscope onward. But how to share and preserve those revelations of the "invisible realm"?

Bagshaw presents three "ways of showing the special objects of his study to his friends. Firstly, he [the microscopist] may exhibit the mounted specimens in the ordinary way, when every individual must of necessity look down the tube of the microscope; or, secondly, he may attach the microscope to a lantern[234] and throw the enlargement upon a screen visible to all; or, thirdly, he may photograph the objects through the microscope, and thus obtain a permanent and ever available record" (Bagshaw 1902,

[234] Magic lantern, a slide projector used in various contexts, from scientific lectures to theatre and story-telling. For more on the topic of the magic lantern (Mannoni and Crangle 2000b).

10), that is to say, he may make use of photomicrography[235]. In other words, the union of photography and microscopy, brought to existence a whole new way, not solely of accessing, but also of divulging and perpetuating a visual universe until then only accessible to those who came into direct contact with science. Furthermore, being a branch of photography, photomicrographs could be reproduced several times. We find this represented a major step forward in the diffusion of scientific knowledge, in a sense that the use of a greater number of reproductions in scientific publications would increase their potential to reach a more numerous and broader public.

The second half of the nineteenth century was particularly thriving in regard to scientific discoveries. And photomicrography, as a means for illustrating knowledge, played an extremely relevant role in science communication during this period. In fact, the scientific principles and technological progress of photomicrography itself were among the many subjects covered by scientific literature at the time. It is also worth mentioning that the popularisation of science and microscopy, had become a serious hobby for gentlemen and pastime for ladies, and was fuelled by the publication of illustrated books on the subject. As explained by Alison Meier (2014), "there was a huge demand for scientific books, but also a desire for the romance associated with nature, colliding with a Victorian passion for all things ornate."[236]

For instance, from the last quarter of the nineteenth century onward, the *Naturalists' Edinburgh Field, and Microscopical Society* published an annual Journal (doc.308) where it explored the then-current subjects related not only to optics and to microscopy itself, but also a wide range of natural sciences. In his opening statement, the president of aforesaid society, Symington Grieve, stated that their intent was:

> to introduce some variety into the meetings by having each evening not only papers on Natural History subjects, but also others on Microscopy, as well as demonstrations. At those meetings to be held after the field

[235] It is debatable who made the first photomicrograph. Andreas Ritter von Ettingshausen is amongst its pioneers (c.1840) as well as William Henry Fox Talbot (c. 1841), whose photomicrographs were obtained by connecting a solar microscope and a photographic camera to photograph crystals by polarised light Minute images of plant and animal specimens, would be among the most popularized visual records captured by photomicrographers in the following years. (Frizot 1998, 275, 2016, Armstrong 2004, 94).

[236] A very interesting selection of such publications may be found in the article "Image Gallery: some favourite plates from Victorian microscopy books, by Dave Walker in *Micscape Magazine* (Walker 2002).

> excursions begin, we hope to have the results of the observations of our members at those excursions brought before us in the form of contributions for our 'Transactions.' (…) The Council hopes that the great majority of our members will join this section, as if they do, they may hope to obtain much information that is invaluable to every naturalist. When I had the honour to read to you last year my opening address, I had occasion to refer to the advantage that would accrue to our members if we had committees appointed to devote special attention to each of the following subjects, Flora, Fauna, Geology, Archaeology, and Microscopy. (Society 1886, 1-2)

This is merely one of the many examples of specialised scientific publications, among which, we find a considerable number of books and articles specifically dedicated to photomicrography, most of them from a scientific and technical point of view. Appendix 2 shows a selection of the above-mentioned books and journal articles, published in the United Kingdom over a period of one hundred years (1864 – 1964)[237]. To set these chronological boundaries we took into consideration three very revealing articles published in the same journal, *The Photographic Journal* of the Royal Photographic Society of Great Britain, about one hundred years apart. The first was written by Richard Leach Maddox in 1864 and conveys a reflection on what he considers to be a difficult path of photomicrography, with difficulties along the way, but also with positive expectations for the future. The second and third, date back to the years of 1963 and 1964. These were authored by Douglas Lawson and exult the value of pictorial photomicrography, confirming its place as an important representative of dialogue that may be established between art and science. Both of these articles will be cited further ahead in this chapter.

It is clear the broadening range of approaches on the theme of photomicrography throughout the years; as it goes from a pure technical and scientific perspective to a wider interdisciplinary spectrum of viewpoints which include considerations about the aesthetic/artistic qualities of photomicrographs. This included

[237] There are also other very relevant publications in non-British contexts. Articles such as Thomas J. Bray's "Photomicrography" in the *Transactions of the American Microscopical Society* (1897); "Photomicrograph versus Microphotograph", by Clifford Mercer, in the *Proceedings of the American Society of Microscopists*; and books such as "La photographie appliquée aux recherches micrographiques" (1866) and "Atlas de photomicrographie des plantes médicinales" by Louis Suis Armand(1900).

a copious amount of botanical subjects (figure 38 shows the cross-section of a cucumber stem, from the 1910 book "Photomicrographs of botanical studies" (Flatters 1910, 35).

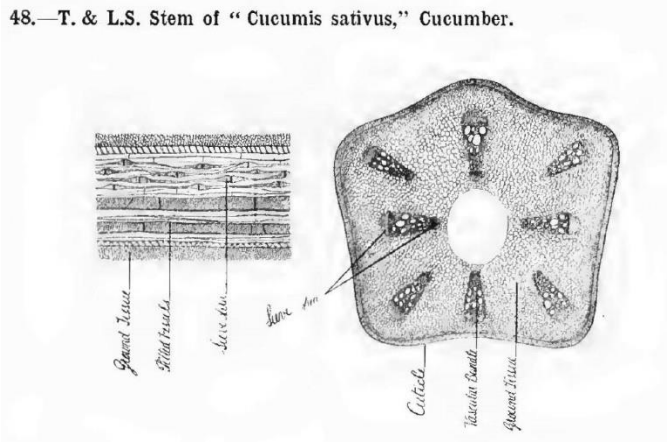

Figure 38. Cross-section of a cucumber stem, from the 1910 book "Photomicrographs of botanical studies" by Flatters, Milborne & McKechnie Ltd, p.35.

In short, the connection between microscopy and photography was an exponentially growing thematic within Victorian scientific literature[238], as books and articles were increasingly accessible to both the scientist and the amateur enthusiast. Docs 309 to 313 present various images of minute elements of nature as observed through the microscope and dating back to the late nineteenth century and the first decade of the twentieth century. Some of these images were drawn directly from nature while observed trough the microscope, while others are photomicrographs. The subjects range from geological to zoological and botanical elements with variable degrees of magnification.

The aesthetic properties of such images are tremendously varied. And, as ultimate seekers of form, artists were likely to be impressed by this visual realm brought to public knowledge through microscopy and photomicrography. One wonders, would aesthetics and beauty, as subjective as it was and still is, soon be an integrant part of the vocabulary used to describe microscopic images, including photomicrographs? As we will see further ahead, the answer is yes. And its basis lies on the closeness that, gradually, emerged from a dual interest which combined scientific curiosity and

[238] Although with some oscillations, this tendency persisted until the present day, and the thematic was considerably broadened.

aesthetic awareness. As we will see, the beauty and overall aesthetic qualities of these images were already acknowledged by some in the early years of the 20th century, with the appearance of pictorial photomicrography. Nonetheless, it was only as the abstract in Art began to escalate its way within the universe of the arts, that these images were also perceived by their beauty[239].

3.2.2. Beauty in Science? Symbiotic endeavours in the early years of photomicrography

By the second half of the nineteenth century and beginning of the twentieth century, the contributions of microscopy on a growing insight into Nature were clearly apparent. It contributed greatly to the emergence of new perceptions of the natural world, many of which were materialized through art. As a result, Art and Science were brought together in a combination of scientific objectivity, aesthetic inspiration and artistic creativity. That symbiotic connection was then present not only in the continuance of scientific illustration (which is ultimately an objective visual scientific explanation) but also in fine and applied arts as well as in the emerging discipline we came to know as *Design*.

Several authors mention European personalities such as Scottish artist and Botany lecturer Christopher Dresser[240] (1834-1904), French glassmaker Emille Gallé (1846-1904) or Austrian painter Gustav Klimt (1862-1918), among many others of their time[241], as examples of artists who nourished a profound connection to nature and to science (Gamwell 2002, Thomas 2007b, Maxmen 2010, Walgate 2003) and who expressed that connection through art. The search for those intertwined visions is a very interesting and quite fruitful task.

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[239] We, must, however keep in mind that the concept of "beauty" was and continues to be subjective. Plus, the concept of Art itself is filled with ambiguity; even more so in regard to more "unconventional" practices, such as photomicrography.

[240] For more on Dresser see chapter "2.2. Science, an art matter: botanical lectures and diagrams of Christopher Dresser at the Department of Science and Art, London".

[241] Given the varied artists who expressed an interest in the link between art and science, and the specific topic of this thesis and this particularly chapter, we opted to give solely these three examples. Whilst focusing on Klimt directs our attention to the subject of photomicrography.

Doc. 314 shows one of Gustav Klimt's most well-known works, *The Kiss* (1907). The oval forms on the dress of the female figure clearly resemble cellular structures. Furthermore, they are disposed inside a circle-like area, as if seen through the lens of a microscope. This composition is reminiscent of early photomicrographs[242] which illustrate microscopic subjects in books and journals, in the early years of photomicrography. Klimt was a regular attendant at scientific lectures, where he contacted with microscopic images[243] (Maxmen 2010). Those certainly caught his attention, because elements such as these are recurrent in his graphic vocabulary. Klimt's work is an interesting example of the connection between photomicrography and art. Yet, a major question still arises pertaining to this subject. Was photomicrography an art itself? To address this matter we briefly recall the long-lasting discussion on whether *photography is* or *is not* considered art.

The place of photography among the world of art during the first decades that followed its appearance was far from being unanimous. While some looked at it with sheer enthusiasm (Alfred Stieglitz 1970, 3), others kept somewhat suspicious of its hybrid-like essence (a product and a tool of science and a means for creating images with artistic potential). While referring to photography, in his critique of the 1859 *Salon*, Charles Baudelaire wrote:

> If photography is allowed to replace art in any of its functions, it will soon be entirely supplanted or corrupted, thanks to the natural alliance it will find in the foolishness of the crowd. It must therefore return to its real duty, which is to be the servant of sciences and arts, but the humblest servant, such as printing or stenography that neither creates nor replaces literature. It quickly enriches the album of a traveller, and renders before his eyes the precision missing from his memory, it decorates the naturalist's library, exaggerates microscopic animals, even strengthens some information hypothesis of the astronomer, it is finally the secretary and the notary anyone needs in his profession of an absolute material accuracy, so far nothing better. It rescues from oblivion pending ruins, books, prints and manuscripts that time devours, the precious things whose form will disappear and request a place in our

[242] Martin-Duncan (1937, 37) provided a clear definition of a photomicrograph: "a photograph of the magnified image of a small or very minute object obtained by the combined use of a camera and a microscope, or by the use of a camera to which a microscope objective has been attached".

[243] Probably lantern slides, which were a common medium used by lecturers at the time (Martin-Duncan 1911, Smith 1911, Smith 1887).

memory archives, it will be thanked and applauded." (Baudelaire 1868, 261)[244]

The writing of Baudelaire is but one of many sources that allows us to comprehend the discussion about the existence of an artistic side to photography, in its early years.[245] We find there are two main issues in the centre of this debate, which also apply specifically to photomicrography. Firstly, photography was a mechanical process in which it would only be possible to obtain an image through the use of the camera. This represented significant "limitations" for the photographer. Meaning that to create a picture the photographer was dependent upon a machine. In addition, the camera was only controllable to some extent. This was especially significant for composition, point of view and the final touches on the picture. Any instrument used to create art, inherently poses a certain level of "limitation" to the artist and the resulting work of art; not necessarily positive or negative, but a restriction nonetheless. Moreover, the photographic camera was also a mechanical novelty that, alongside the complexity of the photographic process itself, challenged the creative autonomy of the photographer. Despite the enthusiastic side of this novelty, we gather these factors would stimulate an initial resistance to photography, especially from those poorly acquainted with mechanical instruments and science. Secondly, a photograph was a truthful, thus objective, picture of reality. This was likely to raise doubts in the minds of those most sceptical about the artistic worth of photography, as it seemed to collide with inspiration, creativity and imagination, inherent to artistic expression. Similar reservations were certainly directed to photomicrography, a then-fairly new and very

[244] Original French text: "S'il est permis à la photographie de suppléer l'art dans quelques-unes de ses fonctions, elle l'aura bientôt supplanté ou corrompu tout à fait, grâce à l'alliance naturelle qu'elle trouvera dans la sottise de la multitude. Il faut donc qu'elle rentre dans son véritable devoir, qui est d'être la servante des sciences et des arts, mais la très-humble servante, comme l'imprimerie et la sténographie, qui n'ont ni créé ni suppléé la littérature. Qu'elle enrichisse rapidement l'album du voyageur et rende à ses yeux la précision qui manquerait à sa mémoire, qu'elle orne la bibliothèque du naturaliste, exagère les animaux microscopiques, fortifie même de quelques renseignements les hypothèses de l'astronome; qu'elle soit enfin le secrétaire et le garde-note de quiconque a besoin dans sa profession d'une absolue exactitude matérielle, jusque-là rien de mieux. Qu'elle sauve de l'oubli les ruines pendantes, les livres, les estampes et les manuscrits que le temps dévore, les choses précieuses dont la forme va disparaître et qui demandent une place dans les archives de notre mémoire, elle sera remerciée et applaudie".(Baudelaire, Gautier, and Poe 1868)

[245] Various authors address this matter (e.g. (Armstrong 2004, Benjamin et al. 2008, Frizot 1998, Martin-Duncan 1911, Horsfield 2004, Rosenblum 1997).

particular branch of photography. Was it an expression of *beauty*? Was it a medium to convey scientific knowledge? *Was* it art? Was it *science*? Or, with the passage of time, could it be potentially both? We searched for answers predominantly in *The Photographic Journal* of the Royal Photographic Society of Great Britain (1853 to 2013).

This is a complex matter and one may not state this branch of photography was undoubtedly accepted as a form of art immediately after its appearance[246]. In fact, by the second half of the nineteenth century photomicrography *per se* remained, to some extent, disregarded within the scientific community itself. The efforts to take it a step further were clear, but in the 1860s it still failed to:

> keep pace with the development of other branches of photography, though it must be admitted that in the hands of the more modern experimenters and especially of Prof. Gerlach of Erlangen, Jos. Albert of Munich, and Dr. R. L. Maddox of Southampton, the success has been such as to guarantee a wide field of usefulness for this method of representation. (Woodward 1866, 122)

This tendency was well demonstrated by Dr. Richard Maddox[247] in 1864, when he authored a particularly insightful article about not only the path of this photographic genre but also its then-present situation among those dedicated to both photography and science:

> Without in any way detracting from their [referring to the pioneers of photomicrography] most valuable efforts to lift this art to some acknowledged rank in science, I fear we shall find their appeals did not obtain, from either microscopists or photographers generally, the favour their talent and energy in clearing away obstacles, coupled with the beauty of their achievements, might have been expected to command. Where was the fault? Surely there must have been something serious against this branch; for we can note how feebly it has

[246] This remains a debated topic in contemporaneity.

[247] Richard Leach Maddox (1816-1902) was a British scientist and MD. He was one of the pioneers and most important contributors to photomicrography. (Stevenson 2011) “As early as 1853, he took up the study of photography, and in a contribution to "Photography," February 11, 1892, he refers to this in the following words: «My first lens was bought about 1846, but active professional duties prevented its being used until 1852; from that date onwards, as an amateur, I have been interested in photography. » Then, too, he was undoubtedly the pioneer in the application of photography to microscopical work, just as he was one of the very first to grasp its potentialities for the reproduction of pictures of microscopical preparations. In spite of his early failures in this direction he was sanguine of ultimate success and subsequently referring to the subject he wrote: " Still, I felt and trusted its day would come, and be of much assistance to the busy microscopist.” (J. W. H 1904, 156-157).

> kept pace with the vast progress of photography in all other kind of illustration.
>
> Loud was the cry against it in some quarters; hopeless the efforts of individuals to obtain satisfactory recompense, either complementary or pecuniary; yet, in working at the subject, I felt confident the day must come when its feeble voice would be recognized, and its assistance sought for a far more correct interpretation of some of the minutiae of minute objects than the most intelligent draughtsman could afford time to indicate in his beautiful delineations; and in this conviction I have worked hard, battling with obstacles, here and there encouraged by the kind remarks of some of those in whose steps I have been glad to tread. Why this neglect? Why this want of general encouragement? Partly it may have been caused by photography carrying a high hand of lucrative, less troublesome, and more ready departments; partly by the necessity to be acquainted with a second branch of science – microscopy; partly by the fact, which we none can gainsay, that in a properly corrected object-glass for objects which, when set upon or well prepared, have their various parts lying in different planes, it is impossible for each to be optically in focus at the same moment, and it is difficult to arrive at the whole features of such an object by a single photograph, the microscopist of course varying the focus of his object-glass to suit these different planes, whilst the photographer must remain content with choosing the general view, or take several negatives, subject, of course, to some confusion in detail; partly by the necessity of much patience, a virtue drawn on largely by all photographers, but in this branch worked out to its finest threads. (Maddox 1864, 151)

Despite his apprehension concerning the then-current state of photomicrography, Dr. Maddox was confident that microscopic images were close to attaining a more rightful place within the practice of photography. He hoped “the day may not be distant when [the] present thin ranks may be swelled by those who have mastered the photographic side, and are willing to conquer the microscopic portion” (Maddox 1864, 151).

In 1891, A. Pringle, addressed this same matter in an article entitled “Photomicrography” in “The Photographic Journal”. Following the reasoning of Dr. Maddox, he confirmed a growing awareness of the scientific worth of photomicrography within a considerable part of the scientific community:

> great many bacteriologists and pathologists and physiologists followed his [Dr. Koch] lead[248], and some of them actually depreciated it [photomicrography], others damned it with faint praise, and others did not use it at all. But partly on account of the improvement in colour rendering, almost all of these men of whom I am speaking have been reconverted, and are now beginning to see it is an invaluable method of "reproducing" their investigations"(Pringle 1891, 72)

In the late 1800s photomicrography was established as a growing practice among scientists.[249] Technical improvements such as those related to the rendering of colour and innovations in microscope and camera lenses contributed much to this success (Gunther 1890, 75). In this regard, in 1891, A. Pringle presented a lecture to the Royal Photographic Society. He spoke of the improvements made to photomicrography, and considered it to be "fast gaining ground" in England and other countries, and "playing an exceedingly important part in connection with certain branches of general science" (Pringle 1891, 71). He continued by saying:

> I am alluding to the improvements that have been lately made in our plates in the matter of rendering of various colours. For the diatomaniacs[250], as they have been called, this enhanced power of properly rendering various colours is certainly one of minor importance, but for the branch of photo-micrography with which I am especially interested, and for which I personally claim the greatest importance of all the branches, and where we are almost certainly dealing with stained objects, the advance made in photographic science is of the upmost importance and cannot be over-estimated(...) We have got the achromatism to an almost ideal point of perfection (...) it is very well seen indeed in optical observation with the apochromatic objectives, and it is still better seen when we come to use them for photography.

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[248] Most probably referring to Nobel Prize winner (1905) Robert Koch (1843 – 1910). One of the most important contributors to bacteriology, who, "directed considerable attention for very many years to photography of bacteria". Pringle (1891, 72) stated that, faced with great difficulties in his use of photomicrography, Dr. Koch "not only discontinued the use of photo-micrography for this purpose, but unfortunately he also "ran it down".

[249] Demonstrated in articles such as "On photo-micrography and its value in biological research", by Edgar Crookshank (1887) or "Photomicrography", by A. Pringle. In the latter, the author states that the "subject of photo-micrography (…) is very fast gaining ground in this and other countries, and which is now playing an exceedingly important part in connection with certain branches of general science. (…) Consequently I propose to rather touch upon what I venture to call improvements that have been made within the last two or three years, partly in our apparatous [sic], partly in our plates, and partly in our methods of working."(Pringle 1891, 71).

[250] Diatoms were one of the preferred subjects amongst photomicrographers. As Dr. Maddox described, these are "beautiful structures (…), which consist of microscopic forms in all the varied costume of variety, encased in a siliceous structure and highly variegated with either superficial or more deeply penetrating markings."(Maddox 1864, 152).

> (…) we have been enabled to obtain a much greater angular aperture without resulting in such aberrations as to make the glasses to a great extent useless. (…) Of course they [the apochromatic lenses] have a serious drawback, their high price. (Pringle 1891, 71-73)

The use of photomicrographs as lantern slides to illustrate scientific lectures is also considerably recorded, as well as their contributions to the development of a wide range of sciences, from medical research to botany, zoology, entomology, geology, chemistry or physics.[251] The aforementioned accounts demonstrate that photomicrography was clearly acknowledged within the scientific community by the end of the nineteenth century. Nonetheless, a question still remains: were photomicrographs, such as the wings of a May-fly or the entangled pattern of a leaf, shown in docs. 315 and 316, respectively, appreciated and even created based on their aesthetic features?

3.2.3. A glimpse into botanical photomicrographs at the Victoria and Albert Museum

The Victoria and Albert Museum currently holds (2018) what is set to be the world's largest photography collection. Among the tens of thousands of photographs kept by the V&A, are several examples of botanical photography, and among those several examples of botanical photography a niche of microscopic images of plants. We will succinctly refer to two groups of the above-mentioned photomicrographs, listed in table 10. The first group of documents is authored by George Hook Rodman (1861-1933), the prominent photmicrographer and physician who frequently exhibited at the Royal Photographic Society.[252] The second, and most complex, is a photographic album, with 85 micrographs featured in "Unknown pleasures", the author is unknown and it is dated 1898.

[251] These contributions are well documented in various papers published in specialised periodicals (e.g. *The Photographic Journal*, *The British Journal of Photography*) and books (e.g. (Seiler 1881, Malley 1885, Mercer 1886, Moitessier 1866, Carpenter 1901, Walmsley 1902, Kerr 1905, Bagshaw 1902, Hind 1913)

[252] Rodman's photomicrographs are integrated in the collections pertaining to the Royal Photographic Society, located in Bath, England. These were previously held by the National Media Museum, Bradford, and transferred to the V&A museum in 2017.

Table 19. Photomicrographic work by George Rodman and Album featured in "Unknown Pleasures" kept at the Prints and Drawings Study Room, Victoria and Albert Museum.

Inventory number	Photographer	Title/ description
21728	George Rodman	Tongue of a blowfly
20192	George Rodman	Hairs of a housefly
24555	George Rodman	A diatom x 630
24552	George Rodman	The housefly x35
24553	George Rodman	The human flea (male) x63
24554	George Rodman	A Group of Diatoms x 400
24557	George Rodman	Coal section x
24558	George Rodman	Pollen Grains of a hollyhock
RPS. 21/9 (XRP 708)	Unknown	Photomicrographs of Diatoms - Album featured in “Unknown Pleasures”

Rodman was very highly regarded at the Royal Photographic Society where he was a member since 1915, and became president for the period between 1920 and 1922.[253] The records of the exhibitions held at the Royal Photographic Society between 1904 and 1915 show that Rodman exhibited there annually for a period of eleven years (1904-1915)[254]. Records list 508 entries within the aforementioned exhibition catalogues, containing hundreds of botanical subjects. 1911 to 1912 being his most productive years in terms of botanical photomicrographs. He mostly exhibited photomicrographs of diatoms[255] both isolated and grouped. Nonetheless, his work also included sections of vegetable structures such as petioles and stems, for instance, hairs of leaves, anthers, and pollen. Doc.317 shows one of the many catalogue pages of the “1911 Fifty-sixth Annual Exhibition of the Royal Photographic Society of Great Britain” where Rodman entered “Fifty Stereo-Photomicrographs (Natural History and Botanical Subjects)” (Britain 1911). Some of his work is currently kept at the archives of the Victoria and Albert Museum.

[253] One of the earliest awards in the field of photomicrography was the Rodman Medal, instituted in 1935 by the Royal Photographic Society to award “outstanding work, preferably in photomicrography and radiography”, in honour of George Rodman (journal 1991).

[254] Exhibitions of the Royal Photographic Society 1870-1915. Catalogue records from the annual exhibitions (available online at http://erps.dmu.ac.uk/).

[255] Diatoms are translucent microscopic algae of the class Bacillariophyceae, which featured among the most photographed microscopic botanical organisms from the late 1800s onward.

Aside from the photograph of a photomicrography apparatus with schematics and instructions, Rodman's set of documents at the V&A contain seven photomicrographs, four of which are of botanical subjects: diatoms, pollen grains from a hollyhock and a cross-section of coal. There are two plates with images of diatoms. According to the records of the exhibits Rodman entered, diatoms were most certainly at the top of the microscopic subjects he photographed. The first is a micrograph of an isolated Heliopelta Metii, amplified x630 with 7 minutes exposure (doc.318). Rodman entered several photomicrographs of this same type of diatom in 1906, 1909 and 1915, however with distinct amplification (from x83 to x950). The second shows a group of diatoms amplified x400, captured with 80 seconds exposure (doc.319). Rodman's micrograph, as well as many similar compositions produced in his time is a confident open door to the variety of shapes and patterns found in the micro visual universe of algae.

The third image shows a microscopic view of pollen grains from a hollyhock (Altheae Rosea)[256], amplified x100 (doc.320). The hollyhock (docs. 321 and 322) is commonly seen in British wild landscapes and gardens, and was photographed several times by Rodman, with different degrees of magnification. Pollen is another very appreciated subject for photomicrographers. Today, and in view of the advancements of conceptual pictorial photomicrography, this image alone is representative of the visual appeal of pollen grains. The spherical shapes, the subtle grainy-like texture which is here is seemingly translucent and the way it reflects or absorbs light throughout its surfaces, all contribute to its great visual appeal. This leads us to question how they were actually perceived in the time they were produced (early 20th century), as, by then, the aesthetic values of photomicrographs were still in the early stages of their recognition. Moreover, colour, which although not present in these photomicrographs, is one of the most appealing of all features in the vegetable world. Although with completely different visual characteristics from pollen grains, sections are also very common not only in Rodman's work but in photomicrography in general. One of his images at the V&A shows a coal section of a "seed bearing fern" amplified x13 (doc.323). This may

[256] Genus: Malvaceae.

have been part of Rodman's studies on the origins and formation of coal (Rodman 1920, 271-274). While in isolated images such as of diatoms or pollen grains the visual features that stand out are mainly shape and patterns, in cross-sections such as this one, highlight repetitive patterns as well as lines.

The album of photomicrographs included in the collection "Unknown pleasures" dated 1898 and kept at the archives of the Victoria and Albert Museum is mainly composed by botanical subjects. Docs.324 and 325 show the consultation of the album at The Prints and Drawings Study Room, V&A Museum, and the handwritten Index of the album, respectively. On the whole, out of a total of 85 images, the album comprises 50 botanical photomicrographs. The first 36 images are all photomicrographs of diatoms (docs.326 and 327). The album also contains 4 images of sections of stems and 10 micrographs of pollen (docs.328 and 329). The number and variety of diatom images are what makes this album most extraordinary. It is yet another testimony of the rich visual tapestry of the organic structure of algae. The album starts with elliptical-shaped diatoms grouped in a composition and isolated. They have clam shell-shaped contours crossed by straight dotted double lines and a subtle very fine equally stripped pattern filling most of the white surface, like a pontilistic vision of the microscopic realm. The first of the album's circular diatoms is of the Heliopelta Metii, which we have previously seen in George Rodman's work. This is one of the most visually profuse diatoms encountered in the photomicrography work analysed in this study. It convenes a star-shaped centre surrounded by a series of dividing sections alternating from light to dark tones and forming a six-pointed star; all encapsulated within a circular shape. The album contains an isolated as well as a grouped composition of the aforementioned diatom. It is but one of several circle-shaped diatoms among this album's collection; some with radial segmented patterns similar to the Heliopelta Metii, others with repetitive circular patterns, some reminiscent of artificially created optical illusions. The following present generally simpler patterns, usually dotted and equally pontilistic-like**.** Some of them, combined with their naturally translucent properties, are remindful of textured glass materials. Regardless of shape, this is a core visual feature common to virtually every diatom. Shape wise, the aforementioned album also includes triangular, square and star shaped diatoms, with varied patterns. The majority present either net-like patterns

covering their entire surface or what resembles air bubbles in vitrofusion structures. Complementing the diatoms, the album also contains micrographs of stems and pollen grains. There is a total of 4 cross-sections of stems. Here we find partial views showing either the borders of the rounded sections or the whole contours of the sections presenting all the hierarchy of layers from core to surface. Lastly, 10 micrographs of pollen grains, scattered throughout the circular surface of the microscope's lens limits, complete the series of botanical photomicrographs composing the album.

All in all, these examples bring us closer to what the perception of a botanical microscopic realm was like in the late years of the nineteenth and the early years of the twentieth centuries. They also confirm the place of diatoms, pollen grains and sections of stems on the top of the preferred botanical subjects for photomicrographers. Varied in shape, pattern, texture and translucent qualities, these three groups of subjects are the source for creating numerous unique images of the minute features of plants, guiding us to look for the specific within the whole. A universe that would exponentially influence, inspire and determine not only scientific but also artistic practices.

3.2.4. The aesthetic appeal "of a "Lilliputian" world: the emergence and development of pictorial photomicrography from the Victorian period to the mid twentieth century

In the late nineteenth century and the and early 1900s scientific applications of photomicrography were much more highly regarded than its potential artistic value. Nevertheless, microscopic natural compositions and patterns were definitely considered *beautiful*[257] by many (including artists *and* scientists). As said by Thomas Stock, in 1887, "when the lights and darks of the *clichés* (upon which intaglio and relief depend) nearly correspond to the real intaglio and relief of the object photographed, the resulting cast will of course be accurate as well as beautiful" (Stock 1887, 84). Patterns and shapes presented in photomicrographs suggested an abstract and

[257] With all due care regarding the subjective nature and significance of *beauty*. Several articles within the Photographic Journal allude to the *beautiful qualities of photomicrographs* (e.g.(Maddox 1864, Smith 1887, Stock 1887, Grindrod 1903, Norman 1903) or Grindrod (1903, 154) who considered that "beauty has a range as wide as the realm of nature and the mind of man, and to try to limit it is like the Chinese process of binding the feet."

subjective world which was often considered extremely pleasing to the eye while challenging the observer's attention to pattern and detail.

An artistic intention was also emerging in the production of photomicrographs. What began by being an unfamiliar and unreachable visual vocabulary, given enough time, would touch the imagination and creativity of the artistically aware photographer. In 1903, Albert Norman, [258] shared some of his thoughts and experience regarding the aesthetics of photomicrography and its expressive potential:

> I feel it a great honour to be asked to address you this evening on the subject of photomicrography, possessing as we do so many able exponents of this art in our society. I trust you do not expect to hear a learned paper on the science of microscopy as applied to photography, for it is not my intention nor in my ability, to give you such, so I hope that you will accept a few notes which are based on my experience of several years of photomicrography, combined with upwards of twenty years of practical photography. With these few remarks I will proceed with my notes, and at the conclusion I will exhibit some slides illustrative of the work.[259]
>
> In photomicrography we have a great branch of our science which is of immense value to scientific men for obtaining not only accurate records of microscopical research for illustrating text-books, lectures and journals, but also of absorbing interest to many in portraying the varied beautiful minute vegetable and animal forms. But this work presents many difficulties, some real, others imaginary, or at least others which can be overcome as experience is gained. (Norman 1903, 64)

Faced with a world primarily explored by science but envisioned with countless aesthetic possibilities, *pictorial photography* finally ventured into the invisible. The first allusion to the concept of "pictorial" as associated with photomicrography in *The Photographic Journal* relates to an exhibit entitled "The photomicrography of metals: a house exhibition" presented in 1903. The exhibit was comprised of photomicrographs by Charles Grindrod[260]. In the opening address he stated:

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[258] Most likely Albert Norman, one of the founding members of the Institute of Biomedical Science, London, in 1912. (Science 2012).

[259] The chairman of the meeting where this lecture was presented would conclude stating that "nobody could leave that room with any doubts as to the great value of these photomicrographs to medical men, teachers and scientists. The colour slides were especially valuable and the lecturer was to be complimented on the success with which he had applied the three colour process to his work". (Norman 1903, 73).

[260] Grindrod was an author, a photographer and a member of the Royal Photographic Society.

> I am only a pictorial photographer, a lover of and humble follower after beauty, and it would be hard to find any person more ignorant of the science of photography than myself. If anybody asked me awkward questions about my lenses, or the chemicals I use, I should have to put them off with (…) a very full aperture, of my ignorance." (…) Whether we are true artists. or mere clutchers [sic] at the fringed robe of art, at least our ambition is a worthy one, at least our shaft is aimed at the throne of beauty, and by aiming high we may perhaps strike the feet of the goddess and the goddess of beauty has golden feet as well as golden head; there is no clay in her, every part of her is precious metal.[261] (Grindrod 1903, 152-158).

From this point onward, pictorial photomicrography appeared more regularly, although not copiously within *The Photographic Journal*.[262] It is important to take into account that, given its technical demands (the need for previous knowledge of microscopy and access to laboratorial equipment, would have made this branch of photography more accessible to scientists than to photographers)[263]. On this matter, formerly cited Walter Bagshaw stated in 1902:

> it is much easier to instruct the microscopist in the mysteries of photography than it is to teach the amateur photographer the uses of the microscope. If the reader, then, is not conversant with the microscope, he is recommended to study some good textbook on the subject before attempting to photograph through an instrument he does not understand. (Bagshaw 1902, 10)

Nonetheless, Bagshaw encourages this pursuit, alludes to its fascinating nature and provides the aspiring photomicrographer with valuable guidelines while venturing into this complex but enriching branch of photography:

> Independent of weather, scenery, and sunshine, the photographer may be seated at a comfortable fireside by gaslight and produce pictures both marvellous and beautiful. Every article at hand is capable of being pressed into service, or if the operator dislikes the preparation of his

[261] We are unable to transcribe the entire text, but an attentive reading of this lecture is extremely insightful regarding the artistic recognition of photography and photomicrography in the early 1900s. Among other aspects, it comprises a series of comments on the artistic nature of photography, including an interesting, and quite revealing account of his attendance at the Jubilee dinner of the Royal Photographic Society where, to his surprise "Scarce a word was uttered the whole evening by the eminent speakers present on the art side of photography; all was about the progress of the scientific side". (Grindrod 1903, 153).

[262] E.g. (Martin-Duncan 1911, 64).

[263] This continues to be an important topic when discussing the link between art and science in contemporary photomicrography.

> own objects, he has at command for a small sum about 40,000 fine specimens of infinite variety, which can be sent by post from the circulating departments of Mr. C. Baker, and Messrs. Watson and Sons, of Holborn, London. (Bagshaw 1902, 16-17)

Although clearly in a growing path, in the early years of the twentieth century a division seemed to persist within photomicrography and more specifically when it involved and interconnection between its artistic and its scientific sides. As if referring to two separate territories with a shared borderline, Thomas Scott describes a "dividing gulf" between pictorial and scientific photomicrography:

> there does not appear, on the surface, much in common between the "ultra" scientist and the "infra" artist; and the photomicrographist [sic] is apt to hold himself aloof from the High Art aspirant to soulful Sonatas. (…) Generally speaking, of course, there are exceptions _the qualifications of profound science are and advanced pictorialism are not combined in one person. Outlook and aim give them separate entities, and in that outlook and aim is the alleged great "gulf" or difference. The scientific worker has perhaps more definite aims, and certainly a definite technical standard, but the pictorial worker's outlook is more or less abstract and idealistic, and he does not lay claim to any definite and tangible standard as a measure of success. (Scott 1917, 122)

In pictorial photomicrographs, composition, light and colour were combined with the intrinsic aesthetic qualities of the microscopic dimension. Without abandoning the scientific and technical quality, the *artist-scientist*, rearranged, coloured, highlighted and interpreted the infinitely small as to capture the hidden beauty of the vegetable, mineral and animal realms with a camera. According to E. E. Jelley[264], these would have to fulfil a certain set of visual and aesthetic criteria so as to be considered pictorial images and differentiated from scientific images. Therefore, pictorial photomicrographs should present "well-balanced composition and should exhibit some striking or beautiful aspect of the microscopical object, but they should not unduly reveal the limitations of microscopy, such as curvature of field, lack of definition at high magnifications, and shallowness of depth of focus." (Jelley 1934a, 492-493)

[264] Edwin E. Jelley, a researcher at Kodak laboratories. His research interests included several fields such as microscopy, crystallography, photomicrography, photographic film, colour (including pioneering work in infra-red photography) and projection. His name is also present in various optics related registered patents. (Jelley 1931, 1936, 1942, Henry C Staehle 1945, Jelley Edwin E 1946, Jelley 1950, Arthur H Herz 1954, Edwin E Jelley 1961).

Diatoms, plant stems and leafs, insect wings and crystals are at the top of the subjects in pictorial photomicrography; a result of what E.E. Jelley describes as aspects of Nature's "fine architecture" in small objects (Jelley 1934b, 419); a unique spring of inspiration and a somewhat omnipresent source of aesthetic revelations. Doc.330 shows a photomicrograph by August Kreyenkamp entitled "Deep Sea Mud". It shows a set of Diatoms "in random arrangement" and was considered "remarkable for its depth of focus and crisp definition". It was part of a set of pictorial photomicrographs which received wide praise:

> His «Wood Chips» (680) is a splendid illustration of the beauty to be found in a seemingly common-place object. «Wasp's head» (681) is also an effective study which could easily serve as a design for up-to-date feminine hat. (…) «Butterfly wing» (683) is yet another illustration of the possibilities of decorative photomicrography in the hands of an artist. (Jelley 1932, 338)

The author of these remarks is presented as "E. E. Jelley", most probably the above-quoted scientist Edwin E Jelley. His observations in regard to August Kreyenkamp's photomicrographs, reflect not only acceptance but admiration for the artistic side of photomicrography; with the added significance of being uttered by a scientist. In short, in the 1930s, the artistic distinction between pictorial and scientific photomicrography was clear.[265] Nonetheless, by then, artistic merit, when existent, of pictorial photomicrographers was also generally accepted and even encouraged within a restricted universe amongst peers. Still to a limited extent, photomicrography was then acknowledged as a photographic technique which produced images of science as well as images of beauty. At the time, consensus was far from established, as it still happens in contemporaneity as well, and it was not until the 1930s that photomicrographs had a firmer presence among the world of aesthetics and art. This presented new challenges for those who wished to explore the artistic side of

[265] By 1931, French photographer Laure Albin-Guillot published her book *Micrographie Decorative*, a 'profoundly original work' as described, in the preface, by Paul Leon, comprised of a total of 20 photomicrographs, several of them featuring botanical subjects. In a time when photomicrography was taking its first solid steps towards an artistic side that could stand on its own; with a purely abstract, decorative purpose, this highly internationally acclaimed book appears as a landmark in the history of pictorial photomicrography (Albin-Guillot et al. 1931).

photomicrography. Beginning with the demanding task of keeping its artistic "status", while adapting to the advances both in technology and in art.[266]

In 1937, a text accompanying the catalogue of the annual exhibition of the RPS stated:

> Photographs which achieve the distinction of being placed upon the walls in other sections do so by virtue of artistic or aesthetic merit, but here the case is simpler, the object of the photographer is, in general, to efface himself as completely as possible, to suppress his own personality and to concentrate upon giving the camera every opportunity to record exactly what it sees. Factual observation is the first step to knowledge, and photography makes observation possible far beyond the limits of our human senses. Furthermore, it makes its own notes in permanent form so that, instead of fallible human memory, we have a record, accurate in detail and free from personal bias. To enlarge upon the variety of the applications of photography is unnecessary, but to obtain a representative selection of exhibits which shall convey any real impression of its value to science and to industry is impossible. (Mitchell 1937, 283-284)

The author's opinion still bears ambiguity between what is scientific and what is artistic in photomicrography and the functions and merits of both.[267] Photomicrographs such as the one seen in doc.331 were artistically acknowledged but still a long way from gathering consensus, as this intended to promote their scientific worth.[268] Nonetheless, in that same year, the RPS promoted a series of exhibitions entitled *Photography in the Service of Mankind*. The goal was to "take up one of the many aspects in which photography entered into the daily life, so that the man in the street could understand something of what the experts were doing in each particular branch."[269] It included an exhibition entitled *Camera and Microscope in the Service of Mankind*, which, among other examples of scientific photography, featured botanical photomicrographs. This latter exhibition distinctly conveyed the notion that botanical photomicrography is

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[266] A pressing matter in contemporaneity.

[267] Other photomicrographers, such as German August Kreyenkamp, or British H.J. Howard and Douglas Lawson explored the aesthetic potential of photomicrographs, like Lawson's transverse stem sections, showing the repetitive patterns of vegetable tissue, where plants were among the privileged subjects (doc.335).

[268] Something that persists until this day, as ambiguity is timelessly connected to art.

[269] F. Martin-Duncan, "Camera and microscope in the service of mankind: A talk on the exhibition" in, *The photographic journal: including the journal and transactions of the royal photographic society of Great Britain* LXXVI (London: Royal Photographic Society, 1937), pp.74–81.

applicable to numerous areas, even those that may seem less ‘evident’ or less ‘expectable’. The acceptance of Art as one of those areas, throughout the following years, as it accompanied the challenges and rewards of technical advancements.

Allusions to the developments in photomicrography, some containing references to its artistic variant, extended throughout the decades of 1940 to 1960 and onwards[270]. Some of these texts were then, illustrated in colour[271], adding another element to that visual universe (as seen in docs. 332 and 333). But would the “dividing gulf”, described by Thomas Scott, narrow and bring both sides closer? In other words, could there be a common ground in photomicrography? We find the answer may be found in the essence of what Paul Strand wrote in 1923 about photography:

> Look at all these things. Get at their meaning to you; assimilate what you can, and get rid of the rest. Above all, look at the things around you, the immediate world around you. If you are alive, it will mean something to you, and if you care enough about photography, and if you know how to use it, you will want to photograph that meaning. (Strand 1923, 615)

Elizabeth Wilkinson mentions an exhibition centred on “natural shapes and structures revealed by modern science” and, entitled 'Growth and Form' in tribute to scientist D'Arcy Thompson[272]. Over 2 decades had passed since the 1930s, and the dialogue between arts and sciences was, by then (1951), an actual realisation. With a tone that combines surprise and a certain dose of excitement and expresses her views on this approximation between the artistic and the scientific:

> Stability of structure, individual identity is, it seems, a property not of material particles, but of form. It is perhaps not surprising that in this climate of thought the arts and the sciences, after a longish estrangement, should show signs of drawing together again. The artistic and the scientific imagination are compared now as much as they are contrasted. A poet and an astrophysicist can find common ground for an exchange of their views of nature. Wilkinson (1968, 114)

[270] E.g. Howard (1941)

[271] Despite the great appeal and vast variety and potential of colour plates which were available since the early twentieth century, only a few were dedicated to that variant, most probably due to its high costs associated to both producing and printing colour images. (Lawson 1960, 3, Northall-Laurie 1923, 48)

[272] Author of the highly acclaimed book: "On growth and form”, 1917.

Over 10 years after the above-mentioned exhibition, photographer Douglas Lawson[273] wrote and illustrated an article for *The Photographic Journal* entitled "The aesthetic and pictorial applications of photomicrography" (Lawson 1963). This was a pioneering work which has much to contribute to the efforts put into the dialogue between artistic and scientific concepts and practices. It is a profound statement of his view of artistic photomicrography. It also reveals a sort of symbiotic maturity of photomicrography regarding this interdisciplinary link. As we read through the whole composition of text, drawings[274] and photomicrographs (docs. 334 and 335), It resonates with Paul Strand's message on finding and photographing the meaning of the world around us:

> On the one hand, with the help of the telescope we raise our eyes to the distant stars and behold something of their fascination, and on the other hand, with the help of the microscope, our eyes see the wonder and beauty which is offered by nature. Around our feet, in every blade of grass and in every tree, not to mention insect life, there are limitless details of creation". (…) When mentioned within the hearing of some pictorialists they immediately think it is only for the scientifically minded, or the record worker. Nevertheless, the so-called record photograph can be made to look quite attractive. Some of you may remember Mr. H. A. Murch, one of our great pictorial photographers, once saying, "I do understand the desire to apply pictorial ideas in record work, which is a very different objective, and we ought to welcome such an application when it can be done without losing anything of the essential factual value of the record". Photomicrography offers expression not in what the painter has already done but in what the painter cannot do". (Lawson 1963, 1)

This text celebrates freedom of creative expression by means of photomicrography. It helps us perceive that this *art-science* was finally embracing its individual identity as a distinct medium for reproducing the deepest layers of the world. Furthermore, Lawson presents us with a micrographic universe where Art and Science

[273] Lawson's skills as a photographer and interest in science lead him to work in photomicrography in both fields. His photomicrographs allowed him to explore both the scientific side of microscopic images, for example, illustrating scientific journal articles (Feinberg 1958, Hillaby 1961), as well as their aesthetic features, where he united science and art.

[274] Drawings produced based on microscopic images are referred to as "micrographs". (Lawson 1960, 4)

can and *do* coexist, within a territory governed by mutual respect for one and the other, that even though not always easy, is definitely proven possible.

The images contained in doc. 335 are, likewise, authored by Douglas Lawson. The drawings unveil form and line as the photomicrograph highlights transparencies and detail. Here expression and interpretation meet impression and objectivity. Whether they are aesthetically appealing is a subjective matter. Whether they convey scientific knowledge depends on their specific characteristics and the perspective from which they are looked at and even the intent of their creation. But they do demonstrate the potential of an artistic-scientific common ground and the vast visual territories that may result and be explored from that union. As we pass the threshold of invisibility, nature becomes clearer, closer, more complex and yet more perceivable at the same time; a reality utterly untouched by human vision if it were not for microscopy. Simultaneously, senses are awakened beyond knowledge or understanding; accurateness and deconstruction, truth and subjectivity coexist, as reason and creativity gaze at the vast cosmos of minute vegetable structures.

Although it is first and foremost associated with biology, the use of botanical micrographs for scientific purposes reaches now far beyond the field of botany. If we take a minute to think of the various fields of science that either benefit from or contribute to the observation and study of plants, we will begin to grasp the vast reach of botanical photomicrographs in science. For a long period of time photomicrography appeared as if suspended in a conceptual limbo between artistic endeavour and scientific purpose. In its earlier years, pictorial and scientific, knowledge and beauty, however, were part of one unique visual universe. And it was not until the twentieth century that photomicrography was seen unpretentiously as a form of artistic expression, as Science and Art were looked upon as two complementing and well accepting sides of the same visual cosmos. In conclusion, it is fair to say that the artistic acknowledgement of this branch of photography is not an undisputed issue, however it is also safe to say that it has come a long way to bring science and art closer together.

Today, a great part of what was once visually unreachable in nature can be observed, studied and admired. From entire specimens with slight magnification to the venation of leaves, or the cells and molecules that compose the structure of plants; from

minute sections of stems, anthers, stigmata, leaves, petals, buds, roots, pollen grains, filaments, or seeds. Botanical photomicrographs have become indispensable to understand plants, what they are made of, how they grow, reproduce and decay; how they act, react and interact in particular circumstances and contexts. Consequently, since its beginning, botanical photomicrography has helped shape the understanding of the natural world and sustain the progress of science and technology through decades of evolution. Throughout this study, additional questions arose. Where can one find these images today? What do they look like? What subjects do they represent? And how do they reflect this interdisciplinary dialogue and contribute to the development and importance of both Science and Art? The challenge to answer these questions leads us venture into other sources of information and explore a portion of the visual realm of photomicrographs. The contributions of photomicrographs for the construction of an intertwining botanical iconography, reflecting and interesting both Art and Science are immense. We find the potential of these images to continue to facilitate and promote the dialogue between the two areas is one of the most promising of all visual records of plants.

CONCLUSION

The process of our research was based on a theoretical approach involving archival investigation, systematization, analysis and interpretation of various written sources and formal analysis and interpretation of art work, primarily paintings, drawings, watercolours, photographs and photomicrographs. *This thesis posed three sets of questions, from specific to all-encompassing. The first set of questions (a, b, c) were the following:*

a) May we clearly identify a consistent symbiotic approach to Botany, joining scientific understanding and artistic intent, from Victorian times to the early 1900s?

b) What were the contributions of British art and design training for building a botanical artistic-scientific iconography during this period? How was it advocated and put into practice, and by whom?

c) Based on a case study, what evidence may be found to assess/attest this symbiosis in artists' preparatory sketches?

Sections 1 and 2 of our research aimed to conjointly answer questions a), b) and c). With this purpose, firstly, and to set the tone and context for the core of our investigation, we studied the thought and pictorial practice of John Ruskin, in regard to the artistic approach to Nature, and more specifically Botany. We analysed his views on the dialogue between the scientific understanding of plants, based on observation, perception and study, and the transposition of their features into artistic visual forms, primarily through drawing. The investigation on Ruskin was based on the study of his own writing (e.g. "Proserpina", "Pre-Raphaelitism", "Modern Painters", "Sesame and Lilies", etc.), articulated with the analysis of his botanical works kept by the Ruskin Library and Research Centre, Lancaster University. Our analysis shows that although acknowledging the importance of sciences and scientists, particularly their role in making the world perceivable to those who are not familiar with science, Ruskin also identified a very clear distinction between the practice and attitude of an artist towards Nature and the practice and attitude of a scientist. The first should be ruled by the

conjunction of the thorough observer, the poet, the emotional heart and the inquisitive mind, whereas the latter was, according to Ruskin, somewhat of a prisoner of pure logic, discarding all that was subjective and abstract in Nature. He did, however express his admiration for science and clearly wished it would extend its spectrum into emotion and poetic contemplation, besides knowledge and understanding. His own botanical drawings are testimony that he practiced that alliance himself. With the study of Ruskin, we present one of the protagonists of the connection between botany and art during the Victorian period. Given the large universe of writing on Ruskin in the historiography of Art, it is quite challenging to construct a new perspective or approach. Nonetheless, and being specifically dedicated to Botany and Art, we sought to keep our analysis focused and to the point.

From Ruskin we went on to explore the botanical motif in the pictorial universe of the Pre-Raphaelites. The choice for the Pre-Raphaelites, comes in line with Ruskin's own views on the way the group approached Nature, the botanical richness present in their art, and the immense role they have in British Art within the chronological boundaries of our study. This chapter is predominantly based on a visual analysis of painting compositions by the three founders of the movement (Hunt, Millais and Rossetti) and by John William Waterhouse, a later follower and contributor of the Brotherhood. The latter being object of analysis through his sketchbook drawings as well as his paintings. The selection of the works to include in our study was pressing and extremely necessary, given the immense variety of works to select from. From the analysis of these works (66 paintings and 4 sketchbooks in total) we clearly identify the presence of at least 80 plants (all listed within the chapter), the majority being British / European wildflowers, represented in various ways and compositions. We say "at least 80" because some are difficult, in some cases, even impossible, to identify with all certainty, mostly due to the lack of enough elements or detail, or the great similarity between plants.

With variable degrees of detail and accuracy, our analysis shows a clear predilection for the rose, as various species are depicted by the four artists. Moreover, wild species such as the Daffodil, the Marigold, or the Bindweed, for example, are also among the most common. Others appear only once. Furthermore, we find one great

feature common to all, with more or less detail, the fidelity to the truth in Nature, which, in the majority of the cases corresponds to its beauty, such as Ruskin advocated is transversal to all. Together, the works analysed show us a very clear portrait of a great portion of British flora. Through the sketchbooks of John William Waterhouse, in this chapter we also return to the theme of drawing in regard to plants and flowers, something that, in Waterhouse we saw was mainly focused on the study of colour as preparatory work and visual annotations. So, in the Pre-Raphaelites we find four great protagonists of the dialogue between botany and art in the Victorian Era. These two chapters refer to articulation of theory and practice in art. But Ruskin also introduces the topic of artistic education, in regard to drawing plants and flowers. This brings us to the next chapter which is one of the most relevant of this study, where we address the topic of botanical studies in art and design training. Besides contributing to answer research question a), it also provides the answer to research question b): *What were the contributions of British art and design training for building a botanical artistic-scientific iconography during this period? How was it advocated and put into practice, and by whom?"*

To produce this chapter, we researched all the annual reports of the Department of Science and Art kept at the V&A archive, Blythe House, London (1853 - 1899), and other official documents, such as minutes, lecturers and manuals, day-books, plans and drawings; as well as periodical articles in regard to the Government School of Design, the Department of Science and Art and South Kensington Museum, focusing on the topic of the Art and Design Schools and artistic training. We also researched the Archives of the Royal Botanic Gardens, Kew, with particular focus on the director's correspondence between the years 1848 and 1910.

Our study clearly shows the ongoing investment by the Government School of Design and the Department of Science and Art to integrate botanical studies within the curriculum of British Art and design education, with primary focus on the training of Victorian design students. The results of our research also provide a clear understanding of the stages in the courses of instruction for designers where the study and practice with flowers was applied. Moreover, they clarify the strategies and resources used in order to administer the theoretical-practical teaching of Botany applied to the arts,

copies, botanical diagrams and fresh live specimens and cuttings of plants and flowers, being the predominant. Furthermore, they attest to the determinant role of personalities such as William Dyce, Henry Cole, Richard Redgrave, John Lindley and Christopher Dresser as promotors of a most fruitful link between art and science though the teaching of botany in the context of art and design classes. Finally, the study documents and consubstantiates the importance of the collaboration between botanic gardens and the schools of art and design in London and Dublin, all throughout the second half of the nineteenth century, through the free entrance of Art students in the botanic gardens, the use of the gardens' grounds by the masters of the schools of art and Design to deliver lectures on botany applied to art, and the continuous supply of plants from the gardens to the schools.

Continuing from the previous, the next chapter develops further the role of Christopher Dresser in implementing botanical studies within the training in art and design in the DSA, during the second half of the nineteenth century. Our study was based on the articulation of two fundamental sources: the eleven articles he published in the *Art-Journal* entitled "Botany: as adapted to the arts and manufacture" and the set of botanical diagrams he created for his lectures on botany applied to art and design. Our study demonstrates the importance Dresser attributed to the knowledge and understanding the morphology and physiology of plants in order to transfer their features into design. Articulating the articles and the diagrams, the results of our analysis recreate what would be an approximation to the content and sequence of Dresser's lectures. They followed the sequence of the plant's lifecycle: from underground to over-ground structure, with special attention given to leaves, stems, flowers and the reproductive system, the latter closing the narrative. Our study also elucidates the diverse effects of plants and its parts on human perception, as well as the expected results on the pupils' learning process, and ultimately their practice as fully trained designers. From here we went on to explore the drawing of plants and flowers in artists' day to day practice. In the following chapter we present a case study based on the analysis of the botanical drawings by Charles Rennie Mackintosh and Margaret MacDonald. In addition to contributing to answer research question a), it also answers

research question c): *Based on a case study, what evidence may be found to assess/attest this symbiosis in artists' preparatory sketches?*

We studied the botanical drawings contained in 6 sketchbooks kept by the National Library of Ireland and the Hunterian Museum and Art Gallery. Among these there is also a set of 34 watercolours, many of which are co-authored by Charles Rennie Mackintosh and Margaret Macdonald. A large part of the study focused on listing the depicted species by common name, botanical name/genus and family, thus completing the what had already been done by other researchers. Based on the authors' notes and records of travels thought the UK, France and Italy, we were also able to map their distribution at the time they were portrayed by the artists. As for the formal analysis of the drawings, we especially took into account the parts of the plant depicted, the views, the style (in Mackintosh, we found a predominantly linear style), as well as any confluences with botanical illustration techniques, as well as accuracy and detail. The earlier drawings present a more improvised aspect, and were, most certainly, the result of speed drawing, taking the most of what the artist could observe in the moment. The following, seem more thought out, very precise and accurate in detail, the general tendency being not to depict the entire structure of the plant but, for the most part, partial stems, leaves and flowering parts. In addition, besides seemingly unfinished drawings, where the drawing is only finalised in a section of the plant, leaving the rest solely outlined, a common technique in scientific illustration, there are also drawings representing the parts of the plant in various angles/views, another feature of botanical illustration. This chapter closes the section dedicated to the training and practice of artists, especially in regard to observation drawing. It was the purpose of this research to study the botanical image through mediums which are not predominant in this specific topic and can articulate and complement each other. The following section explores botanical photographic images within the construction of a botanically inspired visual universe and seek to where scientific and artist concepts and practices share a common ground. The results of the research answer the following two sets of questions (d, e, and f, g):

d) Expanding from the British context, can an example of this connection be found in the Portuguese history of photography, as well?

e) Expanding from the mid-1800s to the mid-1900s, what evidence may be found to assess/attest this symbiosis in British photomicrography?

f) What botanical specimens, elements, structures and features are present in the whole of the pictographic universe studied?

g) Based on this research and its results, can the study of botanical images which were grounded on knowledge and understanding of science but produced with an essentially artistic intent, enrich and inform both Art and Science? If so, what are the contributions and implications of a shared iconography between the two fields?

To answer research question d) _ *Expanding from the British context, can an example of this connection be found in the Portuguese history of photography, as well?* _ we researched the photographic images of plants created by Aurélio da Paz dos Reis, who was first and foremost known and acknowledged for his work with moving images, but who has also left us a rich collection of still images of plants and flowers, captured though the lens of his camera and inspired by his passion and his way of life so intimately connected to floriculture. It is our conclusion that Aurélio's work is, most definitely a valuable contribute to building a botanical iconography. It is predominantly focused on the ornamental attributes of plants and mainly flowers. This is very clearly seen in his staged floral arrangements, for example. Nonetheless, and although direct symbiotic connection between art and science is generally absent of these images, the potential for a link between art – botany – science, despite tenues is still present; as Aurélio gives us a documental perspective on floriculture in Oporto during the early years of the 20th century, including unique visual documents of the hybrid Dahlia he created, as well as visual records of plants such as the Arum Lily, the Delta Maidenhair Fern, the Gloxinia, or the wisteria, for example. Of all case studies this is one of the most succinct. This was mostly due to the lack of time within the context of this PhD to carry out a much more extensive multi-documental research that could deliver more data on the topic.

The following chapter answers research question e) _ *Expanding from the mid-1800s to the mid-1900s, what evidence may be found to assess/attest this symbiosis in British photomicrography?* _ we dove into the microscopic scale and accompanied the emergence and acknowledgement of photomicrography as it crossed the threshold of

scientific exclusivity to establish a harmonious, well-accepting coexistence and even open dialogue and cooperation between Art and Science. The chapter starts with a reflexion on development of photomicrography as part of the popularisation of science during the late nineteenth century. It goes on to explore early symbiotic practices linking science and art in photomicrography, and presents two examples of botanical photomicrographic collections kept by the Victoria and Albert Museum, together dated between 1898 and ca. 1915; for the most part, sections of stems, anthers, pollen grains or diatoms. The latter, an undoubtedly preferred subject for photomicrographs since its early years. Our research also shows that it was only in the beginning of the twentieth century that the aesthetics of photomicrography was fully acknowledged as a valuable feature in the production and observation of these images. Moreover, our study establishes that pictorial photomicrography began its ascendant path towards full recognition as an artistic facet of photomicrography during this period, particularly in the 1930s. Furthermore, it clearly confirms that, although not a gatherer of consensus, even until the present time, one of the strongest links between science and art can most certainly be found in this photographic technique, where we also attest a very significant predominance of botanical subjects.

Lastly, research question f) asked "*What botanical specimens, elements, structures and features are present in the whole of the pictographic universe studied*"; and research question g) asked: *"Based on this research and its results, can the study of botanical images which were grounded on knowledge and understanding of science but produced with an essentially artistic intent, enrich and inform both Art and Science, and vice-versa? If so, what are the contributions and implications of a shared iconography between the two fields?* Both of these research questions are transversal do the study.

To answer the first, we analysed the whole botanical universe found in the different media studied, sought for common points and specificities and systematised the taxonomic information of the species identified. Our analysis retrieved a total 236 plants identified in the pictorial works studied, from the initial chapters on Ruskin and

the Pre-Raphaelites, to the photography of Aurélio da Paz dos Reis.[275] Our analysis evidences a clear prevalence of partial structures of plants depicted. It also shows a very clear predominance of flowering plants and, most particularly, of flowers themselves. In Ruskin, Dresser and Mackintosh, for example, we encountered the supremacy of drawing. Ruskin is a studious of detail. The majority of his drawings depict details of parts of flowers, such as petals, calyx or corolla, for instance. Some following a sequence to illustrate a principle (e.g. growth), others concentrating on the aesthetics of the flower itself and its geometry. He also presents us with scientific-like diagrams used in his lectures at Oxford. Dresser is the most systematic and didactic of all. We can clearly attest the functionality and practical focus of his botanical diagrams, as he created them as visual explanations, one of the fundamental principles of botanical illustration itself. As for Mackintosh, he and Margaret MacDonald together create a botanical visual universe based on a predominantly linear style. Attention to detail, to the variety of views to depict a plant, accuracy, a steady and confident hand, and the appropriate use of colour, when it exists, are the features that most standout in both artists' work. The majority of the drawings and watercolours present images of partial structures of plants, generally cuttings including stem, with a portion of leaves and flowering elements. Others, more rarely, are represented on a landscape or are constituted solely by the flower itself. As most of these drawings are inserted in sketchbooks of travels or include annotations of the place they were created, we are also able to map them, as well as the existence of the plants represented, in time and place. In the Pre-Raphaelites, we found once again, the emphasis on the flowering parts of plants. Realistically depicted, amidst the Brotherhood, leaves and flowers are the main vegetable elements to inhabit their pictorial compositions. Our study highlights the predominance of wild flowers in the Pre-Raphaelite paintings and drawings we analysed. They appear as full vegetable structures adorning different scenes (from man-made scenarios to natural landscapes), as cuttings positioned in water vases or simply placed on an open book, as natural

[275] Although some of the photomicrographic images studied refer to the species registered, many are not identified. Since these would not constitute a sufficiently wide sample we have left these out of the listings of plants represented. Nonetheless, whenever there is an identification, it is included in the respective caption and body of text.

ornaments adorning the hair of feminine characters, as background patterns, or in freshly picked bunches of flowers in scenes set on the British countryside.

As for photography, in Aurélio da Paz dos Reis, analysis highlights the predominance of garden flowers, either recorded in the context of garden sceneries, flower exhibitions, or studio arrangements. The majority are cuttings, where the flowering parts of plants are clearly emphasised. On the other hand, the botanical photomicrographs studied in the course of our research are focused on minute elements, as most show sections of stems, anthers, pollen grains and diatoms.

Lastly, answering research question g), evidence is conclusive in showing that intent, although extremely relevant in the production of botanical visual records and their final appearance, is not the one and only validation of their scientifically informed features, nor is an artistic intent the exclusive validation for their aesthetic qualities and potential. We have seen numerous examples of essentially artistic botanical images, regardless of the medium, which show vegetable elements just as they are, and based on close observation and even profound study of plant morphology and physiology, in the most variable degrees. We also encounter images created with a scientific intent, namely photomicrographs, but whose inherent aesthetic features are carriers of artistic potential, in themselves. On the one hand, for the visual appeal of their natural forms, patterns, lines, textures which potentiates them as objects of beauty (taking into account the subjective nature of the concept), adding another facet to them alongside their scientific function or features. On the other hand, as a source of inspiration for artistic creations. The potential of these images as contributors to both fields is, most certainly, highly possible.

Another matter we should factor in is that, as we have seen through the numerous visual works included in our study, painting, drawing or photographing a plant (or anything, for that matter), more or less consciously, always involves choice and intent. The choice for the style of a drawing, the choice to visually register a certain plant and its parts from a certain point of view, the choice to do it realistically or to stylize it, will all contribute to the perception the observer will have of it, and to what the resultant image will transmit, whether it is knowledge, sensation or a mixt of both. In addition, taking into account that there is only one creator but may be many observers, the way

images are interpreted, and impact the observers depends on both the image itself and the purpose underlying its production, as well as the observer and what he seeks for or is attracted to in the image itself. In conclusion, we can, most definitely, state that generalisation is inapplicable when exploring the symbiosis of art and science in botanical visual records. It is not an absolute that botanical images of art are informed or can inform science, nor that images of science have appealing aesthetic or artistic qualities. But we can also confidently affirm, that symbiotic practices, and a twofold relevance to art and to science have an extremely strong presence and significance, within the scope of our research.

A shared iconography immediately means a wider and more varied collection of images, because it derives from a wider and more varied range of points of view, interests and intents. It also means that artistic perspectives which are unfamiliar or unconventional in scientific practice can influence science in a constructive and complementary way. In addition, artistic images can also highlight features which may be disregarded by science (and vice-versa). For example, in a scientific illustration, the illustrator depicts an extremely accurate, detailed and comprehensive portrait of the species and its parts, whereas many drawings created as sketchbook annotations and studies, usually represent a specific specimen, with its specific characteristics, resultant from specific environmental and biological conditions, in a specific context. The first being a generalisation of the "ideal plant", and the second being a particularisation of one individual. Consequently, subtleties such as insect bites, abnormalities of growth, uncommon variations of colour, for example, are more likely to be seen in artist's sketchbooks than in actual scientific illustrations. If, represented accurately, based on close attention to detail and understanding of the plant's structure and behaviours, they can be considered both instruments of knowledge and of beauty, one not limiting or invalidating the other, but, on the contrary, complementing each other. Likewise, images of science, produced to observe and study the morphology and physiology of plants, if seen through an artistic eye are likely to evidence features that, although seemingly irrelevant for their scientific purpose, may, nonetheless be meaningful for their aesthetic and expressive qualities; and overall presenting a look into objects of science not contemplated by science itself. All in all, this validates the affirmation that

intent, either scientific or artistic, does not mandatorily impose a limit to the perceptions, perspectives, and purposes with which we may approach the image of a plant, as the vegetable kingdom is essentially multidimensional.

Our research may contribute to the literatures by providing an articulated study of the botanical image grounded on the concepts of dualism or symbiosis between art-science. It is focused on an extended period of time (1837 to 1964) and explores the botanical image mainly through three different media (drawing, photography and photomicrography) and in different contexts (United Kingdom and Portugal). The introductory section covers the work of Ruskin and of the Pre-Raphaelites (Hunt, Millais, Rossetti and Waterhouse). The images studied in this section (drawing and painting) are dated between 1843 and 1917. The research on the role of botanical studies in the training of design students, including the teachings of Christopher Dresser, covers the period between 1837 and 1910. Moreover, the study of Charles Rennie Mackintosh and Margaret Macdonald, includes drawings and watercolours dated between 1891 and 1925. In photography, the earliest dated photograph by Aurélio da Paz dos Reis contemplated in our study dates back to 1900; the latest being dated 1927. Lastly, our analysis of photomicrography, including the botanical variants and the study of the evolution of pictorial photomicrography ranges from 1864[276], and 1964.

Furthermore, it articulates the study of theory and of practice in the analysis of case studies. Overall, it's main contributions are found in the emphasis given to the role of botanical studies in art and design training, botanical observation drawing in artist's sketchbooks, and botanical photomicrography, in the United Kingdom. It particularly highlights the way uniqueness and complementarity coexist in the image of plants. In that sense, if recorded through different points of view, diverse purposes, various media, techniques and scales, one plant can offer a multitude of unique but complementary images, which together, can converge to construct an all-encompassing portrait of it. And each piece of that portrait (or puzzle) has the potential to benefit not

[276] We have searched the issues of *The Photographic Journal* since 1853, but the first mention to photomicrography in this publication is dated 1864 (by Richard L. Maddox).

only the field it was created for (e.g. scientific research; artistic creation) but also to have an interdisciplinary reach, not limited by the intent it was created for.

In the first part of our study (*Art, science and the study of nature in British art: from Ruskin to the Pre-Raphaelites*), we contribute to the literatures by delivering a perspective that successfully complements what has been written on Ruskin, primarily because our analysis articulates his theory and his practice in regard to botany applied to art, developing further the study of his botanical work. Our analysis is in line with the work of Professor David Ingram, whose interest in Ruskin's Botanical work and collaboration with the Ruskin Library and Research Centre has proven to be most valuable, as we can see in the catalogue entrances he has researched. Our approach continues and complements his research. We provide taxonomic identification of depicted specimens which had not been researched yet. Moreover, we explore, further in-depth, the connection between Ruskin's theory and his practice. Plus, our study adds to the literatures by providing an extensive list of identified botanical specimens found in Pre-Raphaelite paintings and drawings (the latter exclusively in regard to John William Waterhouse) and a formal analysis of their integration within compositions, along with the articulation, when applicable, with Ruskin's theory. Furthermore, our work on botanical subjects in the work of the Pre-Raphaelites, may also be relevant to other researchers who focus their studies on the symbolistic facet of plants and flowers in Pre-Raphaelite Art (e.g. Debra N. Mancoff's "The Pre-Raphaelite Language of Flowers")[277]. Plus, the visual universe of the movement is so rich that a similar study as the one we conducted may be extended to many more works both final and preparatory, complementing science, art, poetry and symbolism is, most certainly a promising research avenue.

Furthermore, one of the most extensive and meaningful contributions of our study is found in the topic of botanical studies within the curriculums of art and design education within the Government School of Design and the Department of Science and Art. According to the archivists of the V&A archive at Blythe House, it was the first time the entire collection of the annual reports of the DSA was researched. In addition, during

[277] (Mancoff 2012).

the investigation process we digitised all the tables of contents of the reports, *in situ*, gathered them in a searchable PDF file and supplied them to the V&A archive. Aside from a brief reference by Stuart Macdonald, regarding the use of flat examples of plants in the Schools of Art in "The history and philosophy of art education ", the topic of botanical studies in art and design training is close to inexistent within the historiography of art. Our research also contributes to the literatures by providing a comprehensive study of the educational philosophy, theory and practice with the Government School of Design and the Department of Science and Art in regard to botanical studies applied to the arts. Evidence demonstrates the growing commitment and investment of the Government School of Design, the Department of Science and Art, the South Kensington Museum, the Royal College of Art and also the Dublin School of Design in integrating and developing a programme of botanical studies in the curriculum of art and design training, between the years 1837 and 1910. Moreover, this research also contributes to the literatures with an in depth investigation, which was lacking on the field, of the connection between botanic gardens, namely London – Kew and Dublin, with the schools of art and design. The first is briefly mentioned in general accounts regarding Christopher Dresser and also the GSD London. As for the latter, to our knowledge, it has not been studied within this context. On the whole, the results of our analysis significantly add to what we know about this specific topic.

Moreover, we continue what has been studied and written on Christopher Dresser and his connection to botany. Our research adds to studies of Stuart Durant, James Joll, or Michael Whiteway, for example, who focus mostly on Dresser's work as a designer, and mention his connection to botany within that scope. Plus, in line with Wendy Walgate (2003), who alludes to Dresser at the GSD and later in the DSA, both as student and lecturer, we mostly add to what has been studied on Dresser by combining the first thorough and comprehensive study which articulates two main sources: the whole set of his botanical diagrams, currently kept by the V&A, the eleven articles "Botany: as adapted to the arts and manufacture" published in *The Art-Journal* and his views on rustic and suggestive botany, thus offering a new and wider perspective on the study of Dresser's role as promoter of the study of botany applied to art and design, based on his pictorial and theoretical work.

Furthermore, the results of this research also contribute to widen the study of Mackintosh's botanical drawings, namely, by completing the identification of the specimens and mapping them, as well as by complementing the work of researchers Pamela Robertson and Elaine Grogan (Grogan 2002, Robertson 1995), in the formal analysis of his and Margaret MacDonald's botanical compositions, based on the dialogue art-science. Based on this study we presented and publish the following conference paper: Santos, Sandra. 2015. "Sketching from nature. Art? Science? Both? Botanical drawings of Charles Rennie and Margaret Macdonald Mackintosh." Arts and Sciences in Dialogue - International Congress Proceedings, Porto, 2013.

In addition, our study also complements what we know about Aurélio da Paz dos Reis, the photographer, by providing a close look into the botanical visual universe of his photography. Although he is acclaimed as a floriculturist and photographer, the great majority of the authors who studied Aurélio da Paz dos Reis' work, such as Sérgio Andrade or Maria do Carmo Séren, for example (Andrade 2002, Serén and Siza 2001, Serén 1998), mostly centre on his work as a filmmaker and his facet as a documentarist photographer. Our investigation, on the other hand, highlights his facet as a floriculturist and a photographer of flowers, contributing to complement what we know about Aurélio da Paz dos Reis himself and his work as a botanical photographer. A deeper investigation of the flower exhibitions in Oporto, as briefly alluded in our study, would be very beneficial as well, for the study of this artist.

We further argue that another of the major contributions of our research is in regard to botanical photomicrography, which closes our study. As mentioned in the literature review, most studies on photomicrography are found in either contemporary artistic-scientific practices and artists' books (e.g. the work of Rob Kesseler); within books on the history of photography; or technical publications on photomicrography. Our approach finds its place primarily in line with the approach of Rob Kesseler, e.g. "The power of x2: a botanical collaboration" (Kesseler 2006), as well as the work of Lynn Gamwell, e.g. "Beyond the visible: microscopy, nature, and art" and "Exploring the invisible: art, science, and the spiritual"(Gamwell 2003b, 2002). We find it offers a very relevant contribution to the field of research connecting art and science. It does so by delivering a very complete analysis of the development of a symbiotic connection

between Art and Science in regard to microscopic images in a very extended and uninterrupted period of time (ca.100 years) from the mid-1800s to the mid-1900s. Furthermore, it delivers an unprecedented comprehensive study of the topic of photomicrography within the scope of *The Photographic Journal*, as well as the critical and reflective analysis of the birth and evolution of "pictorial photomicrography" in the United Kingdom and its relevance to the territories shared between art and science. In this perspective our investigation also brings to light the names of Edwin E. Jelly, James Crowther, W.H. Walmsey, Walter Bagshaw, John Ward, George Rodman, Douglas Lawson and August Kreyenkamp, as promoters, through theory and/or practice, of the link between the pictorial and the scientific facets of photomicrography, which include an incredible universe of botanical images. On the whole, we find our research, may be of interest to multiple fields, both individually and collaboratively, primarily the History of Art, the History of Photography, the History of Science, Fine Art, Design, Botany and Biology. Furthermore, the course and results of this study also opens up possibilities for future research and development avenues.

Further research may be developed, for instance on the depiction of both plants and animals in artist's sketchbooks. Another interesting possibility of research is the study of Nature, not only botany but also zoology in the training of artists after 1910. The same applies to an in depth study on the role of Botanical Studies within the Royal Dublin Society, its Art schools and Botanic Garden. In addition, and given the immense international influence of Christopher Dresser, a promising research avenue is the range of influence of British design training and practice in other European countries. An extremely relevant study would be the work of Portuguese Ceramist Raphael Bordalo Pinheiro, as we can see, for example from his "Vine stem jar" (doc.336).

Moreover, and we believe with great potential, is the development of the study of botanical photomicrography by locating and studying images mentioned within the scope of *The Photographic Journal*, especially the catalogues of the exhibitions at the Royal Photographic Society and their archives. Furthermore, as we have done in regard to painting, drawing, photography and photomicrography, it would be interesting and innovative to extend the study of botanical images to other media, such as film, x-ray photography and infrared photography. Lastly, a future multidisciplinary would be the

development of a comprehensive inventory of the plants depicted in art works. A database constructed collaboratively by scientific and artistic institutions and made available to researchers in fields related to both the arts and the sciences, and linked to other databases (e.g. herbaria and other botanical collections; natural history museums and other natural history collections; science museums; botanical gardens; art, design and photography museums; libraries.

In conclusion, we expect, with our research, to contribute to the promotion of the dialogue between Art and Science as a field of research and academic study, to help inspire collaborative and interdisciplinary thinking, and to participate in the efforts to know and value the natural world, being conscious these are determinant requisites for its preservation.

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