The *Historia Plantarum Generalis* of John Ray: Book I - a translation and commentary.

In three volumes

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Volume One

John Ray, drawn from the engraved frontispiece
to the second edition of *Historia Plantarum*, Volume I.

For David

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I wish to express especial gratitude to two people: first and foremost to Dr. David Gardner-Medwin for not only providing me with the text but also for transmitting his enthusiasm for John Ray and for his unfailing support and encouragement whilst I have been researching this thesis. I would also like to thank my husband, Professor John Lazenby, who admits that he 'knows no science', for his long sufferance, which even extended to reading the finished product.

I must also thank my supervisor, Mr. James Longrigg, for his encouragement, although this work is far from the field of his own interests in ancient medicine. My thanks go too to the staff of the university library, who willingly and with a sense of humour dredged up books from their storerooms, which, if the issue labels they bore attributing ownership to King's College and frequently even to its predecessor, Armstrong College, are anything to go by, had not seen the light of day for many years and were not even included on the library's computer catalogue!

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Book I - a translation and commentary.

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Abstract

After a preface explaining the origins of my interest in John Ray, and the general principles on which I propose to proceed, the thesis consists, firstly, of a brief account of Ray's life and work, with particular attention to the state of botanical studies in his day, and of his main contributions to them.

The main part of the thesis (Volumes 1 and 2) then takes the form of a commentary on Book I of the *Historia Plantarum Generalis* and the three subsequent tables interpolated into Volume I at the suggestion of Dr. Tancred Robinson; the third volume of the thesis consists of my translation and of a photocopy of the text.

Since Ray lived before Linnæus, to whom we owe our modern binomial system of nomenclature, and because of the confused state of botanical nomenclature up to Ray's time, much of the commentary consists of the identification of the plants mentioned by Ray as examples of various botanical and horticultural processes. However, I also discuss the accuracy of Ray's observations and explanations of the various processes in the light of modern scientific views, and assess their place in the development of botanical science.

Ray's sources and his use of them would make an interesting thesis in itself. Since, however, to comment upon them all in detail would have made an already lengthy thesis even lengthier, I have singled out for detailed analysis the material cited by Ray from his contemporary Malpighi and the first century A.D. Roman writer, Pliny the Elder. Brief biographies of all Ray's sources, both ancient and modern, are also given.

Finally, I have included diagrams where I felt this would help to clarify what Ray says.

Abbreviations used in plant identifications

Works are listed here in the order in which they usually appear: i.e. with modern works first.

Clapham, A.R., Tutin, T.G. and Moore, D.M., *Flora of the British Isles;* Cambridge University Press, Cambridge 1952, reprinted with corrections 1987 (third edition). [C.T.& M.]

Blamey, Marjorie and Grey-Wilson, Christopher, *The Illustrated Flora of Britain and Northern Europe;* Hodder and Stoughton, London 1989. [B.& G.-W.]

Bentham, George and Hooker, Sir J.D., *Handbook of the British Flora, A Description of the Flowering Plants and Ferns Indigenous to, or Naturalised in, The British Isles;* L.Reeve & Co., London 1900. [B.& H.]

Linnæus, Carl. *Species Plantarum,* A Facsimile of the First Edition of 1753; The Ray Society, London 1957. [Linn.*Sp.Pl.*]

Ray, John. *Synopsis Methodica Stirpium Britannicarum,* A Facsimile of the Third Edition of 1724; The Ray Society, London 1973. [*Syn.Meth.St.Br.*]

Ray, John. *Historia Plantarum,* The Royal Society, London: Volumes I and II, First Editions of 1686 and 1688. [*H.P.*]

Ray, John, *Historia Plantarum,* The Royal Society, London: Volume III, First Edition 1704. [*H.P.III*]

Ray, John. *Dictionariolum Trilingue, Editio Prima 1675;* reprinted by The Ray Society, London 1981. [*Tri.*]

Ray, John. *Catalogus Plantarum Angliæ, et Insularum Adjacentium;* John Martyn, London: first published in 1670, edition used that of 1677. [*Cat.Angl.*]

Ray, John. *Catalogus Plantarum circa Cantabrigiam nascentium;* edition used Ewen A.H. and Prime C.T. (translators and editors). *Ray's Flora of Cambridgeshire;* Wheldon & Wesley Ltd., Hitchin, Hertfordshire 1975. [*Camb.*]

Plus the following modern works, cited occasionally in the identifications:

Isaacs, Alan. *The MacMillan Encyclopædia;* MacMillan, London 1981. [*Mac.Enc.*]

Phillips, Roger. *Grasses, Ferns, Mosses and Lichens of Great Britain and Ireland,* Pan Books 1980. [*G.F.M.& L.*]

Polunin, Oleg. *Flowers of Greece and the Balkans, A Field Guide,* Oxford University Press 1987. [*Flowers G.& B.*]

Stuart, David C. *The Kitchen Garden, A Historical Guide to Traditional Crops,* Alan Sutton 1987. [*Kit. Gar.*]

Preface and *modus operandi.*

John Ray (1627-1705) has been called the 'father of English botany'. Son of an Essex blacksmith, he went to Cambridge, where he became a Fellow of Trinity. He was also a fellow of the Royal Society, and, with the possible exception of Gilbert White, the naturalist most often quoted and referred to in England until the publication of *The Origin of Species* in 1859. His idea of the natural classification of plants was developed by Jussieu and other later naturalists and his methods were highly commended by his successors, such as Cuvier.

His first publication, in 1660, was a catalogue of plants growing near Cambridge, and he went on to publish further catalogues of both British and continental plants, as well as much non-botanical work. Among his later works was the Latin *Historia Plantarum Generalis* (three folio volumes published in 1686, 1688 and 1704), which has never been translated into English, This work takes the form of a long introductory essay [Book I], consisting of about 80,000 words at the beginning of Volume I, being in effect a textbook of botany and horticultural practice of the late seventeenth century, setting out the principles on which the author proposes to classify plants and their botanical differences and development, followed by a lengthy catalogue (c.2,700 pages) of the plants themselves; in Book I Ray discusses the work of such great botanists as Malpighi, Grew and Jung.

Several years ago I was asked by David Gardner-Medwin to translate Book I of *Historia Plantarum;* the more I studied the text the more fascinated I became by Ray and his ideas. This thesis is the result of the last five year's researches and what I suspect and hope may become the beginning of a lifetime's pursuits. The commentary covers Book I of John Ray's *Historia Plantarum Generalis,* and in addition the three summarising tables interpolated into Volume I at the request of Dr. Tancred Robinson. My translation of this work, together with a photocopy of the text, is included as the third volume of the thesis after the commentary.

In the commentary, because of the confused state of plant nomenclature up to Ray's time, I have endeavoured to identify the plants given by Ray as examples of the various botanic and horticultural processes, and also to explain the accuracy of Ray's explanations of these processes in the light of modern scientific knowledge. I have included diagrams where they can help elucidate Ray's arguments; some of these I have devised and drawn from his Latin text, for example, those of the various experiments described: others I have redrawn from various modern textbooks: and a few have been taken directly from earlier works.

The first time each of Ray's sources (e.g. Malpighi) is mentioned, I have given a short biography of the author with, where possible, details of the edition known to be in Ray's possession. At the end of the commentary I append a table of authors etc. cited by Ray, listing each one's first mention with chapter and line reference and the number of times each is cited in Book I. As it would be very difficult and extremely time consuming to check and cite/quote all Ray's references, I have selected two representative authors, Pliny and Malpighi,[1] and checked through their writings to confirm Ray's accuracy. In some instances I have quoted from both Pliny and Malpighi, but because in most cases Ray is either quoting at length, paraphrasing or selecting various sections (with omissions) from an argument of either Pliny or Malpighi I have given only the general reference. Quotations from other authors are given only where necessary. Although Ray's quotations sometimes differ from our modern texts, it must be noted that he may still be quoting accurately, because his texts perhaps themselves varied from those in current usage and these variations may not necessarily appear in the *apparatus criticus* appended to the modern text.

As mentioned above, I have tried to identify the plants named by Ray in Book I of *Historia Plantarum;* Ray and his contemporaries used many individual names for a particular plant, many of them descriptive, which Ray

1 In Book I of *Historia Plantarum* Pliny is the ancient author most referred to by Ray, with 35 references being made to his work; Malpighi is the contemporary author most referred to with 67 references.

lists in the main text of *Historia Plantarum.* Usually, but not always, the first name given in his lists in the main text of *Historia Plantarum* is the single name he, although perhaps not others, adopted for a particular plant. On occasion Ray himself uses more than one name for an individual plant, for example, *Ricinus* and *Palma Christi* for *Ricinus communis,* the Common Castor Oil Plant and *Xanthium* and *Bardana minor* for *Arctium minus,* the Lesser Burdock (both Cap. 10, lines 3 and 4). There was much confusion before Ray's time over plant taxonomy because of individual variations in names and a standard classification system was needed. Modern identification is now based on the binary system of Linnæus with a generic name and a specific epithet, not necessarily based on a description of the plant; before this most plant names were either the local names or descriptive and based on those of the ancients. The Greeks often based their names on the appearance of the root, for example, because that was the part most often used (in medicine); writers such as Theophrastus gave the most common species the generic name and other species a qualifying adjective. However, such descriptive names based on one characteristic, such as the root, could often cause confusion since unrelated plants were given the same name with one being qualified by an adjective, as happens in English with the unrelated Ivy and Ground Ivy. The Romans adopted this practice of using common and descriptive names and it passed thence to the herbalists. Such a system worked well while there were comparatively few known species, but as more and more plants were discovered such a system of nomenclature would inevitably fail and as Ramsbottom says 'the distinguishing phrase replaced the descriptive adjective'.[2] Even professional gardeners were beginning to realise the necessity for correct nomenclature; Peter Aram in his *A Practical Treatise of Flowers* states that there was needed 'a Set of names immutably establish'd & generally receiv'd & known amongst us, by which one & ye same Flower might be known every where in all Gardens where it grew by ye Name assign'd it and no

2 Ramsbottom: 9.

other'.[3] As Ramsbottom also says 'Some authors showed considerable ingenuity in keeping these phrases within reasonable bounds, for all were free to use whatever name they chose'.[4] Thus by Ray's time there were many variants for a particular plant's name, which I have tried to correspond to the modern equivalent. Nowadays, although ancient names are still in use, modern identification does not always use the oldest names correctly, as is seen, for example, in the names of certain fungi: 'the boletus of Latin authors, βωλίτης of Galen, is *Amaita caesarea;* pezica of Pliny, πέζις of Theophrastus, is *Lycoperdon giganteum;* agaricum of Pliny, ἀγαρικόν of Dioscorides, is *Polyporus (Fomes) officinalis;* ἀμανίται of Nicander is *Psalliota campestris,* and υδνον of Theophrastus is a truffle'.[5] Although all these examples are taken from fungi, the same problems have arisen with all plant names. I have traced the names by following up all the various names given by Ray in the main text of *Historia Plantarum,* through writings by his contemporaries and through representative works from the centuries following Ray, occasionally also by referring to earlier works such as those of William Turner, Culpeper, Gerard, Parkinson etc. The main works I have used in the identifications are listed in the Abbreviations' section: works are listed in this section in the order in which they usually appear: i.e. with modern works first. All information from these works has been transcribed but is too lengthy to give in this thesis, although as examples of the methods used and where the plants were more difficult to identify, I have given several identifications in full, for example, those for *Cerinthe purpurea annua* and *Cerinthe montana perennis* at Cap.13, line 10. Details of plants are given at their first occurrence and reference is made back to this point each time a plant is referred to again. I begin each identification with the Latin name given as in Ray's text, followed by its modern equivalent with the modern source in which I found it. I then list the works from which I traced

3 Aram: *A Practical Treatise of Flowers:* 12.
4 Ramsbottom: 9.
5 *ibid.:* 6.

the plant, listing these works from modern times back to Ray's, giving brief details of the plant and its family, followed by references to the various plants in the above works. In total Ray cites 628 different plants as examples of the various processes in the 58 pages of Book I and the following 4 pages of tables. Some of these plants are mentioned only once as examples of differing botanic processes, for example, *Luteola*, the modern *Reseda luteola*, Weld or Dyer's Rocket (Cap.7, line 22), but some many times, such as *Pyrus*, still having the same name of *Pyrus*, the Pear (occurring 24 times, the first at Cap.4, line 145).

Because I have retained Ray's chapter numbering and headings, my first introductory chapter does not have a chapter number; I have used the standard classical method of line numbering for ease of reference, although the text itself does not have numbered lines. Each note, therefore is indicated by line reference, followed by the relevant section of Latin [either plant name, phrase or sentence/paragraph] with its accompanying notes. The Latin quotations from Ray's text introducing each note in the commentary are, as is usual for Latin, given in italics; I have changed this from my standard Times Roman to Chancery script to indicate where Ray, himself, has some or all of this Latin already in italics, for example: Cap.1, line 9 *Æscynomenas seu pudicas Veteribus dictas*. Plant names for identification are given first in the Latin case in which they appear in the text, followed by the nominative, if not already in the nominative, for example: Cap.1, line10 *Mimosas: Mimosa* or Cap.1, line 49 *Calendula.*

When citing Ray's *Dictionariolum Trilingue* I give the genitive forms as he gives them, although he tends to give more of the stem of a noun than we would now do. This is perhaps to show where the accents fall; see, for example, the notes to Chapter 10, line 57, for *Symphytum majus*, where the Greek of *Dictionariolum Trilingue* has Σύμφυτον, –ύτου.

In the footnotes, works referred to many times are indicated by abbreviations as indicated in the bibliography; those occurring only occasionally are given in full.

In the translation certain words have been left in their Latin forms, because the modern translation is not an accurate representation of their meaning in Ray's time, for example, *utriculus* for 'cell', the cellular theory being in its infancy then and the modern technical meaning not fully established. [See the notes to Chapter 5, line 2 in the commentary on *Utriculos hic e vasorum numero excludimus, & parenchymatis ascribimus.*] As Ray often uses the first person plural in Latin, when indicating his own ideas, I have used the first person singular in the translation rather than the 'royal we'.

John Ray and *Historia Plantarum Generalis.*

Methodum Memoriæ matrem esse apud omnes in confesso est, Memoriam autem Musarum fabulantur Veteres.[6]

> John Ray (1627-1705) was the supreme British naturalist of the 17th century, the author of numerous works relating not only to botany and zoology but also to travel, theology and the English language, a man both erudite and many-sided and possessed moreover of an attractive, modest, genial and generous personality.[7]

Ray's life has been well documented,[8] so I will give only a brief resumé here. He was born on 29th November 1627 at Black Notley in Essex, where his father was the village blacksmith; Raven believes that Ray derived his life-long fascination for the structure of things from watching his father work in the smithy:

> It was this desire to see how things are made and how they function that gave him his conviction of the importance of anatomy, his skill in dissection, his insistence that specific distinctions must be based upon structural characteristics, not upon colour or size or habit.[9]

Ray was also greatly influenced by his mother, Elizabeth, who was the local 'herb-woman', whom he must have accompanied on excursions hunting for medicinal plants. Derham says of her:

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6 John Ray in his Preface to *Historia Plantarum*, where he explains his philosophy and conceptions for this work. The three volumes of *Historia Plantarum* were published by The Royal Society, London, in 1686, 1688 and 1704.

7 William T. Stearn, introduction to the facsimile edition of Ray's *Dictionariolum Trilingue, Editio Prima 1675*, published by The Ray Society, London 1981.

8 The most authoritative appraisal of Ray's life and work is that by Canon Charles E. Raven, *John Ray, Naturalist: His Life and Works*, first published by Cambridge University Press in 1942 and later reprinted in the Cambridge Science Classics series 1986. The introduction to this work lists the many publications from which Raven drew his material: xiii-xv.

9 Raven: 7.

She was a very religious and good woman, and of great use in her neighbourhood, particularly to her neighbours that were lame or sick, among whom she did great good, especially in chirurgical matters.[10]

Ray's potential must have been realised early, most probably by the local clergyman, as he became a pupil at Braintree Grammar School in 1638. He attended this school from the age of ten to sixteen, when he obtained a scholarship to Cambridge University, largely thanks to the vicar of Braintree, Samuel Collins. Ray entered St. Catherine's Hall as a beneficiary of the will of Thomas Hobbs; within two years he transferred to Trinity College as a subsizar under James Duport, Professor of Greek. He graduated B.A. in 1647/8 and was made a Minor Fellow in 1649, followed by a major fellowship in 1651. He was appointed Lecturer in Greek in 1651, Lecturer in Mathematics in 1653 and Reader in Humanities in 1655. He was also appointed to various college offices - Prælector, Junior Dean and twice College Steward - as well as being a college tutor. It was at Cambridge that he made many friends, later to have considerable influence on his life, including Francis Willughby, from whom came the idea to produce an account of all living things, a *Systema naturæ*.

He began to study the local plants in 1650, when recovering from an illness; his *Catalogus Plantarum circa Cantabrigiam nascentium* was published in 1660. Between 1658 and 1662 he travelled in England, Wales, southern Scotland and the Isle of Man. Ray was persuaded to take Holy Orders in 1660,[11] since it was a university requirement that all Fellows should be clergymen; however, at the age of thirty-five in 1662, he quietly proved his Puritan ideals, when he gave up both his ecclesiastical and university careers because he felt himself unable to sign the Act of Uniformity. Until 1665 he travelled with his friend Francis Willughby in Europe; it has been said that 'this tour was to him what the voyage of the Beagle was to Darwin'[12] Ray's

10 William Derham, *Select Remains of the Learned John Ray*, 1760: 52-53.
11 See the letter from Ray to Peter Courthope, dated 3rd January 1658; *Further Correspondence:* 16-17.
12 J.G.Crowther, *Founders of British Science* 1960: 111.

scientific work was also encouraged by his nomination on 31st October for membership and election on 7th November 1667 to The Royal Society.[13] Fellows were expected to pursue experimental research and to present papers; his first presentation on 10th June 1669 was entitled *Experiments concerning the motion of the Sap in Trees, made this Spring by Mr. Willughby and Mr. Wray.*[14] Despite his modest means Ray managed to continue presenting such papers, for example, presenting in 1674 (although not in person) his work *A Discourse on the Seeds of Plants* and *A Discourse on the Specific Differences of Plants.*[15] When Willughby died in 1672 he left Ray an annuity of £60 per annum; for the next three years Ray remained at Willughby's home at Middleton, as tutor to Willughby's two young sons. In 1673 he married Margaret Oakley, a member of the Willughby household; in 1679 they moved to Black Notley, where their four daughters were born. Ray remained here until his death in 1705, and despite difficult conditions, such as lack of access to a library and of secretarial help,[16] and suffering much ill health, he produced an incredible number of books.[17]

Although, as I have mentioned above, during these years in Black Notley Ray did not have direct access to an academic library, such as he would have had in his Cambridge days, he did possess a considerable working library of his own; many of these books were sent to him by their authors and by his friends, as is evident from his correspondence. That any books, which

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13 *Further Correspondence:* 44.

14 Reprinted in *Further Correspondence:* 45-47.

15 Both reprinted in *Further Correspondence:* 70-83.

16 In the preface to Volume I of *Historia Plantarum* he modestly confesses his difficulties:

> *Quid enim aliud sperari potest ab uno, & homine, qui ne Amanuensem quidem habuerim, verum propria manu omnia exarare coactus sum.*
>
> [What else can be expected from one mere man who had not even a secretary but must needs plough the whole field with his own hand (translation by Raven)]

17 That he was forced [from cold weather or ill health?] to work huddled up to the fire, and also to work with his children present [from lack of space?] is indicated in a letter written to Hans Sloane in 1699: 'being forced to use them [books borrowed from Sloane] by the fireside, and partly by a child's unluckily scattering ink upon them'. *Correspondence:* 364-365.

he either owned or borrowed were for use rather than ornament, is indicated in his correspondence; he apologises to Hans Sloane in a letter, written from Black Notley on 2nd June 1699, that:

> Your Hermann's 'Parad. Bat.' and Boccone's two books I intend to remit by next week's carrier, with thanks for the use of them. I must beg your pardon for having in some measure defaced them .....[18]

After his death this library, including many of the works written by her husband,[19] was sold by his widow, who in writing to Sloane in 1704[20] confessed her penury on losing the allowance of £60 *per annum* left to her husband by Francis Willughby[21] and that:

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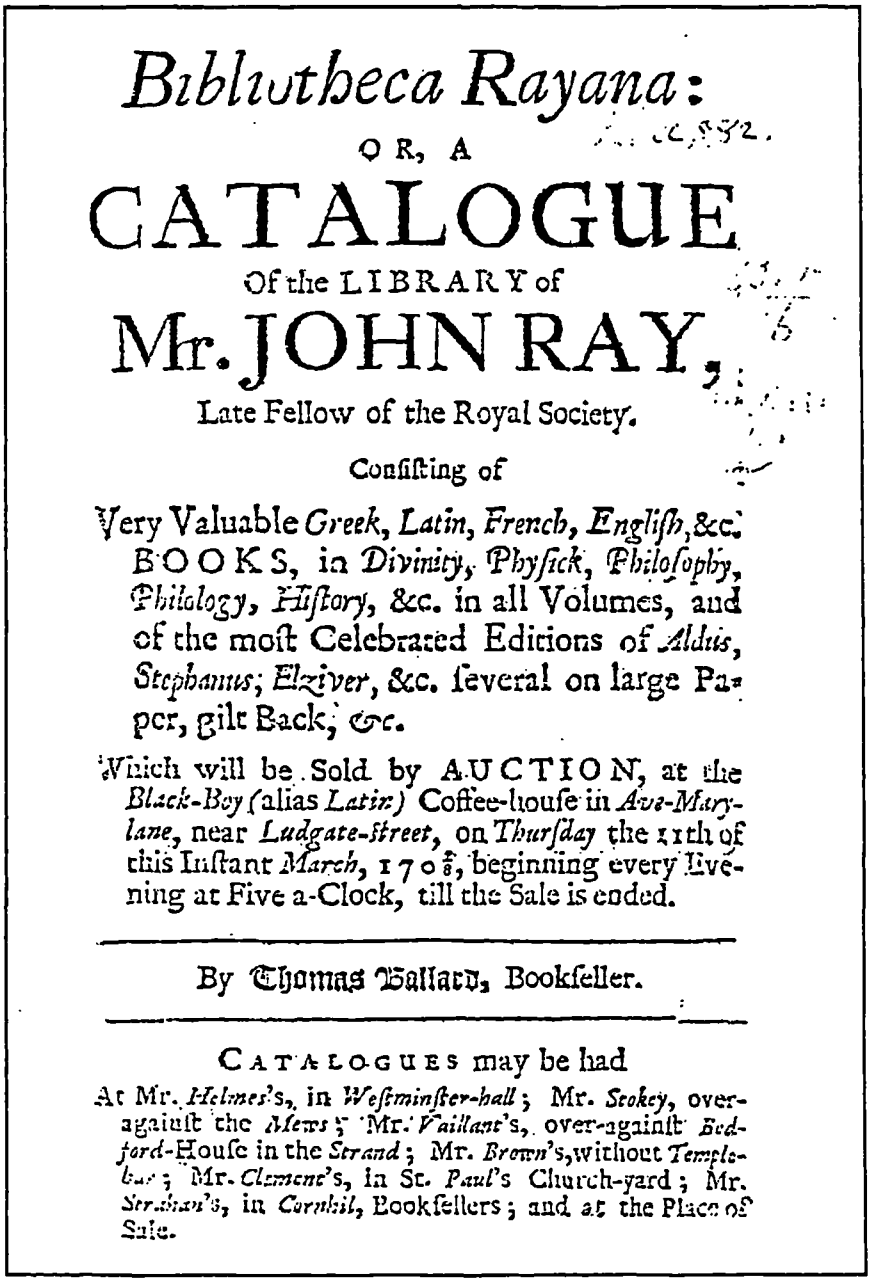
18 *Correspondence:* 364-365.

19 The sale catalogue is preserved as document British Museum: *S-C 326* (6).
British Museum: *S-C 326* (6): 2, *Libri Latine &c. in Folio,* number 44;
Historia Plantarum 3 vols. (Charta magna), no place of publication or date given (!);
ibid.: 12, *Libri Latine &c. in Octavo,* number 99;*Catalogus Plantarum Cantabr.,* first edition published in Cambridge in 1660.
ibid.: 12, *Libri Latine &c. in Octavo,* number 100;*Catalogus Plant. Angliæ,* first edition published in London in 1670.
ibid.: 12, *Libri Latine &c. in Octavo,* number 101;*Catalogus Plant. Angliæ Edit. alt. cum Notis M.S. Authoris,* second edition published in London in 1677.
ibid.: 12, *Libri Latine &c. in Octavo,* number 102;*Catalogus Stirpium Exoticarum,* edition published in London in 1673. [NB This work is not listed by Raven.]
ibid.: 12, *Libri Latine &c. in Octavo,* number 103; *Methodus Plantarum Nova,* edition published in London in 1682.
ibid.: 12, *Libri Latine &c. in Octavo,* number 104; *Fasciculus Stirpium,* edition published in London in 1688.
ibid.: 12, *Libri Latine &c. in Octavo,* number 105; *Synopsis Animalium Quadrup.,* edition published in London in 1693.
ibid.: 12, *Libri Latine &c. in Octavo,* number 106; *Sylloge Stirpium Europœarum,* edition published in London in 1694.
*ibid.:*12, *Libri Latine &c. in Octavo,* number 107; *Dissertatio de Plantis,* edition published in London in 1696.
ibid.: 12, *Libri Latine &c. in Octavo,* number 108;*Synopsis Plantarum Britannicarum,* second edition published in London in 1696.
ibid.: 12, *Libri Latine &c. in Octavo,* number 109; *Methodus Plantarum emendat. et aucta,* edition published in London in 1703.
ibid.: 12, *Libri Latine &c. in Octavo,* number 110;*Methodus Insectorum,* edition published in London in 1705. [NB Raven gives the date for this work as 1704.]
ibid.: 30, English Books in Octavo & Twelves, number 233;*Collection of Local Words,* second edition published in 1691 (no place of publication given).
ibid.: 21, English Books in Folio, number 31;*Translation of Willoughby's* [*sic*] *Ornithology,* edition published in 1678.

20 NB This letter, although no day or month is given, is dated in the *Correspondence* as being written in 1704; Ray's date of death is usually given as 17th January 1705 - see Raven: xix.

21 *Memorials of John Ray:* 28.

being left with three daughters ..... and nothing near so much left to maintain myself and them with as that legacy was, my circumstances must be but straight. I do intend to dispose of Mr. Ray's books, and will get Mr. Dale to make a catalogue of them, which shall be sent to you, as likewise an account of what papers Mr. Ray left, and doubt not your assistance therein.



Bibliotheca Rayana:

OR, A

CATALOGUE

Of the LIBRARY of

Mr. JOHN RAY,

Late Fellow of the Royal Society.

Conſiſting of

Very Valuable *Greek*, *Latin*, *French*, *Engliſh*, &c. BOOKS, in *Divinity*, *Phyſick*, *Philoſophy*, *Philology*, *Hiſtory*, &c. in all Volumes, and of the moſt Celebrated Editions of *Aldus*, *Stephanus*, *Elziver*, &c. ſeveral on large Paper, gilt Back, &c.

Which will be Sold by AUCTION, at the *Black-Boy* (alias *Latin*) Coffee-houſe in *Ave-Mary-lane*, near *Ludgate-ſtreet*, on *Thurſday* the 11th of this Inſtant *March*, 1705, beginning every Evening at Five a-Clock, till the Sale is ended.

By Thomas Ballard, Bookſeller.

CATALOGUES may be had

At Mr. *Helmes*'s, in *Weſtminſter-hall*; Mr. *Stokey*, over-againſt the *Mews*; Mr. *Vaillant*'s, over-againſt *Bedford*-Houſe in the *Strand*; Mr. *Brown*'s, without *Temple-bar*; Mr. *Clement*'s, in St. *Paul*'s Church-yard; Mr. *Strahan*'s, in *Cornhil*, Bookſellers; and at the Place of Sale.

The title page of the sale catalogue of Ray's library.

A later letter from Margaret Ray to Sloane emphasises the family's straitened circumstances, their income having dropped to less than half what it had been:

> when Mr. Ray did not leave £40 per year among us all, out of which taxes, repairs and quit-rents make a great hole.[22]

Ray's library at the time of the sale consisted of 1350 volumes.[23] These were on very wide ranging subjects, revealing Ray as a polymath with a lively, enquiring mind; for example, he possessed books not only on the natural sciences, medicine, theology and philosophy in many languages, but also general history, such as a *History of Charles 5, Emperour of Germany,*[24] *Compleat Hist. of the Cevennois,*[25] *Hist. of the Conquest of Spain by the Moors,*[26] there are also several editions of the works of classical historians, such as Polybius' *Historia*[27] *published in Paris in 1619* and Thucydides' *de Bello Pelop. per. H.Steph. edit.*[28] published in 1564. He also included books on art, for example, *Effigies of the Painters, and Lives in 100 Cuts,*[29] and *Elsum's Art of Painting after the Italian manner.*[30] Even local, more parochial matters were included, such as *Dugdale's Hist. of Imbanking and Draining,* published in 1662, on the perennial problem of the drainage of the Fens![31] On a more serious note, he owned a good selection of dictionaries of many languages, including one in nine languages, *Minshieu's Dictionary in 9 Languages,* published in 1627.[32] Among his many theological books are Bibles, as well as commentaries on sections of the Bible, in Hebrew, Latin, Greek and French.[33]

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22 Margaret Ray to Hans Sloane, dated 19th November 1706; *Correspondence:* 478-479.
23 British Museum: *S-C* 326 (6).
24 *ibid.:* 29, English Books in Octavos and Twelves, number 175.
25 *ibid.:* 29, English Books in Octavos and Twelves, number 187.
26 *ibid.:* 29, English Books in Octavos and Twelves, number 189.
27 *ibid.:* 2, *Libri Latine &c. in Folio,* number 41.
28 *ibid.:* 2, *Libri Latine &c. in Folio,* number 54.
29 *ibid.:* 22, English Books in Folio, number 72.
30 *ibid.:* 29, English Books in Octavos and Twelves, number 173.
31 *ibid.:* 21, English Books in Folio, number 9.
32 *ibid.:* 22, English Books in Folio, number 61.
33 These editions are listed in the footnote to the commentary on Chapter 20, line 20.

Ray's major publications are:[34]

1660 - *Catalogus Plantarum circa Cantabrigiam nascentium*

1670 - *Catalogus Angliæ*

1670 - *A Collection of English Proverbs*

1674 - *A Collection of English Words not generally used ...*

1675 - *Dictionariolum Trilingue*

1676 - *Willughby's Ornithologia*[35]

1682 - *Methodus Plantarum*

1686 - *Willughby's Historia Piscium*[36]

1686 - *Historia Plantarum, Volume I*[37]

1688 - *Historia Plantarum, Volume II*

1690 - *Synopsis methodica Stirpium Britannicarum*

1691 - *The Wisdom of God manifested in the Works of the Creation*

1692 - *Miscellaneous Discourses*

1693 - *Synopsis methodica Animalium Quadrupedum et Serpenti Generis*

1693 - *Collection of Curious Travels*

1694 - *Stirpium Europæarum extra Britannias nascentium*

1700 - *Persuasive to a Holy Life*

1703 - *Methodus Emendata*

1704 - *Historia Plantarum, Volume III*

1704 - *Methodus Insectorum*

and posthumously:

1710 - *Historia Insectorum*

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34 NB. Ray edited some of these works for several editions in his own lifetime.

35 Ray's own copy of this was sold after his death, as is indicated by the sale catalogue of his library:
British Museum: *S-C 326* (6): 2, *Libri Latine &c. in Folio,* number 55.*Ornithologia (Charta magna),* edition published in London in 1676.

36 This too was sold after Ray's death:
Historia Piscium, edition published in Oxford in 1686; British Museum: *S-C 326* (6): 2, *Libri Latione &c. in Folio,* number 56.

37 Morton wrongly gives the date of Volume I as 1682; it is clear from the various letters published in *Correspondence* and *Further Correspondence* and indeed from the title page of the first edition that it was not published until 1686.
Morton: 198.

1713 - *Synopsis Avium et Piscium*

1718 - *Philosophical Letters*

His personality is described by his biographer, Dr. William Derham, writing in 1760:

> In his dealings, no man more strictly just; in his conversation, no man more humble, courteous, and affable; towards God, no man more devout; and towards the poor and distressed, no man more compassionate and charitable, according to his abilities.[38]

As a philosopher and scientist, Ray believed in disciplined study and that this was 'the supreme instrument in science and religion'.[39] Raven admirably analyses Ray's attitudes towards science and religion:

> If he did not identify the spiritual with the rational, he was convinced that every tenet of theology or philosophy must be assayed by the test of its reasonableness; that loyalty to truth was loyalty to God ..... There was for him nothing incongruous in seeing the objects of his study, the order of the universe, the life of plants and animals, the structure and functioning of nature, as the manifestation of the Mind of God. Indeed the wonder with which he regarded the works of creation, and the thrill which accompanied his growing insight into the processes of their growth and function, were to him, as to mankind in general, essentially religious. ..... and though it was difficult to reconcile his discoveries with the formulæ of Christian tradition it was impossible not to find in them a profound religious and indeed Christian significance..[40]

In the seventeenth century England went through a profound social, ideological and constitutional crisis (Cromwell and the Civil War etc. and the renaissance of academic thought); Ray was conditioned by his religion in both his philosophical and scientific outlook, and, although intellectually able to make 'quantum leaps' he found it very difficult, being, despite the current winds of

38 *Memorials of John Ray.*
39 Raven: 455.
40 *ibid.*

change, a product of his deeply held beliefs. He, therefore, wrote within the limitations of this religious background - both professionally and personally. For example, he could not accept that there is any true transmutation of species among plants[41] - 'on the sixth day God ceased from his labours', therefore no more species could be created. He rejected 'the Aristotelean hypothesis that the world is co-eternal with God, and likewise the Epicurean view that the world was made by casual concurrence and cohesion of atoms. ..... Lastly he refutes Cartesianism and the idea of a divine start of the world mechanism which is then left to itself'.[42] Ray accepted the mechanical principles of the atomic theory,[43] and also the theory of the Cambridge Neo-Platonists that life is controlled by 'some intelligent plastick Nature ... guiding the whole œconomy of plants'; this was perceived as something intermediary between God and the material world.[44] It has been said that this dualism allowed 'a refuge where materialist explanations appeared to be lacking';[45] scientists could thus feel free to pursue their researches safe from interference by the clergy - 'although Ray himself, in his straightforward piety, certainly did not have this in mind'.[46] He did, however see 'it as his sacred duty to dispel the dark clouds of superstition and credulity, to lay bare the wonderful secrets of nature'.[47]

Sachs summarises the state of botanical physiological knowledge immediately before Ray's time:

> All that was known in the 16th and at the beginning of the 17th centuries of the phenomena of life in plants was scarcely more than had been learnt in the earliest times of human civilisation from agriculture, gardening, and other practical dealing with plants. It was known, for instance, that the roots serve to fix plants in the soil

41 Cf. *Historia Plantarum*, Book I, Chapter 21.
42 Morton: 211-212.
43 For a discussion on this, see Morton: 212 and also 231, note 56.
45 Ray may have read Ralph Cudworth's *True Intellectual System of the Universe*, published in 1696, in which the term 'plastick nature' is used in this way.
45 Morton: 212.
46 *ibid.*
47 Jenkins, Alan C. *The Naturalists: Pioneers of Natural History*, Hamish Hamilton, London 1978: 27. NB Jenkins shows here that he has read Lucretius.

> and to supply them with food; that certain kinds of manure, such as ashes and, under certain conditions, salt, strengthen vegetation; that buds develope [*sic*] into shoots; and that the blossom precedes the production of seeds and fruits. These and a variety of minor physiological phenomena were disclosed by the art of gardening. On the other hand the physiological importance of leaves in the nourishment of plants was quite unknown, nor can we discover more than a very indistinct perception of the connection between the stamens and the production of fruitful seeds. That the food-material taken up from the soil must move inside the plant in order to nourish the upper parts was an obvious conclusion, which it was attemped to explain by comparing it with the movement of the blood in animals. Writers on the subject up to the end of the 17th century make very slight mention of the influence of light and warmth on the sustentation and growth of plants, though doubtless the operation of these agencies in the cultivation of plants, as in other matters, must have been early recognised.
>
> So scanty was the stock of knowledge which the founders of vegetable physiology in the latter half of the 17th century found ready to their hand. While the physiological significance of the different organs of the human body and of most animals were known to everyone, at least in their more obvious features, the study of vegetable life had to begin with laborious enquiries, whether the different parts of plants are generally necessary to their maintenance and propagation, and what functions must be ascribed to individual parts for the good of the whole.[48]

Thus the first necessity was for description and classification and followed then by interpretation and speculation. In studies of vegetable physiology in the seventeenth century, there was much comparison with that of animals and an assumption that there must be a similarity of function for the organs of plants.

48 Sachs: 359-360.

As Sachs says we must use our own experience of human life as the basis of our studies of anything else.[49] He adds that:

> It has become more and more evident in our own days, that the material foundations of vegetable and animal life are in the main identical, - that the processes connected with nourishment, movement of juices, sexual and asexual propagation present the most remarkable similarities in both kingdoms.[50]

Actual experimental work developed throughout the seventeenth century, although in the earlier years it was perhaps concerned more with horticulture than the science of botany itself. For example, Bacon had done a considerable amount of research into seed germination, the use of manure and the ripening of fruit; this work was published posthumously in 1627 as *Sylva Sylvarum*. Peter Lauremberg, one of Ray's sources for the *Historia Plantarum*, who published his *Horticultura* in 1654, shows by his ideas that the link between horticulture and botany was developing.[51] As Morton says:

> The immediate results contributed ..... comparatively little to botany, beyond strengthening reliance on the test of practice for deciding questions of theory. These simple experiments did, however, demonstrate that certain ideas, some traditional, some the products of exuberant renaissance fancy, were untrue, misapplied or ineffective, and some long-persisting errors were finally laid to rest.[52]

The herbalists had listed plants alphabetically, without any proper delineation of species; there were many synonyms for plants, based on physical details, that is as it appeared to its discoverer, and even sometimes included details such as the time and place of flowering. This lengthy nomenclature created much confusion in identifying the actual plants, so that by the sixteenth and seventeenth centuries a few attempts were beginning to be

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49 Sachs: 362.
50 *ibid.*
51 Morton: 222, note 12.
52 *ibid.*: 175-176.

made to create a new system of classification.[53]

As Vines says, botanical knowledge:

> can only be fairly judged from the standpoint of its author. What has to be considered is (1) the soundness of the principles adopted, and (2) the consistency in the application of those principles.[54]

Ray in Book I of *Historia Plantarum* applied himself to the explanation of the physiological processes of plants from 'certain incidental circumstances, or logically deduced from the result of experiments'.[55] But, as Sachs adds:

> experiment presupposes the proposing a definite question resting on a hypothesis; and questions and hypotheses can only arise from previous knowledge. An early attempt to connect the subject with existing knowledge was made in the use of the comparison of vegetable with animal life.[56]

For example, after Harvey's discovery of the circulation of the blood in 1628, attempts were made to correlate this with the circulation of the sap in plants.

> Thus a first hypothesis, a definite question was framed, and attempts were made to decide it by more exact observation of the ordinary phenomena of vegetation, and still better by experiment; and though a discussion which lasted nearly a hundred years led to the opinion that there is no circulation of sap in plants corresponding to the circulation of blood in animals, the result was obtained by the aid of this hypothesis derived from a comparison between animals and plants.[57]

Sachs further comments that:

> In all cases of this kind it was matter of indifference whether the analogies presupposed were finally confirmed after prolonged

53 See the discussion on classification below in this introduction and in Chapter 20.
54 (Oliver - Ed.), *Makers of British Botany;* Vines, Robert Morison and John Ray: 25-26; [hereafter referred to as Vines].
55 Sachs: 360.
56 *ibid.*
57 *ibid.*: 360-361.

> investigation, as in the question of sexuality, or disproved as in that of the circulation of the sap. The result was of less importance than the obtaining points of departure for the investigation.[58]

The philosophy of the approach to scientific investigation in the seventeenth century can be expounded thus:

> In all questions connected with the phenomena of life, our own life is not only the starting-point but also the standard of our conceptions; what animate nature is as opposed to inanimate we discern first by comparing our own being with that of other objects.[59]

Francis Bacon also discussed the problems of experimental science in the early seventeenth century and the new approach to it in his work *Novum Organum,* published in 1620. He stated that:

> Good hope for the further advance of knowledge depends on the inclusion and gathering into natural history of a great many experiments which are of no use in themselves but simply serve to discover causes and axioms, *experimenta lucifera* as I call them, to distinguish them from those I call *fructifera.*[60]

In this work he showed that advances could be made, not only by experiment, but by co-operation between scholars, such as happened later in the century with the foundation of such institutions as The Royal Society.

In the seventeenth century knowledge of vegetable physiology was based on observations of living plants and not on current chemical or physical theories, which were in their infancy at this time. However, Grew in 1682 in his *Idea of a Philosophical History of Plants*[61] proposed a programme of botanical research, which included classification, physiology, anatomy and experiments on the chemistry of plants.[62] He, like Ray, believed that 'one

58 Sachs: 361.
59 *ibid.*: 362.
60 Francis Bacon, *Novum Organum,* 1620: Aphorism XCIX.
61 Nehemiah Grew, ***The Anatomy of Plants, with an Idea of a Philosophical History of Plants,*** Rawlins for the author, London 1682.
62 Morton: 194.

property, agreeing to diverse vegetables, should have one cause'.[63] The availability of microscopes and good hand lenses at this time also made possible 'an enlargement of the dominion of the senses';[64] the work of Malpighi and Grew introduced proper experimental research to botany, which greatly influenced Ray, leading to:

> a clearer understanding of the nature of the principal organs and tissues of the plant, and of the formal relations between them. This was a carrying forward of the morphological analysis begun by Theophrastus, and continued by Cesalpino and Jung. But Grew and Malpighi also investigated how organs and tissues are formed during growth, and this was an essentially new kind of enquiry, leading to the conception of the plant body as a co-ordinated developing structure, and marking the beginning of efforts to link structure and development, which were to become an important part of botanical investigation in the future.[65]

Until the seventeenth century the study of botany had been for the greater part an adjunct to the study of medicine, and was even considered so in the eighteenth century, as can be seen from the following:

> The science of botany certainly holds its most dignified station when subservient to *medicine;* but its utility does not terminate in this alone, though it has too long been considered as having no other connection. This, notwithstanding, is but a partial, nay even an injurious idea of it, for nothing has more retarded its usefulness than this contracted notion.[66]

In the same work may be found the recommendation that:

> In this view of the affair, it will be seen that physicians are not the only persons who may study botany to advantage; many others

63 Grew, quoted by Morton: 194.

64 Robert Hooke, *Micrographia,* London 1665; reprinted by Weinheim, New York 1961.

65 Morton: 180-181.

66 Pulteney, Richard. *A General View of the Writings of Linnæus;* T.Payne and B.White, London 1781: 374.

would find, not only a fund of pleasure from this study, but numberless other advantages resulting from the knowledge of the plants of their own country.[67]

Ray, himself came to the study of natural history not from the viewpoint of a physician or pharmacologist but, like many others of his age, as one with a passionate interest in natural phenomena; his contemporaries and friends included many of the great minds, who formed the original Royal Society.

Ray explains his botanical beliefs by quoting Lauremberg in his preface to the *Cambridge Catalogue*:[68]

> Nothing within the compass of the whole wide world yields a richer pleasure not only to the mind but also to the body, the servant of the mind, than the rich store of plant life, and the copious and varied produce of things growing in the earth. ..... I say that man receives from plants all the many things which life requires, whether for living simply or in moderation or in luxury. Human frailty has need of food, drink, medicines, clothing, housing, furniture, shipping, the pleasures of the senses and of the mind - all of these needs plants lavish upon us for our use and enjoyment from their store.

Together with his scientific and analytical approach to botany, Ray believed in an overall divine creation and plan of the universe. This is expressed most clearly in one of his later works, *The Wisdom of God manifested in the Works of the Creation*, first published in 1691. For example, he attributes to a divine creator the natural beauty of flowers[69] and leaves,[70] the intricacies of the embryonic seedling within the seed;[71] he questions the natural limitations on the size of trees[72] and marvels at the minute size and vast quantity

67 Pulteney, Richard. *A General View of the Writings of Linnæus;* T.Payne and B.White, London 1781: 377.

68 Translated here by A. H. Ewen and C. T. Prime; *Ray's Flora of Cambridgeshire*, Wheldon and Wesley Ltd., Hitchen, Herts 1975: 26.

69 *The Wisdom of God:* 80.

70 *ibid.:* 78.

71 *ibid.:* 76.

72 *ibid.:* 74.

of seeds produced by some plants.[73] All of these, he believes, are too incredible to have evolved naturally.

> That all this be done, and all these Parts duly proportioned one to another, there seems to be necessary some intelligent plastick Nature, which may understand and regulate the whole Economy of the Plant: For this cannot be the Vegetative Soul, because that is material and divisible together with the Body.[74]

Ray, himself, expresses his intentions for the *Historia Plantarum* in both the Preface to this great work and in a letter to Hans Sloane, written from Black Notley on 11th February 1684:

> Your advice concerning inserting the varieties of sundry species, especially such as are esteemed for their beauty or variety, I approve and shall observe. Howbeit it is not my intention to supersede the use of any approved botanic author; but my reasons for attempting this work were, - 1. To satisfy the importunity of some friends, who solicited me to undertake it. 2. To give some light to young students in the reading and comparing other herbarists, by correcting mistakes, and illustrating what is obscure, and extricating what is perplexed and entangled, and in cutting off what is superfluous, or under different titles repeated for distinct. 3. To alleviate the charge of such as are not able to purchase many books: to which end, I endeavour an enumeration of all the species already described and published. 4. To facilitate the learning of plants, if need be, without a guide or demonstrator, by so methodizing of them and giving such certain and obvious characteristic notes of the genera, that it shall not be difficult for any man who shall but attend to them and the description, to find out infallibly any plant that shall be offered to him, especially being assisted by the figure of it.[75] And, lastly,

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73 *The Wisdom of God:* 82.

74 *ibid.:* 75.

75 At this point Ray perhaps hoped that *Historia Plantarum* would contain illustrations; see below in this introduction for a discussion on plates in this work.

because no man of our nation hath lately attempted such a work; and those that formerly did, excepting Dr. Turner, were not sufficiently qualified for such an undertaking, and so have acquitted themselves accordingly.[76]

Ray had originally embarked upon the *Historia Plantarum* at Willughby's instigation, but after Willughby's death left it for some years believing that Morison was working on a similar project; however, after Morison's death in 1683, which left the latter's work incomplete, Ray resumed his own work encouraged by Charles Hatton to whom *Historia Plantarum* is dedicated.

Ray relied on the works of other authors and on his many contacts for much information for his work, as he was unable through lack of funds and frequent ill-health to obtain all material first hand. This is seen in his many letters to, for example, Tancred Robinson, who provided him with much information on all aspects of natural history:[77]

wherein a person of your skill and insight may afford me great assistance, by the advantage of your travelling into those parts where those plants are said to grow that I doubt of.[78]

That Ray depended on previously published work is indicated in the following letter:

Mr. Faithorne writes me, that you advised to add to the Brief

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76 *Correspondence:* 139-140; this letter is repeated in a shorter form at 160-161.

77 Many of these letters, although friendly, were of a semi-official nature, since Robinson became Secretary to The Royal Society in 1685, and as such corresponded with Ray; these letters, written during his secretaryship to The Royal Scociety, are the only ones written between them to survive intact; *Correspondence* and *Further Correspondence: passim.*
One of these 'official' letters, dated 13th March 1684, expresses Ray's gratitude to The Royal Society for agreeing to publish *Historia Plantarum; Further Correspondence:* 142.
Some three hundred others, unfortunately, have not been preserved and are found only as the epitomes listed by Dr. William Derham (1657-1735);
Further Correspondence: 285-306.
The contents of other letters between Ray and Robinson can only be inferred from Robinson's letters to other people.

78 Letter from John Ray to Tancred Robinson, dated 27th July 1683; *Further Correspondence:* 139.

> Account I sent him of the H.P. these words, *as also a particular description of their Parts, as Roots, leaf, flower, seed etc. taken from the life;* which I cannot allow, it being not true, the far greater number of descriptions being transcribed out of books ..... [79]

Ray suggested an emendation to this:

> As also particular descriptions of their parts, roots, stalk, leaf, flower, fruit and seed either taken from the plants themselves, or out of the best Authors.[80]

The letter of 22nd May also indicates his personal interest in the actual publication of his work, when he states that he did not want it to be published by subscription:

> I did not intend the work should have been printed by subscription. I do not love to draw in men to subscribe as I like not myself to be so, but that everyone should have his free liberty whether he would purchase the book or no: and if no Booksellers dare venture upon it without subscriptions, I am well content it should rest and be so suppressed.[81]

However, by June of that year he had mellowed in his opinions:

> But since they have set it on foot without my privity, I am content they should proceed.[82]

That Ray appreciated the cost of publication is indicated later by a letter to Hans Sloane, dated 2nd June 1699, concerning the third volume of *Historia Plantarum:*

> I have now agreed with Mr. Smith and partner about printing my Supplement; they are to give me for the copy in proportion as Mr. Fairthorne and Motte gave for the History itself, viz. thirty pounds in money and twenty copies bound; and I have permitted to procure

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79 Letter from John Ray to Tancred Robinson, dated 22nd May 1685; *Further Correspondence:*147-148.

80 Letter from John Ray to Tancred Robinson, dated 5th June 1685; *ibid.:*149.

81 Letter from John Ray to Tancred Robinson, dated 22nd May 1685; *ibid.:* 147-148.

82 Letter from John Ray to Tancred Robinson, dated 5th June 1685; *ibid.:* 149.

what subscriptions they can to save themselves harmless.[83]

He adds that he had considered publishing the work himself, but that it would have been difficult to raise subscriptions and troublesome to himself and his friends and 'because there is such a discouragement put upon the book trade'.[84]

Being mindful of the immense size of *Historia Plantarum*, the cost of books in the late seventeenth century can be gauged from the following; the publisher Henry Faithorne[85] advertised the first volume of *Historia Plantarum* thus:

> It is propos'd to the Subscribers at 1d. per Sheet; they paying down first ten Shillings in part, and the rest upon delivery of the Book. ..... There are some few printed on a very extra-ordinary Paper, at 2d. per Sheet.[86]

Ray was inclined at first to believe that plates were necessary for *Historia Plantarum;* in the letter to Sloane dated 11th February 1684, cited above, he expresses his wish for plates. In a letter to Tancred Robinson dated 22nd October 1684 Ray states that:

> As to the particular of figures, I find that others are of a different opinion from you, looking upon an history of plants without figures as a book of geography without maps..... [87]

Another letter from Ray to Robinson, dated 12th May 1685, also discusses the problem of plates:[88]

> I am so teased about cuts for my History of Plants all my friends condemning wooden, and telling me I had better print it without any; that I am almost unsettled again in my resolutions, and if your judgement concur, I will print it without any indeed. And if the

83 *Correspondence:* 364-365.
84 *ibid.*.
85 The order to Faithorne to publish *Historia Plantarum* had been signed on 15th September on behalf of the Royal Society by Samuel Pepys, as can be seen from the first *verso* page of Volume I. The title page tells us that the work was printed by Mary Clark.
86 Agnes Arber, *Term Catalogues* II: 162.
87 *Correspondence:* 151-156.
88 *Further Correspondence:* 146-147.

world thinks it deserves it, cuts may be added afterwards.[89]

That Ray continued to hope for plates, which he believed to be necessary for easy identification, is indicated by his appeal right at the end of Volume I of *Historia Plantarum* [on page 983] headed *De Iconibus Sculpendis Admonition,* asking for subscriptions to enable plates to be produced family by family as money should become available; unfortunately this did not happen.[90]

Raven enthuses about the first volume:

> This first volume, a very large folio, containing 22 unnumbered and 984 numbered pages, printed in a small type, is one of those works which by their sheer mass and magnitude create a sense of awe. In these days of small books and co-operative effort it seems hardly credible that such a tome can be the product of a single author and three years of writing. As one studies the endless series of descriptions, the multitude of references, the concentrated attention bestowed upon each separate species, and the innumerable points of detail discussed in the appended notes, the impression is deepened. ..... If he had lived in a cloister or a library, the work would still have been heroic: he did it in a cottage with few books, dependent upon a rather unreliable carrier and on the good offices of friends in

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89 That the problem of plates continued is indicated by Ray's correspondence with Hans Sloane on the possibility of plates for Volume III of *Historia Plantarum; Correspondence:* 406-409.
Ray asked Sloane to visit, on his behalf, the Bishop of London, who recommended that plates be included. Sloane reported that, although the Bishop was in favour, it seemed as if it would be very complicated and costly to find suitable material for engraving and to pay the engravers and 'supervisors'. Ray replied that:

> I see there are so many difficulties that attend the management, that as I never intended it at first, so I am now very willing to lay aside all thoughts of it.

Letter from John Ray to Hans Sloane, dated 20th January 1702; *Correspondence:* 409.

90 After Ray's death, James Petiver (1664?-1718) published a catalogue of plants with sixty-seven plates, probably as a memorial to Ray. This work is advertised at the end of Ray's posthumous work *Synopsis Methodica Avium & Piscium* of 1713 as follows:

> Mr. James Petiver's ENGLISH HERBAL, in which will be the *Figures* Engraved on *Copper Plates,* of above one Thousand *English Trees* and *Herbs;* adapted to that late Celebrated Botanist Mr. JOHN RAY'S *Universal History of* PLANTS .....

Keynes: 79.

London: he was nearly sixty, already in indifferent health, and the four baby girls were born during its production. There have been giants upon the earth: and on the evidence of these books Ray would have a claim to stand among them.[91]

Ray began *Historia Plantarum* with thirty sections [Book I] on what is, in effect, an up-to-date general textbook of botany and gardening methods, covering the morphology, physiology,[92] reproduction and classification of plants. He defined the parts of plants including the flower more precisely than ever before; he outlined the movement of sap and began to feel his way towards the concept of photosynthesis.[93] He also distinguished between flowering and non-flowering plants. He included the second of his publications on classification, distinguishing between monocotyledons and dicotyledons; he noted the difference between what we now term angiosperms (with enclosed seeds) and gymnosperms (with naked seeds), pointing out that one species never grows from the seed of another. He discusses the size and age and duration of plants. He also gives methods of propagation, and ways of collecting and drying plant material, the medicinal and chemical properties of plants and descriptions of plant diseases. In Book I he collected together virtually all known work on plant physiology; that he constantly tried to keep himself up to date with current research is shown in his later work *The Wisdom of God,* which includes more physiological data and experiments. His theories on the movement of sap, nutrition and respiration can be said to form the foundations of plant physiology, despite the fact that he himself did not conduct many experiments. If, as Sachs says, the sections which Ray derives from other scholars are omitted, his most important contributions in Book I of *Historia Plantarum* can be summarized as follows:

First and foremost Ray adopted the idea which Grew had conceived,

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91 Raven: 261-217.

92 From the time of his work on the movement of sap, presented to the Royal Society in 1669 [*Philospohical Transactions* IV, Number 48: 963-965], Ray began to 'treat physiology as an integral part of botany, which had not been done since Theophrastus' remarkable attempt in the *Causæ* two thousand years before'. [Morton: 208].

93 He elaborated on this in *The Wisdom of God*:: 77-78.

but in a very clumsy form, that difference of sex prevails in the vegetable kingdom, and hence the flower had a different meaning and importance for him from what it had had for his predecessors, though his views on the subject were still indistinct. Ray perceived more clearly than Cesalpino that many seeds contain not only an embryo but also a substance, which he calls 'pulpa' or 'medulla', and which is now known as the endosperm, and that the embryo has not always two cotyledons, but sometimes only one or none; and though he was not quite clear as regards the distinction, which we now express by the words dicotyledonous and monocotyledonous embryo, yet he may claim the great merit of having founded the natural system in part upon this difference in the formation of the embryo. He displays more conspicuously than any systematist before Jussieu the power of perceiving the larger groups of relationship in the vegetable kingdom, and of defining them by certain marks; these marks moreover he determines not on *a priori* grounds, but from acknowledged affinities; but it is only in the great divisions of his system that he is thus true to the right course; in the details he commits many and grievous offences against his own method, as we shall see below when we come to an enumeration of his classes.[94]

In *Historia Plantarum* Ray attempted to create a world-wide flora, describing fully all new species, giving characteristics, habit, time of flowering, whether annual or perennial and medical properties, but unfortunately, from our point of view, did not treat those already published in such a full manner. As Raven says:

When he has himself seen and identified a species it is usually easy to recognise: when he has described it, it is almost always fixed beyond doubt. His descriptions are masterpieces of brevity and

94 Sachs: 69-70.
NB The class tables which follow this quotation in Sachs are given in full in the introductory notes to Chapter 27 of this commentary.

completeness.[95]

> *Historia Plantarum* was 'not only intellectually "great" but also physically, both from the immense labour that went into it and the statistics of the three massive folio volumes (each about 8kg) with a total of over 2,600 pages of small type, each page measuring some 45cm by 28cm'.[96]

Reynolds Green has calculated that the first two volumes describe about 6,900 plants and the third, *Addenda et Corrigenda,* deals with another 11,700 plants.[97]

The bibliography attached to *Historia Plantarum* is similar to that appended to the *Cambridge Catalogue,* published twenty-six years earlier. It has been said that the Catalogue 'lists about fifty sources mostly drawn from G. Bauhin's *Pinax.* Not all of these were consulted by Ray, and some of the books were inaccurate and unreliable'.[98] However, one feels that by the time of writing *Historia Plantarum* Ray had studied much more closely the works of other authors and could comment critically upon them. He includes many new names in his bibliography,[99] and throughout Book I is especially indebted to Marcello Malpighi, Nehemiah Grew and Joachim Jung, quoting them all at length, and referring to them constantly and generously; he also cites to a lesser degree others such as Cesalpino, Sharrock, Columna, Parkinson, Vesling, Cornut etc. Added to these later authors, he quotes at length from Pliny and to a lesser extent other ancient sources, such as Theophrastus, Varro and Columella. One must not, however, overlook Ray's own considerable achievements and originality. He writes clearly and in excellent Latin, which, at least until his era, was the international language of scholarship, although henceforth its use

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95 Raven: 225.

96 Baldwin: 37.

97 Reynolds Green: 86 and 88.
Raven also discusses the numbers of plants described by Ray in the first two volumes of *Historia Plantarum:* 241.

98 *Camb.:* 4.

99 See Raven: 219-221.

gradually declined.[100] In the thirty chapters of Book I he quotes and summarises the work of others,[101] adds his own observations, where he considers them necessary, and occasionally gives his own original ideas in detail, for example concerning cotyledons and his classification system. His achievements in Book I of *Historia Plantarum* have been admirably described by Cuvier and Thouars:

> He has displayed the rare talent requisite to bring scattered observations into one point of view, here may be found the principal discoveries made by Cæsalpinus, Columna, Grew, Malpighi and Jungius in addition to those made by Ray himself; and in this way resulted the most complete treatise which had yet appeared on vegetation in general; and it must be remarked that, although this work may not have been very frequently quoted, yet it is through it that the doctrines of these authors were made common and became as it were popular in the science; and on this account we believe that the best monument that could be erected to the memory of Ray would be the republication of this part of his work separately. These writings formed an epoch in the history of botany.[102]

Although the following was said by Linnæus of Morison, it can equally apply to Ray:

> *Roma certe non uno die, nec ab uno condebatur viro. Ille tamen faces extinctas incendit, a quibus ignem mutuati sunt subsequentes, quibus datum ad lucidum magis focum objecta rimare.*[103]

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100 Ray himself showed the decline in Latin as a scholarly language when he wrote in a letter to Edward Lhwyd, dated 26th November 1693:

> truly I know no other Printer in London that one may trust with the printing of a Latine book but he [i.e. Benjamin Mott].

Further Correspondence: 237-240.

101 The work of his contemporaries, Malpighi and Grew, on internal plant anatomy was known to Ray and much quoted by him. Their microscopic studies had shown that a all higher plants had a basically similar anatomical structure, arranged in a regular pattern; this knowledge was used to advantage by Ray in comparative morphological studies.

102 Georges Cuvier and Albert Dupetit-Thouars, *Biographie Universelle*, Paris 1843: XXXV: 252-256.

103 Linnæus, *Classes Plantarum:* 33.

Two men, Hans Sloane[104] and Tancred Robinson,[105] greatly encouraged Ray in the writing of *Historia Plantarum.* Apart from the attribution of Chapter 29 to Robinson, neither are directly mentioned in Book I of *Historia Plantarum,* but Ray's debt to them both was immense. As Raven says:

> They were both men of singular energy, in touch with the world of science and culture, and in their own field eminent: but they both realised and were proud to demonstrate that at Dewlands was their master, the man who had a great gift to make to the world and whom they could enable to finish his work.[106]

Ray was helped in the editing of his great work by Samuel Dale[107] in Black Notley, and again, after delivery of the manuscripts by

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104 Sir Hans Sloane (1660-1753) was a British physician and naturalist, whose many books, manuscripts, natural history specimens etc. became the basis of the British Museum collections, for example, his herbarium comprises 337 folio volumes. He was an enthusiastic botanist, who collected over 800 plants while in Jamaica as physician to the Duke of Albemarle. He returned to England in 1689. Among his friends were John Ray, Samuel Pepys, Robert Boyle, John Locke, Edmund Halley and Isaac Newton; he was elected to the secretaryship of The Royal Society in 1693 and, following the death of its president Isaac Newton in 1727, he became its president, a post which he occupied until 1741.
There is much correspondence between Ray and Sloane, and although most of it is of a medical nature - Sloane treated Ray and his family without charge for many years - Sloane always encouraged Ray in his work and advised on the production of *Historia Plantarum.*
After his death in 1753, in accordance with his will that his collections should remain intact for the benefit of the public, his trustees sold them to the nation for £20,000. To them were added the Harleian collection of manuscripts and the Cotton Library, and thus was formed the British Museum. The bulk of Sloane's collection later became the kernel of the Natural History Museum, opened in South Kensington in 1881.
DSB XII: 456-459.
Also Raven: 209-210; *Correspondence: passim; Further Correspondence: passim.*

105 For a brief biography of Robinson see notes below at Chapter 29, line 100.

106 Raven: 210.

107 Raven [205-206] gives the following details of Dale's life.
Samuel Dale was born in Whitechapel, London, in 1658 or 1659, and, after training as an apothecary, he began to practise in Braintree and Black Notley soon after Ray settled there in 1679. Ray encouraged him in his studies of natural history and he willingly became Ray's proud helper. He published his work on drugs *Pharmacologia seu Manuductio ad Materiam Medicam* in 1693, in which he pays tribute to Ray for his help and advice. After Ray's death he was asked by Sloane to complete Ray's *Historia Insectorum,* but felt his inability to write Latin prevented this. He also prepared the catalogue of Ray's books for sale, and continued to care for Ray's family. The life of Ray published in the *Compleat History of Europe for the year 1706,* although unsigned, is by Dale; it is reprinted in *Further Correspondence:* 4-7.

weekly carrier to London, by Tancred Robinson. He also acknowledges in the Preface to *Historia Plantarum* the help received in different ways from many friends.[108]

One of Ray's greatest contributions to botanical knowledge was in the field of classification, especially in the adoption of the number of seed-leaves as a systematic character when classifying herbaceous plants. Until the seventeenth century the classification system adhered to was that introduced by Theophrastus, based on trees, shrubs and herbs; although Ray did much to alter our perceptions of the classification of herbaceous plants, he still used the Theophrastian division into trees, shrubs and herbs.[109] Up to the sixteenth century scholarly works on plants, if they were not actual commentaries on the writings of Dioscorides and Theophrastus, consisted mainly of discussions of the properties, medicinal or economic, of the plants, rather than actual characteristics and classification. Fuchs in the sixteenth century listed plants alphabetically in his *De Historia Stirpium Commentarii* of 1542; Dodoens in his *Cruydtboeck* of 1554 was beginning to attempt a classification system, although the groups themselves were not named. De l'Obel has a more carefully constructed classification in his *Nova Stirpium Adversaria* of 1570, which again is improved upon in Dodoens' *Stirpium Historiæ Pemptades Sex sive Libri XXX* of 1583. By 1583 and the publication of Cesalpino's *De Plantis Libri XVI* a classification based on morphological observation was being evolved; he based his classification on a division into trees and shrubs, subshrubs and herbs, these groups being sub-divided according to the nature of the fruit and the flower. In the seventeenth century the *Pinax Theatri Botanici* of Caspar Bauhin, published in 1623, contained about 6,000 plant names, but did not attempt a proper system of classification. The *Historia Plantarum Universalis* by Jean Bauhin, published in three folio volumes in 1650, contained both his own researches and collated that of his predecessors, both ancient and modern. Before Ray, in the seventeenth century Joachim Jung in his *Isagoge Phytoscopica* of 1678 had attempted to rationalise the previous attempts at

108 *Historia Plantarum: Præfatio.*

109 See the introductions to Chapters 26 and 27 for further discussion on classification.

classification; as Vines says:

> He [Jung] did not propound a system of his own, but he sought to arrive at the principles upon which a classification should be based, with the logical result that he rejected the time-honoured Theophrastian division of plants into Trees and Herbs. Though Jung failed to produce any immediate impression upon the Botany of his time, he powerfully influenced the great developments which took place in the eighteenth century.[110]
>
> Jung did not experiment in botany as far as we know, but he was led by philosophy and observation to a systematic analysis of plant form which had a lasting impact on descriptive botany.[111]

The systematic terminology of Jung, who much influenced Ray by his working methods and lines of thought, is described by Morton:

> Many of Jung's terms entered botanical language permanently, but their evident fittingness was the consequence of his unifying conception of morphological relationship. Some of the terms he used were already current and others he created for the purpose; his real contribution, however, was to give order and precision to terminology by linking it to principled definitions, which were exemplified by constant reference to named plants.[112]

If anything could show that the age of the herbalists was over and a new approach to the study of plants was beginning it would be the work of Ray; he included Jung's *Isagoge* in *Historia Plantarum*, although he still adhered to the division into trees and herbs, exemplifying the influence of the Greeks. Linnæus in the eighteenth century based his elaborate classification system on the principles and terminology of Jung, rather than that of Ray.

Ray attempted in *Historia Plantarum*::

> not only to formulate a correct definition and arrangement of the 'genera' (that is, the large groups or orders), but to marshal

110 Vines: 15.
111 Morton: 168.
112 *ibid.*: 173.

> correctly the 'species subalternae' (or genera) and the 'species infimae' (or species). He then briefly recapitulates the reasons for preferring his own Method as already published, though he alters it by uniting Shrubs with Trees and beginning not with Trees but with Algae.[113]

He divided the herbs into *Imperfectæ* (algæ, fungi, mosses, ferns) and *Perfectæ*,[114] which were further subdivided on the basis of the cotyledon into nineteen dicotyledonous and three monocotyledonous groups.

Ray's botanical works, and in particular, *Methodus Nova* of 1682, the first volume of *Historia Plantarum* of 1686 and *Methodus Emendata* of 1703,

> most completely sum up both the way his ideas grew and ripened, and the final result - the transformation of Cesalpino's brilliant vision into the first outline of a system of plant classification based on natural affinity.[115]

Briefly, Ray's system did not bring together dissimilar species or separate those which were obviously closely allied.

It was said of Ray by Lindley, writing in 1850, that:

> the classification he propounded, after the short period of domination of the artificial system of Linnæus, furnished the basis of that of De Jussieu, on which the system of De Candolle was subsequently founded; the system which underlies, to a great extent, the classification adopted by Bentham and Hooker in the *Genera Plantarum*. To Ray is thus due the germ of the classification still in vogue in England, though his proposals were very far from even indicating their final form.[116]

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113 Raven: 219.

114 NB The terms *Imperfectæ* and *Perfectæ* did not have the same connotations in the seventeenth century as now.

115 Morton: 201.

116 Reynolds Green: 70.

In the Preface to *Historia Plantarum*, Ray describes how he has approached this work:

> *Primo in loco omnes hactenus editas, & per multa volumina sparsas, in Genera & Species veluti tot membra distributas in unum quasi corpus redegi. Quod ut efficerem, non omnes quotquot extant Stirpium Historias, Theatra, Pandectas, Adversaria, Observationes, Illustrationes, Commentarios evolvere & examinare necessarium duxi, ne actum agerem, cum Viri longe eruditissimi maximeque industrii J. Bauhinus & Casp. Bauhinus fratres immenso labore diligenter perlectis & studiose inter se collatis Botanicorum scriptis ante se editis, species jam tum cognitas, paucissimis omissis excerptas & methodice digestas, hic in Theatri Botanici pinace, ille in Historia Plantarum generali exhibuerunt. Stirpes novit er inventas, & post Bauhinum utrumque denatum editas a Clariss. Viris Prospero Alpino, Joanne Veslingio, Jacobo Cornuto, Jaon. Parkinsono, aliisque superius memoratis ipse collegi & ad sua genera retuli: non paucas denique a meipso observatas tam in Anglia, quam in transmarinis regionibus adjeci.*[117]

Despite Ray's intentions in *Historia Plantarum* to describe all known plants, he is well aware of the difficulties of this task and that in fact it would be impossible for anyone ever to list all plants:

> We should be apt to think too meanly of those Attributes of our Creator, should we be able to come to an End of all His Works, even in this sublunary World. And therefore I believe never any Man yet did, never any Man shall, so long as the World endures, by his utmost Industry attain to the Knowledge of all the Species of Nature. Hitherto we have been so far from it, that in Vegetables, the

117 Briefly, Ray is saying here that he first collated into a single body all the plants so far published and scattered over many volumes into tribes and groups. To do this he did not consider it necessary to read and examine all existing 'Histories' since the Bauhin brothers had completed this immense task with great care. He then adds that he has worked through the publications of subsequent authors and also includes material from his own observations both in England and abroad.

number of those which have been discovered this last Age hath far exceeded that of all those which were known before.[118]

In modern times his character and erudition has been succinctly assessed by Morton:

> When in later life Ray moved as a respected equal among the intellects and virtuosi of his day, he never lost the calm consciousness that most of them were his social superiors. To this feeling may be attributed not only the outward reserve that protected an inner warmth and humanity of which his closest friends speak with unmistakable affection, but also what seems in retrospect his chief scientific weakness, a sometimes excessive caution in drawing the final conclusions to which his own evidence and opinion impelled him.[119]

His caution and modesty are indicated throughout his works: when he does not know the answer to a problem he says so as, for example, in Chapter 18, lines 185-186, when discussing 'imperfect' plants, he states that:

> *Alii fortasse post nos diligentiores aut feliciores harum etiam semina detegent, aut propagandi modum invenient.*[120]

That he was greatly respected both for his scholarship and for his humanity is clearly indicated in the many letters from prominent scholars of his own age and that he continued to be so respected is demonstrated by the following, chosen almost at random from many later works.

In the eighteenth century Gilbert White praised the work of Ray in a letter written from Selborne on 1st August 1771 to the Honourable Daines Barrington:

> But our countryman, the excellent Mr. *Ray*, is the only describer that conveys some precise idea in every term or word, maintaining

118 *The Wisdom of God:* 259.

119 Morton: 196.

120 *Historia Plantarum*, Book I, Cap.18: 35, lines185-186.
[Perhaps others coming after us, who are more careful or luckier, will detect the seeds even of these or will discover their method of propagation.]

his superiority over his followers and imitators in spite of the advantage of fresh discoveries and modern information.[121]

Pulteney's comments, written in 1790, are equally applicable today to Ray's *Historia Plantarum:*

> It is not easy to refer the modern student to a more perfect view of the state of this science near the close of the last century than will here be found; while the work itself exhibits the great improvement it had received since the beginning of the same period, and to which the author had himself contributed in an eminent degree.[122]

To conclude, as an indication of Ray's lasting achievements, a modern quotation:

> By his comprehensive treatment [in *Historia Plantarum*] and unfailing awareness of the need for a consistent theoretical outlook, specific yet consonant with that of related sciences, Ray accomplished for the new empirical botany what Theophrastus had done for ancient botany, and welded it into a unified science. It is this achievement that puts Ray above all his contemporaries and justifies Albrecht von Haller's judgement that he was the consummate botanist of his age.[123]

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121 Gilbert White to Daines Barrington, *The Natural History of Selborne,* 1813 edition: 145. This letter, although referring to Ray's work on birds, can equally apply to all of Ray's works.

122 Richard Pulteney, *Historical and Biographical Sketches of the Progress of Botany in England,* Cadell, London 1790.

123 Morton: 211.

Chapter One:

The definition of a plant.

This chapter begins with a definition of a plant from Joachim Jung; Ray follows this with a definition of life itself as applied to the plant kingdom.

In *The Wisdom of God* published in 1691, Ray begins his discussion of 'Animate' bodies with:

> Such as are endued only with a Vegetative Soul, and therefore commonly called Vegetables or Plants.[124]

Ray elaborates on the wonders of the plant kingdom and then says:

> That all this be done, and all these Parts duly proportioned one to another, there seems to be necessary some intelligent *plastick Nature*, which may understand and regulate the whole Economy of the Plant: For this cannot be the Vegetative Soul, because that is material and divisible together with the Body; which appears, in that a Branch cut off a Plant will take root, and grow, and become a perfect Plant itself, as we have already observed.[125] [126]

He next comments on the physiology of the Sensitive plant (*Mimosa pudica*), of the closing up of leguminous leaves and of many flowers, discussing the effects of pressure, temperature, light and moisture.[127] Sachs gives Ray priority and high praise for this discussion:

> Ray in his 'Historia Plantarum' (1693)[128] commences his general considerations on the nature of the plant with a succinct account of

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124 *The Wisdom of God:* 73.

125 *ibid.:* 75-76.

126 Cesalpino, who influenced Ray, also discusses the seat of the soul in plants and whether there is one soul throughout the plant or different souls in different parts such as the root and the stem. Sachs says that Cesalpino believes there to be only one soul in both stem and root but 'that it is not present in all the parts'. Sachs: 45-47.

127 Raven: 222.

128 This is the date given by Sachs for *Historia Plantarum,* which was in fact first published in 1686 not 1693; Sachs must have owned or worked from the second edition, which was published in 1693.

phytodynamical phenomena, and introduces the whole by a sentence of Jung ..... Though Ray, like Cesalpino, seems to believe in the Aristotelian soul of plants, yet he does on the whole endeavour to explain the movements which he describes by physical and mechanical laws.[129]

Sachs also discusses Ray's theories on the periodical movements of plants and that they are dependent on temperature. As he says:

> This fact, afterwards forgotten and discovered again a few years ago, of the dependence of the movements of flowers on changes of temperature, was applied by Ray to explain the periodical movements of leaves, which, to use his own expression, fold themselves together as the cold of night draws on, and open again with the day, and as he thought that these movements are of the same kind as the movements of irritability in Mimoseae, he tries to explain how cooling has the same effect as a touch.[130]

Text page 1

Line 1. *Jungio:* Jung.[131] Margin reference to *Isag. Phytoscop. cap.1. corpus vivens, non sentiens, certo loco, aut certæ sedi affixum, quod nutriri, augeri, se denique propagare*[132] *potest:* quotation given from Jung defining a plant; this definition is virtually a condensed form of Aristotle's discussion in his work Περὶ Φυτῶν.[133]

129 Sachs: 536-538.

130 *ibid.:* 537.

131 *DSB* VII: 193-6; Morton: 167-74; Raven on Jung and Ray: 38, on Jung's *Isagoge:* 80, 105- 6, 194, 221; Arber: 162; Sachs: 40,43, 58-63, 64, 73, 80, 115, 155, 221, 381, 454-456.

132 NB. As Morton says, 'propagation is used in Cesalpino's sense to mean reproduction of specific form *(planta gignit sibi specie similem)*, and thus includes propagation by vegetative means and by seed'; Morton: 169.

133 Aristotle, *Περὶ Φυτῶν [On Plants];* Loeb edition Volume XIV *Minor Works:* 142 - 233.

Joachim Jung, 1587-1657, born in Lubeck and studied at the universities of Rostock and Giessen. Appointed professor of Mathematics at Giessen at the age of 22 and delivered his inaugural lecture on 'The splendour, excellence and utility of mathematics'. Under Galileo's influence he became interested in astronomy and made observations on sunspots, but then turned to medicine, from which began a life-long interest in natural science. He founded in Germany the *Societas Ereunatica*, dedicated to scientific research. He wrote on logic and the place of mathematics in science, and these works were known to Robert Boyle.

Jung used mathematics as a model on which to base a theory of science in general; he outlined this principle in the *Protonoeticæ philosophiæ sciagraphia*, of which a copy was sent by Samuel Hartlib to Robert Boyle in 1654. Jung's predilection for systematisisng led him to develop a classification for plants, based on that of Andrea Cesalpino; some of this was incorporated by Ray in *Catalogus plantarum circa Cantabrigiam nascentium* (1660), and was delivered for him to The Royal Society by John Beale on 6th May 1663. The *Isagoge Phytoscopica* [*The Introduction to the Examination of Plants*], before posthumous publication in Hamburg in 1678,[134] was sent in manuscript form in 1660 to Ray by Samuel Hartlib: the *Isagoge* is a pamphlet of 40 pages.[135] Jung is important as a source of Ray's interest in plant structure and of his ideas of classification.[136] He acknowledges in the *Historia Plantarum* the value of Jung's work, together with that of Grew, and indeed includes much of the *Isagoge* in this work.[137]

134 There is no indication from the sale catalogue of his library that Ray ever possessed a copy of the final publication. British Museum: *S-C 326* (6).

135 See also Ray, the Preface to *Methodus Plantarum*, published in 1682.

136 Raven: 106.

137 A complete bibliography of Jung's printed works may be found in Hans Kangro, *Joachim Jungius' Experimente und Gedanken zur Begründung der Chemie als Wissenschaft, ein Beitrag zur Geistesgeschichte des 17. Jahrhunderts* (Weisbaden 1968): 350-394.

Line 3. *Vita quid:* Ray analyses Jung's definition beginning with his definition of a living plant, which he defines as 'a union of spirit and body'.

Line 7. *Non sentiens in Definitione.....:* 'Not sentient' in Jung's definition to differentiate plants from animals; this is based on the old Aristotelian definition.

In modern terms a plant can be described as follows:

> The plant kingdom is generally taken to include all the green plants (i.e. all organisms containing chlorophyll); it may also include the fungi and bacteria. Plants are distinguished from animals by several factors; most are autotrophic, making their food from inorganic materials by photosynthesis. Animals on the other hand are heterotrophic. However, the fungi, most bacteria, and certain parasitic higher plants are also heterotrophic. Plants are usually attached, as Jung says, to a substrate and not able to move around freely like animals (this does not apply to some flagellate algæ and fungi). Plants usually only respond to external stimulus by growth movements, and this is very slow compared with animal responses. Most plant cells are surrounded by cellulose unlike those of animals. Perennial plants tend to grow indefinitely, whereas animals cease growing when they reach maturity.[138]

Line 9. *Æscynomenas seu pudicas Veteribus dictas: Æschynomenæ* or *pudicæ* of the ancients, '*Vivæ, Sensitivæ* and*Mimosæ* of more recent writers' - touch sensitive plants.

138 Summarised with additional comment from *Penguin Dictionary of Botany:* 281.

Ray then tries to explain why such plants react in this way, 'if we deny all feeling and spontaneous motion to plants'.

As I said in my general introduction various hypotheses were formed based on a comparison with the animal world, including that on the movement of *Mimosa* leaves. It was later said that the name *mimosa* 'signifies "mimic" and is given to this genus on account of the sensibility of the leaves, which, by their motion, mimic or imitate, as it were, the motion of animals'.[139]

As Sachs says:

> He [Ray] thinks that the irritability of Mimosa in particular is not due to sensation, but to known physical causes; the movement of the leaf when it is touched is caused by a contraction, which again is due to a withering or relaxation of its parts.[140]

Line 10. *Mimosas: Mimosa.*

[Flowers G. & B. 281.490][141]*Acacia dealbata* (Link), Silver Wattle or Mimosa: a species of the *Acacia* genus of the *Leguminosæ* or Pea family.

139 E.Sibly, *An Appendix to Culpeper's British Herbal, being an Account of Foreign Plants;* this work was appended to a book with the title *A Key to Physic and the Occult Sciences ..... :* sixth edition published by G. Jones, 17 Ave-Maria Lane, St. Paul's, London 1821: 52-55.

140 Sachs: 536.

141 Polunin: 281.490.

C., T. & M. - no ref:[142] B. & G.-W. - no ref:[143] B. & H. 100:[144]

Linn. *Sp.Pl.* 516-23:[145] *Syn.Meth.St.Br.* - no ref:[146] :

H.P. 978-80:[147] *H.P. III* 479-80:[148] *Tri.* - no ref:[149]

Cat.Angl. - no ref.:[150] *Camb.* - no ref.[151]

H.P. 978-80:

Caaco Brasiliensibus; Herba viva vulgo Marggrav.*Æscynomene spinosa II, seu foliolis Acaciæ latioribus siliquis longis hirsutis* Breyn. *An mimosa spinosa Fernambucensis* Zanoni?

The Sensitive Plant.

H.P. III 479-80

28 additional species given.

142 A.R.Clapham, T.G.Tutin and D.M.Moore, *Flora of the British Isles;* Cambridge University Press, Cambridge 1987 (third edition).
[Abbreviated to C.T.& M. in plant identifications and referred to as Clapham, Tutin and Moore in footnotes]

143 Marjorie Blamey and Christopher Grey-Wilson, *The Illustrated Flora of Britain and Northern Europe;* Hodder and Stoughton, London 1989.
[Abbreviated to B.& G.-W. in plant identifications and referred to as Blamey and Grey-Wilson in footnotes]

144 George Bentham and Sir.J.D.Hooker, *Handbook of the British Flora, A Description of the Flowering Plants and Ferns Indigenous to, or Naturalised in, The British Isles;* L.Reeve & Co, London 1900.
[Abbreviated to B.& H. in plant identifications and referred to as Bentham and Hooker in footnotes]

145 Carl Linnæus, *Species Plantarum,* A Facsimile of the First Edition of 1753; The Ray Society, London 1957.
[Abbreviated to Linn. *Sp.Pl.* in plant identifications and referred to as Linnæus *Species Plantarum* in footnotes]

146 John Ray, *Synopsis Methodica Stirpium Britannicarum,* A Facsimile of the Third Edition of 1724; The Ray Society, London 1973.
[Abbreviated to *Syn.Meth.St.Br.* in both plant identifications and footnotes]

147 *Historia Plantarum Generalis.* [Abbreviated to *H.P.* in plant identifications]

148 *Historia Plantarum III.* [Abbreviated to *H.P. III.* in plant identifications]

149 *Dictionariolum Trilingue.* [Abbreviated to *Tri.* in plant identifications]

150 John Ray, *Catalogus Plantarum Angliæ, et Insularum Adjacentium;* The Royal Society, London, first published in 1670; edition used that of 1677.
[Abbreviated to *Cat.Angl.* in both plant identifications and footnotes]

151 *Catalogus Plantarum circa Cantabrigiam nascentium.*
[Abbreviated to *Camb.* in both plant identifications and footnotes]

Text page 2

Line 15. *Herbarum folia & summitates avulsas aut decerptas brevi flaccescere & collabi experientia constat:* the loss of sap when leaves or tops of plants are torn off; comparison with the lungs of animals. Leaves, stem etc. have their sap replenished 'from the root'.[152]

Sachs summarises Ray's discussion as follows:

> He endeavours to apply the knowledge of his time to the explanation of the mechanical process: leaves, he says, remain tense only because the loss by evaporation is kept constantly supplied by the water that flows to them from the stem; if then in consequence of a touch the sap-passages of the leaves are pressed together, the supply of water is not sufficient to prevent their becoming relaxed.[153]

Line 19. *per nervos* the word *nervus* is not used in classical Latin in connection with plants, but Ray is not perhaps using it here solely as a synonym for 'channels', as in this section he clearly believes that plants such as *Mimosa* have feelings and are physically sensitive to touch; hence *per nervos* in line 19, *nervorum compressu* in line 25, *qui nervos & vasa replebat* in line 26, *in nervis* in lines 41 and 44 indicate a neurological response on the part of the plants.

The term 'nerve' was first used in a botanical sense in 1585 for one of the ribs of fibro-vascular matter extending through the parenchyma of a leaf, especially the mid-rib.[154]

. In the introductory section to *Historia Plantarum*, corresponding to a modern glossary, Ray defines *nervus* thus:

> *Nervus, in Phytologia, prælongum & continuum filamentum folis perreptans, ut in Plantagine, quæ inde*

152 *Vide supra* Cap.1, line 23.
153 Sachs: 536.
154 *OED:* 1396.

quinquenervia & septinervia dicitur.[155]

nervus: Tri. 35. 1 *et seq.*: *"Of Homogenous Parts conteining"*:[156]

Nervus, -i, m: a sinew: *νεῦρον, -ου,* n.[157]

Line 24. *ut tangentis manus nervorum compressu ....:...:* he believes that by compressing a stem the flow of sap is impeded and the leaves etc. above this point will 'contract and collapse'.

Line 27. *partes siccitate etiam contrahuntur .....:* contraction of leaves etc. because of dryness, and subsequent expansion when moistened again, as 'in that plant falsely called ***Rosa Hierichuntina***'.
Ray believes that transpiration is a state of constant water flux and that leaves keep their shape and extension because of their water content.

Line 29. *Rosa Hierichuntina.*
[*Mac. Enc.* 1051] *Anastatica hierochuntina* (L.), the Rose of Jericho, 'falsely called....' because it is not a member of the *Rosaceæ* or Rose family; it is a perennial native of Western Asia, a member of the *Cruciferæ* or Cress family, also called 'The Resurrection Plant'. During the dry season the leaves are shed and the branches curve inwards so that the whole plant forms a wickerwork-like ball that is blown by the wind; when moistened the plant regains its shape and produces tiny white flowers. Ray was correct in assuming that drought caused its contraction.
C.,T.& M. - no ref: B.& G.-W. - no ref: B.& H. - no ref: Linn. *Sp.Pl.* 641: *Syn.Meth.St.Br.* - no ref: *H.P.* 1711: *H.P. III* - no ref:

155 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.
156 *Dictionariolum trilingue:* 35.1.
157 Seneca, the philosopher and tragedian, who died in 65 A.D., uses the phrase *nervorum* of a plant.

Tri. - no ref: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1711:

Rosa Hierichontea vulgo dicta C.B. Park. *Rosa Hiericho* J.B. *Thlaspi Rosa de Hiericho dictum* Moris. ***Rose of Hiericho.*** *An Myagrum Arabicum?* Zanon..

Line 38. *contractio ex frigore.....*: contraction due to cold. Ray believes that the contraction in the *Mimosa* plant is of this kind.

Line 40. *Mimosarum:* for *Mimosa* see above Cap.1, line 9.

Line 43. *lobi autem foliorum .....*: he says that 'the lobes of leaves contract inwardly upon each other perhaps because the upper little fibres in the nerves are drier and for this reason contract more promptly and swiftly, and the lower ones are softer and therefore more easily yield and expand'. Does he mean 'drier' and thus 'more brittle', and in the lower ones 'softer' and also 'less dry' and thus 'more malleable'?

Line 47. *Quod contractio hæc foliorum a frigore sit ..... :* Ray correctly believes that this 'sleep' movement in legumes may be due to the same cause as that of the *Mimosa* when touched, although he is not completely sure of this.

As Sachs says:

> Ray mixes up together the movements from irritability and the daily periodical movements, as was done till recent times; the latter, he says, occur not only in the leaves of Leguminosae, but in almost all similar pinnate leaves, and with these periodical movements of leaves he places also the periodical opening and closing of the flowers of Calendula, Cichorium, Convolvulus, and

others.[158]

These types of movement are known as turgor movements, which are due to changes in the water content of cells making them flaccid. The drooping of leaves under drought conditions and the variation between day and night positions of leaves of the legume family are examples of this process; so too are the changes between the normal position and the sleep position of leaves of the mimosa, which lie folded together at night. This sleep position can also be induced by touch, as Ray says here.[159]

Line 48. *similis prorsus nocturno tempore contractio ...*: contraction of leaves at night. Ray believes this too to be due to cold rather than lack of light. This type of behavioural response, which is not due to growth, and which is reversible and non-directional, can be caused by such stimulus as either light or temperature change; it is is known as a nastic response. The opening up of leaves and flowers during daylight hours only are examples of nastic responses. The exact mechanism is not understood, but it is probably a reaction to a lowering of water pressure in cells at the base of the stems.[160]

Line 49. *Calendulæ: Calendula.*

[C.T.& M.459] *Calendula officinalis* (L.), the Pot marigold; a species of the *Calendula* genus of the *Compositæ* or Daisy family.
B.& G.-W. 418: B.& H. 225: Linn. *Sp.Pl.* 921-2:
Syn.Meth.St.Br. - no ref: *H.P.* 337: *H.P. III* 209: *Tri.* 11.116:
Cat. Angl. - no ref.: *Camb.* - no ref.
H.P. 337:

Calendula sativa. Caltha J.B. *Caltha vulgaris* C.B.

158 Sachs: 537.
159 *Lowson's Botany:* 284-285.
160 *Oxford Dictionary of Botany:* 270; also *Penguin Dictionary of Botany:* 240; also *Lowson's Botany:* 286

Garden Marigold

Caltha arvensis C.B. *minima* J.B. *sylvestris* Ger.

Wild Marigold.

H.P. III 209:

10 additional species given.

Tri. 11.116:

Marigold: *Calendula, -ae*, f.: *χρυσάνθεμον, -ον*, n.

Ray's note Tri. 11.116, ' This is thought to be the *Caltha* of the poets'.

Line 50. *Cichorii: Cichorium.*

[C.T.& M. 490-1] *Cichorium* (L.), Chicory; a genus of the *Compositæ* or Daisy family.

Cichorium Intybus (L.), Chicory or Wild Succory; a species of the *Cichorium* genus of the *Compositæ* or Daisy family.

B.& G.-W. 428: B.& H. 270: Linn.*Sp.Pl.* 813:

Syn,Meth.St.Br. 172: *H.P.* 255: *H.P. III* - no ref: *Tri.* 14.187:

Cat. Angl. 69: *Camb.* 53-4.

H.P. 255:

Cichorium sylvestre & sativum J.B. *Cichorium Sativum & Cich. sylvestre sive officinarum* C.B. Ger. Park.

Garden and Wild Succory.

Tri. 14.187:

Succory, *Cichorium, -i*, n: *Κιχορείον, -είου*, n.[161]

Line 50. *Convolvuli: Convolvulus.*

[C.T.& M. 364] *Convolvulus* (L.), Bindweed: a genus of the *Convolvulaceæ* or Bindweed family.

B.& G.-W. 318: B.& H. 305: Linn.*Sp.Pl.* 153-9:

161 The spelling in Liddell and Scott differs from Ray's, having κιχόριον, ου, κίχορα, -ων (neut. pl.), or κίχορη.

Syn.Meth.St.Br. 275-6: *H.P.* 722-31: *H.P. III* 371-2: *Tri.* 8.19: *Cat.Angl.* 78: *Camb.* 56.

H.P. 722-31:

35 species given, including:

Convolvulus minor vulgaris Park. *minor arvensis* C.B. *Helxine cissampelos multis sive Convolvulus minor* J.B. *Smilax lenis minor* Ger. ***Small Bindweed.***

H.P. III 371-2:

96 additional species given.

Tri. 8.19:

Bindweed: *Convolvulus, -i,* n: *Σμίλαξ, –ακος,* f.

Line 50. *Etenim, Jacobi Cornuti,*[162] *experimento* .... : Jacob Cornutus / Jacques Cornut says that the *Anemone* flower, which usually closes up at night, 'when plucked off and hidden in a very warm place .... opens up there after a time if its base is simply immersed in warm water'. Ray seems to agree with Cornut here, that it is warmth rather than water which encourages the flower to open.[163]

Sachs discusses Ray's comments on this experiment of Cornut's on the flowers of the Anemone, proving the dependence of the movements of flowers on changes of temperature.[164] Ray also applied this theory to explain the periodic movements of leaves, which as he says 'fold themselves together as the cold of night draws on, and open again with the daylight'; because he thought that these movements were the same as the movements of irritability in the mimosa, he tried to explain how a cooler temperature has the same effect as touch.

162 Raven: 76 note 5, 191, 220.

163 *Vide supra* Cap.1, line 47 on nastic responses.

164 Sachs: 537.

Jacques Philippe Cornut, a doctor of Paris, published *Canadensium Plantarum Historia* in Paris in 1635.

Line 50. *Anemones: Anemone.*

[C.T.& M. 36-7] *Anemone* (L.), Anemone: a genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 108: B.& H. 4: Linn. *Sp.Pl.* 538-542:

Syn.Meth.St.Br. - only *Anemone nemorum* 259: *H.P.* 624-633:

H.P. III - no ref: *Tri.* 8.5: *Cat.Angl.* 21-22: *Camb.* - no ref.

H.P. 624-633:

9 species of true Anemone given.

13 species of *Anemone latifoliæ simplici flore* (10 from Park. *Paradiso*).

4 species of *Anemone latifoliæ flore pleno* (4 from *Horto Regio Parisiensi*).

21 species of *Anemone tenuifoliæ flore simplici* (14 from Park. *Paradiso*, 8 from *Horto Regio Parisiensi*).

3 species of *Anemone tenuifoliæ flore pleno* (listed as 65 from *Horto Regio Parisiensi*, 9 from Park. *Paradiso*, 22 from J.Ray *Flora*).

Tri. 8.5:

Anemone or Windflower: *Anemone, -es*, f: *Ἀνεμώνη, -ης*, f.

Ray's footnote *Tri.* 8.5 says that, 'This in *English* is commonly, though corruptly, called *Emmony*'.

Line 53. *Verum in causis hujus phænomeni assignandis* ....; Ray now shows doubts about the reasons for these contractions; he does not agree with some scholars that there are valvules in the ducts of plants.

The internal structure of a plant stem is fairly consistent among different genera, with only a few minor variations. In cross

section there is a clearly defined outer layer of slightly thickened cells forming a protective impermeable skin, known as the epidermis, needed to prevent unnecessary water loss. Immediately below this there is often a ring or series of cords of flexible strengthening tissue. Just within these is the vascular conducting tissue - the xylem and the phloem, which, instead of occurring in a central core as in the root, has spread out into a series of peripheral 'bundles', each containing some water-transporting tissue (xylem) and food-conducting tissue (phloem). The central portion of the stem is generally occupied by undifferentiated 'ground' tissue, correctly called parenchyma [pith or medulla]. Although the cells are unthickened and unsupported they give the stem its rigidity entirely through the water pressure within them. If the water pressure drops the stems wilt and become less rigid.[165]

For a diagram of a basic stem see below Cap.4, line 7.

Line 55. *Augeri dicitur planta quæ plus substantiæ sibi restituit quam dissipata est.*: The growth of plants and increase in size and replacement of parts - leaves, flowers, fruits. The importance of Ray's observations here are summarised by Morton:

> Ray subjoins a definition of growth as "an increase of substance", a simple additional statement that is none the less a landmark, a sign of the birth of physiological understanding.[166]

He then continues with the difference between plants and animals.

Line 61. *Periosteo:* 'Bones when denuded of the periosteum are lacking in feeling.'

Bone is liable to exfoliation or necrosis when denuded of the

165 Gibbons: 35-6.
166 Morton: 208.

periosteum by injury or disease.

Periosteum.[167] Earliest known usage in English 1597. A modern Latin word from Greek *περιόστεον;* whence late Latin *periosteon, -i,* n.[168] The dense fibro-vascular membrane which envelops the bones (except where they are covered by cartilage). Bone cells receive nourishment from blood vessels which weave through the periosteum and reach the spongy interior directly or through an intricate network of tiny canals. Nerve fibres follow similar routes; the periosteum conveys sensations of bone pain and pressure.[169]

Line 64. *Cum autem Animalium ova ...* : comparison of eggs, ovaries etc in plants and animals.[170]

The egg of an animal is defined as being the oval body laid by the female of birds and other animal species, and containing the germ of a new individual, enclosed within a shell or strong membrane.[171]

The fruit of a plant is defined as being the seed of a plant or tree, regarded as the means of reproduction, together with its envelope.[172] Specifically 'the ripe pistil containing the ovules, arrived at the state of seeds'.[173]

The ovary of a plant is the lowest part of the pistil in a flower, consisting of one or more carpels, which ultimately becomes the fruit or seed-vessel, and contains the ovules.[174]

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167 *OED:* 1556.

168 *Vide* Cælius Aurelianus, physician, fl. A.D.420, *Tardae Passiones:* 5.1.5.

169 Gray's *Anatomy:* 1096.
Also *Harrap's Dictionary of Medicine and Health:* 308.

170 NB James Longrigg tells me that there is a fragment of Empedocles which states that 'tall olive trees bear eggs'.

171 Eggs of animals - *OED:* 633.

172 Fruit of plant - *OED:* 812.

173 John Lindley (1799-1865), *The Vegetable Kingdom,* Bradbury and Evans, London 1846: 1853.

174 *Penguin Dictionary of Botany:* 254; also *OED:* 1478.

The ovary is the female organ of reproduction in animals, in which ova or eggs are produced.[175]

Line 68. *Plantæ perennes augmenti respectu ....*: comparison of animals and perennial plants. Ray states that plants keep on growing throughout their lives, whereas animals cease when they reach maturity.

Line 72. *Certo loco, aut certæ sedi affixum:* 'In a fixed place': see Jung's definition, Cap.1, lines 1-2.

Line 73. *Stratiotes Veteribus dicta (Dioscoride teste):* 'Stratiotes of the ancients': cf Dioscorides 4.101.

Line 73. *Stratiotes.*

[C.T.& M. 518] *Stratiotes aloides* (L.), the Water Soldier; a species of the *Stratiotes* genus of the *Hydrocharitaceæ* or Frogbit family. A submerged dioecious herb rising to the surface at flowering time. The floating and submerging of the plant is said to be due to changes in the amount of calcium carbonate in the leaves.
B.& G.-W. 444: B.& H. 434: Linn. *Sp.Pl.* 535:
Syn.Meth.St.Br. 290: *H.P.* 1324: *H.P. III* - no ref: *Tri.* - no ref:
Cat.Angl. 199: *Camb.* - no ref.
H.P. 1324:

> *Militaris Aizoides* Ger. *Stratiotes sive Militaris Aizoides* Park.
> *Aloe palustris* C.B.
> ***Water-Sengreen***, or ***Fresh-water-Souldier.***

175 *OED:* 1478.

Line 73. *Dioscoride teste:* Pedanius Dioscorides:[176] c.40-90 A.D. Greek physician, who compiled the first pharmacopœia. He travelled widely as a surgeon in the Roman army and in his work the *De Materia Medica* (c.77 A.D.) he described nearly 600 plants and their medicinal properties.

Morton gives a different date for *De Materia Medica* (c.60 A.D.) and says that it lists approximately 1000 drugs, about 3/5 of which are from plants.[177]

Dioscorides prided himself on his thorough study of previous authors but even more on his own practical expertise, 'knowing most herbs with my own eyes, others by historical relation agreeable to all, and by questioning [and] diligently enquiring of the inhabitants of each sort'.[178]

NB There are many references in Morton to Dioscorides; he also gives some extra notes on *De Materia Medica* and its style and botanical content.[179]

Raven has mostly incidental references to Dioscorides, except on page 461, where he says that in *The Wisdom of God* 'the list of plants with which he [Ray] illustrates his sections on signatures is presumably from Dioscorides'.[180] Ray, although Raven may well be correct, does not mention any author by name in this section.[181]

The best attempt at identifying the plants in Dioscorides

176 *DSB IV:* 119-123: *Mac.Enc.:* 368; Morton: 66-68, 85-86, 88. 117; Arber: 8-12, 14, 25, 55, 59, 61, 70, 74, 75, 92-97, 104, 116, 124, 140, 147, 164, 185, 270, 272, 273, 276, 277; see also *Codex Aniciæ Julianæ* and *De materia Medica libri quinque*.: Sachs: 3, 4, 13, 18, 22, 29, 30.

177 Morton: 67.

178 From John Goodyer's English translation of 1655, published by Robert T. Gunther, *The Greek Herbal of Dioscorides* (New York, 1934: repr. 1959).

179 Morton: 67.

180 Raven: 9, 75, 461.
There is no indication from the sale catalogue of his library that Ray ever possessed a copy of Dioscorides. British Museum: *S-C 326* (6).

181 *The Wisdom of God:* 85.

is in the commentary to Berendes' translation, *Des Pedanios Dioskurides aus Anazarbos Arzneimittellehre in funf Buchern* (Stuttgart 1902).[182]

Line 74. *Aizoo simile:* as *Stratiotes* Cap.1, line 73 above.

Line 74. *Prosper Alpinus:* Prospero Alpino (margin reference) *De Plantis Aegypt,* c.35: '*pro radicibus exiua quædam & rara lanugo dependet*'.

Alpino (1553-1616) published at Venice in 1592 his *De plantis Ægypti,* in which he described fifty-seven plants and trees (forty-nine are illustrated). Alpino was a doctor, who accompanied the Venetian consul, Giorgio Emo, to Egypt, where he took full advantage of this botanical opportunity. He is said to be the first European to mention the coffee plant (*Coffea arabica,* L), which he saw growing in Cairo. He eventually became the holder of the oldest chair of botany in Europe at Padua, established in 1533, where he grew many Egyptian plants in the botanic garden, which had been established there in 1542.[183]

An interesting note to add here is that the self-same palm tree, which is said to have inspired Goethe's theory of metamorphosis, was already growing in the Padua botanic garden in Alpino's day, and is said to still survive to this day.[184]

Alpino is listed in the preface to *Historia Plantarum* as the author of *De Plantis Ægypti* (Venice 1592) and of *Dialogus de Balsamo* (Venice 1591).[185] Ray also discusses his work in *A Collection of Curious Travels and Voyages,* 2 vols. (London 1693), II, 92-98.

182 *DSB IV*: 122.
183 *DSB I:* 124-125; Arber: 100-102; Sachs: 380; Raven: 191, 220.
184 Arber: 101-102.
185 There is no indication from the sale catalogue of his library that Ray ever possessed copies of Alpino's works. British Museum: *S-C 326* (6).

Line 76. *Veslingius:* Johannes Vesling:[186] margin reference to *Alpin..Ægypt. plant. cap.35: Planta tota sessili basi Nilo incubat, aquis innatans citra radicem, quamvis radicum vicem demissa terram versus tenuissima fibrarum veluti filamenta sustineant.*

Ray then goes on to cite some animals, which exist in a fixed place, 'not only those .... which we call zoophytes,[187] but also more perfect ones, such as some shellfish, the μόνιμα[188] of Aristotle, that is Stabilia', although he doubts that they can be classed as animals since they do not have freedom of movement. He then gives personal examples such as Mytili, Balani usually called Conchae Anatiferæ, which attach themselves to ships by means of 'a certain *fistulosa*, which is a leathery, wrinkled and prolonged offshoot'.

Despite the similarity of the last two references in lines 74 and 76, Ray is referring to two somewhat different works by Alpino and Vesling. Johanes Vesling was the editor of Alpino's *De Plantis Ægypti* (1592) and of *Dialogus de Balsamo* (1591); he revised and enlarged these works.[189] In *Observations* of 1673 Ray quotes Vesling's epitaph at Padua.

Line 81. *Zoophyta:* earliest known English usage 1621 [French - *zoophyte* (Rabelais): modern Latin *zoophyton:* Greek ζωόφυτον (Aristotle)].

Any of the various animals of low organization, formerly classed as intermediate between animals and plants, resembling the latter in being usually fixed and in having a branched or radiating structure,

186 *DSB XIV:* 12-13: Raven 220, 236.

187 *Zoophyta - OED:* 2597.

188 μονιμα – Liddell and Scott: 1143.

189 There is no indication from the sale catalogue of his library that Ray ever possessed a copy of *de Plantis Ægypti*, although he did own a copy of Vesling's *Anatomia cum fig.*, edition published in Amsterdam in 1666; British Museum: *S-C 326* (6): 8, *Libri Latine &c. in Quarto*, number 135.

as crinoids, sea-anemones, corals, sponges etc.[190]

Ray's confusion over Zoophytes is also shown below Cap. 26, line 9.

Line 82. *μόνιμα* or *stabilia* of Aristotle:[191] *μόνιμος, -ον,* also *η, -ον,* staying in one place or stationary: *ζῷα μόνιμα κατὰ τόπον* Aristotle *de An* 410, 19. *Stabilia* in Latin as *μόνιμος* in Greek.

Line 82. *Aristoteli:* Aristotle: 384-322 B.C.

Greek philosopher and scientist. His father was court physician in Macedonia. Aristotle joined Plato's academy at Athens (367-347) but, when he failed to become head of the academy on Plato's death, he accepted the protection of Hermeias, ruler of Atarneus in Asia Minor. About 343 Philip of Macedon appointed him tutor to his son Alexander then aged 13. After Alexander's accession in 336, Aristotle founded, with Alexander's help, a research community with library and museum in Athens, the Lyceum. There Theophrastus studied botany and Aristoxenus music, and Aristotle, among other projects, organised a comparative study of 158 constitutions of Greek states. When Alexander died in 323, anti-Macedonian reaction in Athens forced Aristotle to leave for Chalcis, where he died. He wrote over 400 books on every branch of learning, including logic, ethics, politics, metaphysics, biology, physics, psychology, poetry and rhetoric. About one quarter survive, but are apparently memoranda for his students' use, not intended for general publication.[192]

Doubt has been expressed about Aristotle's authorship of

190 See note 24 above.

191 See note 25 above.
There is no indication from the sale catalogue of his library that Ray himself ever possessed copies of Aristotle's writings on natural history, although he would, as a classicist, have been familar with at least some of Aristotle's writings.
British Museum: *S-C 326* (6).

192 *DSB I:* 250-281; *Mac.Enc.:* 76.

any books on plants;[193] although he seems to have written mostly on animals, and Theophrastus, his friend and pupil, on plants, there is no doubt in my mind that the scattered references to plants throughout his work are based on writings of his, which have been lost. (The work on plants *De Plantis* included in his minor works is probably by Nicolaus of Damascus, born in 64 B.C., the court historian of Herod the Great.)[194]

Line 83. *Mytili: Mitulus/Mytulus/Mytilus, -ii,* m. = *μύτυλος:*[195]

Pliny 9, 51, 74, §160: 32, 9, 36, §111: also *mutulus* Cato R.R. 158: Horace §2, 4, 28.

A genus of bivalves now comprising the marine mussels.[196]

Line 84. *Balani illi Conchæ anatiferæ dici:*

Balanus, -i, f, rarely m. Greek *βάλανος.* Any object in the form of an acorn; a shell-fish, a species of sea mussel: Col.8, 16, 7: Plin. 32, 11, 53, §145: Plaut. Rud. 2, 1, 8,: Metell. ap. Macr. S.2, 9.[197]

Balanus - Acorn Barnacle *(Balanidæ).* This is a member of the only class of crustaceans, the Cirripedes, apart from parasitic groups, in which the adults are wholly sessile; order Thoracica, suborder Balanomorpha. The family includes the barnacles exposed at low tide, of the genus Balanus, which is divided into 10 subgenera.[198]

The name *anatifera* still continues to this day for a type of barnacle - *Lepas anatifera,* the Goose Barnacle, of the order

193 See the lengthy discussion by D.M.Balme in *DSB, Vol.I:* .258-266, on the authorship of Aristotle's works on natural history.

194 There is considerable argument in Morton on Aristotle's ideas on botany. Morton: 27-29; Arber on Aristotelian botany: 2-6, 23, 108, 143-147, 163-164, 272; Sachs: 4, 6, 13, 16, 43, 51, 219, 376, 450.

195 *Mytili* - Lewis and Short: 1153; also *OED:* 1376.

196 *Mac.Enc.:* 848.

197 Lewis and Short: 220.

198 *Oxford Dictionary of Natural History:* 66.

Thoracica, suborder Lepadomorpha, family Lepadidæ. As in all lepadids the stalk is naked, lacking setae or scales; this pedicle can grow to 7 centimetres in length even when contracted - Ray's *fistulosa, coriacea, rugosa, oblonga* (his 'leathery, wrinkled and prolonged offshoot'). As Ray says, *navium carinis aliisque lignis vetustis in mari fluitantibus adhærescunt*, and 'with densities of 400-500 individuals per square metre *L. anatifera* may cause severe fouling of ships' hulls.'[199]

Barnacle is also the name of a species of wild goose, *Anas leucopsis*, found breeding in the Arctic Sea, but visiting British coasts in winter. It was originally believed to grow out of the fruit of a tree or to grow upon the tree attached by its bill (hence its name of Tree Goose) or to be produced out of a shell. Hence Ray's name of *Conchæ anatiferæ* or Goose-bearing shells. According to the *OED*[200] the term Barnacle was used first for the bird and then for the Crustacean. Since 1768 the bird has been known in English as the Barnacle Goose.

It is perhaps worth noting that the legend of the Barnacle Goose had been rejected much earlier by the mediaeval Aristotelian scholar Albertus Magnus (Albert of Bollstadt, St Albert), who died in 1280, although he still suffered from some confusion about its origins. He states that it was popularly believed to be born from a tree, but says that 'with us, a goose of this kind paired with a domestic goose and reared chickens'.[201] [202] Later he gives the barnacle legend in more detail and says that 'This is altogether absurd as I and many of my friends have seen them pair and lay eggs and hatch chicks'.[203]

The confusion continued,when in the sixteenth century

199 *Oxford Dictionary of Natural History:* 351.
200 *OED:* 158.
201 Raven C E, *Science and Religion*, Cambridge University Press 1953: 67-68.
202 Albertus Magnus *De Animal.* XXIII: 6.
203 *ibid.:* 19.

scholars, such as J.C.Scaliger in his book *De Plantis*, still cite the barnacle legend as an example of transmutation,[204] although Fabio Colonna, in his *Phytobasanos* of 1592 rejected the legend completely. Arber says that the editions of Gerard's *Herball* published after his death do not contain this story, but the edition edited by Thomas Johnson in 1636 does still contain it.[205]

Gerard writing at the end of the sixteenth century did believe in the legend; I give Gerard's version here as an example of the way in which scientists of the period, although they were beginning to experiment and to test their own observations, were frequently happy to rely on legendary stories passed down over many generations and which had no doubt been added to in the manner of the 'oral tradition'.[206] Gerard gives the story at the end of his *Historie of Plants* as 'one of the marvels of this land (we may say of the World)'. He states that, although he cannot vouch for all of the information he gives and feels that he should leave it to 'some excellent man, learned in the secrets of nature, to be both fined and refined,' he believes in his sources and can bear witness to some of the details.

Of the Goose tree, Barnacle tree, or the tree bearing Geese.[207]

> There are found in the North parts of Scotland and the Islands adjacent, called Orchades, certaine trees whereon do grow certaine shells of a white colour tending to russet, wherein are contained little living creatures: which shells in time of maturity doe open, and out of them grow those little living things, which falling into the water do become fowles, which we call Barnacles .... Thus much from the writings of others, and also

204 J.C.Scaliger, *De Plantis*, Paris 1556: 125.
205 Arber: 133. See also note 39 below.
206 Gerard [Ed. Johnson]: 282-285.
207 *ibid.*: Cap.188: 282-285.

from the mouthes of people of those parts, which may very well accord with truth.

He then continues:

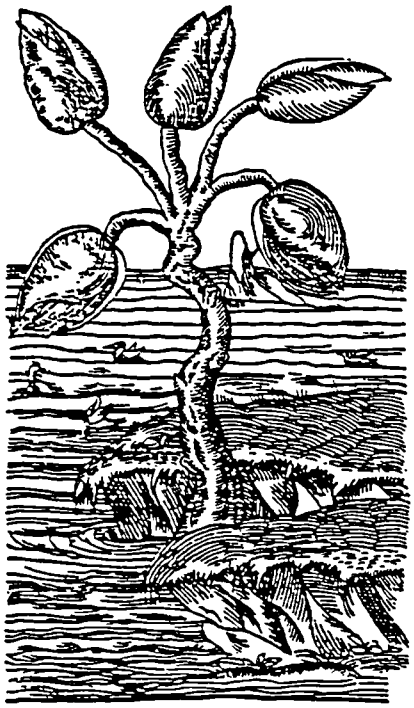
> But what our eies have seene, and hands have touched we shall declare. There is a small Island in Lancashire called the Pile of Foulders, wherein are found the broken pieces of old and bruised ships ....; whereon is found a certaine spume or froth that in time breedeth unto certaine shells, in shape like those of the Muskle, but sharper pointed, and of a whitish colour; wherein is contained a thing in forme like a lace of silke finely woven as it were together, of a whitish colour, one end whereof is fastned unto the inside of the shell, even as the fish of Oisters and Muskles are: the other end is made fast unto the belly of a rude masse or lumpe, which in time commeth to the shape and forme of a Bird: when it is perfectly formed the shell gapeth open, and the first thing that appeareth is the foresaid lace or string; next come the legs of the bird hanging out, and as it groweth greater it openeth the shell by degrees, til at length it is all come forth, and hangeth onely by the bill; in short space after it cometh to full maturitie, and falleth into the sea, where it gathereth feathers, and groweth to a fowle bigger than a Mallard, and lesser than a Goose, having blacke legs and bill or beake, and feathers blacke and white, spotted in such manner as is our Magpie, called in some places a Pie-Annet, which the people of Lancashire call by no other name than a tree Goose.

Gerard then goes on to say that he himself saw on the coast between Dover and Romney growing on a rotten tree drawn from the water

many thousands of long crimson bladders, in shape like unto puddings newly filled ....; at the nether end whereof did grow a shell fish, fashioned somewhat like a small Muskle, but much whiter, resembling a shell fish that groweth upon the rockes about Garnsey and Garsey, called a Lympit: many of these shells I brought with me to London, which after I had opened I found in them living creatures without forme or shape; in others which were neerer come to ripenesse I found living things that were very naked, in shape like a Bird; in others, the Birds covered with soft downe, the shell halfe open, and the Bird ready to fall out, which no doubt were the Fowles called Barnacles.

He gives the time of development thus, 'They spawn as it were in March and Aprill; the Geese are formed in May and June, and come to fulnesse of feathers in the moneth after.'

Illustrations of *Concha anatifera* from Gerard's *Herball:* from the edition of 1597:



from Johnson's edition of 1636:

Britanicæ Conchæ anatiferæ.
The breed of Barnacles.

Line 84. William Turner, who wrote about fifty years before Gerard, also gives this version of the barnacle and its geese, although he does not vouch for it from his own experience, but says he has it on good authority,[208]

> Boethius [Boece], in his sixteenth century Scottish Chronicle, believes that geese grow from driftwood
>
> > in the small boris and hollis growis small wormis; first thay schaw their heid and feit, and last of all thay schaw thair plumis and wyngis; finaly quhen thay ar cumyn to the iust mesure and quantite of geis, thay fle in the aire, as othir fowlis dois.[209]

208 William Turner, *Avium præcipuarum .... Per Dn, Guilielmum Turnerum .... Coloniae excudebat Ioan, Gymnicus,* 1544.
Turner on Birds: .... first published by Dr William Turner, 1544.
Edited by A H Evans, Cambridge, 1903: 27.

209 Hector Boethius, *Heir beginnis the hystory and croniklis of Scotland .... Translatit laitly in our vulgar and common langage, be maister Johne Bellenden .... And I mprentit in Edinburgh, be me Thomas Davidson,* 1536, Cap. XIV.

Line 85. *Fistulosa: fistulosus, -a, -um*, adj. = pipe-shaped.[210]

A *fistulosa* is the long fleshy foot-stalk of the Cirripedes, by which they attach themselves to objects such as the keels of ships.[211]

Line 86. *Verum terræ aliive sedi ita adhærere* .... Ray however believes that it is a characteristic of plants and not animals to adhere to the earth in this way.

Line 87. *Nam quæ de Agno Scythico ....:* Ray says that he considers 'the traditions about the Scythian Lamb to be false and fabulous'.

He may be referring to the story brought back by early travellers about the vegetable lamb of Tartary, a fabulous plant on which, so they said, lambs were growing in clusters. This is thought to have been a type of fern covered in thick soft down.[212]

210 Lewis and Short: 754.

211 *Oxford Dictionary of Natural History:* 140.

212 Venetia Newall, *Discovering the Folklore of Birds and Beasts*, Shire Publications, 1971: 41.

Chapter Two:

On the parts of plants in general.

In *The Wisdom of God*, as here in *Historia Plantarum*, Ray discusses the various parts of a plant and their differences, for example, the various types of leaf and varying positions on the stem, the various shapes of flowers and varying arrangement of the inflorescences.[213]

In the seventeenth century, the prevailing attitude towards the parts of plants was still Aristotelian, that is, that all parts were designed for a particular function and thus for maintaining the life of the plant; this provided a good reason for examining the various organs of the plant. At this time, with the advent of microscopes, it became possible to study the detailed structure of very small parts of a plant, and by observation and experiment to evaluate various phenomena. For example, both Malpighi and Grew, quoted frequently by Ray, believed that all plants consisted of 'two bodies' of plant tissue, that is the fibro-vascular tissue and the parenchymatous tissue. Grew, in fact, comes close to recognising the cellular structure of plants:

> All the parts of a vegetable, the root, branch, leaf, flower and seed, are still made up of two substantially different bodies. ..... all properly woody parts, strings and fibres, are one body: all simple barques, piths, parenchymas and pulp, and as to their substantial nature, pills [peels] and skins likewise, are all but one body: the several parts of a vegetable all differing from each other only by the various proportions and mixtures, and variated pores and structures of these two bodies.[214]

Text page 3

Line 2. *celebrem illam distinctionem partium in similares & organicas*

Ray introduces this chapter by saying that he wishes to define what

213 *The Wisdom of God:* 74-85.

214 Quoted by Morton: 186. Morton has a lengthy discussion on the contributions made by Malpighi and Grew to the theory of the cellular structure of plants: 186-192.

he understands by the terms *similares* (tissues) and *organicæ* (organs).

Line 4. *Pars similaris:* literally *a similar part.* Ray emphasises this by giving the Greek term too - 'ὁμοιομερής. Used to define *a tissue* here.

Tissue: the substance, structure or texture of which an animal or plant body, or any part or organ of it, is composed; especially any one of the various structures, each consisting of an aggregation of similar cells or modifications of cells, which make up the organism and work in a co-ordinated manner towards a common function. They are normally bound together by their cell walls (in plants) or by an intercellular substance (in animals).[215] The first such use of this definition in English is thought to be in 1831,[216] but it seems that Ray was using the Latin *similaris* in exactly this way.

Line 4. *Sennerti:*[217] margin reference to *Institut.* lib.1, cap.3.

Daniel Sennert, 1572-1637. After attending schools in his home town of Breslau, he attended the university of Wittenberg, where he gained his master's degree in 1598; after this he studied medicine at the universities of Leipzig, Jena and Frankfurt an der Oder. He practised briefly, but then took up the chair of medicine at Wittenberg in 1602, which he held until his death in 1637.

He first published in 1611 the *Institutionem medicinæ* libri V, referred to by Ray, and continued with other lengthy medical works such as *De febribus* libri IV (1619) and *Practicæ medicinæ,*

215 *OED:* 2313; also *Oxford Dictionary of Natural History:* 638.
216 *OED:* 2313.
217 *DSB XII:* 310-313.

which was in six volumes published between 1628 and 1636.[218]

Line 4: *Pars Similaris:*

> of simple and uniform nature, with no obvious function, but deriving its own nutrition.

Ray gives as examples: *bones, catilages, flesh, membranes, nerves, veins* etc.

Line 8. *Pars organica:* literally an 'organic part'.

Organs derive their own nutrition, but also serve another function in the body.

Organ: a part or member of an animal or plant body adapted by its structure for a particular vital function, as seeing, hearing, speaking, digestion, respiration etc. First use in late Middle English.[219]

Line 9. *Hinc patet partem ..... :* his main argument seems to be that tissues are uniform rather than non-uniform: that they are not necessarily different to an organ, which can be uniform.

Line 10. *Eadem enim pars potest esse &similaris &Organica diverso respectu:*

Ray elaborates on his thesis of line 9 by saying that 'the same part can be both similar and organic in different respects'. He maintains that the actual physical make-up or tissue can be consistent throughout an organ, while its 'shape and conformation' vary according to its use and function in the body.

He then gives as examples to support this argument:

> a *vein*, which is similar in composition throughout, but in shape is designed for a specific purpose, such as the

218 That Ray owned a copy of Sennert's work is indicated in the sale catalogue of his library:
Opera in three volumes, edition published in Lyons in 1650; British Museum: *S-C 326* (6): 2, *Libri Latine &c in Folio*, number 47.

219 *OED:* 1462.

vein carrying blood back to the heart.

The circulation of the blood had been first discovered by William Harvey in 1628, the year after Ray's birth.

He also cites the *tibia*, which he says

> in its composition is simple, but in shape designed for a specific purpose.

Line 16. *Pars organica alia est simplex, alia composita:* organs can be simple or compound.

> *Simple:* of the same composition and consistency, but shaped for a particular purpose, such as mouth, veins, nerves etc.
>
> *Compound:* of varied composition and consistency, but which function together for a specific purpose, such as the eye.

Line 24. *Perfectas vocat Galenus:* Galen calls this 'a perfect function'.[220]

Galenus: Galen, 129-199(?) A.D. Greek physician and scholar, whose ideas dominated medicine until at least the Renaissance. From his dissections of such animals as monkeys and dogs, Galen showed the importance of the spinal cord in muscle activity, the role of the ureter in kidney and bladder function, and that arteries carry blood rather than air. However he held mistaken views on blood circulation, including the idea that blood seeped through minute pores in the wall of the heart separating the two ventricles. Galen also wrote on philosophy, law and mathematics.

He was born in Pergamum in Asia Minor in 129 A.D.; he was educated at Pergamum, Athens and Alexandria, and acquired a thorough knowledge of all the philosophic schools of the time as well as the accumulated knowledge of Greek medicine. The latter

220 There is no indication from the sale catalogue of his library that Ray himself ever possessed a copy of Galen's work. British Museum: *S-C 326* (6).

part of his life was spent in Rome as physician to the emperor Marcus Aurelius. Both scientifically and philosophically he was an eclectic and represented the summation of the biology of his time in its strength and its weakness, including the narrowness and isolation into which botany had already fallen.

Morton says that Galen 'was deeply impressed by the internally regulated unity of the animal organism, physiologically adapted to its way of life, and this concept was perhaps his most important contribution to the development of biological theory. These ideas had no impact on botany, however, and Galen did not consider their extension to plants; in fact, he was content to follow Aristotle in separating plants specifically from animals because the former have no sensations, and to leave it at that'.[221] Galen's own interest in plants was mainly pharmaceutical and he was able to recognize the specimens he needed as drugs, and lists over 450 herbs with their medical uses and effects,but he gives no actual botanical detail, being content to derive his information from Dioscorides.[222]

Line 25. *partes plantarum dividemus in simplices & compositas:* after defining *tissues* and *organs* Ray goes on to differentiate the parts of plants into *simple* and *compound.*

Line 27. *Simplices:* simple are:

Throughout of the same texture and composition.

Either containers or vessels, or contents or sap.

He believes that simple parts of plants, if not also of animals, are either the vessels for liquids or the liquids themselves.

221 Morton: 72.

222 *DSB V:* 227-237; *Mac.Enc.*: 48; Morton: 72, 81; Arber: 25, 47, 105, 248, 249; Sachs: 3, 15.

Line 28. *Compositæ:* compound are composed of:

Parts of a differing nature.

Many different simple parts.

Line 29. *Simplices sunt vel continentes seu vasa, vel contentæ seu succi:* Ray uses a neat stylistic trick here to express two alternative phrases, which each in themselves also contain an alternative.

Line 32 *Partes contentæ* the *contained parts* or *the contents* of vessels, Ray believes to be *similares*, as however much they are reduced to their constituent parts, they still remain similar or uniform.

Line 36. *Partes continentes:* the *containing parts*, which can be regarded as *tissues*, if they are judged by composition and texture, but as *organs* if by shape designed for a specific purpose.

Line 42. *Partes compositæ:* the compound parts of a plant - root, stalk, leaves, flower, fruit: plus less important but nevertheless compound parts - tendrils, little hooks, hairs, thorns etc.

Compare John Ray, *Dictionariolum trilingue*, 1675, pages 34-36. Here Ray lists '*The parts of Man's Body: De Partibus Humani Corporis: Περὶ τοῦ Ἀνδρωπίνου* [*sic*][223] *Σώματος Μερῶν.*'

I. Of Homogenous Parts conteining.

II. Of Homogenous Parts conteined.

III. Of External Heterogeneous Parts.

IV. Of Internal Heterogeneous Parts.

Although this section of the *Dictionariolum trilingue* relates to human beings, Ray distinguishes the parts of the body in the same way as he does Plants in the *Historia Plantarum* into *homogenous*

223 NB Liddell and Scott give no word 'ἀνδρώπινος'.

(i.e. similar or uniform) and *compound.* Within this categorisation he also subdivides into '*conteining*' and '*conteined*'.

Chapter Three:

On the roots of plants.

As Ray says in *The Wisdom of God,* all parts of a plant have a particular function, that of the roots being 'for its Stability and drawing Nourishment from the Earth'.[224] Morphological studies had developed considerably in the seventeenth century; the root and stem should not be distinguished by function,

> the root absorbing food and the stem bearing the seed, nor by position in earth or air respectively. A true morphological distinction could be derived from the fact that roots do not bear leaves, that branch-roots arise from the inner tissue only (endogenously), and that the woody tissue lies centrally in the young root (a fact only clearly revealed by the microscope)..... [225]

Text page 3

Line 1. *Radix est pars Plantæ inferior* ..... : Ray again begins with a definition from Jung: a root is 'the lower part of the plant, intended for the absorption of food, and hidden below the surface'. In his glossary at the beginning of *Historia Plantarum*, Ray gives this same quotation from Jung but adds:

> *Nonnullæ ex plantis submarinis radices habent expositas & minime intra corpus aliquod solidius abditas sed duntaxat saxa in fundo jacentia amplectentes.*[226]

He has already touched briefly on the habits of marine/water plants in Book I, lines 72-88, when discussing the movements of plants.

Roots have two main functions: they anchor the plant to the ground and help to keep it upright, and they provide the rest of

224 *The Wisdom of God:* 76.
225 Morton: 181.
226 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

the plant with water and mineral salts absorbed from the soil. They can also act as food storage organs, such as the tap roots of carrot or parsnip. There are two types of root systems: fibrous roots and tap roots.[227]

Line 4. *in fibrosas & crassiores:* Ray divides roots into *fibrous* and *thicker:* i.e. into fibrous and tap roots.

Line 4. *Radices fibrosæ*: in a fibrous root system there is no clear dominant root, but instead there is a mass of smaller roots extending in all directions, spreading out from the base of the stem.[228]

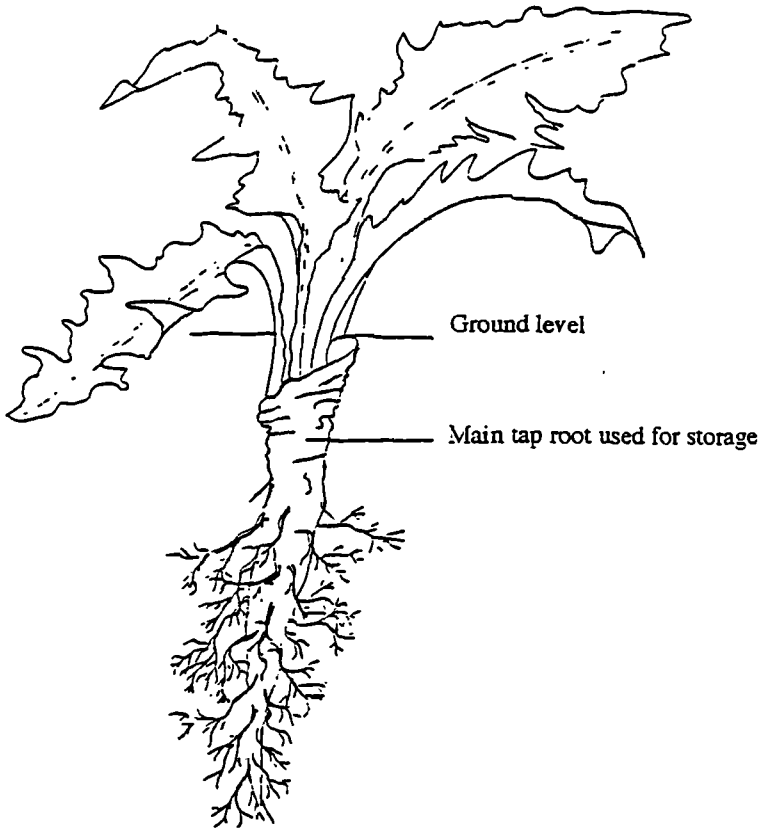
Added to his definition of *fibræ* in the glossary to *Historia Plantarum,* Ray adds that the term may be used of fine roots:

> *Item fibræ dicuntur minutissimæ & extremæ radiculæ.*[229]

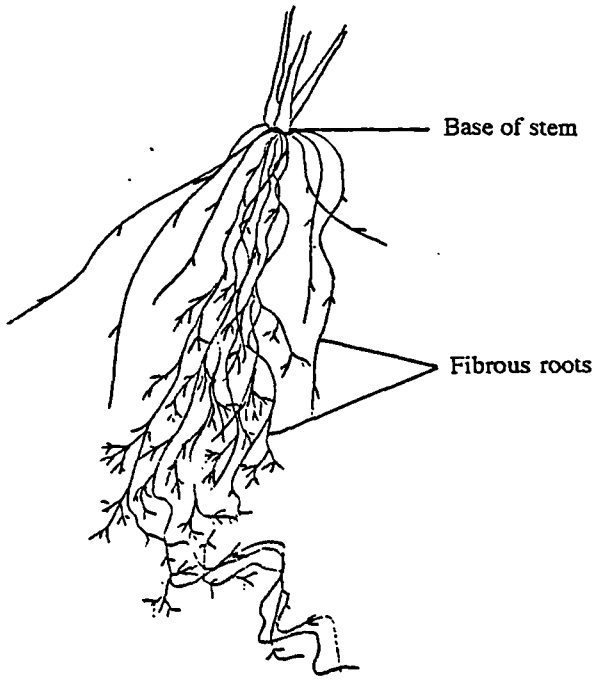
Line 6. *Crassiores quæ corpore pro plantæ modo crassiore .....:* plants with tap roots have one main well-defined root, which penetrates well into the soil, from which other branching roots arise. The main tap root is frequently used for storage of food materials.[230]

227 Gibbons: 27-33.
228 *ibid.:* 28.
229 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.
230 Gibbons: 28.

Dandelion plant showing the tap root:[231]



A fibrous root system:[232]



231 Drawn from Gibbons: 29.
232 *ibid.*

Line 6. *pro plantæ*: Ray describes a tap root as being thicker in the manner of a plant - presumably the stem.

Line 8. *in latum extumescentes sunt vel Bulbosæ, vel Tuberosæ:* bulbous and tuberous roots. Ray defines these as fleshy and swelling to the side.

Line 9. *Bulbosas voco* .....: bulbous roots. Ray defines them as having (Tr.) 'a single tuber or head, which is either scaly or layered, and which gives out many fibres from its lowest point or base'.

Ray, in the *Synopsis Methodica Stirpium Britannicarum,* first published in 1690, defines bulbs in the same terms as above but adds the following details: (Tr.) 'This type of plant has a single-leafed seedling or single cotyledon and produces long leaves like grass without a pedicel. Its seed vessels are divided up into three compartments containing six ranks of seeds. Its flowers are mostly six-petalled or cut into six flaps at the margins'.[233]

Bulbs consist of a base plate, which is a modified part of the stem, on top of which develop a large number of sheathing, non-photosynthesizing leaves, surrounded by a papery bract. The leaves store food materials, and these provide for the growing shoot, which emerges from the top when conditions are suitable.[234]

In a bulb it is possible to draw a distinction between tunicated bulbs (Onion, Daffodil etc.), in which there is an outer papery covering, and scaly bulbs, like those of Lilies, in which the storage organs are naked. Some bulb scales are complete cataphylls, which never extend above ground but others are the long-lived bases of foliage leaves. Many bulbs contain scales of both types.[235]

233 *Syn.Meth.St.Br.*: 369-370.
234 Gibbons: 95.
235 *Lowson's Botany*: 72.

Line 11. *Bulbosæ ergo strictæ dictæ sunt vel tunicatæ ..... vel Squamosæ ..... :* Ray divides bulbs into two types, *tunicatæ* and *Squamosæ*.

1. *'layered or composed of many skins built up into a ball'*, such as the *Cepa, Allium, Hyacinthus, Tulipa.*

These bulbs have a tunic covering the bulb.[236]

2. *'scaly or composed of many scales arranged almost like tiles'*, such as the *Lilium* and *Martagon.*

These bulbs do not have a tunic covering the bulb.[237]

Line 12. *Cepa.*

[C.T. & M.539] *Allium Cepa* (L), Onion: a species of the *Allium* genus of the *Liliaceæ* or Lily family.

B. & G.-W. 458: B. & H. 465: Linn. *Sp.Pl.* 300:

Syn.Meth.St.Br. - no ref.: *H.P.*1115-1116: *H.P.III* - no ref.:

Tri. 12.136: *Cat.Angl.*12-13 [as *Allium*, not *Cepa*]: *Camb.* - no ref.

H.P. 1115-1116:

> *Cepa vulgaris* C.B. *Cepa alba & rubra* Ger. Park. *Cepa sive Cepa rubra & alba, rotunda ac longa* J.B. ***Onions.***

Tri. 12.136:

> Onions: *Cepa, -æ,* f.: κρόμμυον, *-ου,* n.

Line 12. *Allium.*

[C.T.& M.538-541] *Allium* (L.), Onions and Garlic: a genus of the *Liliaceæ* or Lily family.

B.& G.-W. 458-460: B.& H. 464: Linn. *Sp.Pl.*294-302:

Syn.Meth.St.Br. 369-370: *H.P.*1117: *H.P.III* 552: *Tri.* 10.77:

*Cat.Angl.*12-13: *Camb.* 39-40.

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236 Clapham, Tutin and Moore: *passim.*

237 *ibid.*

H.P. 1117:

Allium sylvestre Park. Ger.emac. *sylvestre tenuifolium* Ad.Lob. *campestre juncifolium capitatum purpurascens majus* C.B. ***Common Crow-Garlick.***

Tri. 10.77:

Garlick: *Allium, -ii,* n.: *Σκόροδον, -όδου,* n.

Line 12. *Hyacinthus.*

[C.T.& M.538] *Hyacinthus non-scripta* (L., Chuard ex Rothm.), Bluebell, Wild Hyacinth: [B.& G.-W.456] *Scilla non-scripta* (L.): *Hyacinthoides non-scripta, Endymion nutans, Endymion non-scriptus*; a species of the *Hyacinthus* genus of the *Liliaceæ* or Lily family.

B.& G.-W. 456: B.& H. 463: Linn. *Sp.Pl.* 316-318: *Syn.Meth.St.Br.* 372-373: *H.P.* 1155: *H.P.III* 555: *Tri.* 11.97: *Cat.Angl.*166: *Camb.* 75.

H.P. 1155:

35 species given, including:

Hyacinthus Anglicus Ger. *Anglicus sive Belgicus* J.B. *oblongo flore cæruleus major* C.B. *Anglicus, Belgicus vel Hispanicus* Park.parad.

English Hyacinth, or Hare-bells.

H.P.III 555:

p.1164, *Ad cap. de Hyacintho:* 15 additional species given.

Tri. 11.97:

Hyacinth or Jacinth: *Hyacinthus, -i,* m.:

Ὑάκινθος, -κίνθου, m.

Line 12. *Tulipa.*

[C.T.& M. 536] *Tulipa sylvestris* (L.),Wild Tulip: a species of the

Tulipa genus of the *Liliaceæ* or Lily family.

B.& G.-W. 454: B.& H. 460: Linn.*Sp.Pl.* 305-306:

Syn.Meth.St.Br. - no ref.: *H.P.* 1146-1151: *H.P.III* - no ref.:

Tri. 14.198: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1146-1151:

12 species given, including:

Tulipa minor lutea Narbonensis J.B. *minor lutea Gallica* C.B. *Narbonensis sive Monspeliensis vel pumilus* Park.parad.

Tri. 14.198:

Tulip: *Tulipa, -æ,* f.: [No Greek].

Line 13. *Lilium.*

[C.T.& M. 535] *Lilium* (L.), Lily: a large genus of the *Liliaceæ* or Lily family.

B.& G.-W. 454: B.& H. 455: Linn.*Sp.Pl.* 302-303:

Syn.Meth.St.Br. 264: *H.P.* 1109: *H.P.III* 552: *Tri.* 11.106:

Cat.Angl. - 186: *Camb.* - no ref.

H.P. 1109:

9 species given, including:

Lilium album Ger. *album vulgare* J.B. Park. *album flore erecto & vulgare* C.B. ***Common white Lily.***

H.P.III 552:

p.1111, *Ad cap. de Lilio adde*: 7 additional species given.

Tri. 11.106:

Lily: *Lilium, -ii,* n.: *Κρίνον, -ου,* n.

Line 13. *Martagon.*

[C.T.& M. 535] *Lilium martagon* (L.), Martagon Lily: a species of the *Lilium* genus of the *Liliaceae* or Lily family.

B.& G.-W. 454: B.& H. - no ref.: Linn.*Sp.Pl.* 303:

Syn.Meth.St.Br. - no ref.: *H.P.* 1112-1114: *H.P.* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1112-1114:

8 species given, including:

Martagon Imperiale sive Lilium montanum majus Park. *Lilium sylvestre sive Hemerocallis moschata polyanthes. Martagon Imperiale nuperorum* Lob. Adpar.2. *An Lilium flore mutante maximum* J.B.? *Lilium pyramidale moschatum* C.B.

Line 14. *Notandum autem Bulbosas stricte dictas Fibrosis rectius accenseri:* Ray considers that the roots of bulbs are fibrous. He then goes on to define a bulb as 'nothing more than a larger, subterranean bud'; here he agrees with Grew in his *Anatomy of Plants*.

Bulbs are a conglomeration of non-photosynthesizing leaves, from which, however, the plant can reproduce vegetatively; for a fuller definition see above Cap.3, line 9.

Text page 4

Line 16. *ut recte eruditissimus & ingeniosissimus Vir, D. Negemias Greiv. M.D.:* Grew, reference in text to *Anatome Plantarum.*

Nehemiah Grew: born in 1628. Studied medicine, although his interests were mainly in botany (plant morphology and plant anatomy). He was probably the first person to hold a post specifically in botany, when in 1672 he was made Curator of the Anatomy of Plants to the Royal Society at a salary of £50 a year to be raised by subscription from 'willing members'.[238]

The suggestion that Grew plagiarised Malpighi was made by Schleiden in 1845 but rebutted by Sachs.[239] Although they admitted a mutual indebtedness they worked independently; this

238 *DSB V:* 534-536; Sachs: 189. For further biographical details see W.Carruthers, On the life and work of Nehemiah Grew, *Journal of the Royal Microscopical Society,* 1902: 129-141.

239 Schleiden, *Grundzuge,* 1845: 207; also Sachs: 232.

is seen in the differences of nomenclature and in a reference to Grew's *Anatomy of Trunks* in the *Philosophical Transactions of the Royal Society* in 1675, which mentions 'a very happy concurrence of these two eminently learned persons'. Both Malpighi and Grew are to be praised for their efforts in trying to understand the anatomical structure of plants.

> Yet we must not undervalue what Malpighi and Grew had to say on more delicate anatomy, and especially on the nature of the solid framework of cell-membrane in the plant; imperfect and crude as their views on such points may be, yet they continued for more than a hundred years to be the foundation of all that was known about cellular structure.[240]

Grew presented his *Anatomy of Plants Begun* at the same meeting of the Royal Society in December 1671 as Malpighi presented his *Anatome Plantarum Idea*.[241]

Morton gives some extra notes on Grew and Malpighi and a comparison of their works,[242] as do Agnes Arber in two papers published in 1941[243] and Sachs in Book II of his *History of Botany*.[244]

Very little is known about Ray's relationship with Grew,[245] although both were educated at Cambridge, and both were members of the Royal Society. They refer politely to each other in print but there is no indication of friendship despite the fact that they must have met. Indeed Ray praises Grew frequently in the

240 Sachs: 233.
241 Morton: 179.
242 *ibid.*: 178-195.
243 Agnes Arber, 'The Relation of Nehemiah Grew and Marcello Malpighi', *Chronica Botanica* 6: 1941: 391-392; and 'Nehemiah Grew and Marcello Malpighi', *Proceedings of the Linnæan Society of London*, 1941: 218-238.
244 Sachs: 232-235.
245 Raven: 200-201.

Historia Plantarum, but does not mention him as a personal acquaintance.[246]

Grew's botanical works are:

1. *The Anatomy of Vegetables Begun, With a General Account of Vegetation Founded Thereon,* London 1672.
2. *An Idea of a Phytological History Propounded, Together With a Continuation of the Anatomy of Vegetables, Particularly Prosecuted upon Roots, and an Account of the Vegetation of Roots, Grounded Chiefly Thereupon,* London 1675.
3. *The Anatomy of Plants With an Idea of a Philosophical History of Plants and Several Other Lectures Read Before the Royal Society,* London 1682.

Grew also wrote a work *Cosmologia sacra or a Discourse of the Universe as It Is the Creature and Kingdom of God,* London 1701, which is on similar lines to Ray's *The Wisdom of God Manifested in the Works of the Creation,* London 1691.[247]

Line 18. *Tuberosæ sunt quæ carne solida continua constant:* Ray defines tuberous roots as consisting of solid continuous flesh, and

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246 Ray did, however, possess several copies of Grew's writings, as is indicated in the catalogue for the sale of his library [no place of publication is given for any of them]:
The Anatomy of Plants, edition of 1682; British Museum: *S-C 326* (6): 21, English Books in Folio, number 14.
The Anatomy of Vegetables, edition of 1672; *ibid.:* 26, English Books in Octavo, number 61.
The Anatomy of Trunks, edition of 1675; *ibid.:* 26, English Books in Octavo, number 62.
Mixtures, edition of 1675; *ibid.:* 30, English Books in Octavos and Twelves, number 219.
Experiments, edition of 1678; *ibid.:* 30, English Books in Octavos and Twelves, number 220.

247 General references to Grew:-
Morton: 178-194, 213;
Arber: 7, 119, 138, 160;
Agnes Arber, 'Tercentenary of Nehemiah Grew (1641-1712)', *Nature,* Vol.147 (1941): 630-632;
Sachs: 69, 89, 93, 97, 221-225, 231-234, 239-244, 263, 382-385, 551;
Raven: Grew and Ray 55, 181, 200-201 / Grew and the structure of plants 188, 221 / Grew's *Musæum* 135 note 4, 231, 386 / Grew's teleology 455.

comprising a single tuber like those of *Rapa* and *Crocus*, or comprising a multiple tuber like those of *Asphodel* and *Pæonia.*

Ray is probably citing Grew here, as apart from the margin reference to Grew, *Anatome Radicum*, this statement contradicts Ray's own earlier definition of a bulb, given in his glossary at the beginning of *Historia Plantarum,* in which he says that the roots of *Crocus* and *Colchicum* are usually considered to be bulbs, not tubers as here.

> *Bulbus est radix subrotunda vel pluribus tunicis in orbem se amplexantibus, vel pluribus squamis imbricatim fere dispositis coagmentata, fibras plurimas ex ima sede seu basi emittens.*
>
> *Interdum latius accipitur pro radice quavis uno tubere constante etiam solida & substantia continua, nec divisa in squamas aut tunicatum involucra, fibras ex ima sede aut basi emittente. Sic Croci & Colchici radices bulbosæ censentur.*[248]

Ray's own definition of a tuber given in the glossary to *Historia Plantarum* corresponds to the modern definition of a tuber, as being a swollen part of a stem or root:[249]

> *Tuber, est fungus subterraneus, a tumeo. Hinc dicitur de plantarum radicibus prætumidis, rotundis. Radices tuberosæ,* ***Knobby roots.***[250]

Line 18. *Rapā: Rapa.*

[C.T.& M. 71-72] *Brassica napus* (L.), Rape, Wild Turnip, Cole, Swede; a species of the *Brassica* genus of the *Cruciferæ* or Cress family. Strong and often tuberous tap root.

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248 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

249 *Penguin Dictionary of Botany:* 369.

250 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

B.& G.-W. 158: B.& H. 38: Linn. *Sp.Pl.* 666: *Syn.Meth.St.Br.* 294: *H.P.* 800-801: *H.P.III* - no ref.: *Tri.* 14.199: *Cat.Angl.252: Camb.* 102.

H.P. 800-801:

Rapa sativa rotunda C.B. *rapum majus* Ger. *Rapum* Park.

Rapum sativum rotundum & oblongum J.B.

Round and long Turneps.

Tri. 14.199:

Turnip: *Rapum, -i,* n.: *Γογγύλη, -ης,* f.

Line 18. *Croco: Crocus*:

[C.T.& M. 555] *Crocus nudiflorus* (Sm.), Autumnal Crocus; a species of the *Crocus* genus of the *Iridaceæ* or Iris family.

[C.T.& M. 555] *Crocus vernus* ([L.] Hill), Purple Crocus; a species of the *Crocus* genus of the *Iridaceæ* or Iris family.

B.& G.-W. 468: B.& H. 451: Linn. *Sp.Pl.* 36: *Syn.Meth.St.Br.* 374: *H.P.* 1173-1177: *H.P.III* 561: *Tri.* 13.167: *Cat.Angl.* 84: *Camb.* 58.

*H.P.*1173-1177:

22 species given, including:

Crocus J.B. Ger.*sativus* C.B.*verus sativus Autumnalis* Park.parad. ***Saffron.***

H.P.III 561:

p.1177, *Ad cap de Croco:* 3 additional species given.

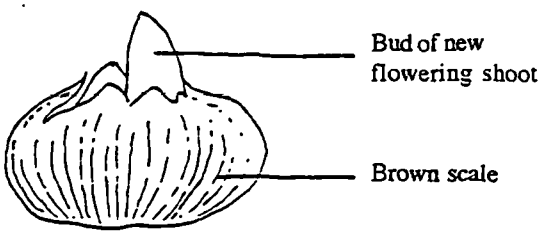
Tri. 13.167:

Saffron: *Crocus, -i,* m.: *Κρόκος, -ου,* m.

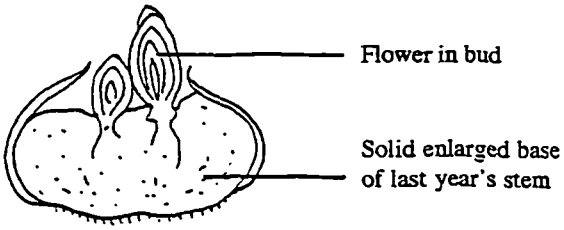
Line 18. *vel simplici tubere ut in Rapa, Croco &c.*: Ray/Grew consider the *Crocus* corm to be its root, and as such to be a tuberous root. In fact it is the swollen base of the stem covered in a membranous

protective sheath derived from the remains of the previous year's leaf bases:[251]

The *Crocus* corm in winter:[252]



Longitudinal section of the *Crocus* corm in winter:[253]



Line 19. *Asphodelo: Asphodelus.*

[C.T.& M. 533] *Tofieldia pusilla* ([Mich.] Pers),*Tofieldia palustris* (Hudson *pro parte*), *Tofieldia borealis* (Wahlenb.), Scottish Asphodel; a species of the *Tofieldia* genus of the *Liliaceæ* or Lily family.

[C.T.& M. 533] *Narthecium ossifragum* ([L.] Hudson), Bog Asphodel; a species of the *Narthecium* genus of the *Liliaceæ* or Lily family.

Both with rhizomatous roots.

B.& G.-W. 452: B.& H. 456-458: Linn.*Sp.Pl.* 309-310: *Syn.Meth.St.Br.* 372: *H.P.* 1191: *H.P.III* 562: *Tri.* - no ref.: *Cat.Angl.* 30-31: *Camb.* - no ref.

251 *Lowson's Botany:* 72-73; also *Penguin Dictionary of Botany*: 88.
252 Drawn from Cooke, Burkitt and Barker: 287.
253 *ibid.*

H.P. 1191:

4 species given, including:

Asphodelus major ramosus flore albo J.B. *maior albus ramosus* Park. *albus ramosus mas* C.B. *ramosus* Ger.

The great white branched Asphodel.

H.P.III 562:

p.1191, *Ad cap de Asphodelo*: 8 additional species given.

Line 19. *Pæoniā: Pæonia.*

[C.T.& M. 53] *Pæonia mascula* ([L.] Miller) [*P.corallina, P.caucasia*], Pæony; a species of the *Pæonia* genus of the *Pæoniaceae* or Pæony family; formerly included in the *Ranunculaceæ* or Buttercup family. Fleshy roots.

B.& G.-W. 124: B.& H. 14: Linn.*Sp.Pl.* 530:

Syn.Meth.St.Br. - no ref.: *H.P.* 693-696: *H.P.III* 367: *Tri.* 12.147:

Cat.Angl. - no ref.: *Camb.* - no ref.

*H.P.*693-696:

14 species given, including:

Pæonia mas Park. Ger. *præcocior* J.B. *folio nigricante splendido, quæ mas* C.B. ***The male Peiony.***

H.P.III 367:

7 additional species given.

Tri. 12.147:

Peiony: *Pæonia, -æ,* f.: *Παιονία, –ας,* f.

Line 20. *Orchis.*

[C.T.& M. 569-582] *Orchis* (L.), Orchid: a genus of the *Orchidaceæ* or Orchid family.

B.& G.-W. 478-484: B.& H. 436-448: Linn.*Sp.Pl.* 939-943:

Syn.Meth.St.Br. 376-382: *H.P.* 1212 etc.: *H.P.III* 586:

Tri. 13.171: *Cat.Angl.* 215-218: *Camb.* 88-90.

H.P. 1212 etc.:

Orchis ejus species 1212, 1213 &c., 1907. *testiculata* 1212 &c. *palmata* 1223. *abortiva, i. Nidus avis* 1228. *Anthropophora* 1218. *Melittias & Sphegodes* 1220. *Myodes* 1219. *fœtida seu Tragorchis* 1212. *Arachnitis* 1222. *Batrachites ibid. Ornithophora* 1222. *hermaphroditica ibid.*

H.P.III 586:

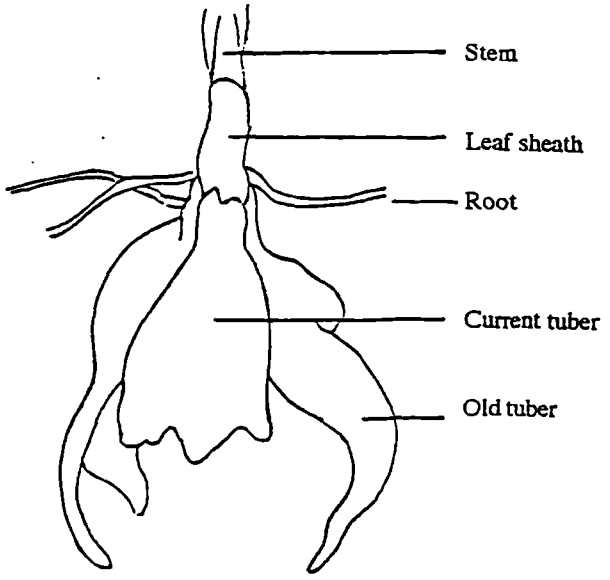
51 additional species given.

Tri. 13.171:

Satyrion: *Orchis, -idis,* f.: *Ὄρχις, -ιδος,* f.

Line 20. *Plantæ nonnullæ duum generum radicibus donantur, tuberosis & fibrosis, ut Orchis:* Ray believes that some plants have both tuberous and fibrous roots., and he gives as an example the Orchid.

The root system of the Spotted Orchid (*Dactylorhiza*):[254]



Line 22. *Glycyrrhizæ: Glycyrrhiza.*

[C.T.& M. 187] *Astragalus glycphyllos* (L.), Wild Liquorice, Milk Vetch; a species of the *Astragalus* genus of the *Leguminosæ* or Pea family.

254 Drawn from Gibbons: 38.

B.& G.-W. 204: B.& H. - no ref.: Linn.*Sp.Pl.* 741-742:
Syn.Meth.St.Br. 324*: H.P.* 910: *H.P.III* 449:
Tri. 11.107/*Tri.* 17.52: *Cat.Angl.*133-134: *Camb.* 68.
H.P. 910:

1 species only given:

Glyrrhiza vulgaris Ger.emac. *vulgaris* Park. *siliquosa vel Germanica* C.B. *radice repente, vulgaris Germanica* J.B.

Liquorice.

H.P.III 449:

1 additional species given.

Tri. 11.107 / *Tri.* 17.52:

Liquorice: *Glycyrrhiza, -ae,* f.: *Γλυκύῤῥιζα, -ης,* f.

Line 22. *Cardui viarum: Carduus viarum.*

[C.T.& M. 483] *Cirsium arvense* ([L.] Scop.), *Serratula arvensis* (L.), *Carduus arvensis* ([L.] Hill), Creeping Thistle; a species of the *Carduus* genus of the *Compositæ* or Daisy family.
B.& G.-W. 424: B.& H. 251-252: Linn.*Sp.Pl.* 820:
Syn.Meth.St.Br. 194: *H.P.* 310: *H.P.III.* - no ref.:
Tri. 14.195: *Cat.Angl.* 54: *Camb.* 51.
H.P. 310:

84 species given, including:

Carduus vulgatissimus viarum Ger. *ceanothos, sive viarum & vinearum repens* Park. *vinearum repens folio Sonchi* C.B. *serpens lævicaulis* J.B.

Common way-Thistle, or rather creeping Thistle.

Tri. 14.195:

Thistle: *Carduus, -ii,* m.: *Σκόλυμος, -ύμου,* m.

Line 22. *Acetosæ ovillæ: Acetosa ovilla.*

This is presumably the plant Ray calls Sheep's Sorrel, as *ovilla* means 'of sheep'.

[C.T.& M. 306] *Rumex acetosella* (L.), Sheep's Sorrel; a species of the *Acetosa* genus of the *Polygonaceæ* or Dock family.

B.& G.-W. 68: B.& H. 380: Linn.Sp.Pl. 338:

Syn.Meth.St.Br. 143: *H.P.* 180: *H.P.III* - no ref.: *Tri.* - no ref.:

Cat.Angl. 15-16: *Camb.* 38.

*H.P.*180:

Acetosa arvensis lanceolata C.B. *minor lanceolata* Park. *parva auriculata repens* J.B. *Oxalis tenuifolia* Ger. ***Sheeps Sorrel.***

Line 25. *Gramine Canino Offic.: Gramen Caninum Offic..*

[C.T.& M. 633-644] *Elymus caninus* (L.), Bearded Couch Grass; a species of the *Elymus* genus of the *Gramineæ* or Grass family.

B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 86:

Syn.Meth.St.Br. 390: *H.P.* 1255: *H.P.III* 598: *Tri.* - no ref.:

Cat.Angl. 139: *Camb.* 69.

H.P. 1255:

10 species given, including:

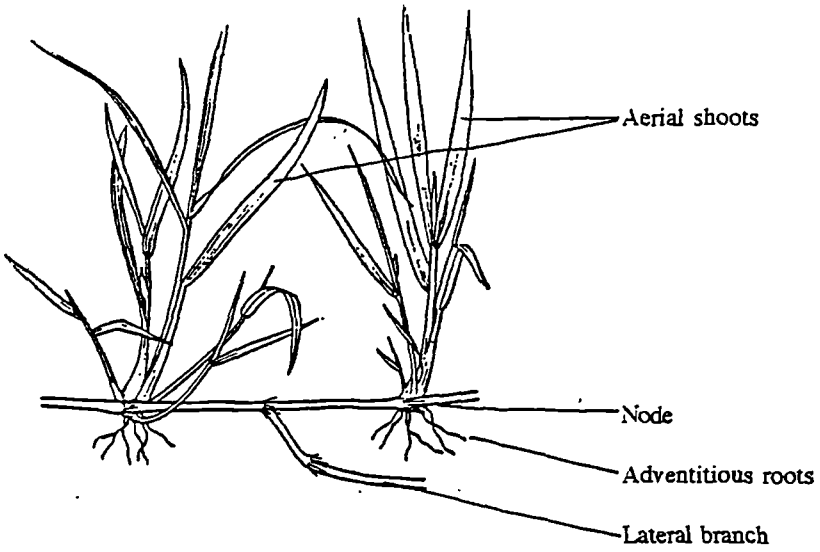
Gramen repens, Officinarum forte, spicæ Triteæ aliquatenus similis J.B. *An Gramen caninum* Ger? *caninum vulgatius* Park? *caninum arvense, seu Gramen Dioscoridis* C.B.

Common Dogs-grass, or Quich-grass, or Couch-grass.

H.P.III 598:

6 additional species given.

Rhizome of *Gramen caninum Offic.*:[255]



Line 25. *Menthā: Mentha.*

[C.T.& M. 403-406] *Mentha* (L.), Mint; a genus of the *Labiatæ* or Mint family.

B.& G.-W. 344: B.& H. 345: Linn.*Sp.Pl.* 576-578:

Syn.Meth.St.Br. 232-234: *H.P.* 530-531: *H.P.III* 284: *Tri.* 12.124:

Cat.Angl. 198: *Camb.* 84.

H.P. 530-531:

13 species given, including:

Mentastrum folio rugoso spontaneum, flore spicato, odore gravi

J.B. *Mentastrum* Ger.descr. *mentha sylvestris rotundiore folio*

C.B. ***Horse-mint or round-leaved wild Mint.***

H.P.III 284:

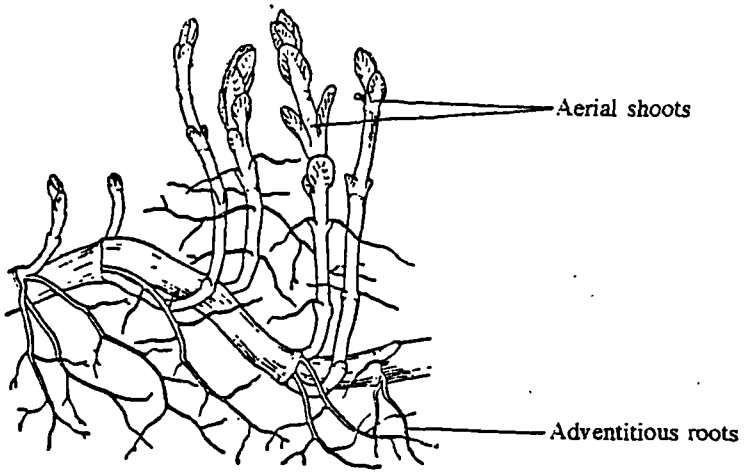
20 additional species given.

Tri. 12.124:

Mint: *Mentha, -æ,* f.: *Ἡδύοσμος, –όσμου,* m.

255 Drawn from Cooke, Burkitt and Barker: 293.

Rhizome of *Mentha*:256



Line 25. *Pilosellā aureā: Pilosella aurea.*

[C.T.& M. 510] *Hieracium pilosella* (L.), Mouse-ear Hawkweed; a species of the *Hieracium* genus of the *Compositæ* or Daisy family.

B.& G.-W. 440: B.& H. 267: Linn.*Sp.Pl.* 800:

Syn.Meth.St.Br. 170: *H.P.* 242-243: *H.P.III* 147: *Tri.* 12.126:

Cat.Angl. 232-233: *Camb.* 94.

H.P. 242-243:

4 species given, including:

Pilosella repens Ger. *minor vulgaris repens* Park. *major repens hirsuta* C.B. *majori flore, sive vulgaris repens* J.B.

Common creeping Mouse-ear.

H.P.III 147:

1 additional species given.

Tri. 12.126:

Mouse-ear: *Pilosella, -æ,* f.: *Μυοσωτὶς, -ίδος,* f.

Line 25. *Ptarmicā:* Ptarmica.

[C.T.& M. 472] *Achillea ptarmica* (L.), Sneezewort;; a species of the *Achillea* genus of the *Compositæ* or Daisy family.

256 Drawn from Cooke, Burkitt and Barker: 293.

B.& G.-W. 408: B.& H. 239: Linn.*Sp.Pl.* 898:
Syn.Meth.St.Br. 183: *H.P.* 344: *H.P.III.* 218: *Tri.* - no ref.:
Cat.Angl. - no ref.: *Camb.* 99.
H.P. 344:

4 species given, including:

Ptarmica Ger. *vulgaris* Park. *vulgaris, folio longo serrato, flore albo* J.B. *Dracunculus serrato folio pratensis* C.B.

Sneezewort, Bastard Pellitory; nonnullis

Goose-tongue, id est *Lingua anserina.*

H.P.III 218:

11 additional species given.

Line 25. *Caules potius subterraneos videri quam radices:* the above four plants all have a creeping rhizomatous, woody root system.

Line 33. *Tuliparum: Tulipa:* see above Cap.3, line 12.

Line 33. *Radices nonnullas bulbosas ut v.g.Tuliparum annuatim in terram descendere .....:* it is in bulbs, and in the more compact kinds of corm, that the problem of depth adjustment becomes most acute. Many of these plants go much deeper than the average rhizome, and as the seedling always has to start at the surface it is a little difficult to see how the shoot apex ever gets down there in the first place. A typical device is for a leaf-axil to be extended downwards in a deep pocket, a tubular extension, which burrows into the soil carrying the axillary bud in its closed lower end. This is called a 'dropper'. Once the working depth has been reached it is maintained by the action of contractile roots. These are quite different from the normal roots and are present only in small numbers. Contractile roots anchor themselves in the soil and then shorten, so counteracting any tendency for the plant to grow upwards.

Line 35. *Observavit D.Grevius:* there is a margin reference to Grew here:

E cujus lib. de Anat. Radicum sequentia omnia transtulilimus.

(Tr.) ' from whose book on *The Anatomy of Roots* I have translated all of the following'.

Line 35. *Ari: Arum.*

[C.T.& M. 583] *Arum* (L.), Arum; a genus of the *Araceæ* or Arum family.

Arum maculatum (L.), Lords-and-Ladies, Cuckoo-pint; a species of the *Arum* genus of the *Araceæ* or Arum family.

B.& G.-W. 470: B. & H. 420: Linn.*Sp.Pl.* 964-967:

Syn.Meth.St.Br. 266: *H.P.* 1208-1211: *H.P.III* 574-575:

Tri. - no ref. *Cat.Angl.* 28-29: *Camb.* 45.

H.P. 1208-1211:

10 species given, including:

Arum J.B. *vulgare* Ger. *vulgare maculatum & non maculatum* Park. *Arum 2 & 3 sive maculatum maculis candidis vel nigris, & vulgare non maculatum* C.B. ***Wake-Robin, Cuckow-pint.***

H.P.III 574-575:

43 additional species given.

Line 35. *Valerianæ: Valeriana.*

[C.T.& M. 437-438] *Valeriana* (L.), Valerian; a genus of the *Valerianaceæ* or Valerian family.

B.& G.-W. 384: B.& H. 216: Linn.*Sp.Pl.* 31-34:

Syn.Meth.St.Br. 200: *H.P.* 388-392: *H.P.III* 242: *Tri.* 14.202:

Cat.Angl. 299: *Camb.* 123.

H.P. 388-392:

19 species given, including:

Valeriana sylvestris major Ger. C.B. Park.

Sylvestris magna aquatica J.B. ***Great wild Valerian.***

H.P.III 242:

7 additional species given.

Tri. 14.202:

Valerian: *Valeriana, -æ,* f.: *Νάρδος ἀγρία,* f.

Line 35. *Scrophulariæ: Scrophularia.*

[C.T.& M. 374-375] *Scrophularia* (L.), Figwort; a genus of the *Scrophulariaceæ* or Figwort family.

B.& G.-W. 356: B.& H. 329: Linn.*Sp.Pl.* 619-621:

Syn.Meth.St.Br. *283: *H.P.* 764-765: *H.P.III* 395: *Tri.* - no ref.:

Cat.Angl. 268: *Camb.* 112.

H.P. 764-765:

Scrophularia major Ger. *major vulgaris* Park. *vulgaris & major* J.B. *nodosa fœtida* C.B. ***Figwort.***

H.P.III 395:

17 additional species given.

Line 35. *Hellebori nigri: Helleborus niger.*

[C.T.& M. 34] *Helleborus niger* (L.), Black Hellebore; a species of the *Helleborus* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. - no ref.: B.& H. 12: Linn.*Sp.Pl.* 558: *Syn.Meth.St.Br.* 271: *H.P.* 697-698: *H.P.III* 367: *Tri.* - no ref.: *Cat.Angl.* 158: *Camb.* 73.

H.P. 697-698:

4 species given, including:

Helleborus niger verus Ger. Park. *niger flore roseo* C.B. *niger flore albo, interdum etiam valde rubente* J.B.

True black Hellebore, or Christmas-flower.

H.P.III 367:

7 additional species given.

Line 35. *Tanaceti: Tanacetum.*

[C.T.& M. 476-477] *Tanacetum* (L.), Tansies; a genus of the *Compositæ* or Daisy family. *Tanacetum vulgare* (L.), Tansy; a species of the above genus.

B.& G.-W. 410: B.& H. 240: Linn.*Sp.Pl.* 843-845:

Syn.Meth.St.Br. 188: *H.P.* 365: *H.P.III.* 230: *Tri.* 14.191:

Cat.Angl. 281: *Camb.* 116.

H.P. 365:

2 species given, including:

Tanacetum Ger. *vulgare* Park. *vulgare luteum* C.B. *vulgare flore luteo* J.B. ***Common Tansy.***

H.P.III. 230:

3 additional species given.

Tri. 14.191:

Tansie: *Tanacetum, -i,* n.: [No Greek].

Line 35. *Lychnidis: Lychnis.*

[C.T.& M. 121-127] *Silene* (L.), Lychnis; a genus of the *Caryophyllaceæ* or Pink family.

B.& G.-W. 96: B.& H. 63: Linn.*Sp.Pl.* 436-437:

Syn.Meth.St.Br. 337-341: *H.P.* 992-1005: *H.P.III* 464: *Tri.* 9.33:

Cat.Angl. 193: *Camb.* 82.

H.P. 992-1005:

60 species given, including:

Lychnis sylvestris flore albo Ger.emac. Park. *sylv. alba simplex* C.B. *Ocymoides album multis* J.B. ***Wild white Campion.***

H.P.III 464:

Incorrect reference in Index to Volume III.

Tri. 9.33:

Campions: *Lychnis, -idis,* f.: Λυχνὶς, –ίδος, f.

Line 36. *Crithmi: Crithmum.*

[C.T.& M. 284] *Crithmum maritimum* (L.), Rock Samphire; a species of the *Crithmum* genus of the *Umbelliferae* or Carrot family.

B.& G.-W. 274: B.& H. 193: Linn.*Sp.Pl.* 246:

*Syn.Meth.St.Br.*217: *H.P.* 456: *H.P.III* 257: *Tri.* 14.189:

Cat.Angl. 83: *Camb.* - no ref.

H.P. 456:

2 species given, including:

Crithmum marinum Ger. Dod. *marinum vulgare* Park. *Crithmum multis, sive Fœniculum marinum* J.B. *Crith. sive Fœniculum maritimum minus* C.B.

Sampire a gallico Saint Pierre.

H.P.III 257:

2 additional species given.

Tri. 14.189:

Sampire: *Crithmum, -i,* n.: *Κρίθμον, -ου,* n.

Line 36. *Primulæ: Primula.*

[C.T.& M. 345-346] *Primula* (L.), Primula; a genus of the *Primulaceae* or Primrose family.

B.& G.-W. 296: B.& H. 289: Linn.*Sp.Pl.* 142-143:

Syn.Meth.St.Br. 284: *H.P.* 1080: *H.P.III* - no ref.: *Tri.* 13.153:

Cat.Angl. 242-243: *Camb.* 98.

H.P. 1080:

6 species given, including:

Primula veris vulgaris Park. *veris minor* Ger. *verus floribus ex singularibus pediculis, majoribus simplicibus* J.B. *Verbasculum sylvarum majus singulari flore* C.B. ***Common Primrose.***

Tri. 13.153:

Primrose: *Primula, -æ,* f.: *Φλομὶς, -ίδος,* f.

Line 36. *Caryophyllatæ: Caryophyllata.*

[C.T.& M. 218] *Geum urbanum* (L.), Herb Bennet, Wood Avens; a species of the *Geum* genus of the *Rosaceæ* or Rose family.

B.& G.-W. 182: B.& H. 131: Linn.*Sp.Pl.* 501:

Syn.Meth.St.Br. 253-254: *H.P.* 606-609: *H.P.III* 324: *Tri.* 8.11:

Cat.Angl. 55-56: *Camb.* 52.

H.P. 606-609:

12 species given, including:

Caryophyllata Ger. *vulgaris* Park. C.B. *vulgaris flore parvo luteo* J.B. ***Avens, Herb Bennet.***

H.P.III 324:

5 additional species given.

Tri. 8.11:

Avens: *Caryophyllata, -æ,* f.: [No Greek].

Line 36. *Acetosellæ: Acetosella.*

[C.T.& M. 177] *Oxalis acetosella* (L.) Wood Sorrel; a species of the *Oxalis* genus of the *Oxalidaceæ* or Wood Sorrel family.

B.& G.-W. 224: B.& H. 94: Linn.*Sp.Pl.* 433:

Syn.Meth.St.Br. *281: *H.P.* 1098: *H.P.III* - no ref.: *Tri.* - no ref.:

Cat.Angl. 6 and under *Trifolium acetosum* 289: *Camb.* 118.

H.P. 1098:

Trifolium acetosum vulgare Park. C.B. *oxys alba* Ger. *Oxys sive Trifolium acidum flore albo & purpurascente* J.B. *Acetosella & Lujula sive Alleluia Offic.* ***Wood-Sorrel.***

Line 36. *Iridis: Iris.*

[C.T.& M. 554-555] *Iris* (L.), Iris; a genus of the *Iridaceæ* or Iris family.

B.& G.-W. 466: B.& H. 449: Linn.*Sp.Pl.* 38-40:

Syn.Meth.St.Br. 374-375: *H.P.* 1128 *Iris bulbosa* / *H.P.* 1180 *Iris tuberosa: H.P.III* 562 *(tuberosa only): Tri.* 10.74: *Cat.Angl.* 171: *Camb.* - no ref.

H.P. 1128: *Iris bulbosa:*

5 species given, including:

Iris bulbosa latifolia acaulos odora C.B. *bulbosa latifolia flore cæruleo & candido* J.B. *bulbosa latifolia* Ger.emac. *bulbosa latifolia prima Clusii* Park.parad.

Broad-leaved bulbous Flower-de-luce.

H.P. 1180: *Iris tuberosa:*

See below under *Iris tuberosa* Cap.3, line 54.

H.P.III 562 *(tuberosa only):*

4 additional species given.

Tri. 10.74:

Flower de Luce: *Iris, -idis,* f.: Ἶρις, -ιδος, f.

Line 42. *Scrophulariã: Scrophularia:* see above Cap.3, line 35.

Line 42. *Succisã: Succisa.*

[C.T.& M. 440-441] *Succisa pratensis* (Moench), Devil's-bit Scabious; a species of the *Succisa* genus of the *Dipsacaceæ* or Teasel family.

B.& G.-W. 386: B.& H. 220: Linn.*Sp.Pl.* 98:

Syn.Meth.St.Br. 191: *H.P.* 380/1866: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 281 and under *Morsus Diaboli* 202:

Camb. - no ref.

H.P. 380:

Succisa sive Morsus Diaboli J.B. *Morsus Diaboli* Ger. *Diaboli vulgaris flore purpureo* Park. *Succisa glabra* C.B. ***Devil's-bit.***

Succisa:

Morsus Diaboli was the mediæval Latin name, of which Devil's Bit(e) is the translation. The fifteenth century *Ortus Sanitatis* tells a Byzantine story of the Devil acting with such power by means of the root that the Virgin Mary intervened and made this impossible. In his irritation the Devil bit the root off. Other explanations of the abruptly ending root stock were a little different. *The Grete Herball* of 1526 wrote of 'devylles bytte' that the Devil envied its virtue and bit the root to destroy it.[257]

Line 46. *Dracontio: Dracontium.*

[C.T.& M. 582 *Arum* but not this species];

[Flowers G.& B. 509] *Dracunculus vulgaris* (Schott), Dragon Arum; a species of the *Dracunculus* genus of the *Araceæ* or Arum family.

B.& G.-W. 470: B.& H. 420: Linn.*Sp.Pl.* 967-968:

Syn.Meth.St.Br. 266: *H.P.* 1211: *H.P.III* 582-583: *Tri.* 10.64:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 1211:

Dracontium majus Ger. *Dracunculus major vulgaris* J.B. Park. *polyphyllos* C.B. ***Dragons.***

H.P.III 582-583

20 additional species given.

Tri. 10.64:

Dragons: *Dracontium, -ii,* n.: *Δρακόντιον, -ίου,* n.

Line 46. *Croco: Crocus*: see above Cap.3, line 18.

257 Grigson: 361.

Line 46. *Gladiolo: Gladiolus.*

[C.T.& M. 556] *Gladiolus communis* (L.), [*Gladiolus byzantinus* (Miller)], Gladiolus; a species of the *Gladiolus* genus of the *Iridaceæ* or Iris family.

B.& G.-W. 468: B.& H. 450: Linn.*Sp.Pl.* 36-37:

Syn.Meth.St.Br. 273/287/375: *H.P.* 1168-1170: *H.P.III* 559:

Tri. - no ref.: *Cat.Angl.* 132: *Camb.* 67.

H.P. 1168-1170:

7 species given, including:

Gladiolus sive Xiphion J.B. *Gladiolus Narbonensis* Park. *Italicus* Ger. *Glad. floribus uno versu dispositis major* C.B. ***Corn-Flag.***

H.P.III 559:

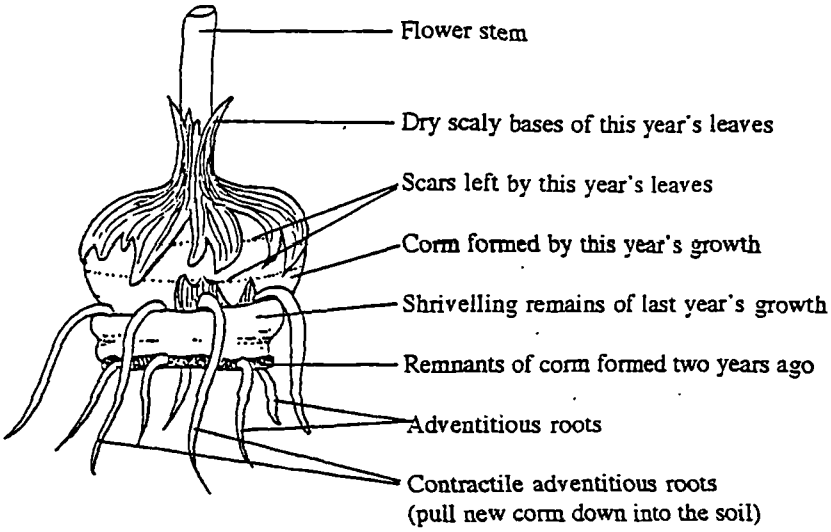
24 additional species given.

Line 46. *ubi bulbus geminus est* .... : development of corms.

Corms are underground very short vertical stems, which are swollen with stored food and enclosed within overlapping fibrous leaf bases. During spring and summer the terminal bud of a corm grows upwards, forming leaves and flowers. This uses up all the food stored in the corm. After flowering the leaves remain and make more food, which passes down to make a new corm in the area of stem immediately above the shrivelled remains of the old corm, and thus a new corm forms on top of the old one each year. This process would lead to the plant growing out of the soil if it were not for the contractile roots, which pull down the corm and then contract and hold it below ground level.[258] Such roots are described by Ray below at line 60 as *in terram recta descendentes, velut totidem funiculi truncum post se rapiunt.*

258 *Penguin Dictionary of Botany*: 87; *Oxford Dictionary of Botany:* 105; Gibbons: 95-96.

Gladiolus corm as it appears in autumn:[259]



Line 50. *Primulæ: Primula:* see above Cap. 3, line 36.

Line 50. *Acetosellæ: Acetosella:* see above Cap.3, line 36.

Line 53. *Hellborastro: Helleborastrum*: see under *Helleborus niger* above Cap.3, line 35.

Line 54. *Iride tuberosã: Iris tuberosa.*

[C.T.& M. 554-555] *Iris* (L.), Iris; a genus of the *Iridaceæ* or Iris family.

B.& G.-W. 466: B.& H. 449: Linn.*Sp.Pl.* 38-40:

Syn.Meth.St.Br. 374-375: *H.P.* 1180 *Iris tuberosa:*

H.P.III 562 (*tuberosa* only): *Tri.* 10.74: *Cat.Angl.* - no ref.:

Camb. - no ref.

H.P. 1180:

De Iride tuberosa & fibrosa:

24 species given, including:

Iris vulgaris Ger. *purpurea sive vulgaris* Park. *Germanica* Fuch. *vulgaris Germanica sive sylvestris* C.B. *vulgaris violacea sive*

259 Drawn from Beckett: 203.

purpurea, hortensis & sylvestris J.B.

The most common purple Flower-de-luce.

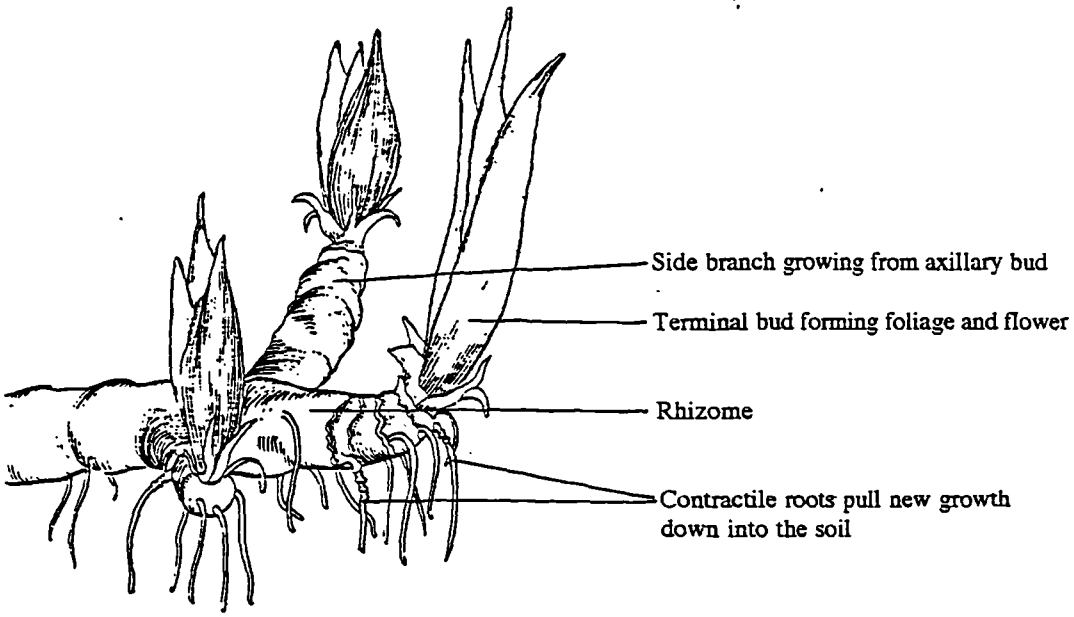
H.P.III 562 (*tuberosa* only)

4 additional species given.

Tri. 10.74:

Flower de Luce: *Iris, -idis,* f.: *Ἶρις, -ιδος,* f.

Line 54. The rhizome of *Iris tuberosa*:[260]



Line 63. *Dente leonis: Dens leonis.*

[C.T.& M. 514] *Taraxacum* (Weber), Dandelion; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 436: B.& H. 263: Linn.*Sp.Pl.* 798:

Syn.Meth.St.Br. 170-171: *H.P.* 245-246: *H.P.III* 146: *Tri.* 10.60:

Cat.Angl. 89: *Camb.* 59.

H.P. 245-246:

17 species given, including:

Dens leonis Ger. *vulgaris* Park. *latiore folio* C.B. *Hedypnois sive Dens leonis Fuchsii* J.B. *Aphaca ex olerum genere Theoph.7.Hist.10.* C.B. Bodæi à Stapel. ***Dandelion.***

260 Drawn from Beckett: 203.

H.P.III 146:

8 additional species given.

Tri. 10.60:

Dandelion: *Dens leonis,* m.: [No Greek].

For diagram of the root system of the Dandelion plant see above Cap.3, line 4.

Line 67. *Succisā: Succisa*: see above Cap.3, line 42.

Line 70. *Orchide: Orchis:* see above Cap.3, line 20.

Line 70. *Battatā: Battata.*

[C.T.& M. 367] *Solanum tuberosum* (L.), Potato; a species of the *Solanum* genus of the *Solanaceæ* or Potato family.

B.& G.-W. 350: B.& H. 318: Linn.*Sp.Pl.* 154:

Syn.Meth.St.Br. 265: *H.P.* 728: *H.P.III* 132: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 728:

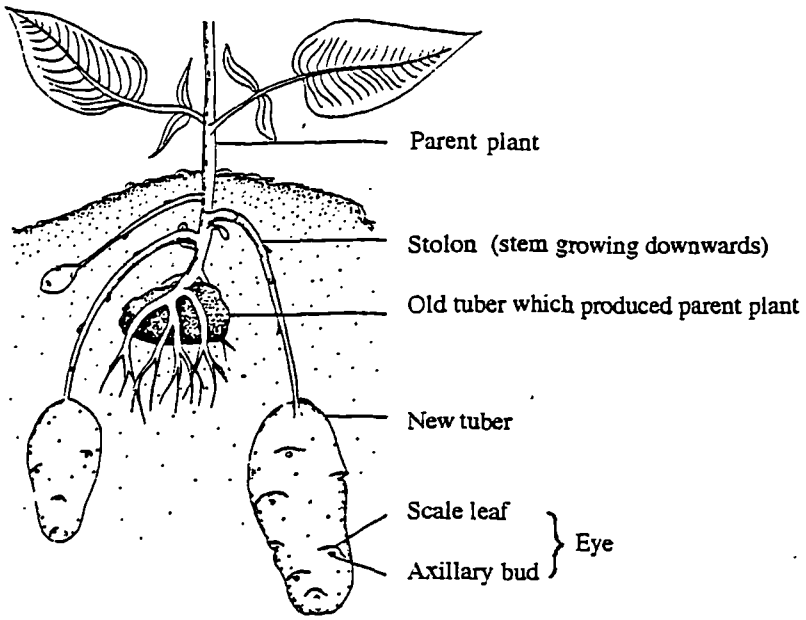
Convolvulus Indicus Batatas dictus. Batatas, Camotes Hispanorum Clus. C.B. *Battatas Occidentalis Indiæ, & Inhame Orientalis Lusitanorum* Park. *Sisarum Peruvianum, seu Battata Hispanorum* Ger. ***Spanish Potatoes.***

H.P.III 132:

Ray says here that botanists believe that plants with the names *Battata sylvestris* and *Rizophora* are clearly dissimilar, not only differing in species but also in genus.

8 additional species of *Battata sylvestris* given.

Stem tubers of *Solanum tuberosum*, the Potato:[261]



Line 70. *Napello: Napellus.*

[C.T.& M. 35] *Aconitum napellus* (L.), subsp. *napellus*, [*Aconitum anglicum* (Stapf.)], Monkshood, Aconite; a species of the *Aconitum* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 108: B.& H. 13: Linn.*Sp.Pl.* 532:

S*yn.Meth.St.Br.* 262: *H.P.* 701-705: *H.P.III* 368: *Tri.* 12.127: *Cat.Angl.* - see under *Christophoriana* 69: *Camb.* - no ref.

H.P. 701-705:

13 species given, including:

Aconitum magnum purpureo flore, vulgo Napellus J.B. *Acon. cæruleum, seu Napellus* 1. C.B. *Napellus verus cæruleus* Ger. *verus flore cæruleo* Park.

Blew Helmet-flower or Monkshood.

H.P.III 368:

10 additional species given.

Tri. 12.127:

Monk's-hood: *Napellus, -i*, m.: *Ἀκόνιτον, -ίτου*, n.

261 Drawn from Beckett: 201.

Line 70. *Chelidoniã minore: Chelidonia minor.*

[C.T.& M. 49] *Ranunculus ficaria* (L.), [*Ficaria verna* (Hudson); *Ficaria ranunculoides* (Roth.)], Lesser Celandine, Pilewort; a species of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 118: B. & H. 8: Linn.*Sp.Pl.* 550:

Syn.Meth.St.Br. 246: *H.P.* 579*: H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 68: *Camb.* 53.

H.P. 579:

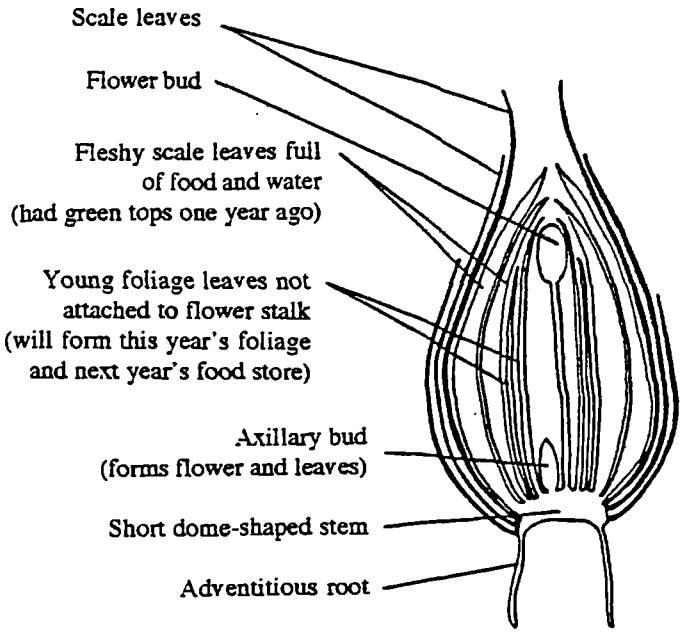
> *Chelidonium minus* Ger. Park. *Chelidonia rotundifolia minor* C.B. *Scrophularia minor sive Chelidonium minus vulgo dictum* J.B. ***Pilewort or the lesser Celandine.***

Line 72. *Tulipæ: Tulipa:* see above Cap. 3, line 12.

Line 72. *etiam consentiunt Tulipæ aliæque radices bulbosæ:* Ray says that 'even Tulips and other bulbous roots are of the same type'. He is incorrect here, as, for example, Tulip and Daffodil bulbs are formed in different ways. In spring a leafless flowering stem emerges from the daffodil bulb, surrounded by separate green leaves, which arise from the central region of the bulb. Growth of flowers and leaves uses up food stored in the rest of the bulb. After flowering the green leaves persist for several months making food which passes down to their leaf bases, which then swell to form a new bulb. Later the green upper part of these leaves dies away. At the same time, one or more axillary buds develop to a stage at which they can form next year's flowers and leaves.[262]

262 *Lowson's Botany:* 72-74; Cooke, Burkitt and Barker: 292-293; Beckett: 204-205.

Longitudinal section of a Daffodil bulb:[263]



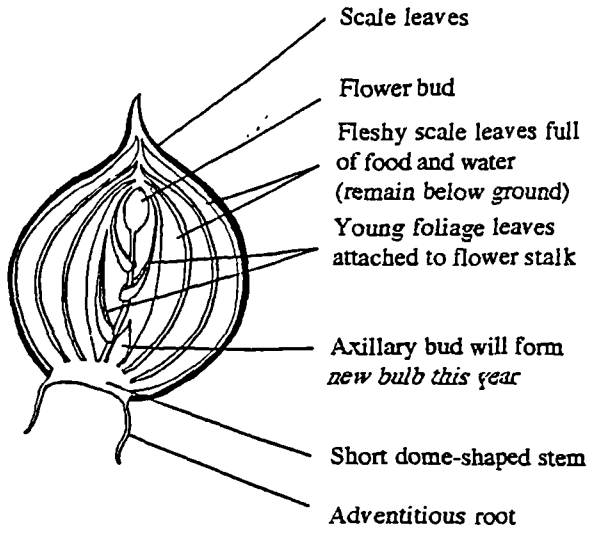
Line 72. *tunicæ enim ex quibus præcipue bulbi constant .....*

Regeneration of a Tulip bulb: in spring the bulb bursts open and the flower stem emerges with large green leaves growing along its length. Growth of this stem uses up all the food in the bulb's underground food-storage leaves so that they dry up into paper-thin brown scales. After flowering the green leaves above the ground persist for several months producing food which passes down the stem and accumulates in one or more axillary buds, which then swell to form new bulbs.[264]

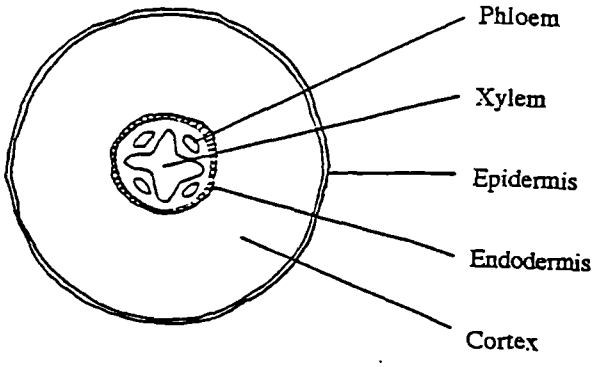
263 Drawn from Beckett: 204.

264 *Lowson's Botany*: 72-74; Cooke, Burkitt and Barker: 292-293; Beckett: 204-205.

Longitudinal section of a Tulip bulb:[265]



Line 77. *Partes radicis* ....: cross-section of a root:[266]



Line 79. *Cortex componitur* ..... : the tissue (including the *endodermis)* between the vascular cylinder (the *stele*) and the epidermis of a root or stem. The cortex usually has many layers of cells.[267] First used in English in 1660.[268]

Line 80. *Cuticula a cortice originem:* Ray is using this word for the epidermis, which is the outermost layer of cells of the plant body.

265 Drawn from Beckett: 204.
266 Drawn from Gibbons: 32.
267 *Penguin Dictionary of Botany:* 88-89.
268 *OED:* 432.

The term epiblem (rhizodermis) is sometimes used in place of epidermis for this layer of cells in the root. The main function of the epidermis is to protect the underlying tissues from excessive water loss and, to a certain extent, from physical injury and attack from pathogens.[269] It is not dried up cortex as Ray thinks. Cuticle is now botanically defined as 'formerly, the primary integumentary tissue; now, a superficial film formed of the outer layers of the epidermal cells': first used in this way 1671.[270]

Line 83: *nimirum utriculis seu vasculis velut parenchymate:*

Utriculus: literally 'a bladder'.

Not used as a term in English until 1731.[271]

Vesicula: vesicle or small bladder; a small body surrounded by a membrane.[272]

Ray uses *utriculus* and *vesicula* for the component cells of the parenchyma. First used in English in 1578.[273]

Parenchyma: the general name for the tissues of cells with thin cell walls, often with intercellular spaces, e.g. the mesophyll of leaves, or the cortex of stems and roots. Parenchyma is an area of relatively unspecialised tissue, which forms the ground tissue in which other more specialised tissues are embedded.[274] First used in English in 1651.[275]

Line 84. *quæ quamvis etiam microscopio ægre visibiles sunt.*

Microscope: Ray and his contemporaries could have had access to some of the earliest microscopes. The microscope was invented in

269 *Penguin Dictionary of Botany:* 121.
270 *OED*: 478.
271 *ibid.:* 2444.
272 *Penguin Dictionary of Botany:* 379.
273 *OED:* 2468.
274 *Penguin Dictionary of Botany:* 260; also *Oxford Dictionary of Botany:* 296.
275 *OED:* 1512.

1609 by a Dutch spectacle maker Zacharias Jannsen (1580-c.1638) and his father, but Robert Hooke (1635-1703) gave the first extensive description of its use in biology in his *Micrographia* of 1665.[276] The earliest microscopes were probably made in Italy and the most active early users of microscopes were the members of the Accademia dei Lyncei in Rome, founded by Federigo Cesi, Duke of Aquasparta, himself a microscopist, who was probably the first to discover the spores of ferns. He produced a huge but incomplete set of *Phytoscophicæ Tabulæ,* which was intended to be a systematic summary of botany. Other early microscopists were J.B.Porta, A.Kircher and P.Borel.[277]

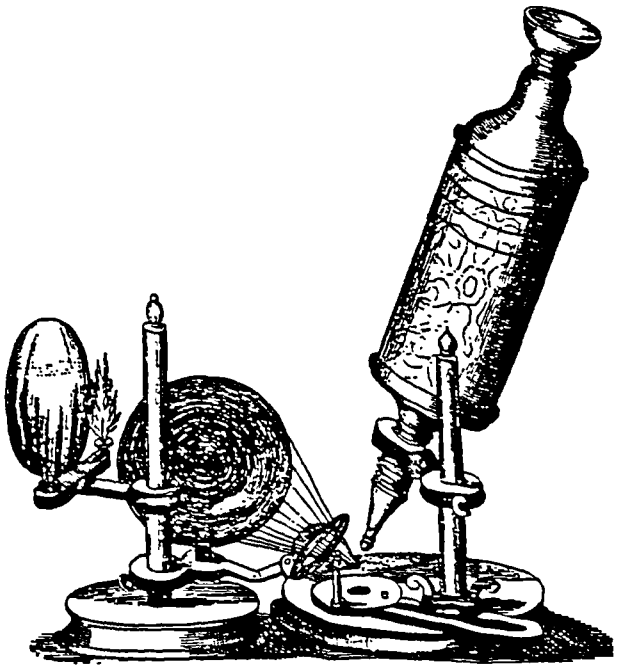
Robert Hooke, 1635-1703, was a British physicist and instrument maker, who became Professor of Geometry at Gresham College, London, in 1665. In 1660 he discovered the law named after him. His work on springs led him into horology and he claimed to have invented the hair spring (also claimed by Huygens). He was one of the first scientists to examine vegetable matter with a microscope. Many of his microscope studies were published in *Micrographia* in 1665.[278] Appointed a city surveyor after the Fire of London, he designed several buildings, including the College of Physicians.[279]

Hooke's *Micrographia,* although not intended to be a systematic study of any particular group of things, but being illustrations of microscopic observations of randomly chosen objects of animal, vegetable and mineral origin, showed what a careful scientist Hooke was; he was the first to see 'cells' in plants (the cells of cork in 1667), although it fell to Malpighi and Grew to show that

276 *Mac.Enc.:* 587.
277 Morton: 225, note 18.
278 There is no indication in the sale catalogue of Ray's library that he owned anything written by Hooke; British Museum: *S-C 326* (6).
279 For more information on Robert Hooke see *DSB VI:* 481-488; Sachs: 229-232; Raven: 145, 169n., 171n., 172., 179.

cells make up the normal structure of the parenchyma in all plant organs.[280] His botanical illustrations show that he realised that 'the pores' of cork were closed bladder-like structures, and he named them 'cells'; he showed that similar structures existed in other plants: in the pith of several trees, in the stalks of carrot, fennel, burdock, teazle, ferns, reeds, and in the leaves of mosses. In fern, moss, and two kinds of fungus he seems to have seen spores. He calculated their size and guessed that they represented 'seed' minute enough to be dispersed by air, and concluded therefore that moss and moulds are true plants and do not just arise from corruption - thus putting the weight of his scientific authority against the ancient doctrine of equivocal or spontaneous generation."[281]

Robert Hooke's microscope of 1664:[282]



280 Morton: 187.

281 *ibid.*: 178.

282 David Goodman and Colin A.Russell, *The Rise of Scientific Europe, 1500-1800;* Hodder and Stoughton, London 1991: 212.

It has been said that:

> The most immediate extension of botanical investigation was in plant anatomy, where the microscope revealed an undiscovered world and in less than thirty years created a new branch of botany.[283]

The name microscope (*microscopium*) was first suggested apparently by J.Faber of Bamberg, physician to Pope Urban VII, in 1625. However, during the seventeenth century the term was used to cover both simple lenses and the compound microscope of the time.[284]

Ray himself had no proper laboratory or microscope; he called any lens a microscope and probably possessed no more than a small magnifying glass.[285] Ray also comments on the work of Grew and others, 'I confess for want of a good microscope I have not observed them for myself'.[286] In 1692 Aubrey sent Ray's wife and daughters a 'glass microscope' which was probably the sort of simple magnifying glass he had normally used; he thanks Aubrey saying, '....my Wife and young girls, who are indeed much pleased with the Glasse Microscope'.[287]

Line 85. *D. Grevius ex eo quod cuticula ..... :* Grew on the fibres in the cuticle of the root and stem.

Line 87. *Flore solis pyramidali: Flos solis pyramidalis.*

[C.T.& M. 447] *Helianthus tuberosus* (L.), Jerusalem Artichoke; a species of the *Helianthus* genus of the *Compositæ* or Daisy family. B.& G.-W. 406: B.& H. 225: Linn.*Sp.Pl.* 905:

283 Morton: 178.
284 *ibid.:* 221, note 5.
285 Raven: 220, note 1.
286 *Further Correspondence:* 193.
287 *ibid.:* 175.

Syn.Meth.St.Br. - no ref.: *H.P.* 335: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 335:

Flos solis pyramidalis, parvo flore, tuberosa radice, Heliotropium Indicum quorundam Ger.emac. *Helianthemum Indicum tuberosum* C.B. *Battata Canadensis* Park.

Jerusalem Artichoke.

Line 88. *Tragopogone: Tragopogon.*

[C.T.& M. 494-495] *Tragopogon* (L.),Goat's Beard; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 432: B.& H. 256: Linn.*Sp.Pl.* 789-790:

Syn.Meth.St.Br. 171: *H.P.* 251-253: *H.P.III* 149: *Tri.* - no ref.:

Cat.Angl. 288: *Camb.* 118.

H.P. 251-253:

10 species given, including:

Tragopogon luteum Ger. Park.parad. *flore luteo* J.B. *pratense luteum majus* C.B. ***Yellow Goats-beard.***

H.P.III 149:

6 additional species given.

Text page 5

Line 90. *Asparagi: Asparagus.*

[C.T.& M. 535] *Asparagus officinalis* (L.), Asparagus; a species of the *Asparagus* genus of the *Liliaceæ* or Lily family.

B.& G.-W. 462: B.& H. 459: Linn.*Sp.Pl.* 313-314:

Syn.Meth.St.Br. 267: *H.P.* 683: *H.P.III* 359: *Tri.* 8.10:

Cat.Angl. 29: *Camb.* - no ref.

H.P. 683:

Asparagus Park. *Sativus* Ger. *hortensis & pratensis* J.B. *sativa* C.B. ***Manured Sparagus or Sperage,*** *corrupte* ***Sparrow-***

grass

H.P.III 359:

12 additional species given.

Tri. 8.10:

Asparagus or Sperage: *Asparagus, -i,* m.:

Ἀσπάραγος, -άγου, f.

Ray's footnote, *Tri.* 8.10, says, 'This also is by the vulgar corruptly called Sparrow-grass'.

Ray has an interesting note on the term *asparagus* and its transference to the plant of the same name in his introductory glossary to *HistoriaPlantarum:*

> *Asparagus dicitur primum germen herbarum quod edendo est vel oleris cujusque turio antequam in folia explicetur, à σπείρω*[288] ***The tender sprout or shoot of any herb from the ground.*** *Hinc per Antonomasian dicitur herba quædam quæ grandes profert & edules asparagos.*[289]

Line 92. *Utriculis seu vesiculis ceu parenchymate:* see note on Hooke at line 84 above.

Line 100. *D.Malpighius utriculos in se mutuo hiantes & pervios facit:* reference in the text to Malpighi discussing the passage of liquids from one cell to the next. This does not seem to be a direct quotation from Malpighi's chapter on roots, although in several places he does discuss the utriculi of the cortex.[290]

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288 NB The Greek verb σπείρω means 'to sow', 'engender' or 'strew'.

289 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

290 The section dealing with roots is to be found in Malpighi's *Anatome Plantarum, Pars Altera* (Part II): 68-93.

Marcello Malpighi: 1628-1694.

Italian anatomist, who made fundamental contributions to human and comparative animal anatomy and embryology; his microscopical studies of living organisms provided new insights into their function. In 1661 he discovered the fine capillaries which connect arteries with veins, substantiating William Harvey's theory of blood circulation. Malpighi made numerous studies of body organs - the kidney glomeruli (Malpighian corpuscles) and a layer of skin tissue (Malpighian layer) are named after him. He also made valuable early studies of comparative plant anatomy; for example, he observed the spiral patterns of the tracheæ in plants. Malpighi, like others, exploited the new microscopes, because

> he had first studied animals and insects, and took up the study of plant anatomy in the hope that he could return to animals with more understanding after studying simpler forms of life.[291]

See also notes on Grew above Cap.3, line 16; Grew also embraced the new microscopes saying that he did it because 'both plants and animals came out of the same Hand'.[292] For nearly a century and a half plant anatomy remained where Malpighi and Grew had left it.[293]

Malpighi's botanical works are:

1. *Anatomes plantarum pars prima, cui subjungitur appendix iteratas et auctas de ovo incubato observationes continens* (London 1675).
2. The above work is prefaced by *Anatomes plantarum idea* dated

291 Morton: 179.

292 *ibid.*

293 *DSB IX*: 62-66; *Mac.Enc.*: 767; Raven :- Malpighi and Ray: 67 / and cotyledons 189 / and Ray's *Methodus:* 192 / his *Anatome Plantarum:* 195 / *De Ovo:* 378 / on galls: 471 / and anatomy: 474; Morton: 178-194; Arber: 138; Sachs: 44, 48, 63, 69, 89, 155, 221, 223, 231-239, 241, 262, 363, 366-367, 381, 457-461.
For further biographical details see H.B.Adelmann, *Marcello Malpighi and the Evolution of Embryology*, Ithaca, New York 1966.

November 1671.

3. *Anatomes plantarum pars altera* (London 1679).[294]

Line 102. *utriculos hosce in nonnullis plantis duum generum esse:*

Ray says that this is Grew's observation from the *Anatome radicum.* Although the cortex consists mainly of ground parenchyma, it often also contains some collenchyma and sclerenchyma cells. Collenchyma cells are relatively elongated cells with thickened cellulose cell walls.[295] Sclerenchyma cells are relatively short cells with thick often lignified cell walls and usually lacking a living protoplast at maturity;[296] both are used for strengthening.[297]

The term collenchyma was first used in English for this type of cell in 1857,[298] and the term sclerenchyma in 1875.[299]

Line 104. *repletos*: literally 'full': translated as 'solid'.

Line 106. *fibræ etiam ligneæ seu vasa succifera:* Ray is referring here to the collenchyma and sclerenchyma cells of the cortex; see above Cap.3, line 102.

Line 111. *nullæ omnino (observante Grevio) dantur inter eas anastomoses:*

reference to Grew on anastomosis.

Anastomosis: the joining of veins or hyphæ into a network.

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294 Ray, at least by the time of his death, owned the following of Malpighi's works, as is indicated in the sale catalogue of his library:
Anatomia Plantarum, 2 vols., edition published in London (no date indicated); British Museum: *S-C 326* (6): 1, *Libri Latine &c. in Folio,* number 33.
Opera Posthuma, edition published in London in 1697; *ibid.:* 1, *Libri Latine &c. in Folio,* number 34.

295 *Penguin Dictionary of Botany:* 82.

296 *ibid:* 322.

297 *ibid.:* 88-89: see also *Lowson's Botany:* 43-45.

298 *OED:* 367.

299 *ibid.:* 1905.

First used in English in 1615 - to furnish with a mouth or outlet. Intercommunication between two vessels, channels or branches, by a connecting cross branch.[300] Originally used by Erasistratus for the cross connections between the arteries and veins; now for those of any branching system.

Line 114. *Plexus hi in variis plantis numero & figura variant, in aliis rariores, in aliis crebriores.* The quantity of collenchyma and sclerenchyma cells differs in different plants.[301]

Line 118. *de tracheis seu vasis ærem deferentibus ..... : trachea,* a vessel, or tube-like series of non-living cells in the xylem of a plant, supplying mechanical support and involved in the transport of water and salts. Ray seems to believe that the tracheæ in the woody vascular stele convey air and the vessels of the cortex (the collenchyma and the sclerenchyma?) convey water and salts; in fact, all are conveyed in the vascular stele.[302]

Line 119. *nec D. Grevii sententiæ ..... :* reference in the text to Grew; both Grew and Malpighi were medical men, who studied plants with the intention of finding, if possible, structures in plants, which would compare with the blood vessels; as mentioned above Harvey had discovered the circulation of the blood in 1628.

Line 122. *inosculatæ:* inosculate, from the Latin *in-osculare,* to furnish with a mouth or outlet. First used in English in 1673 for vessels opening into each other or having a connection at the end; verb - to anastomose.[303]

300 *OED:* 67.
301 Cooke, Burkitt and Barker: 193.
302 *Oxford Dictionary of Natural History:* 641.
303 *OED:* 1078 and 67.

Line 123. *partim denique ab experimento de succi motu deorsum in sectione transversa inferius proponendo:* Ray refers to an experiment described later [in chapter 5, line 74].

Line 126. *Anchusā: Anchusa.*

[C.T.& M. 359] *Anchusa* (L.), Anchusa; a genus of the *Boraginaceæ* or Borage family.

[C.T.& M. 359] *Anchusa arvensis* ([L.] Bieb), *Lycopsis arvensis* (L.), Bugloss; a species of the *Anchusa* genus of the *Boraginaceæ* or Borage family.

B.& G.-W 324: B.& H. 313: Linn.*Sp.Pl.* 133-134:
Syn.Meth.St.Br. 227: *H.P.* 496-497: *H.P.III* 268-269:
Tri. - no ref.: *Cat.Angl.* 21: *Camb.* 43.

H.P. 496-497:

6 species given, including:

Anchusa lutea J.B. Ger. *lutea major* Park. C.B. *major floribus luteis* J.B. ***Yellow Alkanet.***

H.P.III 268-269:

13 additional species given.

Line 126. *Erythrodano: Erythrodanum.*

[C.T.& M. 433] *Rubia tinctorum* (L.), Madder; a species of the *Rubia* genus of the *Rubiaceæ* or Bedstraw family.

B.& G.-W. 316: B.& H. 211: Linn.*Sp.Pl.* 109:
Syn.Meth.St.Br. 223: *H.P.* 480: *H.P.III* - no ref.: *Tri.* - no ref.:
Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 480:

5 species given, including:

Rubia tinctorum Ger. *sativa* J.B. *major sative sive hortensis* Park. *tinctorum sativa* C.B. ***Madder.***

Line 126. *Pastinacā tenuifoliā: Pastinaca tenuifolia.*

[C.T.& M. 294] *Daucus carota* (L.), Wild Carrot; a species of the *Daucus* genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 286: B.& H. 200: Linn.*Sp.Pl.* 242:

Syn.Meth.St.Br. 218: *H.P.* 464: *H.P.III* - no ref.: *Tri.* 9.34:

Cat.Angl. 225-226: *Camb.* 59.

H.P. 464:

> *Pastinaca sativa tenuifolia* Ger. *tenuifolia sativa lutea* Park.*tenuifolia sativa radice lutea vel albo* C.B. *sativa sive Carota rubro, lutea & alba* J.B. ***Carrots.***

Tri. 9.34:

> Carrot: *Pastinaca, -æ,* f.: *Σταφυλῖνος, -ίνου,* m.

Line 127. *Vasa hæc diversorum esse .....:* reference to Grew on sap-bearing vessels. Grew seems to think that the sap-bearing vessels are in the cortex rather than the vascular column or stele in the centre of the root, which Ray calls the *medulla* or pith. He believes that the vessels vary according to the type of sap they contain, but Ray doubts this. Sap is the liquid, consisting of mineral salts and sugar dissolved in water, which is found in the xylem and phloem vessels.[304] It can also take the form of resin and latex, and as such varies in colour and consistency.[305]

Line 131. *Lignea radicis pars*: this is the stele or vascular column consisting of the xylem and phloem, which comprise the vascular bundle in the root.

Line 132. *parenchyma:* see above Cap.3, line 83.

304 *Penguin Dictionary of Botany:* 321.
305 *Oxford Dictionary of Botany:* 364.

Line 132. *utriculi*: see above Cap.3, line 83.

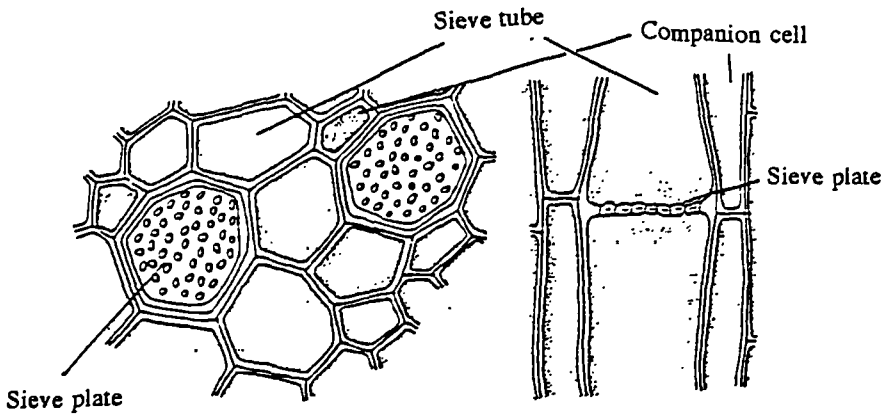
Line 134. *Fibris ligneis seu vasis succiferis:* the woody fibres or sap-bearing vessels are the xylem (the woody part of the vascular tissue - from ξύλον, -ου, n., wood) and the phloem (the softer part of the vascular tissue - from φλόος, -ου, m., skin). Both the terms xylem and phloem would have been unknown to Ray; they were first used in English in 1875.[306]

The xylem consists of strong lignified but dead cells, most of whose end walls have broken down to form almost continuous tubes running up through the plant, and carrying water and dissolved salts. The phloem consists solely of living cells, which transport food materials round the plant; unlike the xylem the cross-walls of the phloem cells do not disappear, but rather develop perforations like a sieve. The xylem and the phloem together form the vascular bundle of the plant (rather like the blood system of animals), and they also help in the rigidity of the plant. The arrangement and number of vessels in the vascular bundles varies somewhat from plant to plant, although usually the xylem forms a star with the phloem in the bays between the arms.[307]

For a diagram of a cross section of a root showing the xylem and the phloem, Ray's 'woody fibres' and 'sap-bearing' vessels, see above Cap.3, line 77.

306 *OED:* 2584 and 1571.
307 Gibbons 32-33.

The phloem in transverse and longitudinal section:[308]



Line 136. *tracheis:* a tracheid is a vessel, or tube-like series of non-living cells in the xylem of a plant, supplying mechanical support and involved in the transport of water and salts.[309] Ray realised that these vessels are in the woody part of the root, but he seems to think that they carry only air. In fact a plant's respiratory system is its root hairs below ground and the stomata and lenticels above.[310] Each root hair has a very thin surface membrane, through which oxygen passes by liquid diffusion, and from there into the living cell tissues of the root, and thence through the xylem to the rest of the plant.[311]

Line 138. *Grevii lib. de Anatome Radicum cap.4:* on tracheae or tracheids in roots.

Line 139. *annotat Malpighius.*

Malpighi believes that the *tracheæ* of the roots are always larger than those in branches and trunks:

> *Hoc tamen videtur quasi perpetuum, tracheas majores esse, & magis patentes, ac in trunco, ac ramis*

308 Drawn from Gibbons: 33.
309 *Penguin Dictionary of Botany:* 363; also *Oxford Dictionary of Botany:* 412.
310 Gibbons: 43 and 55.
311 Cooke, Burkitt and Barker: 144-145.

existant.[312]

Malpighi may be meaning that the vascular bundles in roots seem larger because they are arranged in a different manner than in stems and leaves. In roots they form the vascular cylinder or stele in the centre of the root, which as well as carrying water and salts, gives support to the plant, whereas they are not centrally placed but spread more widely in stems and leaves.[313]

Line 140. *Medulla:* Ray is correct in saying that not all roots have pith.

Line 140. *Nicotianæ: Nicotiana.*

[B.& G.-W. 350] *Nicotiana tabacum* (L.), [*Nicotiana latissima*]; a species of the *Solanum* or Nightshade genus of the *Solanaceæ* or Potato family.

C.T.& M. - no ref.: B.& H. 317: Linn.*Sp.Pl.* 180-181:

Syn.Meth.St.Br. - no ref.: *H.P.* 713: *H.P.III* 658: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 713:

4 species given, including:

Tabaco latifolium Park. *Nicotiana major latifolia* C.B. *Nicotiana major sive Tabacum majus* J.B. *Hyoscyamus Peruvianus* Ger. ***Broad-leaved Tobacco.***

H.P.III 658:

Under *Herbæ anomalæ*, No.34:

Nicotiana VI seu Cassina herba, e cujus succo potionem conficiunt in Florida, quam bibunt ubi in locum periculosum se conferunt, quo famen & sitim per horas 24 tollunt. Part 2a Americ. Navigat. 4 C.B. *An Cassine vera Foridanorum arbuscula baccifera. Alaterni fere facie. foliis alaternis tetrapyrena* Pluk.Mantiss.

312 Malpighi, *Anatomes Plantarum Pars Altera:* 69.

313 *Lowson's Botany:* 120-122.

Line 141. *Stramonii: Stramonium.*

[C.T.& M. 368] *Datura stramonium* (L.), [*Datura tatula*], Thornapple; a species of the *Datura* genus of the *Solanaceæ* or Potato family.

B.& G.-W. 350: B.& H. 317: Linn.*Sp.Pl.* 179:

Syn.Meth.St.Br. 266: *H.P.* 747-749: *H.P.III* 390: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 747-749:

9 species given, including:

Stramonium majus album Park. *Stramon. spinosum* Ger. *Stramonia altera major sive Tatura quibusdam* J.B. *Solanum fœtidum pomo spinoso oblongo.* C.B. ***Thorn-apple of Peru.***

H.P.III 390:

4 additional species given.

Line 148. *quam rete quoddam mirabile:* this is still use as a modern anatomical term for an elaborate network or plexus of blood vessels.[314]

The description is reminiscent of that given by the Greek medical writers for πλέγμα δικτυοειδές, the *rete mirabile Galeni.*[315]

Line 151. *Qua ratione alimentum radices subingrediatur meos adhuc sensus fallit (inquit Malpighius) ut probabiliter tamen conjectari licet; aqueæ particulæ solutos sales, & reliqua mineralia per terram dispersa associant ac fluida reddunt, appellensque hujusmodi heterogeneum corpus ad plantarum radices,*[316] *veluti per cribrum trajectum, in ligneas fistulas exprimitur.* Ray states he still does not understand

314 *OED:* 1814.

315 Herophilus, *Apud Galenum:* 5.155; Galen, *de Usu Partium:* 9.4.

316 NB Ray has one deviation from Malpighi's text in this section; Malpighi has *radiculas* and Ray *radices.* Since the text goes on to say that nourishment passes through the hairs of the roots, Malpighi's word *radiculas* wuld seem to be preferable to Ray's *radices,* which implies a larger root.

how nourishment enters the roots; in fact the whole of the section cited above is quoted directly from Malpighi.[317] It is interesting to note here that Jung's ideas on the absorption of material by the roots showed the new questioning approach to scientific thinking of this age. He suggested that roots might have pores, 'which in different plants are permeable or impermeable to the same material, thus enabling plants to select their appropriate food as animals do'.[318]

Line 153. *aqueæ particulæ solutos sales, & reliqua mineralia per terram dispersa;* he is correct in saying that the roots absorb water and minerals in solution (such as nitrate and phosphate).

Line 154. *in ligneas fistulas exprimitur:* does he mean the collenchyma and sclerenchyma of the cortex here or the xylem and phloem of the vascular column?

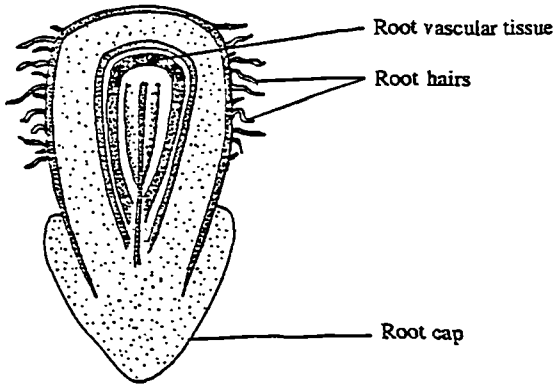
Line 154. *seu per pilorum, qui circa tenellas radices copiose luxuriant, orificia intret:* again this is taken from Malpighi but is not a direct quotation. Rather Ray is paraphrasing and summarizing Malpighi's discussion.[319] Malpighi expresses more doubts:

> *Quænam sint portæ, seu hiantia orificia, quæ propulsum fluidum cribrent, & determinate admittant; adhuc dubium. Circa tenellas Radices pili copiose luxuriant, hinc inde: sunt autem pili candidæ fistulæ, & gracillimæ, minimis orbiculis, invicem hiantibus, coagmentatæ; under horum orificiis determinatæ figuræ analogam fluidi partem, ambientium vi expressam, admittunt, & ligneis fistulis reddunt. .....* [320]

317 Malpighi, *Anatomes Plantarum Pars Altera:* 83.
318 Morton on Jung's fifth fragment of his *Doxoscopiæ:* 174-175.
319 Malpighi, *Anatomes Plantarum Pars Altera:* 84-85.
320 *ibid.:* 84.

Line 158. *quæ fibræ appellantur:* the root hairs are thread-like simple tubular projections from an epidermal cell, the nucleus of the cell usually passing into the hair. They develop behind the root-tip and the actively growing area of a root called the meristem. Root hairs increase the surface area of a root and help in the uptake of water and nutrients. They are delicate structures with flimsy walls with a life-span of usually less than a week. In some roots every cell produces a root hair; in others there is a regular alternation between hair-producing cells and non-producing cells.[321]

Section through the tip of a growing root:[322]



Line 159. *fistulæ:* he obviously had looked closely at root hairs to realise that they are in structure simple tubes, in fact single cells developed from the epidermis of the root.[323]

321 Gibbons 31.
322 Drawn from Gibbons: 31.
323 *Lowson's Botany:* 19-20.

Chapter 4:

On the stems of plants and their constituent parts from the writings of the most famous authors Malpighi and Grew.

In *The Wisdom of God,* Ray summarises his ideas put forward in this chapter and the next of *Historia Plantarum:*

> the Fibres, to contain and convey the Sap; besides which, there is a large Sort of Vessels to contain the proper and specifick Juice of the Plant, and others to carry Air for such a Kind of Respiration as it needeth; ..... The outer and inner Bark in Trees serve to defend the Trunk and Boughs from the Excesses of Heat and Cold, and Drought, and to convey the Sap for the annual Augmentation of the Tree.[324]

Morphological studies had developed considerably in the seventeenth century thanks to the work of Malpighi and Grew, cited here by Ray as his main sources; as mentioned in the previous chapter of this commentary, they believed that the root and stem should not be distinguished by function,

> Stems ..... bear leaves, produce buds in whose formation all the stem tissues take part (exogenously), while the woody tissue is not central but either in a ring or in scattered bundles towards the exterior.[325]

Text page 6

Title. *De aulibus Plantarum et eorum de partibus continentibus e Clariss. Malpighii & Grew scriptis:* Ray states that this chapter is taken from the writings of Malpighi[326] and Grew.

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324 *The Wisdom of God:* 76-77.

325 Morton: 181.

326 Malpighi's writings on the stem may be found in his *Anatome Plantarum, cui subjungitur Appendix, Iteratas & auctas ejusdem Authoris de Ovo Incubato Observationes Continens;* Malpighi, *Anatome Plantarum*: *de Cortice* 1-6; *de Partibus Caulem vel Caudicem componentibus:* 6-17.

Line 1. *In Isag. Phytoscop.:* margin heading. *Caulis definiente Jungio:* Jung's definition of a stem.

In the glossary at the beginning of *Historia Plantarum,* Ray again gives Jung's definition but he precedes it with a short definition of his own:

> *Caulis est quod supra terram simplex assurgit, unde folia frondesque seu ramusculi emicant.*[327]

Line 3. *caudex [Stipes, truncus] in fistulosis calamus, in frumentis culmus dicitur:* various names for the stem:

in trees - *caudex* or trunk, *stipes* or stipe, *truncus* or bole.

in pipe-like plants - *calamus* or reed.

in corn - *culmus* or culm.

Malpighi has a similar list:

> *Variis insignitur nominibus; caudex enim, stipes, & truncus, dum in arboribus, caulis autem in herbis, speciatim vero in fistuloris calamus appellatur, scapus in leguminibus, & culmus in frumentis vocitatur.*[328]

It is interesting to note that Ray considers to be worthy of inclusion in his glossary at the beginning of *Historia Plantarum* only the last three from this list:

> *Truncus caudex arboris ramis & frondibus destitutus.*
>
> *Culmus, frumenti (aut etiam Garminis) calamus a radice ad spicam,* ***The blade of any Corn or Grass.***[329]

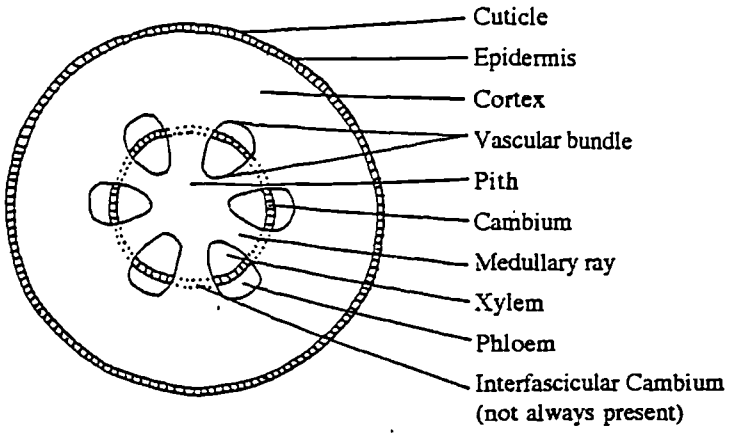
327 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

328 Malpighi, *Anatome Plantarum:* 1.

329 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

Line 7. *Caulis partes sunt Cortex, Lignum, aut in Herbaceis pars ligno respondens, & Medulla:* here Ray gives the parts of the stem*: cortex, lignum* and *medulla*[330].

Diagram of a basic stem:[331]



The internal structure of the stem is relatively constant with only a few variations. In cross section there is a clearly visible outer layer of thickened cells forming a protective impermeable skin. Roots do not have such a skin, as one of their functions is the absorption of water. Below this skin is often a series of cords of flexible strengthening tissue, with directly beneath this the vascular conducting tissue, the xylem and the phloem, which, instead of occurring in a central core as in the root, has spread out into a series of peripheral 'bundles' each consisting of the xylem or water-transporting tissue and the phloem or food-conducting tissue. The central part of the stem is usually occupied by undifferentiated ground tissue., the parenchyma.[332]

Ray seems in this chapter mainly to be using as his example of a stem a woody stem not an herbaceous stem. A woody stem, although it may start life like those described above, contains within it elements of a different growth pattern, which alters the

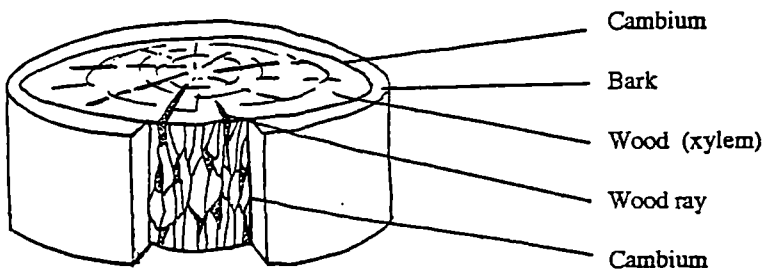
330 Malpighi has a section *De partibus Caulem vel Caudicem componentibus* ['on the parts comprising the stem or trunk']; *Anatome Plantarum:* 6-17.

331 Drawn from Cooke, Burkitt and Barker: 153.

332 Gibbons: 35.

whole character of the stem; this is known as secondary thickening. In the *Quercus* or Oak tree, for example, the trunk consists of an outer corky protective bark, a thin layer of phloem and associated tissues just below the bark, and then the mass of the trunk from here to the centre is composed of heavily lignified xylem vessels laid down in annual rings. here and there a 'ray' of unlignified tissue runs across the trunk from the centre to the edge, and there are occasional 'knots' of xylem and phloem running at an angle, where a branch begins to emerge.[333]

Diagram of a woody stem:[334]



Line 8. *Cortex est* ..... : Ray is using the term cortex here for the bark or outer layer of the trunk or stem. He defines it as being made up of *cuticula* and *substantia interior.*

Bark is the term used for all the tissues lying outside the vascular cambium in the stems of plants showing secondary growth: i.e. the primary and secondary phloem, the cortex, and the periderm. The term is also used as Ray seems to describe it in line 25 for the tissue arising on the outer side of the phellogen or cork cambium.[335]

Malpighi describes the cortex thus:

> *Exterius itaque hoc involucrum, quo quasi corio Natura utitur ad contegendam totius plantæ peripheriam, Cortex dicitur.*[336]

333 Gibbons: 36.
334 Drawn from Gibbons: 36.
335 *Penguin Dictionary of Botany:* 38.
336 Malpighi, *Anatome Plantarum:* 1.

Line 10. *Cuticula: margin heading.* He correctly describes the drier epidermis of the stem. In woody stems the epidermis is replaced by the phellem.

Line 12. *ut in Betula, Cerasis, Pomisque præcipue observatur Malpigh.:* Malpighi begins his *Anatomy* with a discussion on the structure of the cortex;[337] his work on the cortex is summarized here by Ray. The examples given here seem to be Ray's not Malpighi's.

Line 12. *Betulã: Betula.*

[C.T.& M. 313-314] *Betula* (L.), Birch; a genus of the *Betulaceæ* or Birch family.

B.& G.-W. 54: B.& H. 404: Linn.*Sp.Pl.* 982:
Syn.Meth.St.Br. 443*: H.P.* 1410: *H.P.III D.* 12: *Tri.* 15.14:
Cat.Angl. 40: *Camb.* 48.

H.P. 1410:

De Betula omnium Autorum. ***The Birch Tree.***

H.P.III D 12:

2 additional species given.

Tri. 15.14:

A Birch-tree: *Betula, -æ,* f.: *Σημύδα, -ας,* f.

Line 12. *Cerasis: Cerasus.*

[C.T.& M. 232] *Cerasus* ([Miller] Focke), Cherry; a subgenus of the *Prunus* genus of the *Rosaceæ* or Rose family.

B.& G.-W. 198: B.& H. 129: Linn.*Sp.Pl.* 474:
Syn.Meth.St.Br. 463: *H.P.* 1537-1538: *H.P.III D* 45: *Tri.* 15.20:
Cat.Angl. 61-62: *Camb.* - no ref.

337 Malpighi, *Anatome Plantarum:* 5.

H.P. 1537-1538:

8 species given, including:

Cerasa sativa rotunda, rubra & acida, quæ nostris Cerasa sativa

C.B. *Cerasa rubella* J.B. *Cerasus Anglica* Park. *vulgaris* Ger.

The Common English Cherry-tree.

H.P.III D 45:

17 additional species given.

Tri. 15.20:

A Cherry-tree: *Cerasus, -i*, f.: Κέρασος, -άσου, f.

Line 12. *Pomisque: Pomum.*

[C.T.& M. 244] *Malus* (Miller), Apple; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 192: B.& H. 146: Linn.*Sp.Pl.* 479:

Syn.Meth.St.Br. 451-452: *H.P.* 1445: *H.P.III* 352:

Tri. 15. 3/18.92: *Cat.Angl.* - no ref.: *Camb.* 83.

H.P. 1445:

De Malo sativa. The Apple-tree.

He then goes on to list many types of apple grown in England:

1. 21 species which will not keep for long.
2. 6 species which are peculiar to certain areas.
3. 31 species which will keep well.
4. 20 species suitable for making cider.
5. The Crab-apple or Wilding.

H.P.III 352:

Pomum amoris only: 321 additional species given.

Tri. 15.3:

An Apple: Pomum, -i, f.: Μῆλον, –ου, n.

Tri. 18.92:

An Apple: Pomum, -i, n.: Μῆλον, -ου, n.[338]

Line 13. *Corticis substantia interior constat*: Ray is here describing the bark of a woody stem. He gives a definition of cortex in the glossary to *Historia Plantarum:*

> *Cortex, exterior arboris quasi crusta,* ***The bark of a Tree or other plant.*** *Interior tunica ipsi ligno adhærens Liber dicitur. Cortex autem a corium & tego, quia quasi corium tegit, ut Isidorus ἐτυμολογίζει.*[339]

Bark is the area of a stem lying outside the vascular cambium in the stems and roots of plants which show secondary growth (woody stems). The bark consists of the primary and secondary phloem, the cortex, and the periderm.[340]

Line 13. *Ex fibrarum lignearum:* Ray describes the layers of the bark as being like the layers of an onion. In some trees the same phellogen or cork cambium is active each year but in most species a new phellogen arises annually in the cortex below; the bark thus consists of both phellem (cork) and phelloderm (secondary cortex) and is termed rhytidome. As the thickness of the bark increases the outer layer may become either fissured (as in the Elm) or be shed as scales (as in the Plane) or rings (as in the Birch). Thus there is the appearance of layers in the bark.[341]

Ray has again taken this material from Malpighi, who describes the layers beneath the cuticle in similar fashion.

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338 N.B. In *Trilingue* the first in Latin is feminine and the second neuter, i.e. the fruit and the tree.

339 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

340 *Penguin Dictionary of Botany:* 38.

341 *ibid.*

Another term, *liber*, used for the inner bark of a tree, because of its similarity to the pages of a book, is described by Ray in his glossary at the beginning of *Historia Plantarum:*

> *Liber, interior tunica arboris ipsi ligno adhærens. Jun. Unde Liber adhuc dicitur, in quo scribitur ex quacunque fiat materia, quia ante repertum chartæ vel membranæ usum de libris arborum volumina compaginabantur.*
> ***The innermost bark of a Tree.***[342]

Line 14. *Cepæ: Cepa:* see above Cap.3, line 12.

Line 14. *Ex utriculis seu sacculis subrotundis ....:* Ray is here describing the phelloderm or secondary cortex, which is derived from the phellogen. Cells of the phelloderm can be distinguished from those of the cortex by their arrangement in radial columns *(radiorum instar*), which shows their derivation from the phellogen.[343]

Line 16. *ex vasis peculiaribus:* presumably Ray is referring to the secondary phloem of the bark here.

Line 18. *D. Grew. substantiam corticis interiorem in vasa & parenchyma primo distinguit:* Grew correctly identified the tissues now known as phelloderm, secondary xylem and secondary phloem.

Line 18. *parenchyma vocat utriculos:* the phelloderm or secondary cortex: see above Cap.4, line 15.

Line 19. *Vasa dividit in lympham deferentia ..... :* Grew says that the vessels of the bark carry *lympha* and are of two kinds: the

342 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

343 *Penguin Dictionary of Botany:* 269.

secondary xylem and the secondary phloem. Both consist of two systems as Grew states: the axial (vertical) system and the ray (horizontal) system, consisting mainly of ray parenchyma, forming the cross rays, as Ray describes above in Section 2, line 14.[344]

Line 22. *succum plantæ proprium & specificum continentia*: he is referring to vessels such as the resin canals in conifers. Resin is a mixture of polymerised acids, esters and terpenoids, exuded by some plants especially when wounded. They are insoluble in water but soluble in ethanol. Resin canals are longitudinal channels in the secondary xylem of woody stems.[345]

Line 22. *Abiete: Abies.*

[C.T.& M. 26] *Abies* (Miller), Fir; a genus of the *Coniferæ* or Pine family.

B.& G.-W. 40: B.& H. 416: Linn.*Sp.Pl.* 1000-1002:
Syn.Meth.St.Br. 441: *H.P. fœmina* 1394, *mas* 1396: *H.P.III* D 8:
Tri. 16.35: *Cat.Angl.* 1: *Camb.* - no ref.

H.P. 1394, 1396:

4 species given, including:

Abies Park. *Abies fœmina sive* Ἐλάτη θήλεια J.B. *Abies mas conis sursum spectantibus* C.B.

The Yew-leaved Firr-tree, *Abies Taxi foliis.*

Abies mas Theophr. *Picea Latinorum sive Abies mas Theophr.* J.B. *Picea major* Ger. *Picea major prima sive Abies rubra* C.B.

The Common Firr-tree, or ***Pitch-tree.*** *Abies conis deorsum spectantibus.*

H.P.III D 8:

He gives several additional species and voices his doubts on

344 *Penguin Dictionary of Botany:* 323.
345 *ibid.:* 311-312.

species given by other scholars.

Tri. 16.35:

A Fir-tree: *Abies, -ietis*, f.: *Ἐλάτη, -ης*, f.

Line 23. *Pinu: Pinus.*

[C.T.& M. 28-29] *Pinus* (L.), Pine; a genus of the *Pinaceæ* or Pine family.

B.& G.-W. 40-44: B.& H. 416: Linn.*Sp.Pl.* 1000-1002:

Syn.Meth.St.Br. 442: *H.P.* 1398-1399: *H.P.III D* 8: *Tri.* 17.65:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 1398-1399:

9 species given, including:

Pinus sylvestris C.B. *Pinus sylv. vulgaris Genevensis & Tæda* J.B. *An Pinaster Austriacus major, albus & niger* eijusdem? *Item Pinaster, sive Pinus sylv. Hispanicus major* Clus? J.B? i.e. *Pinus maritime altera* C.B? *Pinus sylv. Mugo* Ger. ico.

The Mountain Pine.

H.P.III D 8:

8 additional species given.

Tri. 17.65:

A Pine-tree: *Pinus, -us*, f.: *Πίτυς, -υος*, f.

Line 23. *Prunis: Prunus.*

[C.T.& M.] *Prunus* (L.), the Plum; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 198: B.& H. 129: Linn.*Sp.Pl.* 473:

Syn.Meth.St.Br. 462-463: *H.P.* 1526-1530: *H.P.III D* 40:

Tri. 17.67: *Cat.Angl.* 243-244: *Camb.* - no ref.

H.P. 1526-1530:

14 species given, including:

H.P.Prunus sativa C.B. ***The Plum-tree.***

H.P.III D 40:

21 additional species given.

Tri. 17.67:

A Plum-tree: *Prunus -i*, f.: *Κοκκυμηλέα, -ας*, f.

Line 23. *Cerasis: Cerasus:* see above Cap.4, line 12.

Line 23. *Tithymalo: Tithymalus.*

[C.T.& M. 296-300] *Euphorbia* (L.), Spurge; a genus of the *Euphorbiaceæ* or Spurge family.

B.& G.-W. 232-234: B.& H. 391: Linn.*Sp.Pl.* 450-463:

Syn.Meth.St.Br. 312-313: *H.P.* 863-864: *H.P.III* 428-429:

Tri. 13.184: *Cat.Angl.* 286-287: *Camb.* 117.

H.P. 863-864:

44 species given, including:

Tithymalus Chariacas Amygdaloides C.B. Ger.emac. *Chariacas vulgaris* Park. *Tithymalus sylvaticus toto anno folia retinens* J.B. ***Wood Spurge.***

H.P.III 428-429:

59 additional species given.

Tri. 13. 184.

Spurge: *Tithymalus, -i*, m: *Τιθύμαλλος, -άλλου*, m.

Line 25. *Fibræ ligneæ, seu Vasa lympham deferentia:margin heading. Fibræ ligneæ, describente Clariss. Malpighio, sunt tubulosa corpora, subingredientibus liquoribus pervia, ... unde reticularia quæ diximus involucra, quibus lignum ambitur.*

Ray here cites Malpighi, who is describing the secondary xylem. This is derived from the vascular cambium in plants showing

secondary growth. Secondary xylem consists of two systems: the axial (vertical) system, consisting mainly of tracheary elements and fibres: and the ray (horizontal) system, consisting mainly of ray parenchyma forming the rays.[346] He describes these fibres as carrying liquids from below; the xylem transports water and dissolved salts from the roots. He says that these fibres are not arranged in straight lines; he had noticed, without completely differentiating them, the axial and ray systems of the secondary xylem.

This is almost a direct quotation from the section of Malpighi, where he says:

> *Sunt autem tubulosa corpora subingredientibus liquoribus pervia ..... unde tot delineata reticularia involucra, quibus lignum ambitur.*[347]

Ray, himself, gives a simpler definition of fibres in his glossary at the beginning of *HistoriaPlantarum:*

> *Fibræ sunt veluti stamina rebus nonnullis intertexta, v.g. ligno, foliis &c. sic fibras ligneas vocamus corpora seu filamenta in longum extensa, ex quibus maximam partem lignum componitur, vid. lib.1. cap.8.*[348]

Line 29. *Fibras hasce Lymphæ-ductus seu vasa lympham deferentia appellat D.Grevius:* Grew calls the *fibræ ligneæ* lymph ducts (*lymphæ-ductus*) or lymph-bearing vessels (*Vasa lympham deferentia*).

Line 31. *Plexus hi fibrarum retiformes:* see the note on *retemirabile* and πλέγμα δικτυοειδές above at Cap.3, line 148.

346 *Penguin Dictionary of Botany:* 323.
347 Malpighi, *Anatome Plantarum:* 4-5.
348 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

Line 32. *Rapæ:Rapa:* see above Cap.3, line 18.

Line 34. *Utriculi seu Parenchyma corticis: margin heading.* For the phelloderm see above Cap.4, line 15.

Line 36. *utriculos corticales in radios diametrales rarius disponi: quo a radicis corticis parenchymate differunt.* Does Grew mean that there are fewer radii visible or that they are more random? He seems to be confusing the main cortex of the stem and the secondary cortex of the bark of a stem. In fact the radii are more visible generally in the stem, where the vascular bundle is spaced out, than in the root, where it is centrally placed and closely packed so that there cannot be any visible diagonal spaces between. Is Ray mis-quoting Grew here? Should the text read *non rarius?*

Line 38. *verba sunt Malpighii:* Ray says that he is quoting directly from Malpighi but he is rather paraphrasing and abridging a section of Malpighi's chapter on the cortex.[349] [350]

Line 45. *Vasa succifera:* margin heading. Ray is here describing the resin canals of the secondary xylem. He does not differentiate at any point between the secondary xylem and the secondary phloem. For resin canals see above Cap.4, line 22.

Line 45. *Vasa succum plantae proprium & specificum ....:* he gives here various examples of plants with saps of varying characteristics: *Abies* with resin, *Tithymalus* with milky latex and *Lactuca* also with milky latex.

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349 Malpighi, *Anatome Plantarum:* 3.

350 The phrase referring to 'horizontal rows of hanging *utriculi*' is a frequently recurring one in Malpighi's work: see, for example, *Anatome Plantarum:* 12.

Line 46. *Abiete: Abies:* see above Cap.4, line 22.

Line 46. *Tithymalo: Tithymalus*: see above Cap.4, line 23.

Line 46. *Lactucaceis: Lactuca.*

[C.T.& M. 495-499] *Lactuca* (L.), Lettuce; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 434: B.& H. 260: Linn.*Sp.Pl.* 795-796: *Syn.Meth.St.Br.* 161-162: *H.P.* 220: *H.P.III* 135: *Tri.* 11.105: *Cat.Angl.* 177-178: *Camb.* 77-78.

H.P. 220:

7 species given, including:

Lactuca sativa C.B. Ger. *sativa non capitata* J.B.

Garden Lettuce.

H.P.III 135:

9 additional species given.

Tri. 11.105:

Lettuce: *Lactuca, -æ,* f.: *Θρίδαξ, –ακος,* f.

Line 48. *Succi hujus (inquit Malpighius) varia est natura .....* : Malpighi on varying types of sap.

Line 50. *Hic succus, in singulas partes delatus, roris instar affunditur, & concrescendo ipsas auget, & ad debitam magnitudinem perducit.*

This does not seem to be an actual quotation from Malpighi, although it is in italics in the text as though it were a direct quotation, but I have been unable to trace it. It does, however, convey the theme of Malpighi's arguments on page 12 of his *Anatome Plantarum.*[351]

351 Malpighi, *Anatome Plantarum:* 12.

Line 52. *Videtur ergo respondere sanguini animalium*; comparison with the blood of animals. Ray does not agree wholeheartedly with Malpighi that the sap carries the food of the plant; water and nutrients are carried in the vascular system of a plant. In non-woody plants the primary phloem is the only food-conducting tissue, whereas in plants exhibiting secondary growth this function is usually performed by the secondary phloem.[352] Malpighi believes that it seems to correspond to the blood of animals, which he thinks is changed into the constituent parts of the body.[353] Blood in animals is a fluid circulated through the body by muscular activity and usually containing respiratory pigments containing oxygen, food materials, excretory products, cells which produce antibodies (lymphocytes), and cells which invade tissue to attack invading organisms.[354]

Line 52. *quamvis (ut verum fatear) sententiæ D.Malpighii, nimirum ..... non penitus acquiesco:* Ray disagrees with Malpighi here, where he quotes Malpighi's belief that the sap is the complete food of the plant:[355]

> *Probabile igitur est, succum, qui per fibras ligneas sursum fertur, per caulem & caudicem, appensosque ramos, in utriculorum laterales & continuatas appendices sensim exonerari, ibique diuturniori intercedente mora in nutritivum succum evehi.*

Line 54. *Esse eum Quintessentiam .....*: Ray agrees that this sap or resin varies from plant to plant, and gives each its own

352 *Penguin Dictionary of Botany:* 292.
353 Malpighi, *Anatome Plantarum:* 13.
354 *Oxford Dictionary of Natural History:* 83.
355 Malpighi, *Anatome Plantarum:* 13; see also *ibid.:* 5.

characteristics.[356] For Ray's examples of characteristic saps see above Cap.4, line 46.

Line 56. *Vasa aerem deferentia nulla in cortice observantur:* Ray refers to Malpighi's statement that no air-carrying vessels are visible in the cortex 'until it becomes woody'; air is only carried round a plant by liquid diffusion.[357] See below Cap.4, line 59.

Line 57. *& sola conversione corticis in ligneam naturam manifestantur & patent, ut loquitur Malpighius:* Malpighi is quoted here as saying that the tracheids are only visible in a woody cortex.[358]

Line 59. *De ligno:* margin heading. Ray now goes on to discuss the *lignum*, which he says is composed of the same parts and arranged in the same way as in the cortex. The *lignum* or xylem is vascular tissue whose main function is the upward transmission of water and solutes. It is composed mainly of vessels, tracheids, fibre-tracheids, libriform fibres and parenchyma cells. All of these cell types may not be present in any one wood sample.[359]

Ray is correct in his definition of the wood or xylem:

1. *fibris ligneis fistulosis:* the woody fibres of the xylem are spindle-shaped lignified cells, which lose their protoplasmic contents and have thick walls. The wood fibres have a mechanical function only, and do not serve to conduct water.[360]
2. *utriculis:* this is the xylem parenchyma, which occurs between the vessels and the wood fibres; it consists of fairly thick-walled rectangular cells which have protoplasmic contents, and

356 This is taken from Malpighi, *Anatome Plantarum:* 11.
357 *Penguin Dictionary of Botany:* 105.
358 Malpighi, *Anatome Plantarum:* 14-15.
359 *Penguin Dictionary of Botany:* 384.
360 Cooke, Burkitt and Barker: 157.

frequently contain starch grains. These cells act as storage and packing tissue.[361]

3. *Vasis succum specificum deferentibus:* here he is referring to the primary phloem, which in non-woody plants carries food around the plant, and sometimes does so in woody plants. He may, however, be referring to the vessels among the conducting cells, which are the main water-transporting cells of plants. A vessel is not a single cell, but is formed from a row of cylindrical cells, the cavities of which have become continuous by the disappearance of the transverse walls; these are visible as rings encircling the vessel at intervals.[362]
4. Ray has a fourth category here: *peculiari insuper vasis genere æri derivando destinato, & animalium tracheæ & pulmonibus respondenti.* He believes that plants have an organ corresponding to the throat and lungs of animals. Presumably he is referring to the tracheids among the conducting cells; a tracheid is a single cell which is long and spindle-shaped.[363] Tracheids acquired their names because they were once assumed to be the air-carrying passages of plants [from Greek τραχεῖα, Latin *trachia*].[364] Plants do not have vessels which carry solely air; air is transported round a plant through the xylem of the vascular system. Oxygen in the soil passes into the plant by

361 Cooke, Burkitt and Barker: 157.

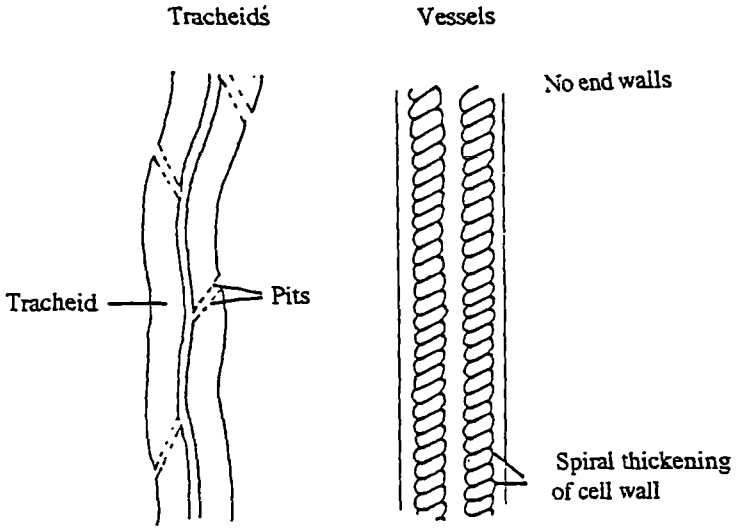
362 *Penguin Dictionary of Botany:* 379.

363 *Oxford Dictionary of Natural History:* 412; *Penguin Dictionary of Botany:* 363; Cooke, Burkitt and Barker: 157.

364 NB The derivation of this word is somewhat confusing; OED gives the derivation as:
med.L., = late L. *trachia* - Gr. τραχεῖα (fem. of τραχύς, 'rough'), short for ἀρτηρία τραχεῖα 'rough artery', in med. L. *arteria trachea.*
Lewis and Short [p.1882] gives the Latin as *trachia;* Liddell and Scott do not give τραχεῖα as a noun, but, as in OED, as the feminine of τραχύς, 'rough'. It presumably came to be a noun, minus ἀρτηρία, in later Hellenistic Greek; the classical Greek for 'throat' or 'neck' is τράχηλος [Liddell and Scott: 1811] and the modern Greek is, as in mediæval times, τραχεῖα [*Oxford Dictionary of Modern Greek:* 193].

liquid diffusion through the root hairs and through the stomata and lenticels above ground.[365]

Cell types in the xylem:[366]



Line 63. *iisdem enim (ut Malpighii verbis utar) componuntur minimis vacuisque orbiculis, invicem hiantibus, & consimilimem amittunt succum.* Ray is quoting Malpighi directly here.[367]

For a definition of wood-fibres see Cap.4, line 59 above.

Text page 7.

Line 68. *Præcipua autem & potior trunci caulisve portio ligneis hisce fistulis constat.* He is right here in that the greater part of a woody stem consists of heavily lignified xylem vessels laid down in annual rings.[368]

Line 70. *Vide Malpighii & Grevii Plantarum & Truncorum Anatamen:* Ray refers to both Malpighi and Grew here and to their works on the *Anatomy of Plants and Trunks*.[369]

365 *Penguin Dictionary of Botany:* 105.
366 *Longman Dictionary of Botany:* 107.
367 Malpighi, *Anatome Plantarum:* 11.
368 Gibbons: 36.
369 Throughout his section on the cortex, Malpighi mentions various different sizes of woody fibres: Malpighi, *Anatome Plantarum:* 1-6, especially on page 4.

Line 72. *Inter ligneas fibras anastomosis intercedere ..... probat Malpighius, Anat. Plant. p.11.* Malpighi says that anastomosis occurs between woody fibres in the same way as between the branches of the veins of animals; one of the few occasions when Ray gives an actual 'chapter and verse' reference.[370]

Line 74. *Utriculi in radios diametrales fibras ....:* he is referring here to the medullary rays, which are parenchymatic cells of unlignified tissue extending from the medulla (pith) between the vascular bundles.[371] Annual rings in woody tissue are the layers of secondary xylem added to the wood of a plant in a single year.[372] They contain radial lines of parenchymatic cells, which are limited in extent by the thickness of a particular year's annual ring, and so, as Ray says, they do not all necessarily extend diagonally throughout a stem.
Again this section is taken from Malpighi, who says, for example:

> *Transversales utriculorum ordines, a cortice emanentes, per ligneas fibras producti interius in medullam exonerantur, unde eadem natura in utrisque reperitur.*[373]

Line 77. *In fruticibus (observante Malpighio) ..... & in ipsum laxantur;* Malpighi believes that in stems,which are not especially woody, these rays of utriculi do extend right across from cortex to medulla or pith. Apart from the omission of *est* after *medulla ampla* this is a direct quotation from Malpighi.[374]

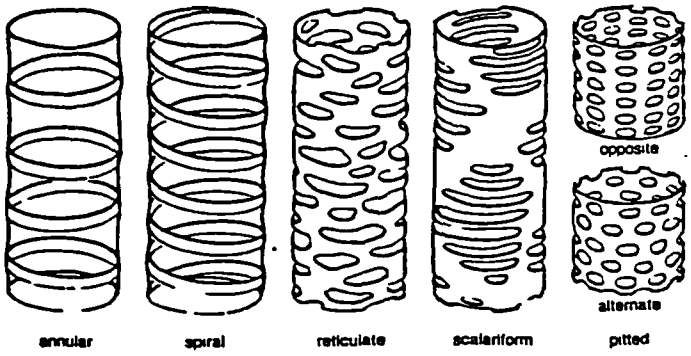
Line 85. *in tot circulos disponuntur ..... :* growth rings in woody stems

370 Malpighi, *Anatome Plantarum:* 11.
371 *Lowson's Botany:* 90-91; *Penguin Dictionary of Botany:* 223; Cooke, Burkitt and Barker: 154.
372 Gibbons: 61.
373 Malpighi, *Anatome Plantarum:* 12.
374 *ibid.:* 12, second paragraph.

are the result of the renewed activity of the vascular cambium each spring and appear as rings of secondary xylem in the stem.[375] For secondary xylem see above Cap.4, line 25.

Line 87. *angustiora duntaxat ob fibrarum lignearum undique circumstantium pressuram reddita:* Ray believes that the variations in the thickness of tree rings is due to variations in the *'pressure of the woody fibres'*; the growth check, which causes varying thickness, is now thought to be due to temperature or water stress or both.[376]

Line 89. *Tracheae:* margin heading. The description here fits that of tracheids, but they do not, as thought in Ray's time, transport air. Tracheids are tube-like series of non-living cells in the xylem of a plant, supplying mechanical support and involved in the transport of water and salts.[377] They are formed by the coalescence of a series of cells with the disappearance of the partitions between them. Xylem sap passes from one tracheid to the next through pits in the cell walls.[378] Tracheids show various types of secondary wall thickening; see diagram below:[379]



Ray, Malpighi and Grew had noticed the spiral shape of tracheids.

375 *Lowson's Botany:* 99; *Oxford Dictionary of Botany:* 414-415.
376 *ibid.:* 414.
377 *Oxford Dictionary of Natural History:* 641.
378 *Oxford Dictionary of Botany:* 412; *Penguin Dictionary of Botany:* 363.
379 Taken from the *Penguin Dictionary of Botany:* 362.

Line 89. *quæ fistulas spirales & tracheas appellat Malpighius:* Malpighi gives the name *fistulae spirales* (spiral pipes) and *tracheae* [now 'tracheid] to the vessels he believes carry air around the plant.

These lie between the fibrous and fistulose bundles of the wood and are fewer in number but larger than the other bundles of tubes, 'so that in cross section they appear with open orifices. They lie in different positions, but the majority in concentric circles'.[380]

Sachs comments that 'Grew in the introduction to his book expressly concedes the priority in this discovery to Malpighi'.[381]

Malpighi states that:

> *hæ tubulosa sunt & subrotunda, identidem tamen angustantur, & perpetuo patent, nullumque, ut observare potui, effundunt humorem: Argentea lamina, in spiram contorta, componuntur, ut facile laceratione, (velut in bombycinis tracheis expertus sum,) in hanc oblongam & continuatam fasciam resolvantur. Lamina hæc, si ulterius microscopio lustretur, particulis squamatim componitur; quod etiam in tracheis insectorum deprehenditur. Spiralibus hisce vasculis, seu ut verius loquar, tracheis, ligneæ fibræ adstant, quæ secundum longitudinem productæ, ad majorem firmitudinem & robur, transversalium utriculorum ordines superequitant, ita ut fiat veluti storea.*[382]

Line 92. *Lamina hæc (observante Grevio) e multis fibris teretibus collateraliter ..... velut subtegmine contextis constat:* Grew here describes the long band made by unwinding the tracheid as being like a ribbon,

380 Malpighi, *Anatome Plantarum*: 14-15; translated here by Sachs: 236.
381 Sachs: 236.
382 Malpighi, *Anatome Plantarum*: 8.
See also *ibid.*: 14.

with long warp threads and short weft threads. Sachs explains this strange idea,

> of a spiral vessel as it appeared to Grew, we ought to know that he thinks that all cell-walls, even those of the parenchyma, are composed of an extremely fine web; ..... he hints at this on pages 76 and 77, and on page 120 he returns once more to this conception and dwells upon it at great length.[383]

Grew, in fact, goes on to say 'that the spiral band is not always single, but that two or more bands entirely separate from one another may form the wall of the vessel, and also' as cited here by Ray, 'that the spiral thread is not flat but roundish like a wire, and its turns are more or less close together according to the part of the plant'.[384]

Line 95. *quandoque invicem hiant:* does he mean that they open one after the other to propel water, or that they are, as seems more likely, in alternate positions? See diagram above, Cap.4, line 59, of a tracheid, for this alternate positioning of the pits in the walls of tracheids.

Line 97. *D. Malpighius Naturam in Insectis & Plantis ...:* Malpighi believes that the *tracheae* of plants and insects are similar. He says that:

> *Trachearum ..... tubos & vesiculas, persimiles insectorum pulmonibus, varie componit.*[385]

See also the passage from *Anatome Plantarum*, page 8, quoted in the notes for line 89 above.

Trachea is the term given to each of the tubes making up the

383 Sachs: 242.
384 Nehemiah Grew, *The Anatomy of Plants*, 1682; this reference from Sachs: 241.
385 Malpighi, *Anatome Plantarum*: 14.

Line 145. *Malo: Malus.*

[C.T.& M. 244] *Malus* (Miller), Apple; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 192: B.& H. 146: Linn.*Sp.Pl.* 479:

Syn.Meth.St.Br. 451-452: *H.P.* 1445-1450: *H.P.III D* 17:

Tri. 15.2: *Cat.Angl.* 196-197: *Camb.* 83.

H.P. 1445-1450:

7 species given:

De Malo sativa ***The Apple-tree.***

Ray then lists 21 species of English apple, 6 peculiar to certain areas, 31 winter apples which keep well, 20 suitable for making cider, and 4 species of Crab Apple or Wilding.

H.P.III D 17:

1 additional species given.

Tri. 15.2:

An Apple-tree: *Malus, -i,* f.: *Μηλέα, -ας,* f.

Line 145. *Pyro: Pyrus.*

[C.T. & M. 243-244] *Pyrus* (L.), Pear; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 192: B.& H. 145: Linn.*Sp.Pl.* 479-480:

Syn.Meth.St.Br. 452: *H.P.* 1450-1452: *H.P.III* - no ref.:

Tri. 17.64 / *Tri.* 18.93: *Cat.Angl.* 247: *Camb.* - no ref.

H.P. 1450-1452:

De Pyro Angl. ***The Pear-tree.***

Ray then lists 19 species which can be trained to grow on walls, 30 species which can be eaten when freshly picked, 8 suitable for cooking and 4 for making wine.

Tri. 17.64:

A Pear-tree: *Pyrus, -i,* f.: *Ἄπιος, -ίου,* f.

Line 112. *Qua parte aer vasa haec subintret quaestio est:.....:* Ray refers to the observations of Malpighi and Grew here concerning plants' intake of air. They realised that water is taken in by the roots (in fact by the root hairs), but they were unsure about the existence of what we now call the stomata and lenticels above ground.

Line 113. *D. Malpighius se diu anxie quæsivisse scribit:..... tracheas subintrans ipsas replet & distendit.* Ray is virtually quoting Malpighi here, changing Malpighi's words into the third person and altering the word order slightly. Malpighi's begins:

Diu anxie quæsivi, an in foliis.....[390]

Also see entry immediately above.

Line 116. *Quare (ut conjectari licet) vapor seu respiratorius succus:* here Malpighi discusses the movement of respiratory sap across a stem;[391] is this an early attempt to describe osmosis?

Line 117. *Ligneæ autem fibræ ..... cum ligneæ fibræ Hederæ instar tracheas ambiant.* Again this is almost a direct quotation from Malpighi - from later in the same paragraph.[392]

Line 119. *Hederæ: Hedera.*

[C.T.& M. 277] *Hedera helix* (L.), Common Ivy; a species of the *Hedera* genus of the *Araliaceæ* or Ivy family.

B.& G.-W. 266: B.& H. 203: Linn.*Sp.Pl.* 202;

Syn.Meth.St.Br. 459: *H.P.*1505-1506: *H.P.III D* 36: *Tri.* 16.48: *Cat.Angl.* 154-157: *Camb.* 72.

H.P. 1505-1506:

Hedera communis major & minor J.B. *arborea* C.B. *item major*

390 Malpighi, *Anatome Plantarum*: 15, paragraph 2.
391 *ibid.*
392 *ibid.*

sterilis ejusdem. *Arborea sive scandens & corymbosa communis* Park. *item Hedera helix* ejusdem & Ger.

Climbing, or berried Ivy; also barren, or creeping Ivy.

H.P.III D 36:

6 additional species given.

Tri. 16.48:

Ivy: *Hedera, -æ,* f.: *Κίσσος, -ου,* f.

Line 119. *D. Grevius ærem omnium partium tam superficialium quam subterranearum poros subingredi statuit:* Grew believed that air entered a plant via pores above and below ground; see note above Cap.4, line 112.

Line 122. *cannæ Indicæ: Canna Indica.*

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn. *Sp.Pl.* 1193: *Syn.Meth.st.Br.* - no ref.: *H.P.* 1202: *H.P.III* - no ref.: *Tri.* - no ref. : *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1202:

Canna sive Arundo Indica, quibusdam flos Cancri J.B. *Canna Indica flore rubro & flore luteo punctato* Park. *Arundo florida* Ger. *Arundo Indica latifolia* C.B. *Meeru Brasiliensis* Marggr.

Line 123. *Pinuum: Pinus:* see above Cap.4, line 23.

Line 124. *Potissima tamen & quasi regia via ..... :* in the respiration of plants gaseous exchange is not the most important process, but precedes and succeeds tissue respiration, which is the main feature of respiration.[393] Grew believed that there could not be much absorption of air above ground as it would collide in its downward

393 Cooke, Burkitt and Barker: 213.

passage through the plant with air absorbed by the roots, which he considers to be the main access route for air *(potissima tamen & quasi regia via)*. Air is absorbed by liquid diffusion through the stomata and lenticels above ground and by the root hairs below.[394] *regia via:* an interesting term to emphasise the importance of this method of respiration; Ray also uses the term in Chapter 12 (lines 111-112) again for nutrition but this time in relation to the nutrition of the seed.

Line 132. *Hactenus D. Grevius, apud quem plura vide:* Ray here refers the reader to Grew's work on a plant's intake of air.

Line 133. *De Medulla:* margin heading. Ray gives here a fairly accurate description of the medulla or pith of a stem, which is formed of large parenchymatous cells, giving the stem its rigidity through the water pressure within them.[395]

Line 133. *Medulla, cordi & cerebro analoga olim credita .....:* this again is taken from Malpighi, who says:

> *Medullæ usus olim insignis, cordi & cerebro analogus credebatur .....*[396]

In his glossary to *Historia Plantarum*, Ray gives a brief definition of *medulla*, and refers the reader to this section of his work:

> *Medulla in Phytologia mediam cujuslibet plantæ partem molliorem & spongiosam significat, quam & Cor matricemve appellant, cujus descriptionem pleniorem vide lib.1. cap.4. p.7.*[397]

394 *Penguin Dictionary of Botany:* 105.
395 *ibid.:* 280.
396 Malpighi,*Anatome Plantarum:* 13.
397 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

NB The comparable Greek term μυελός, 'marrow', is used by Greek medical writers for the brain tissue: cf. Galen, *de Usu Partium* 8.4.[398]

Line 138. *Nam utriculorum ordines a cortice emanantes (ut D. Malpighii verbis utar) per ligneas fibras producti ..... in medullam terminantur, unde eadem natura in utrisque [corticalibus & medullaribus utriculis] reperitur:* Ray again quotes Malpighi here, when he says that the *medulla* or pith and what he calls the cortex (his area between the woody fibres) have a similar structure and continuity, although he omits a few words and qualifies Malpighi's text with his own additions. Malpighi's text is given below (with the changes and omissions in both underlined):

> *Transversales utriculorum ordines, a cortice emanantes, per ligneas fibras producti interius in medullam exonerantur, unde eadem natura in utrisque reperitur.*[399]

The medullary rays can extend from the pith right across a stem.

Text page 8

Line 143. *Medullae magnitudo in variis plantis varia est:* Ray is correct here in stating that the cells of the pith vary in size and quantity from one plant to another.

Line 143. *in Absinthio v.g. Rhoe, Ficu, Oxyacantha (observante D. Grevio) amplissima:* Ray adds evidence for this variation in size from Grew; he gives first the largest as exemplified here.

Line 143. *Absinthio: Absinthium.*

[C.T.& M. 478] *Artemisia absinthium* (L.), Wormwood; a species

398 Galen, *de Usu Partium*, edited by G. Helmreich, Leipzig 1907-1909.
399 Malpighi, *Anatome Plantarum:* 12, paragraph 2.

of the *Artemisia* genus of the *Compositæ* or Daisy family.

B.& G.-W. 412: B.& H.242: Linn.*Sp.Pl.* 844-849:

Syn.Meth.St.Br. 188-189: *H.P.* 366-370: *H.P.III* 231: *Tri.* 14.210:

Cat.Angl. 2-4: *Camb.* 37.

H.P. 366-370:

17 species given, including:

Absinthium vulgare Park. Lob. vulgare majus J.B. latifolium sive Ponticum Ger. *Ponticum seu Romanum Officinarum seu Dioscoridis* C.B. ***Common Wormwood.***

H.P.III 231:

14 additional species given.

Tri. 14.210:

Wormwood: *Absinthium, -ii,* n.: *Ἀψίνθιον, -ίου,* n.

Line 143. *Rhœ: Rhoe:* the identification of this plant is uncertain.

Could Ray mean *Rhœo*, a tender perennial herb, which is a genus of the *Commelinaceæ* family?

Rhœo spathacea (=Rhœo discolor), the Boat Lily, from the West Indies and Central America.

An alternative possibility is *Papaver rhoeas*, the Field Poppy, which at least has the advantage that it would have been known to Ray and to Grew, whose example this appears to be.

[C.T.& M.57] *Papaver rhœas* (L.), Field Poppy, a species of the *Papaver* genus of the *Papaveraceæ* or Poppy family.

C.T.& M. 57: B.& G.-W. 124: B.& H. 18: Linn.*Sp.Pl.* 507:

Syn.Meth.St.Br. 308: *H.P.* 855: *H.P.III.* - no ref.:

Tri. - no ref. to *rhœas*: *Cat.Angl.* 221 : *Camb.* 91.

This species is given *Rhœas* as an alternative name in Ray's *Synopsis* 308:

Papaver lacinato folio, capitulo breviore glabro annuum, Rhœas dictum. Papaver rhœas Ger. 299. *erraticum rhœas sive sylvestre*

Park.367. *erraticum rubrum campestre* J.B.III. 395. *erraticum majus* Ῥοιάς *Dioscor. Theophr. & Plinio*[400] C.B.Pin. 171. *Flos antipleuriticus* Cat.Ald. ***Red Poppy or Corn Rose.***

H.P. 855:

Papaver rhœas Ger. *erraticum rhœas sive sylvestre* Park. *erraticum rubrum campestre* J.B. *erraticum majus* Ῥοιάς *Diosc. Theophr. & Plinio.* C.B. ***Red Poppy or Corn-rose.***

Line 143. *Ficu: Ficus*

[C.T.& M. 312] *Ficus carica* (L.), Fig; a species of the *Ficus* genus of the *Moraceæ* or Mulberry family.

B.& G.-W. - no ref.: *Mac.Enc*, 444: B.& H. 399:

Linn.*Sp.Pl.* 1059: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1431-1439: *H.P.III D* 15: *Tri.* 16.33: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1431-1439:

18 species given, including:

Ficus J.B. Ger. *vulgaris* Park. *communis* C.B.

The common Fig-tree.

H.P.III D 15:

Ad cap. de Ficu Indica Europaeæ analoga: 14 additional species given.

Ad cap. de Ficu Indica, Tuna & Opuntia dicta: 8 additional species given.

Tri. 16.33:

A Fig-tree: *Ficus, -us*, f.: Συχὴ, -ῆς, f.

400 *Papaver rhœas* is referred to three times in Pliny, but none of his references can confirm that this is definitely the plant indicated here by Ray:
Pliny, *Historia Naturalis* XIX, liii: 169; Loeb edition V: 528.
ibid. XX, lxxvii: 204; Loeb edition VI: 118.
ibid. XXI, xciv: 165; Loeb edition VI: 278.

Line 143. *Oxyacanthã: Oxyacanthus.*

[C.T.& M. 54] *Berberis vulgaris* (L.), Barberry; a species of the *Berberis* genus of the *Berberidaceæ* or Barberry family.

B.& G.-W. 124: B.& H. 15: Linn.*Sp.Pl.* 330:

Syn.Meth.St.Br. 465: *H.P.* 1605: *H.P.III* - no ref.: *Tri.* 15.10: *Cat.Angl.* 220: *Camb.* 91.

H.P. 1605:

> *Oxyacanthus Galeni i. Berberis. Berberis dumetorum* C.B. *Berberis* Park. *Berberis vulgo, quae & Oxyacantha putata* J.B. *Spina acida sive Oxyacantha* Ger.
>
> ***The Barberry, or Pipperidge-bush.***

Tri. 15.10:

> A Barberry-bush: *Oxyacanthus, -i,* f.: *'Οξυάκανθα, –ας,* f.

Line 144. *in Pinu, Fraxino, Agrifolio, Juglande minor seu angustior fere duplo:* he now gives Grew's smaller or narrower pith cells, as exemplified in Pine, Ash, Holly and Walnut.

Line 144. *Pinu: Pinus:* see above Cap.4, line 23.

Line 144. *Fraxino: Fraxinus.*

[C.T.& M. 349-350] *Fraxinus excelsior* (L.), Ash; a species of the *Fraxinus* genus of the *Oleaceæ* or Olive family.

B.& G.-W. 302: B.& H. 297: Linn.*Sp.Pl.* 1057:

Syn.Meth.St.Br. 469: *H.P.* 1702: *H.P.III D* 95 (page actually numbered 97): *Tri.* 15.7: *Cat.Angl.* 113-114: *Camb.* 64.

H.P. 1702:

> *Fraxinus vulgatior* J.B. *excelsior* C.B. *vulgaris* Park.
>
> ***Common Ash-tree.***

H.P.III D 95:

Ad speciem 4tam nota:

Notes on places in Italy, where this species is to be found.

Tri. 15.7:

An Ash: *Fraxinus, -i,* f.: *Μελία, -ας,* f.

Line 144. *Agrifolio: Agrifolium.*

[C.T. & M. 181] *Ilex aquifolium* (L.), Holly; a species of the *Ilex* genus of the *Aquifoliaceæ* or Holly family.

B.& G.-W. 240: B.& H. 97: Linn.*Sp.Pl.* 125:

Syn.Meth.St.Br. 466: *H.P.* 1622: *H.P.III D* 71: *Tri.* 16.42:

Cat.Angl. 8-10: *Camb.* 39.

H.P. 1622:

Agrifolium Ger. *Agrifolium sive Aquifolium* Park. *Aquifolium sive Agrifolium vulgo* J.B. *Ilex V. sive aculeata baccifera folio sinuato* C.B. ***The Holly-tree.***

H.P.III D 71:

2 additional species given.

Tri. 16.42:

Holly: *Agrifolium, -ii,* n.: Ἀγρία, *-ας,* f.

Line 144. *Juglande: Juglans.*

[C.T.& M. 312] *Juglans regis* (L.), Walnut; a species of the *Juglans* genus of the *Juglandaceæ* or Walnut family.

B.& G.-W. 52: B.& H. 403: Linn.*Sp.Pl.* 997:

Syn.Meth.St.Br. 438: *H.P.* 1377: *H.P.III D* 5-6: *Tri.* 18.85:

Cat.Angl. 171-172: *Camb.* 76.

H.P. 1377:

Nux Juglans J.B. Ger. *Juglans vulgaris* Park. *Juglans sive Regia vulgaris* C.B. ***The Walnut-tree.***

H.P.III D 5-6:

12 additional species given.

Tri. 18.85:

A Walnut tree: *Juglans, -andis*, f.:

Κάρυον Βασιλικὸν, -ου, n.

Juglans: Ray shows his sense of humour in the section of *Historia Plantarum* on *Juglans* , where he quotes a rhyme, well-known in his time:

A Spaniel, a Woman, and a Walnut-tree
The more they are beaten, the better will they be.[401]

Line 145. *in Quercu, Malo, Pyro, Corylo adhuc minor:* Grew's observation that in Oak, Apple, Pear and Hazel the pith cells are even smaller.

Line 145. *Quercu: Quercus.*

[C.T.& M. 317-318] *Quercus* (L.), Oak; a genus of the *Fagaceæ* or Oak family.

B.& G.-W. 56: B. & H. 407: Linn.*Sp.Pl.* 994-997:

Syn.Meth.St.Br. 440: *H.P.* 1385: *H.P.III D* 7-8: *Tri.* 17.61:

Cat.Angl. 247-248: *Camb.* 100.

H.P. 1385:

12 species given, including:

Quercus vulgaris brevibus ac longis pediculis J.B. *vulgaris* Ger. *latifolia mas, quae brevi pediculo est* C.B. *item Quercus cum longis pediculis* ejusdem. ***The Common Oak.***

H.P.III D 7-8:

11 additional species given.

Tri. 17.61:

An Oak: *Quercus, -us*, f.:*Δρὺς, -υὸς,* f.

401 *Historia Plantarum:* 1377.

Line 145. *Malo: Malus.*

[C.T.& M. 244] *Malus* (Miller), Apple; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 192: B.& H. 146: Linn.*Sp.Pl.* 479:

Syn.Meth.St.Br. 451-452: *H.P.* 1445-1450: *H.P.III D* 17:

Tri. 15.2: *Cat.Angl.* 196-197: *Camb.* 83.

H.P. 1445-1450:

7 species given:

De Malo sativa ***The Apple-tree.***

Ray then lists 21 species of English apple, 6 peculiar to certain areas, 31 winter apples which keep well, 20 suitable for making cider, and 4 species of Crab Apple or Wilding.

H.P.III D 17:

1 additional species given.

Tri. 15.2:

An Apple-tree: *Malus, -i,* f.: *Μηλέα, -ας,* f.

Line 145. *Pyro: Pyrus.*

[C.T. & M. 243-244] *Pyrus* (L.), Pear; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 192: B.& H. 145: Linn.*Sp.Pl.* 479-480:

Syn.Meth.St.Br. 452: *H.P.* 1450-1452: *H.P.III* - no ref.:

Tri. 17.64 / *Tri.* 18.93: *Cat.Angl.* 247: *Camb.* - no ref.

H.P. 1450-1452:

De Pyro Angl. ***The Pear-tree.***

Ray then lists 19 species which can be trained to grow on walls, 30 species which can be eaten when freshly picked, 8 suitable for cooking and 4 for making wine.

Tri. 17.64:

A Pear-tree: *Pyrus, -i,* f.: *Ἄπιος, -ίου,* f.

Tri. 18.93:

A Pear: *Pyrum, -i,* n.:*"Οχνη, -ης,* f.

Line 145. *Coryło: Corylus.*

[C.T.& M. 315] *Corylus avellana* (L.), Hazel; a species of the *Corylus* genus of the *Corylaceæ* or Hazel family.

B.& G.-W. 54: B.& H. 406: Linn.*Sp.Pl.* 998-999:

Syn.Meth.St.Br. 439: *H.P.* 1379: *H.P.III D* 6: *Tri.* - no ref.:

Cat.Angl. 80-81: *Camb.* 56.

H.P. 1379:

Corylus sativa J.B. *item sylvestris.*

The Filberd, and the Hazel-nut.

H.P.III D 6:

4 additional species given.

Line 145. *Ulmo: Ulmus.*

[C.T.& M. 310-312] *Ulmus* (L.), Elm; a genus of the *Ulmaceæ* or Elm family.

Ulmus minor (Miller), [Incl. *Ulmus carpinifolia* (G.Suckow), *Ulmus procera* (Salisb.)], Elm; a species of the *Ulmus* genus of the *Ulmaceæ* or Elm family.

B.& G.-W. 58: B.& H. 401: Linn.*Sp.Pl.* 225-226:

Syn.Meth.St.Br. 468-469: *H.P.* 1425-1426: *H.P.III D* 13:

Tri. 16.32: *Cat.Angl.* 308-309: *Camb.* 125-126.

H.P. 1425-1426:

4 species given, including:

Ulmus vulgatissimus folio lato scabro Ger.emac. *vulgaris* Park.

The Common Elm.

H.P.III D 13:

7 additional species given.

Tri. 16.32:

An Elm: *Ulmus, -i,* f.: *Πτελέα, -ας,* f.

Line 147. *Rhoe: Rhoe*: see above Cap.4, line 143.

Line 147. *Ficu: Ficus*: see above Cap.4, line 143.

Line 147. *Oxyacanthā: Oxyacanthus*: see above Cap.4, line 143.

Line 151. *Carduo: Carduus.*

[C.T.& M. 481-485] *Carduus* (L.), Thistle; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 422-424: B.& H. 249: Linn.*Sp.Pl.* 820-825: *Syn.Meth.St.Br. 193-196: H.P. 299-318: H.P.III 238: Tri.* 14.195: *Cat.Angl.* 52-54: *Camb.* 51.

H.P. 299-318, including:

Carduus nutans J.B. *Cirsion tertium tota sua stirpe magis spinosum* Dod. *Carduus moschatus* Ger.

Thistle with a bending head, Musk-thistle.

H.P.III 238:

Ad cap. de Carduo Sphaerocephalo: 3 additional species given.

Tri. 14.195:

Thistle: *Carduus, -ii,* m.: *Σκόλυμος, -ύμου,* m.

Line 152. *Quercu: Quercus*: see above Cap.4, line 145.

Line 154. *Sambuci: Sambucus.*

[C.T.& M. 433-434] *Sambucus* (L.), Elder; a genus of the *Caprifoliaceæ* or Honeysuckle family.

Sambucus nigra (L.), Elder; a species of the genus *Sambucus* of the

Caprifoliaceæ or Honeysuckle family.

B.& G.-W. 380: B.& H. 206: Linn.*Sp.Pl.* 269:

Syn.Meth.St.Br. 461: *H.P.* 1609-1611: *H.P.III D* 67: *Tri.* 16.31:

Cat.Angl. 264-265: *Camb.* 110.

H.P. 1609-1611:

5 species given, including:

Sambucus vulgaris J.B. Park. *fructu in umbella nigro* C.B. *Sambucus* Ger. ***Common Elder.***

H.P.III D 67:

5 additional species given.

Tri. 16.31:

Elder: *Sambucus, -i,* f.: *Ἀκτὴ, -ῆς,* f.

Line 154. *Oxyacanthæ: Oxyacanthus*: see above Cap.4, line 143.

Line 156. *Medullæ primi anni.....:* is this a reference to sapwood and heartwood? Ray, quoting Grew, says that there is succulence only in the first year; in fact in woody stems the sapwood is converted to heartwood often after ten or fifteen years. Sapwood is almost white, saturated with water and contains living cells (xylem parenchyma and ray cells). Heartwood is completely lifeless tissue, which is hard and dry. However, in oak, ash and elm, which have xylem vessels of large diameter, the only functional vessels are those of the current year.[402]

Line 158. *In medullæ utriculis..... vascula utriculos reticulariter ambientia occurrunt:* Ray is correct here in noting that sometimes vascular bundles, called medullary bundles, occur in the pith.[403]

402 *Lowson's Botany:* 190-191.
403 *ibid.:* 111.

Chapter Five:

Concerning the parts contained in the stems and the movement of sap.

In this chapter Ray discusses the movement of sap within a plant, in particular in trees; it had always been known that plants absorbed nutritional material to enable them to grow, but there had been much discussion on the nature of this nutrition and whether it changed in form after absorption by the plant and also how it moved around the plant. By the end of the seventeenth century, when more detailed studies of plant physiology were being pursued, much more attention was being paid to the problems of plant nutrition.

Malpighi, one of Ray's sources for this chapter, had realised that leaves produce food and from them this food passes to all parts of the plant. Malpighi, however, did not understand the nature of the changes undergone by this food material; Mariotte showed that plants convert nutritional material drawn in by the roots into a new form, which passes to all parts of the plant. Further experiments were done on the movement of sap in the early seventeenth century by Van Helmont and by Hales at the beginning of the eighteenth century. As Sachs says:

> The views propounded by Malpighi, Mariotte and Hales contained the most important elements of a theory of the nutrition of plants; fully understood they would have taught that one part of the food of plants comes from the earth and the water, and another part from the air; that the leaves change the materials thus obtained in such a manner as to produce from them the substance of plants and to apply this to the purposes of growth.[404]

As Ray says, much of the material in this chapter is taken from Malpighi's work *Anatome plantarum*, published in 1675.[405] Sachs summarises Malpighi's theory of nutrition thus:

> that the vessels of the wood are primarily air-conducting organs,

404 Sachs: 446.

405 The relevant section may be found in Malpighi, *Anatome Plantarum:* 6-17.

> that the leaves elaborate the crude sap for purposes of growth, that the sap so elaborated is stored up in different parts of the plant, and that the fibrous elements of the wood convey upwards to the leaves the crude materials of nutrition which are absorbed by the roots.[406]

Another lengthy piece of work on the nutrition of plants, possibly known to Ray,[407] was in the form of a letter written by Edme Mariotte to a M. Lantin in 1679; it was later published at Leiden in 1717 under the title 'Sur le sujet des plantes' in *Œuvres de Mariotte*. Mariotte as a chemist was especially interested in the chemical composition of plants[408] but as part of his chemical study he included a discussion on plant nutrition.[409]

Ray in this chapter summarises what was known in his time about nutrition and the passage of sap around the plant, although he does add his own observations and experiments together with his doubts. As Ray says in this chapter, he had himself done experiments to show that nutritive sap moves both ways in a plant,[410] but as Morton says,

> This pioneer work on the movement of sap in plant *[sic]* did not lead to any very definite results in spite of much care and thought on Ray's part.[411]

Ray's experiments on the movement of sap are discussed in his paper, *Experiments concerning the motion of the Sap in Trees, made this Spring by Mr. Willughby and Mr. Wray,* presented to The Royal Society on 10th June 1669. Malpighi too had shown that sap moves in both directions 'by making cuts in the bark, thereby initiating an experimental procedure which subsequently became standard technique for research on translocation of

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406 Sachs: 459.

407 Ray does refer to the work of Mariotte in *The Wisdom of God:* 77. For this see the introduction to Chapter 9 of this commentary.

408 See Chapter 29 below.

409 This is dealt with fully in Sachs: 461-470.

410 *Philosophical Transactions* IV, Number 48: 963-965. Reprinted in *Further Correspondence:* 45-47.

411 Morton: 208.

nutrients in plants'.[412] Apart from Malpighi, Ray's other major source for this chapter is Nehemiah Grew, whose nomenclature he follows; for example, he calls the ascending sap in wood 'lymph' and the vessels carrying it 'lymph-vessels'. That Ray's doubts continued is indicated by a brief comment in *The Wisdom of God* published in 1691, 'But whether there be such a constant Circulation of the Sap in Plants as there is of the Blood in Animals, as they would from hence infer, there is some Reason to doubt'.[413]

Ray acknowledges his debt in this chapter to Malpighi and Grew, who had done much anatomical work on plants:

> Their parallel efforts revealed much of the range of cell form, and of the position, arrangement and composition of the principal tissues, as well as the existence of many specialized structures such as stomata, glandular hairs, spiral and other types of thickening of vessels and tracheids, lenticels, resin canals, and probably phloem. They distinguished the two main types of arrangement of the vascular bundles in stems, either as rings surrounding the pith or scattered.[414]

Text page 8.

Title. *De Partibus Caulium contentis & de motu succi;* Ray says that in this chapter he is defining the contents of the vascular system of a plant, that is, the sap.

Partim e Clariss. Malpighii, & Grevii scriptis, partim ex nostra observatione: he again gives Malpighi and Grew as his sources, but adds his own observations.

Line 2. *Utriculos:* the term *utriculus* was used by Malpighi for a 'cell', along with *sacculus;* Grew used the terms 'little cell'or 'little bladder'.[415]

412 Morton: 193.
413 *The Wisdom of God:* 78.
414 Morton: 192.
415 *ibid.:* 187.

Line 2. *parenchymatis:* Malpighi and Grew had shown that cells make up the parenchyma. 'The term parenchyma to denote the ground tissue of plants consisting of relatively thin-walled more or less isodiametric cells was coined by Grew and has been used ever since. It derives from the Greek παρέγχυμα 'anything poured in beside', the name originally used by Erasistratus for the peculiar substance of the lungs, liver, kidney and spleen.[416] As Morton says this 'reflects Grew's earliest conception that the softer tissues were somehow poured in among the harder ones, from which he moved a long way towards the recognition of a basic cellular structure.[417]

Line 2. *Utriculos hic e vasorum numero excludimus, & parenchymatis ascribimus:* Ray, like Malpighi and Grew, recognised that the parenchyma is made up of cells *(utriculi).* It is doubtful whether Malpighi realised that cells also make up the 'vessels' of a plant. Grew, however, almost grasped this notion, when he observed 'that parenchyma is present in the vascular tissue, especially in the medullary rays running through the wood, which he was the first to describe and understand'.[418] Since Ray says that he 'ascribes the *utriculi* to the parenchyma', one feels that he agrees with Malpighi but is not fully convinced of Grew's belief that there are *utriculi* in the vascular tissue. Morton makes an important point here:

> That parenchyma is a structure formed of cells was obviously quite clearly understood. In order to avoid any misconception it must be emphasized that this was definitely not an anticipation of later "cell theory".[419]

416 Galen: 14: 697; Liddell and Scott 1332.
417 Morton: 226, note 27.
418 *ibid.:* 191.
419 *ibid.:* 187.

Line 5. *Aer in fistulis spiralibus delatus:* he believes that air is carried separately from liquids in plants. See above Cap.4, line 59, subsection 4.

Line 6. *Succum limpidum in nonnullis plantis ..... colligit D. Grevius:* does Grew mean the primary and secondary vascular systems of a woody stem, or is he referring to the basic difference between the xylem and the phloem in an herbaceous stem?

Line 9. *vel succo crudiori concoquendo inserviunt, ut vult D. Malpighius:* the parenchyma cells of the xylem are concerned with storage and secretion.[420] Ray quotes Malpighi[421] as saying that they make a cruder sap and Grew as saying that they draw off air from the spiral pipes into the sap-bearing vessels. Oxygen, carbon dioxide and water vapour are transported across the stem of woody plants by way of the medullary rays connecting the living tissues with the outside air;[422] is this what is meant here?

Line 13. *Lympha:* margin sub-heading. Ray is following Grew's nomenclature here in calling the ascending sap in the wood 'lymph' and the vessels carrying it 'lymph vessels'.

Line 14. *Tanta copia verno tempore ascendit:* as the temperature rises in spring and the leaves of deciduous trees develop, the rate of transpiration increases and thus the amount of sap rising in the xylem vessels of the stem increases. Ray is again agreeing with Grew here.

420 *Lowson's Botany:* 91.
421 Malpighi, *Anatome Plantarum:* 9.
422 *Lowson's Botany:* 102-103; also Cooke, Burkitt and Barker: 311.

Line 15. *Vasa autem per quæ movetur, autore D. Grevio, sunt fistulae spirales seu tracheae D.Malpighio*[423]*dictæ:* Grew uses the term 'spiral pipes', whereas Malpighi uses *tracheæ;* see above Cap.4, line 89. Ray, together with Grew, believes that in spring the lymph fills the vascular tissues of the wood and because of abundance spreads from them into the *tracheæ*, although he is uncertain why the sap then returns to its own 'lymph ducts' instead of remaining in the *tracheæ*. Malpighi gave the xylem vessels the name of *tracheæ*, 'a name which has stuck, because he thought them equivalent to the respiratory tubes of insects'.[424]

Line 18. *tum primum formari incipiunt:* he may be referring here to the fact that in certain deciduous trees, such as oak, ash and elm, which have vessels of a large diameter, the only functional vessels are those of the current year.[425]

Line 18. *in vasa aerea*: tracheids - see above Cap.4, line 89.

Line 21. *Hæc D. Grevius, qui tamen nobis non undequaque satisfacit:* the explanation for the ascent of sap given in the previous lines (16-20) is, says Ray, taken from Grew, although he does not completely convince Ray that this is the correct explanation.[426]

Line 24. *Interim tamen succum verno tempore per vasa aerea sursum ferri, & vulnerato trunco per eorum orificia effluere minime negamus*. The sap, which flows from a wound, is called *lachryma* rather than *succus* by Ray, citing Schroder and Spieghel, in his glossary to *Historia Plantarum*, where he uses the analogy of crying and tears:

423 Malpighi, *Anatome Plantarum:* 16.
424 Morton: 191.
425 Cooke, Burkitt and Barker: 190-191.
426 See note at line 15 above.

> *Lachryma est humor e plantis, tum sponte effluens (sive is concrescat v.g. in oleum, resinam, gummi, sive non) tum facta incisione emanans. Schrod. Spigelius lachrymam in eo distinguit a succo, quod liquor qui ex contusa herba exprimitur aut elicitur succus vocetur, qui vero vel sponte, vel incisione manat lachryma.*[427]

On one occasion later in this chapter Ray uses the analogy of crying for a damaged tree, when he says *Arbores nonnullæ citius lachrymare incipient .....*[428]

Line 26. *Quæ de motu succi vernali in Betula .....*: here Ray begins a lengthy discussion with experiments on the movement of sap in trees. As Morton says:

> He admitted that he could not give a mechanical explanation, since rise by capillary or under atmospheric pressure were both inadequate to account for the rise of sap to the top of tall trees. On the other hand he thought there was no evidence for the presence of valves in the vessels,[429] or for the occurrence of true circulation as in animals.[430]

Line 26. *Betulã: Betula*: see above Cap.4, line 12.

Line 26. *Vite: Vitis.*

[C.T.& M. 335] *Vaccinium myrtillus* (L.), Bilberry, Blæberry, Whortleberry, Huckleberry; a species of the *Vaccinium* genus of the *Ericaceæ* or Heather family.

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427 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

428 *Historia Plantarum,* Book I: Cap. V, line 93.

429 *ibid.:* line 46-47.

430 *ibid.:* line 11.

Vaccinium vitis-idæa (L.), Cowberry.

B.& G.-W. 294: B.& H. 278: Linn.*Sp.Pl.* 202-2-3:

Syn.Meth.St.Br. 457: *H.P.* 1487: *H.P.III D* 97 / *Vinifera D* 67:

Tri. 15.13: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. *Vitis idæa ejusque species* 1487, 1625.

Idæa 3. Clus. *i. Diospyros* 1461.

Idæa palustris 684.

Vitis vinifera ejusque species 1613.

Folio Apii 1614.

Corinthiaca ibid.

Vitis hederacea Indica Stapel. *v. Hedera* 1699.

H.P.III D 97:

9 additional species given.

Tri. 15.13:

A Bilberry or Whortleberry: *Vitis, -is, Idæa:*

Ἄμπελος παρὰ Ἴδης, -έλου, f.[431]

Ray's note (*Tri.* 15.13): This is usually called in Latin *Vaccinium*, but erroneously as I think.

Line 26. *Acere majore: Acer majus.*

[C.T.& M. 179] *Acer pseudoplatanus* (L.), Sycamore; a species of the *Acer* genus of the *Aceraceæ* or Maple family.

B.& G.-W. 238: B.& H. 96: Linn.*Sp.Pl.* 1054:

Syn.Meth.St.Br. 471-2: *H.P.* 1701: *H.P.III D* 93:

Tri. 17.53 / *Tri.* 18.81: *Cat.Angl.* 4-5: *Camb.* 38.

H.P. 1701:

Acer majus, multis falso Platanus J.B. *majus* Ger. *majus latifolium, Sycamorus falso dictum* Park. *montanum candidum* C.B. ***The greater Maple, commonly, yet falsely, the Sycamore Tree.***

431 *Αμπελος παρα Ιδης, -ελου, f.* = 'vine from Ida'.

H.P.III D 93:

4 additional species given, followed by a list of what Ray calls 'doubtful species', several given by Sloane:

1. *Acer majus folio rotundiore.*
2. *Acer campestre minus.*
3. *Acer Virginianum.*
4. *Acer Bengalense.*

Tri. 17.53:

A Maple: *Acer, -eris,* n.: *Σφένδαμνος, -ου,* f.

Tri. 18.81:

A Sycamore-tree: *Acer, -eris, majus,* n.: *Σφένδαμνος, -ου,* f.

Ray's footnote (*Tri.* 18.81):

That we vulgarly but corruptly call the Sycamore-tree is not the *Sycamorus* of the Antients or the Tree so called in Scripture, but a sort of Maple. I suppose it was first so mis-named because the Leaf resembles a Fig-leaf.

Line 26. *Acere minore: Acer minus.*

[C.T & M. 180] *Acer campestre* (L.), Field Maple; a species of the *Acer* genus of the *Aceraceæ* or Maple family.

B.& G.-W. 238: B.& H. 97: Linn.*Sp.Pl.* 1055:

Syn.Meth.St.Br. 470-472: *H.P.* 1700: *H.P.III D* 93:

Tri. - no ref. but see under *Acer majus* above, Cap.5, line 26:

Cat.Angl. 5: *Camb.* 38.

H.P. 1700:

Acer minus Ger.emac. *minus sive vulgare* Park. *Campestre & minus* C.B. *vulgare minori folio* J.B.

The Common Maple.

H.P.III D 93:

See under *Acer major* above Cap.5, line 26.

Line 26. *Juglande: Juglans*: see above Cap.4, line 144.

Line 26. *Carpino: Carpinus.*

[C.T.& M. 315] *Carpinus betulus* (L.), Hornbeam; a species of the *Carpinus* genus of the *Corylaceæ* or Hazel family.

B.&.G -.W. 54: B.& H. 405: Linn.*Sp.Pl.* 998:

Syn.Meth.St.Br. 451: *H.P.* 1428: *H.P.III D* 13: *Tri.* 16.45:

Cat.Angl. 55 and under *Betula sive Carpinus* 41: *Camb.* - no ref.

H.P. 1428:

Ostrya Ulmo similis fructu in umbilicis foliaceis C.B. *Ostrya sive Ostrya Theophrasti* Park. *Fagus sepium vulgo, Ostrys Theophrasti* J.B. *Betulus sive Carpinus* Ger.

The Hornbeam, or Hard-beam tree.

H.P.III D 13:

1 additional species given.

Tri. 16.45:

The Hornbeam-tree: *Carpinus, -i,* f.:*Ὄστρυς, -υος,* f.[432]

Line 26. *Salice:Salix.*

[C.T & M. 320-330] *Salix* (L.), Willow; a genus of the *Saliaceæ* or Willow family. *Salix alba* (L.), White Willow.

B.& G.-W. 46-50: B.& H. 408: Linn.*Sp.Pl.* 1015-1021:

Syn.Meth.St.Br. 447-450: *H.P.* 1419: *H.P.III D* 12: *Tri.* 18.86:

Cat.Angl. 260-263: *Camb.* 106-109.

H.P. 1419:

24 species given, including:

Salix maxima, fragilis alba hirsuta J.B. *vulgaris alba arborescens* C.B. *arborea angustifolia alba vulgaris* Park.

432 NB Where, as in the *Trilingue*, Ray uses what looks like a terminal *sigma* - *ς* - in the middle of a word (here *Ὄς*ρυ*ς*), it actually represents 'στ'. This is a good example of the difficulties one sometimes encounters in deciphering Ray's Greek. The fact that the classical Greek for Hornbeam is ὀστρύα, ὀστρύη or ὄστρυς [Liddell and Scott: 1264] shows that the correct reading in Ray is ὄστρυς.

Salix Ger. ***The most common white Willow.***

H.P.III D 12:

16 additional species given.

Tri. 18.86:

A Willow-tree: *Salix, -icis,* f.:*Ἰτέα, -ας,* f.

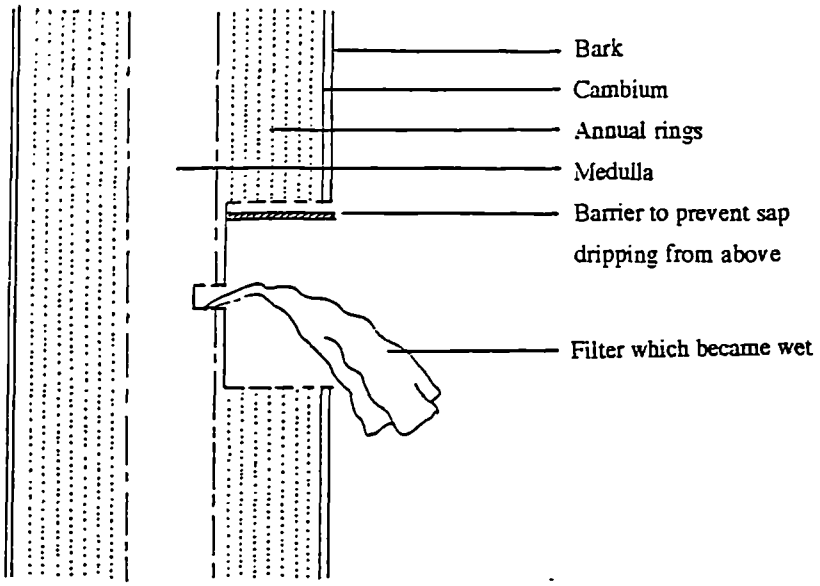
Line 29. *Per quaecunque tandem vasa ascendat succus:* the theory for the mechanism of the ascent of sap was proposed in the 1890s by first Strasburger and then by Dixon and Joly in Dublin, who proposed the cohesion theory in 1894.[433] They suggested that the motive power for the ascent of sap was created in the leaves as water evaporated through the stomata of the leaves into the atmosphere. As a leaf cell loses water, it needs to attract more water from elsewhere. It thus draws water from neighbouring cells, whose need for water is less than its own, and so on. The immediate source of such water is the liquid-filled xylem vessels and tracheids, and so water is drawn up the plant through the xylem. As it moves up the xylem further supplies are drawn in through the root system from the soil. Thus there is a continuous column of water from the root to the leaf, the motive power coming from above; that is, it is generated by the evaporation of water from the leaf cells caused by the heat of the sun, which gives the water molecules sufficient energy to change from a liquid to a vaporous state.

See also the notes to Chapter 17, lines 59-102, [*Quomodo succus nutritus .....*], on how sap rises to the top of trees.

Line 33. *Deinde ut omnem vel scrupulosissimo ....* Each annual ring in a tree trunk has its own xylem and phloem: the older and larger a tree becomes the more water and foodstuffs it needs. The *medulla* or pith of some trees contains medullary vascular bundles; is this what

433 *Lowson's Botany:* 188.

Ray is meaning here? As Sachs says, 'his [Ray's] knowledge of the mechanical causes of the movement of water in the wood was not very great'.[434] In simple diagrammatic form the experiment Ray is describing here seems to be as follows:



Experiment 1 EML

Ray describes a more complex experiment ot prove this theory in his paper on the movement of sap:

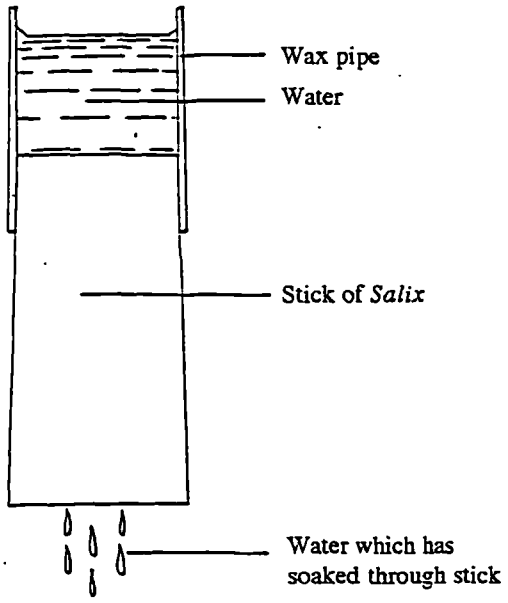
> The sap doth not only ascend between bark and tree, and in the prickt circles between the several coats of wood; but also through the very body of the wood. For, several young *Birches* being nimbly cut off at one blow with a sharp axe, and white paper immediately held hard upon the top of the remaining trunk, we stuck down pins in all points of the paper as they appeared wet; and at last, when most of the paper became wet, taking it away, but leaving the pins sticking, we found them without any order, some in the circles, and some in the wood between. And to confirm this further, we caused the body of a tree to be cut off aslope, and then cut the

434 Sachs: 471.

opposite side aslope likewise, till we brought the top to a narrow edge; ordering the matter so, that the whole edge consisted of part of a coat of wood, and had nothing of a pricked circle in it, which notwithstanding, the sap ascended to the very top of this edge, and wetted a paper laid upon it.[435]

Line 33. *Betulæ: Betula:* see above Cap.4, line 12.

Line 39. *Succum in vasis tam deorsum quam sursum libere moveri constat:* in simple diagrammatic form Ray's experiment to prove this theory is as follows:



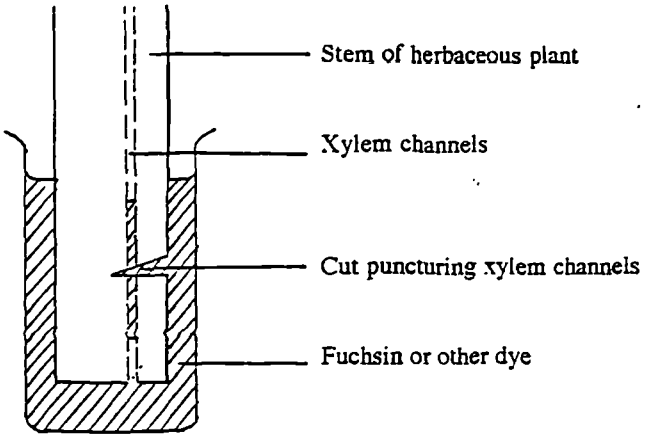
Experiment 2 EML

Ray may be referring to a consequence of the cohesion theory mentioned above, that if the motive power comes from above, the column of water should be in a state of tension. If the stem of an herbaceous plant is immersed in a dye solution such as fuchsin and then cut below the level of the dye and held there for a few moments, the movement of the dye can be seen by sectioning the

435 *Philosophical Transactions*, IV, No. 48: 963-965; also reprinted in *Further Correspondence:* 45-47.

stem. If the plant was transpiring rapidly, the dye will have penetrated for some distance in either direction in the xylem vessels above and below the cut, showing that the xylem contents were in a state of tension when the cut was made.[436]

See diagram below:



Experiment 3 EML

Again Ray gives a complex experiment in his 1669 paper on the movement of sap:

> To find out the motion of the sap, whether it ascended only, or descended also, we bored a hole in a large *Birch*, out of which a drop fell every 4th or 5th pulse. Then, about a hand's breadth just under the hole, we saw'd into the body of the tree, deeper than the hole: whereupon the bleeding diminished one half; and having sawed just above this hole to the same depth, the bleeding from the hole ceased quite; and from the sawed furrow below decreased about half; and it continued bleeding a great while after at both the sawed furrows, the hole in the middle remaining dry. We repeated this with much the like success upon a *Sycamore*.[437]

436 *Lowson's Botany:* 189.

437 *Philosophical Transactions*, IV, No. 48: 963-965; also reprinted in *Further Correspondence:* 45-47.

Line 39. *Salicis: Salix*: see above Cap.5, line 26.

Line 41. *saligni aut Acerni:* these appear to be adjectives derived from *Salix* and *Acer.*

Text page 9

Line 45. *Tithymalo: Tithymalus*: see above Cap.4, line 23.

Line 47. *quod sit alea aut surculus inversus plantetur:* Ray is correct here is saying that a twig can root if planted upside down, but this is not, as he implies, true in all cases. The *Salix*, which he gives as his example, roots more readily than other hardwood cuttings when planted in this way.[438] See note below at line 49.

Line 49. *Salice: Salix:* see above Cap.5, line 26.

Salix is one of the easiest cuttings to root because it has pre-formed roots at the nodes, which begin to develop when the stem is cut from the parent plant. Relatively long internodal cuttings should be taken about five or six nodes in length;[439] the existence of these pre-formed roots would enable Ray's experiment of planting upside down to succeed. Ray gives details of such an experiment in his paper on the movement of sap:

> We set several *Willows* with the wrong end downward, and cut off several *Bryars* that had taken root at the small ends. This 29th of *May* [1669] the *Willows* have shot out branches near two foot long; and from the top of the sets, which were a yard high, the Bryars have also grown backwards, from that part which we left remaining to the roots at the lesser ends; they have great

438 Lloyd, Christopher, *The Adventurous Gardener*, Penguin Books, London 1983: 11.
439 Brickell, *Gardening:* 539.

leaves, and are ready to flower.[440]

Line 50. *Hoc tamen perpetuo evenit (Malpighio monente) plantatos taliter surculos minus proficere*: Malpighi is correctly quoted as saying that twigs planted upside down do not necessarily take root or thrive if they do. See notes above at lines 47 and 49.

Line 52. *Betulæ: Betula*: see above Cap.4, line 12.

Line 58. *cum quibus in superiore arboris parte per anastomoses conjungebantur*: Ray is here describing an experiment to show that even when a tree trunk is cut deeply in two places, one above the other, sap still flows from both cuts. He believes that there is a network of vessels rather than straight vertical vessels in the trunk; this is also discussed by Malpighi.[441] Lowson gives a similar experiment;[442] cutting through the bole of a tree to beyond the half way mark and then making a second cut a few inches higher from the opposite side should sever all intact columns of water and stop transpiration. When this experiment was tried, the leaves continued to transpire, and so evidently the columns of water do not run vertically up a tree, or sufficient water can be passed horizontally through the xylem cell walls to allow transpiration to continue.
In his experiment, quoted above at line 39, presented to the Royal Society in his 1669 paper to prove that sap both ascends and descends, one feels that perhaps Ray was feeling his way towards this concept, which he proposes here in *Historia Plantarum.*

440 *Philosophical Transactions*, IV, No. 48: 963-965; also reprinted in *Further Correspondence:* 45-47.
441 Malpighi, *Anatome Plantarum:* 10-11.
442 *Lowson's Botany:* 189.

Line 59. *Sectionem Corticis transversam circularem non semper aut omnem arborem perimere:* as Ray says trees do not necessarily die if a ring of cortex is removed from the trunk. That water passes up the shoot in the tracheids and vessels of the xylem is shown in several ways. First Strasburger's experiment shows that living cells are not involved.[443] Experiments, in which a stem is ringed by removing a ring of bark and phloem from a length of stem, indicate that the outer tissues are not essential for transpiration to continue. When a cut shoot is placed with its lower end in an eosin solution, subsequent sectioning of the stem shows that the dye has travelled up the stem as the solution was absorbed and has stained the walls of the xylem vessels and tracheids.[444]

Line 60. *Agrifolio: Agrifolium*: see above Cap.4, line 144.

Line 62. *D. autem Malpighius ..... horizontalem sectionem in cortice fecit ..... :* Malpighi's experiments on the girdling of a stem;[445] see diagram at Cap.5, line 74.

It is interesting to note that here Ray attributes this experiment only to Malpighi, one of his major sources, whereas in *The Wisdom of God* he also attributes it to:

> an ingenious Country-Man of our own, *Thomas Brotherton*, Esquire, of which I shall mention only one, that is, If you cut off a Ring of Bark from the Trunk of any Tree, that Part of the Tree above the Barked Ring shall grow and increase in Bigness, but not that beneath.[446]

443 *Lowson's Botany:* 188.
444 *ibid.:* 191.
445 These experiments are described in various places throughout the relevant chapter of Malpighi's work; *Anatome Plantarum:* 6-17.
446 *The Wisdom of God:* 78.

This experiment is one of the first to indicate that leaves are connected with nutrition; Ray later expresses his agreement with Malpighi's conclusion that the leaves are 'fabricated by nature in order that they may serve for the manufacture of food'.[447]

Line 62. *Opuli: Opulus.*

[C.T.& M. 434] *Viburnum opulus* (L.), Guelder-rose; a species of the *Viburnum* genus of the *Caprifoliaceæ* or Honeysuckle family.

B.& G.-W. 380: B.& H. 208: Linn.*Sp.Pl.* 268:
Syn.Meth.St.Br. 460: *H.P.* 1586: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref. under *Opulus* but under *Sambucus aquatilis* 264: *Camb.* 109.

H.P. 1586:

Sambucus aquatilis sive palustris Ger. *palustris sive aquatica* Park. *aquatica* J.B. *aquatica flore simplici* C.B. ***Water Elder.***

Line 62. *Prunorum: Prunus:* see above Cap.4, line 23.

Line 63. *Mali Cydoniæ: Malus Cydonia.*

[C.T.& M. 244] *Cydonia oblonga* (Miller), Quince; a species of the *Malus* genus of the *Rosaceæ* or Rose family.

B.& G.-W. - no ref.: *Trees, B., E. and N.A.* 111: B.& H. 145: Linn. *Sp.Pl.* 480: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1452-1453: *H.P.III D* 18: *Tri.* 17.71: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1452-1453:

Cydonia minora, Mala cotonea minora C.B.

Cydonia majora, Mala cotonea majora C.B.

H.P.III D 18:

Extra notes here on the species mentioned in the earlier volume.

447 *Historia Plantarum:* Book I, line 183.

Tri. 17.71:

A Quince-tree: *Malus Cydonia, -iæ,* f.:

Μηλέα Κυδονία, -ας, f.

Line 63. *Quercûs: Quercus*: see above Cap.4, line 145.

Line 63. *Salicis: Salix*: see above Cap.5, line 26.

Line 63. *Populi: Populus.*

[C.T.& M. 318-320] *Populus* (L.), Poplar; a genus of the *Saliaceæ* or Willow family.

B.& G.-W. 52: B.& H. 414: Linn.*Sp.Pl.* 1034:

Syn.Meth.St.Br. 446: *H.P.* 1417-1418: *H.P.III* - no ref.:

Tri. 15.9 / *Tri.* 17.69: *Cat.Angl.* 240: *Camb.* 96-97.

H.P. 1417-1418:

Populus nigra Ger. C.B. Park. *nigra sive αἴγειρος* J.B.

The Black Poplar.

Populus alba Ger. Park. *alba Λα....ικη* J.B. *alba (quae Λα....ικη ab albedine dicitur) majoribus foliis* C.B.

The white Poplar, or Abele-tree.

Tri. 15.9:

An Aspen-tree: *populus, -i,* f. *Libyca: Κορκὶς, -ίδος,* f.

Tri. 17.69:

A Poplar-tree: *populus, -i,* f.: *Αἰγειρος, -ου,* f.

Line 63. *Avellanæ:Avellana.*

[C.T.& M. 315] *Corylus avellana* (L.), Hazel or cob-nut; a species of the *Corylus* genus of the *Corylaceæ* or Hazel family.

B.& G.-W. 54: B.& H. 406: Linn.*Sp.Pl.* 999:

Syn.Meth.St.Br. 439: *H.P.* 1379: *H.P.III D* 6: *Tri.* 16.34:

Cat.Angl. - no ref.: *Camb.* 56.

H.P. 1379:

Corylus sativa J.B. *item sylvestris.*

The Filberd, and the Hazel-nut.

H.P.III D 6:

Corylus Hispanica fructu majore abgulosos Pluk.Almag.Bot.

An Avellanæ Indicæ species Grevio Hist. nost. p. 1837?

Coryli seu Avellanæ folio oblongo & acuminato, Frutex convolvulaceus Capreolatus Americanæ P.B.P. Pluk. Phytogr.T.162.F.2. *Forte Lupulus Sylvestris Americana claviculis donata* Phytogr. T.204.f.4.

Hop-weed and Hop-seed *Barbadensis dicta V. cap. de Lupulo.*

Tri. 16.34:

A Filberd: *Avellana nux:* [No Greek].

[See also entry under *Corylus* Cap.4, line 145.]

Line 65. *ita excrevit ut longa turgida redderetur:* he seems to be describing scar tissue here.

Line 65. *Quercu: Quercus*: see above Cap.4, line 145.

Line 66. *Prunis: Prunus:* see above Cap.4, line 23.

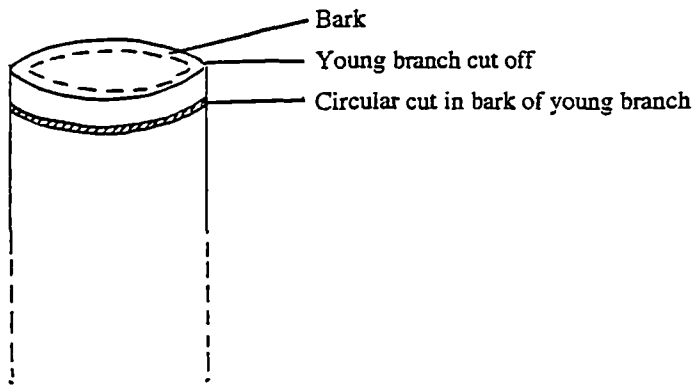
Line 66. *Cydoniā malo: Cydonia malus*: see above Cap.5, line 63.

Line 74. *an expositus tumor ultra circularem sectionem in superioribus ramorum partibus excitatus, ab impetu succi sursum propulsi contingeret.* This is a rather confusing section of the text; Malpighi,

and with him Ray, seems to doubt that a swelling or scar tissue on a tree branch is caused by 'the impetus of the sap propelled upwards', when a circular cut has been made in the bark; sap is still able to ascend the stem through the xylem vessels below the bark.[448]

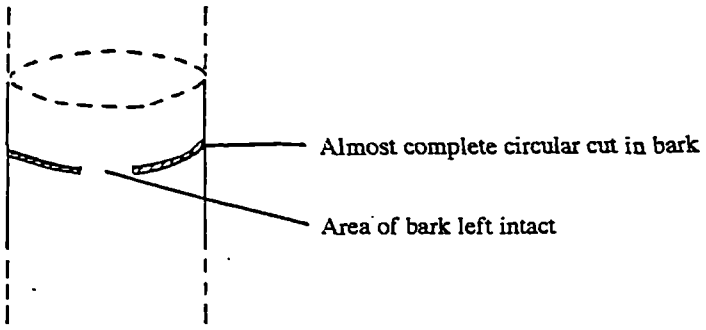
He then goes on to give examples (using a *Quercus* branch) of circular cuts, which do not occasion such swellings.

In diagrammatic form Ray's experiment on a *Quercus* branch, in which no swelling occurs above the section:



Experiment 4a EML

Because the branch has been cut close to the circular section, nutritional sap cannot descend to occasion a swelling at the point of the section.



Experiment 4b EML

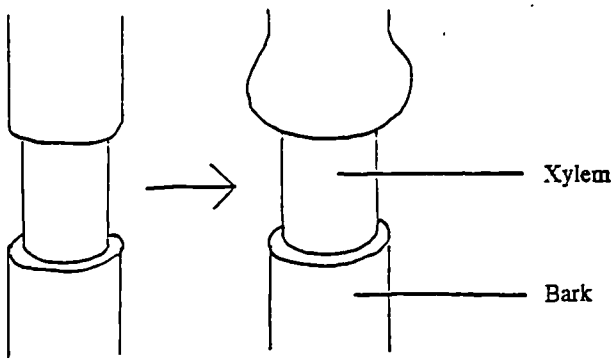
Because a small area of bark has been left intact the descending nutritional sap can pass beyond the almost complete circular section,

448 For wounds and swellings in stems see *Lowson's Botany:* 115-116.

and thus no swelling occurs.

He therefore concludes that a swelling will occur if a completely circular cut is made in the bark and the remaining length of the shoot is left intact, and thus the nutritional sap cannot descend below this cut.

Diagram to show the results of making a completely circular cut in the bark of a woody stem:[449]



A ring of bark is removed from a woody stem, leaving the xylem undamaged.

After a few weeks the tissue above the girdle has swollen with accumulated substances which have moved down the phloem from the leaves.

Experiment 5

In plants exhibiting secondary growth, such as the *Quercus*, the products of photosynthesis, that is Ray's nutritional sap, are carried in the secondary phloem of the bark.[450]

Line 79. *Quercûs: Quercus*: see above Cap.4, line 145.

Line 83. *Quare ex his probabilius conjeci nutritii succi motum a superioribus etiam ad inferiora promoveri:* Malpighi,[451] with whom Ray agreed, showed by this experiment that nutritional sap moves down through

449 Drawn from Beckett: 89.
450 Cooke, Burkitt and Barker: 193-194.
451 See Malpighi, *Anatome Plantarum:* 6-17.

a plant. The phloem carries the products of photosynthesis from the leaves to the rest of the plant.[452]

Lines 74-89. *Quandoque dubitavi .....in corticis & ligni novum involucrum erogatur:*: damage to the bark or outer layers of a tree, that is to the sapwood, is usually healed by chemical means such as the secretion of gum. The cambium produces a callus-parenchyma, which bulges across the exposed wood surface. Eventually the active tissues join up, cambium is formed right across, and the site of the original wound is hidden under layers of new wood and bark.[453]

Line 90. *Succus non tantum inter corticem & lignum ....*: Ray is here feeling his way towards the discovery of primary xylem and phloem and secondary xylem and phloem.

Line 93. *Arbores nonnullæ citius lachrymare incipient .....*: for a discussion of the term *lachrymare* used in connection with a damaged tree, see above Cap.5, line 24.

This statement is taken from Ray's earlier work on the movement of sap, although with slight variations. Here, in *Historia Plantarum*, he adds the qualification that trees bleed in the way described *copiosius etiam ex æqua incisione*.[454] In the earlier paper he states that they bleed faster (as in *Historia Plantarum*) and also 'sooner'.[455]

Line 95. *Arbor quæcunque ex incisione antequam succus ascendat facta, cum idem ascendere incipiet lachrymabit.* Sap begins to ascend in

452 Beckett: 88.
453 *Lowson's Botany:* 115-116.
454 *Historia Plantarum*, Book I, Cap.5, line 94: 9.
[more copiously from an incision of the same depth]
455 *Philosophical Transactions*, IV, No. 48: 963-965;
also reprinted in *Further Correspondence:* 45-47.

spring when warmer weather initiates the growth of new leaves; transpiration in winter is slow as deciduous trees have shed their leaves and it may even be slow in evergreens.[456] Thus Ray's belief that 'a tree will weep when the sap begins to ascend from an incision made before the sap ascends' is an accurate statement; he makes the same statement in his earlier paper of 1669.[457]

Line 97. *Dissecta particulari aliqua radice, ab utraque parte,.....:* Ray has already propounded this theory in almost the same words in his earlier paper of 1669, but in the earlier proposal he adds that:

> But in a cold snowy day, the root of one *Sycamore* we had pared, bled faster from the part separated; and ten times faster than it did in warm weather before.[458]

Line 98. *unde etiam constat eum susque deque in utramvis partem moveri:* he is here describing the xylem carrying water and dissolved salts and the phloem carrying the products of photosynthesis.

Line 100. *Succus e vulnere inflicto .....Coagulum hoc videtur esse materia ligni:* he is here describing the chemical reaction, by which a plant heals a wound; see above Cap.5, line 74-89.

Line 103. *In motu & effluxu succi in varii generis arboribus magna est differentia.* Ray had already considered the problem of variation in the flow of sap at different times of year in his earlier paper on the movement of sap. Here he presents the same ideas and cites the same examples; there is an editor's note in *Further Correspondence*.[459]

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456 *Lowson's Botany:* 190.

457 *Philosophical Transactions,* IV, No. 48: 963-965; also reprinted in *Further Correspondence:* 45-47.

458 *ibid.*

459 *Further Correspondence:* 47-48.

Research on the flow of sap was continued by Dr. Tonge†[460] and by Martin Lister, who added an account of observations made by himself at Nottingham on the Bleeding of the Sycamore in winter, with "some hopes of improving the notion of Winter-bleedings, so happily discover'd by Mr. Willughby and Mr. Wray." His experiments were published in the *Philosophical Transactions* for Feb. 20, with "*An Extract of another Letter written by the same Gentleman,* Mr. Wray, *to the publisher, of* Feb. 8th, 1670-1, *containing some Experiments about the Bleeding of the* Sycamore, *and other Trees; as also, a considerable Note of* Pliny, *about the* Mulberry-Tree." From this title it might be supposed that Ray was the author of the paper. This, however, was not so, a fact emphasized in a manner which must have been unique in the history of the Society, namely by the reprinting of the entire paper in a later number of the *Transactions* (p.2120) with a correct atttribution to Lister, to whom on March 11, 1670-1, Oldenburg wrote "Mr. Willughby and Mr. Wray have not yet sent us any thing relating to ye bleeding of ye Sycamore. When they doe, you shall quickly know, though I doubt not, but you will have them as soon as we."*[461]

From this it appears that the Royal Society expected more work from Willughby and Ray on the winter bleeding of sap; as Ray reports in almost exactly the same way on this here in *Historia Plantarum,* published seven years later, it would appear that he had not progressed in these researches in the intervening period.

Line 103. *Acer majus:* see above Cap.5, line 26.

460 † *Phil Trans.*, pp. 2070-2077.
461 * MS, *Lister* 34, *Letter* No. 6.

Line 105. *aeris temperie*: the word 'temperature' in English (from Latin *temperatura*, which comes from the stem of *temperare*) in the seventeenth century was used (first in 1659) for ' the due measure or proportion in action, thought etc.'; this could include Ray's 'air' temperature. It came to mean a tempered or temperate condition of the weather or climate, and also a (specified) condition of these by 1727.[462]

Line 106. *Acer majus*: see above Cap.5, line 26.

Line 106. *Juglans:* see above Cap.4, line 144.

Line 113. *Aceri majori: Acer majus*: see above Cap.5, line 26.

Line 113. *Juglandi: Juglans:* see above Cap.4, line 144.

Line 116. *Aceris majoris: Acer majus*: see above Cap.5, line 26.

Text page 10.

Line 124. *Succi plantarum proprii & specifici plerumque concrescunt vel in gummi, vel in Resinam, vel in mediam quandam naturam inter gummi & resinam.* For the remainder of this chapter Ray discusses the nature of what he terms 'specific saps'; he cites as his sources here Grew and Caspar Bauhin. Apart from a brief mention earlier in this chapter,[463] Ray does not discuss the special vessels through which these 'specific saps' pass; Malpighi does, however, discuss this problem believing that, in addition to the fluid-conducting fibres and air-conducting tracheæ, there were special vessels for the passage of 'specific saps'.

462 *OED:* 2258.
463 cf. lines 4-5.

Line 126. *Gummi quid:* margin heading.

Gummi est succus concretus ....: Ray gives an accurate description of gum, which is a term used of any substance which swells in water to form gels or sticky solutions. Structurally gums are mainly complex, highly branched polysaccharides, although a few gums with simpler structures are known. There are three main classes of gum.[464] Ray gives the same definition in his glossary at the beginning of *Historia Plantarum.*[465]

Line 127. *Gummi Arabicum: Gummum Arabicum:* Gum Arabic is an example of a gum from the class comprising acidic polysaccharides, made up of D-galactose and D-glucuronic acid, and arabinose and rhamnose; it is often produced by plants as a result of injury, and is used commercially in glues and pastes and as a mounting medium in microscopy.[466]

Line 127. *Gummi Cerasum: Gummum Cerasuum:* Cherry-tree gum is an old medicine recommended by Dioscorides for coughs, for a good complexion, for a good appetite and for keen sight. Dissolved in wine, European herbalists believed that the gum helped to break up and expel the stone.[467]

Line 127. *Hoc genus [D.Grevio] nihil aliud est quam mucilago exsiccata ...:* Ray here adds details on gum from Grew.

Line 130. *Resina quid:* margin heading.

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464 *Penguin Dictionary of Botany:* 165.

465 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

466 *Penguin Dictionary of Botany:* 165.

467 Grigson: 164.

Resina est liquor pinguis & oleaginosus ....: Ray is correct in saying that resin is insoluble in water but soluble in oil. It is a mixture of high molecular weight compounds, mainly polymerised acids, esters and terpenoids, exuded by certain plants, particularly when wounded, as Ray says.[468] In his glossary to *Historia Plantarum* Ray adds to his definition given here that resin is flammable:

..... & flammam facile concipit.[469]

Line 131. *C.B.* is given here as Ray's source; presumably he is referring to Caspar/Gaspard Bauhin.

As Ray refers to both Bauhin brothers in the main text of *Historia Plantarum*, when giving the various names of plants, I am giving biographical details of both here. The brothers Jean and Caspar Bauhin were the sons of a French protestant doctor, who left France because of his religious convictions to live in Basle, where both his sons were born.[470]

Jean Bauhin, (1541-1613) learnt medicine from his father and then studied under Fuchs at Tubingen. He met Gessner and collected plants with him in Switzerland. He visited several foreign universities including Montpellier, Padua and Bologna, and collected plants in France and Italy. After practising in Lyons, Geneva and Basle, he became physician to the Duke of Wurtemberg at Montbeliard, where he had a botanic garden, and where he lived

468 *Penguin Dictionary of Botany:* 311.

469 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

470 Ludovic Legre, *La Botanique en Provence au XVIe siècle. Les deux Bauhins, Jean Henri Cherler et Valerand Dourez*, Marseille 1904; Morton: 146.

until his death.[471]

In 1613 he described about 4000 plants in his *Historia Universalis Plantarum* (not published until 1650/1).[472]

Caspar [Gaspard] Bauhin, the younger son of the elder Jean Bauhin, (1560-1624), studied medicine at Basle and Padua. After travelling in France and Germany. he returned to Basle, where in 1589 he was given a specially created chair in botany and anatomy, which he held at the university for the rest of his life.

His first major botanical work was *Phytopinax* (1596); when his *Pinax* appeared in 1623, it was said to be the result of forty years' work; he included in it over 6000 plants. His nomenclature in this work was a great advance on previous works, since for most species he used both a generic and specific name and this use of binary names no doubt influenced Linnaeus. The *Pinax* offered what was needed if systematic botany was to develop - 'a sufficient foundation of generally recognised and recognisable species, and the beginning of an improved scientific nomenclature, at once flexible and stable'.[473] [474]

Ray was particularly indebted to Caspar Bauhin; for example, in *The Cambridge Catalogue* he lists the books he had used in the

471 *DSB I:* 522-525; Arber: 70, 85, 93, 113-115, 118-119, 283; Raven: 74, Ray's praise of Jean Bauhin: 78, Ray's use of his classification: 108, Ray quotes Jean Bauhin: 158, Jean Bauhin and fossils: 424.
For further biographical details see L.-M. Dupetit-Thouars, *Notices sur quelques médecins, naturalistes et agronomes nés ou établis à Montbéliard dès le seizième siècle,* Besancon 1835: 1-24; and also C.Jenssen, *Allgemeine deutche Biographie II*:: 149-151.

472 Ray had in his library a copy of this work, the edition published Ebrod. 1650, as is indicated by the sale catalogue of his library; British Museum: *S-C 326* (6):4, *Libri Latine &c. in Folio,* number 160.

473 Morton: 145-146.

474 *DSB I:* 522-525; Arber: 93, 113-116, 118, 134, 137, 159-160, 168, 179, 181, 237, 266, 268, 281-283, 285; Sachs: 5-6, 8, 12-13, 17, 19, 24-26, 33, 39, 64, 80, 100, 115; Raven: the books of Caspar Bauhin: 79, his classification: 108, Ray on Caspar Bauhin: 190; Morton: 163 note 6.
For further biographical details see Albrecht Burckhardt, *Geschichte der Medizinischen Fakultät zu Basel, 1460-1900,* Basel 1917: 95-123.

preparation of this work, basing his list of authors on those given by Caspar Bauhin, and including the following works by Bauhin himself, as follows:

1. *Phytopinax,* containing 2460 names of plants with some synonyms, 164 descriptions of new species, and eight plates: [Basle 1596, Quarto].

2. All the works of Pierandrea Mattioli, these not having been printed before in Germany, he (Bauhin) corrected and edited, adding 330 illustrations and 50 new plants with synonyms: [Frankfort 1598, Folio].

3. A criticism of the *Historia Generalis* of D'Alechamps, showing that 400 illustrations had been twice or thrice repeated: [Frankfort 1600, Octavo].

4. The *Kreuterbuch* of Jacob Dietrich of Bergzabern he corrected and enlarged, adding many new illustrations, describing some of them and giving synonyms in the first part: [Frankfort 1613, Folio].

5. *Prodomia Theatri Botanici* by the same author, which contained some 600 plants first described by him and with 140 new illustrations, was published at Frankfort 1620, Quarto.[475]

6. *Catalogue of Plants growing wild around Basle with synonyms and localities:* [Basle 1628, Octavo]. (Raven says that this date should be 1622.)[476]

7. *Pinax Theatri Botanici,* the result of forty years' work, containing the names of about 6000 plants with synonyms and characteristics: [Basle 1623, Quarto].[477]

8. In 1658 many years after his death, his son Jean Gaspard Bauhin edited the first volume of his *Theatrum Botanicum* or

475 Ray's copy of this work is listed in the catalogue for the sale of his library: *Prodromus,* edition published in Frankfurt in 1620; British Museum: *S-C 326* (6): 5, *Libri Latine in Quarto,* number 6.

476 Raven: 79.

477 Ray's copy of this work is listed in the catalogue for the sale of his library: *Pinax,* edition published in Basle in 1623; British Museum: *S-C 326* (6): 5, *Libri Latine in Quarto,* number 7.

Historia Plantarum[478] this being a twelfth of the whole work as is clear from the *Pinax*.[479]

Line 132. *Terebinthina:* turpentine is an oily liquid extracted from pine resin. Its main constituent is pinene ($C_{10}H_{16}$) and it is used as a solvent for paints. The solid residue formed after distillation for turpentine is called rosin and is used in lacquers.

The turpentine to which Ray is referring probably came from the *Pistacia terebinthinus*, a small tree native to the Mediterranean region.[480]

Line 133. *Mastiche:* mastic is the resin derived from the evergreen anacardiaceous tree *Pistacia lentiscus*.[481]

Line 134. *Medii generis succus .....:* Ray seems to be describing latex here; it is a liquid, often milky emulsion, which may however be colourless, reddish or yellowish, and found in certain flowering plants and certain agaric fungi. It has a complex composition and its function in the plant is not fully understood; it contains various substances either in solution or suspension, e.g. alkaloids, starch grains, sugars, mineral salts etc.. The latex of the rubber tree, *Hevea brasiliensis*, is used in rubber manufacture, while opium and morphine are obtained from the latex of the opium poppy, *Papaver*

478 This work, published in Basel in 1658, is listed in the catalogue for the sale of Ray's library: *Theatrum Plantarum*, edition published in Basle in 1658; British Museum: *S-C 326* (6): 1, *Libri Latine in Folio*, number 6.

479 Ray says in a letter to John Aubrey, written on March 3rd 1677, that:
> had ye Author lived to publish it, would have been the most perfect and compleat work of this kind that ever was put forth, taking in all ye species that had been described either by others before him, or newly by himself; but since his death there hath been only ye first tome printed, his son & executors finding I suppose the charge of proceeding with ye edition of the next too immense for them.

Further Correspondence: 160.

480 *Mac.Enc.* 1241: *Penguin Dictionary of Botany:* 312.

481 *Penguin Dictionary of Botany:* 312.

somniferum. .[482]

Line 135. *Galbanum: -i,* n.: [*Χαλβάνη*], the resinous sap of an umbelliferous plant found in Syria, the *Bubon galbanum* of Linnaeus.[483]

Line 135. *Sagapenum: sacopenium, -ii,* n.: [σαγάπηνον], the gum-like juice of an umbelliferous plant; called also from the Greek *sagapenon.*[484]

Line 135. *Ammoniacum: -i,* n.: a resinous gum, which distils from a tree growing near the temple of Jupiter Ammon, hence its name.[485]

Line 138. *Terebinthina:* see above Cap.5, line 132.

Line 138. *Pix liquida:* literally 'clear pitch': from *pix, picis,* f. [πίσσα]: akin to Greek *πικράς,* bitter, *πίτυς,* pine: cf. *πεύκη.* [486]
Ray gives *pix liquida* as an alternative name for *terebinthina.*

Line 139. *Eadem utique (ut recte D. Grevius) vegetabilium quæ animalium lactis origo & causa est ..... :* Grew believed that milky liquids in plants and animals were created in the same way.

Line 141. *Hinc partes lactis serosæ & oleosæ .....:* Ray, agreeing with Grew, seems to be describing a solution in suspension here; latex can contain substances in suspension: see above Cap.5, line 134.[487]

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482 *Mac.Enc.*: 703.
483 Lewis and Short: 800.
484 *ibid.:* under *sacopenium* 1611.
485 *ibid.:* 107.
486 Pliny *Historia Naturalis* XVI: xxi-xxiii; Loeb edition IV: 420-427; also Lewis and Short: 1381.
487 *Penguin Dictionary of Botany:* 204.

Line 142. *Anisi: Anisum.*

[B.& G.-W. 272] *Pimpinella anisum* (L.), [*Anisum vulgare*], Anise; a species of the *Pimpinella* genus of the *Umbelliferæ* or Carrot family.

C.T.& M. - no ref.: B.& H. 186: Linn.*Sp.Pl.* 264: *Syn.Meth.St.Br.* - no ref.: *H.P.* 449: *H.P.III.* - no ref.: *Tri.* 8.6: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 449:

Anisum Ger. Park. J.B. *Anisum herbariis* C.B. ***Annise.***

Tri. 8.6:

Anise: *Anisum, -i,* n.: *Ἄνισον, -ίσου,* n.

The liquorice-flavoured oil (mainly anthole) of *Pimpinella anisum* is extracted from the seeds.

Line 142. *Cinnamomi: Cinnamomum.*

[Mac.Enc. 279] *Cinnamomum zeylanicum*; a species of the *Cinnamomum* genus of the *Lauraceæ* or Laurel family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 369-371: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1559: *H.P.III* - no ref.: *Tri.* 16.24: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1559:

Cinnamomum sive Canella malavarica & Javanensis C.B. *Canella seu Cinnamomum vulgare* J.B. *Canella* Ger. Carua H.M. part.1, Tab.57. ***The Cinnamon Tree of Malabar.***

Tri. 16.24:

Cinnamon: *Cinnamomum, -i,* n.: *Κιννάμωμον, -ου,* n.

Chapter Six:

On the annual increase of the trunk.

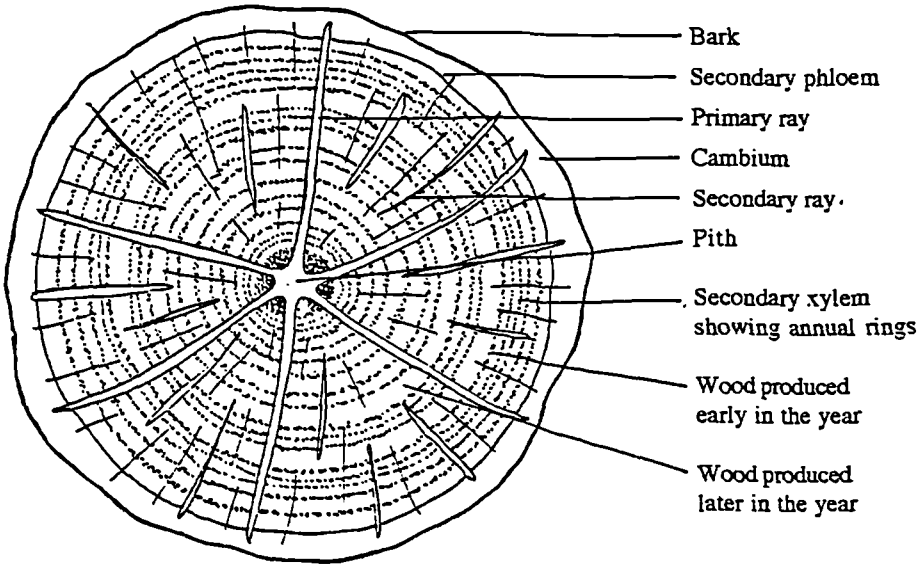
In *The Wisdom of God*, Ray describes the annual increase of the trunk thus:

> for in truth, every Tree may in some Sense be said to be an annual Plant, both Leaf, Flower and Fruit, proceeding from the Coat that was superinduced over the Wood the last year, which Coat also never beareth any more, but together with the old Wood serves as a Form or Block to sustain the succeeding annual Coat.[488]

The first descriptions of the structure of the annual rings and the differences between the spring and autumn wood were given by Malpighi[489] and Grew; they also investigated the growth in thickness (secondary growth) of the stem.

Text page 10

Cross section of a tree trunk:[490]



488 *The Wisdom Of God:* 77.
489 Malpighi, *Anatome Plantarum:* 18-22.
490 Drawn from Cooke, Burkitt and Barker: 194.

Line 1. *Arborum & fruticum trunci, indeque emergentes rami; novis quolibet anno additis ligneis involucris augentur.* Both the trunk and branches of trees are increased in size annually; this is due to an increment in the secondary xylem added to the wood of a plant in a single year.[491] Ray says that this appears as 'woody wrappings', which in transverse section apear as one or more rings due to the seasonal variation in tracheary element diameter. For Ray's definitions of the bark and inner bark given in his glossary at the beginning of *Historia Plantarum*,[492] see notes on *cortex* and *liber* above Cap.4, line 13.

Line 2. *Quolibet enim anno novus fibrarum annulus interiori libro accrescit, & bifariam tandem divisus in diversa discedit.*

> Grew reached the essentially correct conclusion that yearly growth takes place, from spring to autumn, in the thin layer between wood and bark, and that this layer (for which he coined the term cambium,[493] still in use) added wood internally and bark externally.[494]

That this was a new and uncertain concept is shown by the fact that Malpighi believed that each new year's ring of wood already existed in a compressed form in the bark.[495] However, Ray seems to have realised that each year the cambium produces new xylem and phloem. The xylem cells form the annual rings; although the

491 *Penguin Dictionary of Botany:* 22.

492 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

493 *Cambium:* a place of commercial exchange (late Latin); used in the fourteenth century by Arnold de Villa Nova at Montpellier for one of the four alimentary humours, which Arabic medicine believed nourished the body's organs; Morton: 226, note 32.
Grew believed that the cambium contained a lot of sap, which moved from it into both wood and bark; Morton: 192.

494 Morton: 192. Morton concludes by saying that 'Unfortunately ... he failed to see that the cambium consists of cells essentially similar to those of parenchyma in general'.

495 *ibid.:* 226, note 31.

cambium also produces secondary phloem, it occupies a far smaller space in a woody stem than the xylem, partly because the phloem, being soft-walled tissue, is crushed by the growing xylem, and partly because during the division of the cambium more xylem than phloem is produced.[496]

libro: see note above *Ex fibrarum lignearum* at Cap.4, line 13.

Lines 5-8. *ita ut non raro oblongam & continuatam fibram .....D.Malpighius: unde (inquit) ..... nunquam incrementum capiat.* Apart from small changes to indicate the third person such as *animadverterit* for *animadverterim* and slight changes in the punctuation, this is a direct quotation from Malpighi.[497]

Line 7. *nil mirum si in truncis & ramis arborum, quibus corticis exigua portio detracta est, subjecta lignea pars cortice destituta nunquam incrementum capiat:* For a diagram of a 'girdled' stem see Cap.5, line 74. When a girdle is cut round a stem just above ground level, root growth is suppressed and tissues immediately above the girdle swell, owing to the accumulation in them of food, which would have passed down the phloem into the roots. When a girdle is cut between the mature leaves of a plant and developing flowers, fruits or leaves, further growth of these organs is suppressed.[498]

Line 10. *& lignum duntaxat ascendere:* the substance, which Ray calls 'nutritional sap' descends in the phloem of the bark, and does not, as was once believed, ascend between the bark and the wood, as

496 Cooke, Burkitt and Barker: 195.

497 Malpighi, *Anatome Plantarum:* 11.
NB This is not taken from Malpighi's chapter *De Caudicis augmento, & Nodis,* 'On the increase of the stem and on nodes', as one would expect, but from his earlier chapter *De partibus Caulem vel Caudicem componentibus,* 'On the stem and its parts'.

498 Beckett: 88.

Ray has shown above: see note Cap.5, line 74.

Line 11. *Circuli hi seu tunicæ ligneæ in arboribus intra tropicos nascentibus .... & medullam pro centro legitimo obtinent:* Ray realised that there were differences in the growth pattern of tree rings in tropical regions, but he is not correct in describing them as symmetrical. In tropical climates, where there is little distinction between the seasons, many trees produce well-defined growth marks in their wood, but these are formed at irregular intervals and are often not complete rings at all, the resting periods of the cambium being unsynchronised even on the two sides of the same stem.[499]

For Ray's definition from his glossary to *Historia Plantarum,*[500] see note *de Medulla* above at Cap.4, line 133.

Line 12. *Brasiliano Acanthino: Brasilianum Acanthinum.* No reference to this as a plant in any of the sources. However, in the index to Volume III of *Historia Plantarum, Acanthinon* is listed for page 200; this page deals with *Acanthium* or *Carduus tomentosus* and not *Acanthinon* as listed. Therefore *Acanthinon* must be a misprint for *Acanthium.*

Ray is using this plant as an example from the tropics with equidistant annual rings; the adjective *Brasilianum* indicates that this is a plant from the equatorial regions, since the equator runs through Brazil.

See below under *Acanthium*, Cap.10, line 91.

Line 13. *observavit Gassendus Tom.2, pag.178* [margin reference].

Pierre Gassendi, 1592-1655, was a French physicist and philosopher, an ardent believer in the experimental approach to

499 *Lowson's Botany:* 100.

500 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

science. He advocated the atomic theory of matter and in this influenced the ideas of Robert Boyle. His astronomical works supported Galileo's ideas. In philosophy, he wrote extensively on Epicureanism and formulated objections to Descartes' *Meditations*.[501]

Although his work was not profoundly original, his study of Epicurus led him to 'his re-statement of atomism in terms of elemental atoms, capable of forming certain precise structural combinations, or molecules, which are the building stones of things (*corpuscula composita subtilissima, moleculasve tenuissimas, quæ sint quasi semina rerum*), and which moreover are not inert but endowed with self-motion, was exactly fitted to provide a basis for the new chemistry and physiology which scientists were trying to develop. He not only introduced the term molecule but gave it definition and concreteness; it is a specific combination and arrangement of particular atoms (*ceratrum atomorum in certam figuram conformatio et coincidentia*), not a mere agglomeration'.[502] This rationalisation of chemical theory eventually helped lead to greater knowledge of plant physiology.[503]

He believed in discovery through observation and combined this with his view of the world as consisting of matter in

501 *DSB V*: 284-290; *Mac.Enc*: 489.
502 Morton: 224, note 17.
503 *ibid.*: 178.

motion.[504] His complete works were published in 1658,[505] and include his re-appraisal of Epicurus, written between 1647 and 1649.

Raven says in a passing reference that Ray omits Gassendi from his bibliography to the *Historia Plantarum*, although he is listed in that of *The Cambridge Catalogue*.[506]

Line 13. *in cæteris vero regionibus vel ad Austrum, vel ad Septentrionem* .....: there is no evidence to show that, as Ray says, the rings of trees in temperate areas are wider on the side of the trunk nearer to the equator than that facing the pole. Variations can occur in the xylem due to imperfect synchronisation between neighbouring pieces of cambium.[507]

Line 16. *Geoponici*: Agriculturalists, *γεωπονέω*, to till the ground; *γεωπονικός*, of or for agriculture.[508] *τὰ γεωπονικά*, the title of a treatise on agriculture compiled by Cassianus Bassus.[509]

Line 16. *Geoponici peritiores arbores translaturos monent* .....: this is an interesting idea, but I can find no evidence to suggest that it is

504 Pierre Gassendi, *Syntagma Philosophicum*, Op.1: 335b.

505 Ray gives no title, only a volume and page reference (Tom 2, pag. 178), in the text; Ray may be referring to Gassendi's complete works which were published in 1658, but the sale catalogue of his library does not indicate that he owned the complete works. He did, however, own the following of Gassendi's works:
Vita Tychonis Brahei, edition published in Paris in 1654; British Museum: *S-C 326* (6): 6, *Libri Latine &c. in Quarto*, number 38.
Astronomia, edition published in London in 1653; *ibid.*: 11, *Libri Latine &c. in Octavo*, number 47.
Vita Peireskii, edition published in the Hague in 1651; *ibid...*: 14, *Libri Latine &c. in Duodecimo*, number 224.
Institutio Astronomica, edition published in London in 1683; *ibid.*: 17, *Libri Latine in 8° & 12°*, number 376.

506 Raven: 219.

507 *Lowson's Botany:* 101.

508 cf. Galen 16: 311.

509 Liddell and Scott: 1859.

advisable to replant trees in the same relative geographical position as before. Trees should be replanted at the same depth as before, and be well watered and staked until they are growing well again.

Line 18. *Ex circulorum ligneorum numero trunci vel rami ætas innotescit* .....: in British conditions it is a fairly general rule that the age of a tree can be ascertained by counting the number of rings in the trunk, but it is not an absolute rule that a stem will produce a growth ring every year. In a drought year there may be insufficient xylem growth to produce a ring; insect damage followed by a regrowth of foliage may produce two rings in a single year. In the tropics there may be insufficent variation in climate for seasonal variations such as growth rings to occur regularly.[510]

Line 20. *Circuli interiores angustiores sunt quam exteriores*: Ray is correct here in describing the size and condition of tree rings. As a tree becomes older, its wood hardens and becomes drier; that is, sapwood or young secondary xylem, which is saturated with water and contains living cells, is converted into heartwood, which is harder, drier, less permeable and more durable and with completely lifeless tissue, which has blocked and more solid vessels than sapwood.[511]

Line 23. *ὑπεράκμοις: ὑπέρακμος, -ον:* sexually well-developed, having reached full size; = Latin *exoletus*.[512]

Line 25. *Interiores circuli* .....: Ray is correct in saying that the inner rings are drier than the outer, and that in some cases the centre of a trunk

510 *Lowson's Botany:* 100.
511 *ibid.:* 108.
512 Liddell and Scott: 1859.

becomes hollow. As a tree gets older and its trunk increases in girth, the wood at the centre of the trunk, called the heartwood, ceases to conduct water; this function is then carried out only by the outer sapwood, which is the 'functional part of the secondary xylem cylinder'.[513] In some trees, such as the *Salix* (Willow), the heartwood gradually rots away leaving the trunk hollow.[514]

Line 27. *plerunque colore saturatiore tinctum:* in most trees the heartwood is darker in colour than the sapwood. As Ray says it is never paler in colour although it can be the same colour, as in the *Salix*, where as mentioned above, it may rot away leaving a hollow trunk.

Line 28. *Alburnum Plinio dicitur:* Ray gives the following reference to Pliny here, *lib.16, c.38.*

Pliny describes it thus:

> *proximi plerisque adipes; hi vocantur a colore alburnum, mollis ac pessima pars ligni, etiam in robore facile putrescens, teredini obnoxia, quare semper amputabitur.*[515]

Malpighi also describes the sap-wood as *alburnum:*

> *a colore subalbo alburnum appellantur.*[516]

Ray's own definition in his glossary to *Historia Plantarum* is on similar lines and summarises this section from lines27 to 35:

> *Alburnum Plinio dicitur exterior ligni opars mollior & teredini obnoxia, a colore albo.*[517]

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513 *Penguin Dictionary of Botany:* 321.

514 Cooke, Burkitt and Barker: 195.

515 Pliny, *Historia Naturalis* XVI,lxxii: 182; Loeb edition IV: 504.
[Next to the bark most trees have layers of fatty substance, called from its white colour alburnum; this is soft and the worst part of the wood, rotting easily even in oak and liable to woodworm, for which reason it will always be removed.]

516 Malpighi, *Anatome Plantarum:* 20.

517 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

Lewis and Short give *alburnum, -i,* n. as 'the soft, thin, white layer between the bark and wood of trees, sap-wood, alburnum.[518]

The Sap of the Tree: Ray is referring to the sapwood here.

Pliny the Elder [*Gaius Plinius Secundus*], 23-79 A.D. Roman scholar, whose universal encyclopaedia, *Historia Naturalis,* was a major source of scientific knowledge until the seventeenth century.[519] During his military career, Pliny assembled material from numerous sources on a wide range of disciplines, including astrology, geography, agriculture, medicine, precious stones and - most notably - zoology and botany. Pliny did not discriminate fact from fiction and included much folklore and superstition. He finally completed this work of 37 volumes in 77 A.D.[520]

Morton discusses the botany of Pliny's *Historia Naturalis* where he says that in books XII-XXVI is found a rather unsatisfactory presentation of Theophrastian botany, particularly of the *Enquiry into Plants*. Pliny, however, regarded botany as a subject worth studying in itself and not just as an adjunct to medicine or farming. Although there are many of his own observations in his work, he does rely heavily on other authors. He names almost twice as many plants as Theophrastus, but many are synonyms and identification is often impossible.[521]

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518 Lewis and Short: 81.

519 Ray owned several copies of *Historia Naturalis,* as can be seen from the sale catalogue of his library:
Historia Naturalis per Aldum edit. 4 vol., edition of 1536 [no place of publication given]; British Museum: *S-C 326* (6): 12,*Libri Latine &c. in Octavo,* number 94.
Historia Nat. tom 2 & 3 - 2 vol.per Elziv., edition published in Leiden in 1633, *ibid.:* 15, *Libri Latine &c. in Duodecimo,* number 255.
Natural History of the World, published in 1601 [no place of publication given]; *ibid.:* 22, English Books in Folio, number 83.

520 *DSB XI:* 38-40; *Mac.Enc*: 969; Sachs: 3, 13, 15, 34, 378; Kroll W. *et al.*, 'Plinius (5)', in Pauly-Wissowa, *Real-Encyclopadie der classischen Altertumswissenschaft,* XXI, part 1, Stuttgart 1951: 271-439.

521 Morton: 70-71.

Lines 29-35.. *D. Malpighius fibris & transversalibus utriculorum ordinibus ..... a mechanicis ut inutilia abjiciuntur.* Apart from the inclusion of words such as *inquit* to indicate the third person, Ray is quoting directly from Malpighi here.[522] He does, however, omit Malpighi's phrase *adipes dicuntur, & a colore subalbo alburnum*[523] *appellantur*, and change *unde* for *sed* in line 33.

transversalibus utriculorum ordinibus: presumably Malpighi is referring to the medullary rays of the wood here.

firmitas & durities ligno: Malpighi had realised that new sapwood is less hard than the older, central heartwood. Heartwood or *duramen* is derived from the sapwood as it deteriorates due to age.[524]

quam subcrescentia insecta non erodant, sed teredini summe obnoxia sunt. Malpighi realised that the sapwood or functional part of the secondary xylem is softer and therefore more palatable to insects than the heartwood.

Teredo: teredo - late Middle English from Latin *teredo:* Greek τερηδών (from τερέω, 'to bore through' or 'pierce'). It is a genus of lamellibranch boring molluscs, especially the shipworm, *Teredo navalis*, which destroys submerged timbers by boring into them. The term later (1866) came to be used for any disease in plants produced by the boring of insects.[525]

In Quercu: Quercus: see above Cap.4, line 145.

Malpighi notes that the Oak has more rings of sapwood than some other trees and as such is of less use to carpenters, who prefer hard woods. Heartwood is more dense and of a darker colour,[526] and has a greater resistance to decay.

522 Malpighi, *Anatome Plantarum:* 20.
523 cf. note on *alburnum* at line 28 above.
524 *Penguin Dictionary of Botany:* 171.
525 *OED:* 2265.
526 Cf. Cap.6, line 27.

Line 36. *Arbores & rami qui in altitudinem ....*: Ray is correct here in saying that as trees grow the new upper growth has fewer rings; sapwood develops afresh on the outside of the trunk each year, therefore the outer rings are, as he says, common to both the older part of the trunk and the newer.

Text page 11.

Line 40. *Abietis: Abies*: see above Cap.4, line 22.

Line 41. *Ex comparatione horum circulorum in variis arboris ....*: he compares here the size of rings in different kinds of tree; he had realised that some trees grow faster than others.

Line 42. *Quercûs: Quercus:* see above Cap.4, line 145.

Line 42. *ulmi: Ulmus:* see above Cap.4, line 145.

Line 44. *qui non semper aequales sunt ....*: he had noticed that climate affects the growth pattern of trees. See above Cap.6, line 18.

Line 45. *colligere licet ....*: Ray believes that, if a record is kept of weather conditions and this is compared with the size of the tree rings, it is possible to gauge what weather conditions will produce the greater increase in tree girth. Although he is probably correct here, other factors must be taken into account, as the ultimate size of a particular tree will depend on the site, nature of the soil, exposure and rainfall.[527]

527 Hillier: 14.

Chapter Seven:

On the differences of stems,
from the Introduction to the Examination of Plants
by Joachim Jung, with some additions and changes.

In this chapter Ray describes the characteristics of a stem: with or without leaves, branched or unbranched, types of flower head on a stem (Umbel, Corymb etc.), shapes of stem (angular, rounded, solid or hollow), and whether upright or creeping. He takes much of his material from Jung's *Isagoge Phytoscopica*, although there are a few personal additions.

Text page 11.

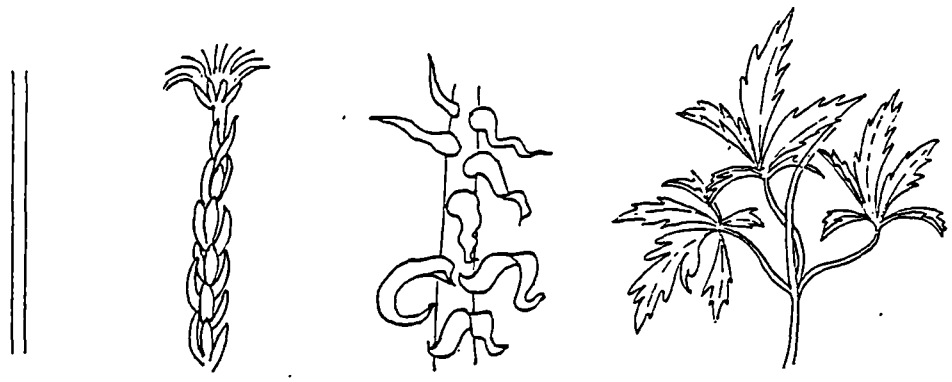
Line 1. *Caulis multipliciter differunt:* Ray/Jung gives five main differences in stems:

1. *Respectu foliorum.*
2. *Respectu ramorum & petiolorum.*
3. *Respectu situs florum.*
4. *Respectu figuræ caulis.*
5. *Respectu situs caulis.*

Line 2. *Differentiæ caulium foliorum respectu:* margin sub-heading.

Caulis vel est foliis vestitus, vel iis omnino destitutus, sive nudus. He says that a stem is either covered in leaves or is bare of them. He then goes on to explain this in greater detail, with examples.

Diagram to show Ray's stems *respectu foliorum:*



Caulis nudus	*Secundum quid nudum*	*Secundum quid nudum*	*Vestitutus determinate*
Taraxacum	*Tussilago*	*Petasites*	*foliatus ex unica*
			Anemone
Line 4	Line 5	Line 5	Line 8

For *ex duabus* see below Cap.7, line 9.

EML

Vestitutus indeterminate foliatus - all other plants.

Line 4. *Absolute nudum dicimus* ....: a stem with absolutely no trace of leaves; here he gives as examples *Taraxacum, Plantago* and *Bellis.*

Line 4. *Taraxaci: Taraxacum.*

For *Taraxacum* see above under *Dens leonis,* Cap.3, line 63.

Line 5. *Plantaginis: Plantago.*

[C.T.& M. 419-421] *Plantago* (L.), a genus of the *Plantaginaceæ* or Plantain family.

B.& G.-W. 380: B.& H. 366: Linn.*Sp.Pl.* 112-116: *Syn.Meth.St.Br.* 314-316: *H.P.* 878-880: *H.P.III* 435: *Tri.* 12.149: *Cat.Angl.* 236-237: *Camb.* 95.

H.P. 878-880:[528]

16 species given, including:

528 Some page numbering in the original text of *Historia Plantarum* is repeated [878/877/878/879/880]; therefore 16 species of *Plantago* are given on five pages and not on three as listed in the index.

Plantago latifolia vulgaris Park. *latifolia sinuata* C.B. *latifolia* Ger. *major folio glabro non laciniato ut plurimum* J.B.

Great Plantain or Way-bread.

H.P.III 435:

12 additional species given.

Tri. 12.149:

Plantain: *Plantago, -inis,* f.: Ἀρνόγλωσσον, -ώσσου, n.

Line 5. *Bellidis:Bellis.*

[C.T.& M. 470] *Bellis perennis* (L.), Daisy; a species of the *Bellis* genus of the *Compositæ* or Daisy family.

B.& G.-W. 394: B.& H. 229: Linn.*Sp.Pl.* 886:

Syn.Meth.St.Br. 184: *H.P.* 349-350 / 350-353: *H.P.III* 219-223:

Tri. 10.59: *Cat.Angl.* 37-38: *Camb.* 47.

H.P. 350-353:

14 species of *Bellis major* given, including:

H.P. 350, *Bellis major:*

Bellis major J.B. Ger. *major vulgaris sive sylvestris* Park. *major sylv. caule folioso* C.B. *Buphthalmum majus* Lob. *Consolida media vulnerariorum* Lob. ***The great Daisie or Ox-eye.***

H.P. 349-350:

6 species of *Bellis minor* given, including:

H.P. 349, *Bellis minor*:

Bellis sylv. minor C.B. *minor sylv., simplex* Park. *minor 4, sive sylvestris & 5, sive sylvestris altera* Ger. *minor sylv. spontanea* J.B. ***Common Wild Daisie.***

H.P.III 219-223:

41 additional species given.

Tri. 10.59:

Daisie: *Bellis, -idis,* f.: [No Greek].

Line 5. *Secundum quid nudum*: he then gives as examples of those which are almost bare of leaves, *Tussilago, Petasites* and *Dentaria aphylla.*

Line 6. *Tussilaginis: Tussilago.*

[C.T.& M. 458-459] *Tussilago farfara* (L.), Coltsfoot; the only species of the *Tussilago* genus of the *Compositæ* or Daisy family.

B.& G.-W. 414: B.& H. 242: Linn.*Sp.Pl.* 865-866:

Syn.Meth.St.Br. 173: *H.P.* 259: *H.P.III* - no ref.: *Tri.* 9.44:

Cat.Angl. 296-297: *Camb.* 122.

H.P. 259:

Tussilago Ger. Park. *vulgaris* C.B. ***Common Colts-foot.***

Tri. 9.44:

Coltsfoot: *Tussilago, -inis,* f.: *Βήχιον, -ίου,* n.

Ray gives *Tussilago* and the following two plants *(Petasites* and *Dentaria aphylla)* as examples of plants with 'scanty leaves, which are not very distinct from the stems'. This is true in the case of *Tussilago*, but not quite so accurate in the other two, as they have small but distinct leaves on their stems.

Line 6. *Petasitis: Petasites.*

[C.T.& M. 458-459] *Petasites* (Miller), Butterburs; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 414: B.& H. 243: Linn.*Sp.Pl.* 866:

Syn.Meth.St.Br. 179: *H.P.* 260-261: *H.P.III* 151: *Tri.* - no ref.:

Cat.Angl. 231: *Camb.* 94.

H.P. 260-261:

3 species given, including:

Petasites Ger. *vulgaris* Park. *major & vulgaris* C.B.

Butter-burr; Pestilent-wort.

H.P.III 151:

Additional notes on *Petasites*.

Line 6. *Dentariæ aphylli: Dentaria aphylla.*

[C.T.& M. 91] *Dentaria bulbifera* ([L.] Crantz), Coral-root, Coral-root Bittercress; a species of the sub-genus *Dentaria* of the genus *Cardamine* of the *Cruciferæ* or Cress family.

None of the various species are given as *aphylla*, i.e. 'without leaves', but presumably Ray means *Dentaria bulbifera*, since it is the only species lacking root leaves and having only stem leaves.

B.& G.-W. 140: B.& H. 32: Linn.*Sp.Pl.* 653:

Syn.Meth.St.Br. 288: *H.P.* 784-785: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 89-90: *Camb.* - no ref.

H.P. 784-785:

5 species given, [none as *aphylla*] including

Dentaria triphyllos Clus.Hist. C.B. Park. *enneaphyllos Clusii* J.B. *Dentaria coralloide radice, sive Dentaria enneaphyllos* Ger. ***Toothwort.***

Dentariæ aphylli: Ray appears here to be using a feminine noun with a masculine or neuter adjective, both in the genitive case.

Line 7. *Caulis foliis vestitus est vel determinate vel indeterminate foliatus.*

Ray defines a leafy stem as having its leaves in a regular or irregular pattern.

Line 7. *Determinate foliatus est* ..... : he defines this as a stem putting out leaves from a definite position, *ex certa distinctione*.

Line 8. *Ex unica:* from one definite position as in *Anemone, Pulsatilla, Herba Paridis* and *Aconitum hyemale*.

Line 8. *Anemone: Anemone:* see above Cap.1, line 50.

Line 8. *Pulsatillā: Pulsatilla.*

[C.T.& M. 37] *Pulsatilla vulgaris* (Miller), Pasque Flower; a species of the *Pulsatilla* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 110: B.& H. 4: Linn.*Sp.Pl.* 539:
Syn.Meth.St.Br. 260: *H.P.* 633-634: *H.P.III* - no ref.:
Tri. - no ref.: *Cat.Angl.* 246: *Camb.* 99.
H.P. 633-634:

13 species given, including:

Pulsatilla vulgaris Ger. *purpurea cæruleave* J.B. *folio crassiore & majore flore* C.B. *Pulsat.Danica* Park.parad.

The greater or Danish Pasque-flower.

Line 8. *Herbā Paridis: Herba Paridis.*

[C.T.& M. 542] *Paris quadrifolia* (L.), Herb Paris; a species of the *Paris* genus of the *Liliaceæ* or Lily family.

B.& G.-W. 462: B.& H. 456: Linn.*Sp.Pl.* 367:
Syn.Meth.St.Br. 264: *H.P.* 670: *H.P.III* 351: *Tri.* - no ref.:
Cat.Angl. 159: *Camb.* 73.
H.P. 670:

Herba Paris Ger. Park. J.B. *Solanum quadrifolium bacciferum* C.B. ***Herb Paris or True-love, One-berry.***

H.P.III 351:

One additional species given:

Herbæ Paris affinis tetraphyllos aut pentaphyllos Marilandica parva, floris calice triphyllo. Helleborine affinis Planta Mariana, Herbæ Paridis facie quinquefoliata Pluk.Mantiss.

Line 8. *Aconito hyemali.: Aconitum hyemale.*

[C.T & M. 34] *Eranthis hyemalis* ([L.] Salisb.) [*Helleborus hyemalis* (L.)], Winter Aconite; a species of the *Eranthis* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 106: B.& H. 2: Linn.*Sp.Pl.* - no ref.:

Syn.Meth.St.Br. - no ref.: *H.P.* 700: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 700:

> *Aconitum Hyemale* Ger. Park. *Unifolium luteum bulbosum* C.B. *Ranunculus cum flore in medio folio radice tuberosa* J.B. ***Winter Wolf's-bane.***

Line 9. *Ex duabus:* leaves growing from two definite positions on the stem in such plants as *Phthora, Unifolium* and any *Cotyledon altera.*

Line 9. *Phthorā:Phthora:* no reference in any of the sources to this as a plant. [In Greek *Φθόρα, ἡ,* 'destruction' or 'ruin'; hence in Latin *phthorius, -a, -um,* adj., 'corrupting' or 'destructive'.]

Line 9. *Unifolio: Unifolium.*

[C.T.& M.535] *Maianthemum bifolium* ([L.] Schmidt), *Maianthemum convallaria* (Weber), *Unifolium bifolium* ([L.] Greene, *Smilacina bifolia* ([L.] J.A. & J.H. Schultes), May Lily; a species of the *Maianthemum* genus of the *Liliaceæ* or Lily family.

B.& G.-W. 462: B.& H.458: Linn.*Sp.Pl.* 316 and 947:[529]

Syn.Meth.St.Br. 264:[530] *H.P.* 668: *H.P.III* - no ref.: *Tri.* - no ref.:

Cat.Angl. 41: *Camb.* - no ref.

Since the modern description of *Maianthemum bifolium* fits Ray's

529 See footnotes below for Cap.7, line 9.

530 This is not an exact parallel but is also a member of the *Liliaceæ* family; there was much confusion over the identification of this plant even a hundred years later, as is shown by the Linnæan names, for which see footnotes below at Cap.7, line 9.

description as having leaves in pairs,[531] it appears that this is the plant indicated here, although there is a discrepancy in Ray's description in *Historia Plantarum*, which combines both of the following plants described by Linnæus: *Convallaria bifolia*[532] and *Ophrys monophyllos*[533] (p.947).

H.P. 668 *(Unifolium S. Monophyllum):*

> *Monophyllon* Ger. *Monophyllon sive Unifolium* Park. *Monoph. sive Lilium convallium minus* C.B. *Unifolium, sive Ophris unifolia* J.B. ***One-blade.***

Ray explains the name *Unifolium* thus:

> *Monophyllon dicitur hæc herbula quod radices inter reptandum folia singularia emittant; nam in caule duo plerunque folia sunt, interdum tria.*[534]

Line 9. *Cotyledone altera:* [535]

[C.T.& M. 248] *Umbilicus rupestris* (Salisb.), *Umbilicus pendulinus* (D.C.), *Cotyledon umbilicus-veneris* (L.), Dandy

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531 *Maianthemum* (Weber) has 'stems erect, with 2 scale lvs at base lvs near the apex'. C.T.& M.: 534.

532 *bifolia:*
Convallaria foliis cordatis Fl.lapp.113. Fl.suec.276. Hort.cliff.125. Roy. lugdb.26. Gmel.sibir.1.p.35.
Lilium convallium minus. Bauh.pin. 304.
Gramen parnassi. Cam.epit. 744.
Linnæus, *Species Plantarum:* 316.

533 *monophyllos:*
Ophrys bulbo rotundo, caule nudo, folio ovato, nectarii labio integro.
Ophris monophyllos bulbosa, Loes pruss. 180.t.57.
Monochris ophioglossoides, Mentz.pug.t.5.f.1.2.
PseudoOchris monophyllos, Clus.hist.1.p.269.
Linnæus, *Species Plantarum:* 947.

534 *Historia Plantarum:* 668:
> [This plant is called 'One leaf' because its roots put out single leaves while creeping; but on the stem its leaves are usually in pairs, sometimes in threes.]

535 Because *Phthora, Unifolium* and *Cotyledon* are listed together there is a remote, although unlikely, possibility that he is referring to monocotyledons (plants with one seed leaf) here, as the term *unifolium* itself means 'single leaf' and Orchids are certainly monocotyledons. He may be using the term *cotledone* to indicate other plants with a single seed leaf, rather than the plant called *Cotyledon*, described above.

Pennywort, Navelwort; a species of the *Umbilicus* genus of the *Crassulaceæ* or Stonecrop family.

C.T.& M. 248: B.& G.-W. 164: B.& H. 159: Linn.*Sp.Pl.* 429: *Syn.Meth.St.Br.* 271: *H.P.* 1045-1046: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 182 with a ref. to see *Umbilicus Veneris* 309 : *Camb.* - no ref.

Linn.*Sp.Pl.* 429:

umbilicus:

Cotyledon foliis cucullatis serrato-dentatis alternis, caule ramoso, floribus erectis.

Cotyledon foliis peltatis. Vir.cliff.39. Roy.lugdb.454.

repens:

Cotyledon flore luteo, radice repente. Dod.mem.265. t.73.

Cotyledon radice tuberosa longa repente. Moris.præl.257. Raj.Hist.1878.

Cotyledon luteum umbilicatum spicatum, radice repente majus. Moris.hist.3.p.471.

Umbilicus repens. Cam.epit.858.

tuberosa:

Cotyledon vera, radice tuberosa. Bauh.hist.3.p.683.

Cotyledon major. Bauh.pin.285. Raj.hist.1878.

Cotyledon umbilicus veneris. Clus.hist.2.p.63.

Sedum luteum murale spicatum, folio umbilicato rotundo. Moris.hist.3.p.470.s.12.t.10.f.4.

H.P. 1045-1046:

De Cotyledone dicta: 6 species with *altera* in their names, including:

Sedum serratum J.B. *Cotyledon media foliis oblongis serratis* C.B. *Cotyledon altera Matthioli* Park.parad. *Cot. alt. versicoloribus floribus* ejusdem *in* Theat.

Also in the *Appendix* to *Historia Plantarum:* 1878:

Cotyledon vera radice tuberosa J.B. *Cot. major* C.B. *Umbilicus Veneris* Ger. *Veneris vulgaris* Park.

Wall penny-wort, Navel-wort, Kidney-wort.

Line 9. *Ex duabus in Phthora ..... :* It is difficult to see exactly what Ray is meaning by the arrangement of the leaves *ex duabus* here,[536] as I have been unable to identify *Phthora* and, although this description does agree with Ray's later one for *Unifolium,*[537] *nam in caule duo plerunque folia sunt,* it only fits the *Crassulaceæ* family, including the Cotyledons, in that their leaves are sometimes in pairs.[538]

Line 9. *Indeterminate foliati sunt reliqui:* Bentham and Hooker describe this arrangement as 'scattered', which seems to be what Ray means here.[539]

Line 10. *Differentia caulium ramorum respectu:* margin sub-heading.
Respectu ramorum & petiolorum: Ray may mean larger and smaller stems here, not specifically 'branches' and 'petioles', which would be the usual translation, but see note below at line 14.

Line 10. *petiolorum*: a petiole is the stalk, which attaches the leaf blade to the stem, but Ray may just be using the term for a small stalk, and not in the modern technical sense. The term 'petiole' was first used in English in 1753.[540]

Line 10. *Differentiae caulium ramorum respectu* - margin sub-heading.
Caulis est vel simplex: for a simple stem Ray gives as his examples

536 i.e. Are the leaves growing from two distinct points or in pairs?
537 *Historia Plantarum:* 668; see also note above at Cap.7, line 9.
538 Clapham, Tutin and Moore: 245.
539 Bentham and Hooker: introduction page XVI.
540 *Penguin Dictionary of Botany:* 268; *OED:* 1564.

Taraxacum, Bellis, Plantago, Pulsatilla, Anemone, Nymphæa, Bistorta, Vincetoxicum and *Pyrola vulgaris.*

Line 11. *Taraxaco:Taraxacum*: for *Taraxacum* see above under *Dens leonis*, Cap.3, line 63.

Line 11. *Bellide: Bellis*: see above Cap.7, line 5.

Line 11. *Plantagine: Plantago*: see above Cap.7, line 5.

Line 11. *Pulsatillã: Pulsatilla*: see above Cap.7, line 8.

Line 11. *Anemone: Anemone*: see above Cap.1, line 50.

Line 11. *Nymphææ: Nymphaea.*

[C.T.& M. 54-55] *Nymphaea* (L.), a genus of the *Nymphaceæ* or Water-lily family.

B.& G.-W. 104: B.& H. 16: Linn.*Sp.Pl.* 510-511: *Syn.Meth.St.Br.* 368: *H.P.* 1319-1320: *H.P.III* 630: *Tri.* - no ref.: *Cat.Angl.* 212-213: *Camb.* - no ref.

H.P. 1319-1320:

5 species given, including:

Nymphæa lutea Ger. J.B. *major lutea* C.B. Park. *Nenuphar luteum* Bruns. ***Water-lily, with a yellow flower.***

H.P.III 630:

20 additional species given.

Line 11. *Bistortã: Bistorta.*

[C.T.& M. 302] *Polygonum bistorta* (L.), Snake-root, Easter-ledges, Common Bistort; a species of the *Polygonum* genus of the *Polygonaceæ* or Dock family.

B.& G.-W. 64: B.& H. 385: Linn.*Sp.Pl.* 360:
Syn.Meth.St.Br. 147: *H.P.* 186-187: *H.P.III* - no ref.:
Tri. - no ref.: *Cat.Angl.* 42: *Camb.* 48.
H.P. 186-187:

6 species given, including:

Bistorta major Ger. *ma. vulgaris* Park. *ma. rogosioribus foliis* J.B. *radice minus intorta* C.B.

The greater Bistort or Snakeweed.

Line 11. *Vincetoxico:Vincetoxicum.*

[B.& G.-W. 310] *Vincetoxicum hirundinaria* (Medicus), *[V. officinale, Cyanchum vincetoxicum]*, Swallow-wort; a species of the *Vincetoxicum* genus of the *Asclepiadaceæ* or Swallow-wort family.

C.T.& M. - no ref.: B.& H. 298 - passing reference only to the *Asclepias* or Swallow-wort family: Linn.*Sp.Pl.* 216:
Syn.Meth.St.Br. - no ref.: *H.P.* 1090: *H.P.III* - no ref.:
Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref..
H.P. 1090:

Asclepias flore albo Park. Ger. C.B. *Asclepias sive Vincetoxicum multis floribus albicantibus.* J.B.

Swallow-wort.

Line 11. *Pyrola vulgari: Pyrola vulgaris.*

[C.T.& M. 338] *Pyrola minor* (L.), Common Wintergreen; a species of the *Pyrola* genus of the *Pyrolaceæ* or Wintergreen family.
B.& G.-W. 288: B.& H. 285: Linn.*Sp.Pl.* 396-397:
Syn.Meth.St.Br. 363: *H.P.* 1233: *H.P.III* 596: *Tri.* - no ref.:
Cat.Angl. 246-247: *Camb.* - no ref.
H.P. 1233:

Pyrola Ger. J.B. *nostras vulgaris* Park. *rotundifolia major* C.B.

Common Winter-green.

H.P.III 596:

4 additional species given.

Line 12. *Ramosus in plerisque:* most stems are branched - he gives no examples.

Line 13. *Inter simplicem & ramosum ambigit caulis in umbellam sparsus.....* : he regards the umbel as half way between straight and branched in its characteristics; he gives as his examples *Primula veris* and *Auricula ursi.*

Line 13. *Primulā veris:Primula veris.*

Ray uses this name to indicate the Common Primrose, *Primula vulgaris,* not the plant now called *Primula veris*, the Common Oxlip. [C.T.& M. 346] *Primula vulgaris* (Hudson), *Primula acaulis* ([L.] Hill), Primrose; a species of the *Primula* genus of the *Primulaceæ* or Primrose family.

B.& G.-W. 296: B.& H. 289: Linn.*Sp.Pl.* 142-143:

Syn.Meth.St.Br. 284: *H.P.* 1080: *H.P.III* - no ref.: *Tri.* 13.153:

Cat.Angl. 242: *Camb.* 98.

H.P. 1080:

Primula veris vulgaris Park. *veris minor* Ger. *veris floribus ex singularibus pediculis, majoribus, simplicibus* J.B. *Verbasculum sylvarum majus singulari flore* C.B.

Common Primrose.

Tri. 13.153:

Primrose: *Primula, -æ, veris,* f.: *Φλομὶς, -ίδος,* f.

Line 13. *Auriculā ursi: Auricula ursi.*

[B.& G.-W. 296] *Primula auricula* (L.), Auricula, Bear's-ear; a

species of the *Primula* genus of the *Primulaceæ* or Primrose family.

C.T.& M. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 143-145: *Syn.Meth.St.Br.* 284-285: *H.P.* 1082-1083: *H.P.III* 509/528: *Tri.* 8.16: *Cat.Angl.* - *Auricula* but not *ursi* 34-35: *Camb.* - no ref.

H.P. 1082-1083:

10 species given, including:

Auricula ursi flore luteo J.B. Ger. *ursi lutea* Park. *Sanicula Alpina lutea* C.B.

Yellow Bears-ear or Oricola, French Cowslip.

H.P.III 509/528:

p.509: 1 additional species given.

p.528: 2 additional species given.

Tri. 8.16:

Bear's ear: *Auricula ursi*, f.: [No Greek].

Line 14. *petiolis potius quam ramulis:* Ray is being quite specific here about the size of these stems. He differentiates between a *petiolus* or'short fine stem' and a *ramulus* or 'small branchlet'. However, see note above at line 10.

Line 14 *et passim.*

petiolis: Ray seems to use petiole and pedicel indiscriminately. For example, here in line 14, he uses the term *petiolus* although he seems to be describing a flower-head. We would now differentiate between the short stems of leaves and flowers, using the technical term petiole for 'a leaf stem' and pedicel for' a flower stem'.

In his introductory glossary to *Historia Plantarum*, Ray defines these terms as follows:

> *Pediculus est a quo folium, aut flos, aut fructus dependet.* ***The foot-stalk of a leaf, flower or fruit.***

Petiolus idem est quod pediculus. ***A foot-stalk.***[541]

N.B. In each instance in the translation, I have given the correct modern technical term, regardless of that used by Ray.

Line 15. *Differentiæ foliorum situs respectu* - margin sub-heading, 'the differences of leaves in respect of position'.

The sub-heading has *foliorum*, 'of leaves', and the text *florum*, 'of flowers'; although *folium* can be used of a petal, it is not usually used of whole flowers, and so from the context one must assume that *foliorum* is a misprint for *florum*, as in the text itself.

Respectu situs florum: Ray says that flowers are either placed in a regular way, *(determinatus)* or irregular *(indeterminatus)*, on the stem. We now define this in quite the opposite way; Ray's *determinatus* is our racemose or indefinite inflorescence, and his *indeterminatus* is our cymose or definite inflorescence.

Line 16. *Determinatus est qui in extremitatibus ..... :* here he says that the flowers are placed at the top of the stem in various forms of inflorescence: *capitulum, spica* or *thyrsus, panicula, umbella* and *corymbus*.

These are the inflorescences now defined as racemose or indefinite.

Line 16. *thyrsum: Thyrsus, -i,* m.: = *θύρσος:* a stalk or stem of a plant.[542]

Ray uses this term as an alternative to *spica*, a spike.

Line 18. *Capitulum quid:* margin sub-heading.

Capitulum est quod constat ex pluribus flosculis ..... : Ray

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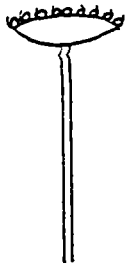
541 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

542 Lewis and Short: 1870.
NB The term *thyrsus* is also used for the Bacchic staff, twined round with ivy and vine shoots, carried by Bacchus and the Bacchantes; *ibid.*

describes this as 'many little flowers packed closely together into a spherical, circular or disc-shaped form'; he gives as examples *Cyanus, Scabiosa, Jacea, Carduus, Bellis* and *Chrysanthemum.* In his glossary to *Historia Plantarum,* he gives the same definition with examples, but omits the last two examples, *Bellis* and *Chrysanthemum.*[543]

A capitulum is now defined as an inflorescence consisting of a head of small closely packed stalkless flowers or florets arising at the same level on a flattened axis. The whole is surrounded by an involucre of bracts and simulates, in appearance and function, a single large flower. The capitulum is typical of members of the *Compositæ* or Daisy family.[544]

Diagram of a capitulum:



Capitulum / Capitulum

Line 19. *Cyano: Cyanus*:

[C.T.& M. *Centaurea cyanus* (L.), Cornflower, Bluebottle; a species of the sub-genus *Cyanus* of the genus *Centaurea* of the *Compositæ* or Daisy family.

B.& G.-W. 428: B.& H. 255: Linn.*Sp.Pl.* 911:

Syn.Meth.St.Br. 198: *H.P.* 321-322: *H.P.III* 201: *Tri.* 8.21: *Cat.Angl.* 85-86: *Camb.* 58.

543 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

544 *Penguin Dictionary of Botany:* 57-58.

H.P. 321-322:

7 species given, including:

Cyanus J.B. *minor vulgaris* Lob. Ger. Park. *Cyanus segetum* C.B. ***Blew-bottles.***

H.P.III 201:

16 additional species given.

Tri. 8.21:

Bluebottle: *Cyanus, -i,* m.: [No Greek].

Line 19. *Scabiosã: Scabiosa.*

[C.T.& M. 440] *Scabiosa* (L.), Scabious; a genus of the *Dipsacaceæ* or Teasel family.

B.& G.-W. 386: B.& H. 220-222: Linn.*Sp.Pl.* 98-101: *Syn.Meth.St.Br.* 191: *H.P.* 374-381: *H.P.III* 234: *Tri.* 13.174: *Cat.Angl.* 267: *Camb.* 111.

H.P. 374-381:

28 species given, including:

Scabiosa major communior hirsuta folio laciniato J.B. *major vulgaris* Ger. *vulgaris pratensis hirsuta, quae Officinarum* C.B. ***Common field Scabious.***

H.P.III 234:

55 additional species given.

Tri. 13.174:

Scabious: *Scabiosa, -æ,* f.: *Ψῶρα, -ας,* f.[545]

Line 19. *Jaceã:Jacea.*

[C.T.& M. 487] *Centaurea jacea* (L.), Brown Knapweed; a species of the sub-genus *Jacea* of the genus *Centaurea* of the *Compositæ* or

545 NB The Greek word *ψῶρα,* from which derives the medical term psoriasis, actually means 'itch', 'mange' or 'scurvy' [Liddell and Scott: 2029]; our modern word scabies, from the Latin, is the term used for an infestation of the skin by the itch mite [*Harrap's Dictionary of Medicine:* 353].

Daisy family.

B.& G.-W. 426: B.& H. - no ref., only *centaurea nigra:* Linn.*Sp.Pl.* 914: *Syn.Meth.St.Br.* 198: *H.P.* 318-321/323-329: *H.P.III* 202/205: *Tri.* - no ref.: *Cat.Angl.* 169-170: *Camb.* 76.

H.P. 318-321:

16 species given.

H.P. 323-329:

31 species given, including:

Jacea major Ger. *itemque Scabiosa flore purpureo* ejusdem, *ut J. Bauhino & nobis etiam videtur. Scabiosa major squamatis capitulis, sive Jacea rubra latifolia laciniata* ejusdem. *Centaurium collinum Gesneri flore purpureo* J.B.

Great Knapweed or Matfellon.

Jacea nigra Ger. *nigra vulgaris* Park. *nigra vulgaris capitata & squamosa* J.B. *nigra pratensis latifolia* C.B.

Knapweed or Matfellon.

H.P.III 202 / *læv.*, 205:

Ad cap. de Jaceis capite spinoso; 43 additional species given.

Ad cap. de Jacea capite lævi seu non spinoso; 35 additional species given.

Line 19. *Carduis: Carduus:* see above Cap.4, line 151.

Line 19. *Bellide: Bellis:* see above Cap.7, line 5.

Line 19. *Chrysanthemo: Chrysanthemum.*

[C.T.& M. 475-476] *Chrysanthemum* (L.), Chrysanthemum; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 410: B.& H. 236: Linn.*Sp.Pl.* 887-890:

Syn.Meth.St.Br. 182-183: *H.P.* 334-343: *H.P.III* 210-217:

Tri. - no ref.: *Cat.Angl.* 69: *Camb.* 53.

H.P. 334-343:

Various genera given, including Starworts, Marigolds and Ox-Eye Daisies; Ray gives a general introduction to *Chrysanthemum* and then lists various genera, including the following species of Marigold:

Chrysanthemum segetum Ger.emac. *segetum nostras* Park. *folio minus secto glauco* J.B. *Bellis lutea foliis profunde incisis major* C.B. ***Corn Marigold.***

H.P.III 210-217:

93 additional species given.

Line 21. *Spica quid:* margin sub-heading.

Spica est quod ex floribus ..... : Ray describes this as being composed thickly of flowers and seeds in such a way that an upright but oblong or very sharp cone develops; he gives as examples *Lysimachia purpurea, Verbascum, Plantago, Luteola, Reseda, Bistorta, Secale* and *Hordeum.*

In his glossary to *Historia Plantarum*, Ray gives a slightly different definition:

> *Spica est quod culmus extulit, continetque granum, glumam & aristam,* ***an Ear of Corn.*** *Verum hoc nomen latius extenditur: unde recte a Jungio definitur, quod ex floribus vel seminibus spisse compositum est , ita ut conus erectus sed oblongus, sive admodum acutus inde evadat, ut in Plantagine, Bistorta, Secali, Hordeo, &c.*[546]

A spike is now defined as being a racemose inflorescence in which the flowers are sessile (without a stalk) and borne on an elongated axis, as in wheat.[547]

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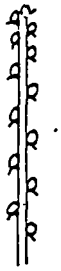
546 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

547 *Penguin Dictionary of Botany:* 337.

Diagram of a spike:



Spica (Thyrsus) / Spike

Line 22. *Lysimachiā purpureā: Lysimachia purpurea.*

[C.T.& M. 258] *Lythrum salicaria* (L.), Purple Loosestrife; a species of the *Lythrum* genus of the *Lythraceæ* or Loosestrife family.

B.& G.-W.258: B.& H. 155: Linn.*Sp.Pl.* 446:

Syn.Meth.St.Br. 367: *H.P.* 1036: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 194: *Camb.* 82.

H.P. 1036:

Lysimachia purpurea spicata Ger. Park. *purpurea, quibusdam spicata* J.B. *spicata purp. forte Plinii* C.B.

Purple spiked Willow-herb, or Loose-strife.

Line 22. *Verbasco: Verbascum.:*

[C.T.& M. 369-371] *Verbascum* (L.), Mullein; a genus of the *Scrophulariaceæ* or Figwort family.

B.& G.-W. 354: B.& H. 324: Linn.*Sp.Pl.* 177-179:

Syn.Meth.St.Br. 287-288: *H.P.* 1094-1095: *H.P.III* 548:

Tri. 12.129: *Cat.Angl.* 300: *Camb.* 123.

H.P. 1094-1095:

10 species given, including:

Verbascum mas latifolium luteum C.B. *vulgare, flore luteo magno, folio maximo* J.B. *verbascum album vulgare, sive Tapsus barbatus communis* Park. *Tapsus barbatus* Ger.

White Mullein, High-taper, Cows Lungwort.

H.P.III 548:

6 additional species given.

Tri. 12.129:

Mullein: *Verbascum, -i,* n.: *Φλόμος, -ου,* m.

Line 22. *Plantagine: Plantago:* see above Cap.7, line 5.

Line 22. *Luteolã: Luteola.*

[C.T.& M. 106] *Reseda luteola* (L.), Weld, Dyer's Rocket; a species of the *Reseda* genus of the *Resedaceæ* or Mignonette family.

B.& G.-W. 162: B.& H. 50: Linn.*Sp.Pl.* 448:

Syn.Meth.St.Br. 366-367: *H.P.* 1054: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 192: *Camb.* 82.

H.P. 1054:

Luteola Ger. *vulgaris* Park. *Lut. herba Salicis folio* C.B. *Lutea Plinii quibusdam* J.B. ***Wild Woad, Dier's-weed.***

Line 22. *Resedã: Reseda.*

[C.T.& M. 106-107] *Reseda lutea* (L.), *[Reseda ramosissima],* Wild Mignonette; a species of the *Reseda* genus of the *Resedaceæ* or Mignonette family.

B.& G.-W. 162: B.& H. 50: Linn.*Sp.Pl.* 449:

Syn.Meth.St.Br. 366: *H.P.* 1033 (incorrect reference in the index to *Historia Plantarum*: Linnaeus, *Species Plantarum*, gives the correct reference as *H.P.* 1053): *H.P.III* 511: *Tri.* - no ref. *Cat.Angl.* 253: *Camb.* 104.

H.P. 1053:

Reseda vulgaris C.B. *minor seu vulgaris* Park. *Plinii* Ger. *Lutea* J.B. ***Base Rocket.***

H.P.III 511:

6 additional species given.

Line 23. *Bistortã: Bistorta:* see above Cap.7, line 11.

Line 23. *Secali: Secale.*

[C.T.& M. 634] *Secale cereale* (L.), Rye; a species of the *Elymus* genus of the *Gramineæ* or Grass family.

B.& G.-W. - no ref.: B.& H. 508: Linn.*Sp.Pl.* 84:

Syn.Meth.St.Br. 388: *H.P.* 1241: *H.P.III* - no ref.: *Tri.* 13.165: *Cat.Angl.* 268-269: *Camb.* 112.

H.P. 1241:

Secale Ger. J.B. *vulgatius* Park. *hybernum vel majus* C.B. ***Rie.***

Tri. 13.165:

Rie: *Secale, -is,* n.: [No Greek].

Line 23. *Hordeo: Hordeum.*

[C.T.& M 634-635] *Hordeum* (L.), Barley; a genus of the *Gramineæ* or Grass family.

Hordeum secalinum (Schreber), [*Hordeum pratense* (Hudson): *Hordeum nodosum* (auct. non L.)], Meadow Barley.

Hordeum distichon (L.), and *Hordeum vulgare* (L.) occasionally exist in the wild as relics of cultivation but do not persist or become naturalised.

B.& G.-W. - no ref.: B.& H. 527: Linn.*Sp.Pl.* 84-85:

Syn.Meth.St.Br. 388: *H.P.* 1243: *H.P.III* - no ref: *Tri.* 8.12: *Cat.Angl.* 164-165: *Camb.* 74-75.

H.P. 1243:

4 species given, including:

Hordeum distichum Ger. J.B. Park. C.B. ***Common Barley.***

Tri. 8.12:

Barley: *Hordeum, -ii,* n.: *Κριθὴ, -ῆς,* f.

Line 24. *Panicula quid:* margin sub-heading.

Panicula, item Juba, est spica laxe diffusa: Ray describes a panicle as 'being like a mane, a loosely spread spike especially with petioles hanging down as in the case of *Milium.*'. In his introductory glossary to *Historia Plantarum,* Ray gives a longer definition of *panicula:*

> *Panicula est lanosa coma unde semen dependet, ut in Arundine, Milio, Gramine, &c. seu (ut Jungius definit) Spica laxe diffusa præsertim propendentibus petiolis, ut in Milio. Idem valet quod Juba & opponitur Spicæ.*[548]

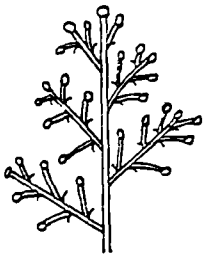
In a raceme itself the flowers are borne on short pedicels on a long peduncle or stem as in the Wallflower; whereas, if in place of each pedicel there is another small raceme, the inflorescence is termed a panicle. A panicle is now defined as a racemose inflorescence in which the flowers are formed on stalks (peduncles) arising alternately or spirally from the main axis. Each stalk is itself a raceme. The peduncles may be long and spreading as in Oats (*Avena*), or short, resulting in a spike-like inflorescence, as in Timothy Grass (*Phleum pratense*). The panicle is thought to be the most primitive form of racemose inflorescence from which the other types have probably evolved. The term is also sometimes used for any type of branching inflorescence.[549]

548 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

549 *Penguin Dictionary of Botany:* 258; Cooke, Burkitt and Barker: 170.

Diagram of a raceme and of a panicle:

Raceme



Panicula / Panicle

Line 24. The text has *petiolis*, whereas the term indicated is *pediculis*; see note above at Cap.7, line 14.

Line 24. *Milio: Milium.*

[C.T.& M. 647] *Milium* (L.), Millet; a genus of the *Gramineæ* or Grass family.

B.& G.-W. - no ref.: B.& H. 508: Linn.*Sp.Pl.* 61:

Syn.Meth.St.Br. - no ref.: *H.P.* 1251: *H.P.III* 598: *Tri.* 12.132:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 1251:

4 species given, including:

Milium J.B. Ger. *Milium semine luteo* C.B. *Milium vulgare album* Park. ***Millet with Yellow seed.***

H.P.III 598:

6 additional species given.

Tri. 12.132:

Millet or Grout: *Milium, -ii,* n.: *Κέγχρος, -ου,* m.

Line 25. *Umbella quid:* margin sub-heading.

Umbella est extremitatis caulis in plures longiores ..... : Ray describes an umbel as being:

> the extremity of a stem divided into many rather long pedicels, which radiate around it, and which are

themselves sub-divided into lesser pedicels carrying flowers radiating in a circle round it.

He also compares it to a parasol.

As with *panicula*, Ray gives a much longer definition of *umbella* in his introductory glossary to *Historia Plantarum:*

> *Umbella vocatur floris seminisve velut pedamentum in plures divisum longiores pediculos, qui simul ex eodem fastigio orti in latus continuo radiantur, singulique florem sustinent in orbem circumactum, ut in Fœniculo, Anetho, Apio, &c. vel, ut Jungius definit, est extremitas caulis per multas subdivisiones in coni universi figuram aptata; a similitudine umbellæ qua mulieres faciem a Sole arcent. In Umbelliferis enim summus caulis, summique ramuli in plures ab eodem puncto ortos radios dividuntur, singuli radii itidem in plures pediculos qui flores sustinent.*[550]

An umbel is now defined as a racemose inflorescence, in which the flowers are borne on undivided pedicels originating from a common node on the main axis. The outermost flowers are borne on the longest pedicels so that the whole inflorescence is flat topped and resembles an umbrella; these inflorescences are typical of the *Umbelliferæ*.[551] *Compositæ* umbels may be borne on branched pedicels so that many smaller umbels constitute the whole inflorescence.

Ray does not differentiate between the two types of umbel; he assumes all umbels are subdivided in the manner of the *Umbelliferæ*.

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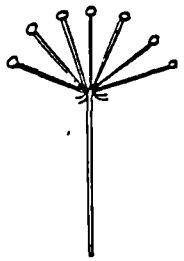
550 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

551 *Penguin Dictionary of Botany:* 372.

Diagram of an umbel:



Umbella / Umbel

Line 25. *in plures longiores pediculos divisa:* Ray is here using the term pedicel correctly for the short flower stalk. A pedicel is now defined as the stalk, which attaches individual flowers to the main axis or peduncle of the inflorescence.[552] See above Cap.7, line 14.

Line 28. *Corymbus quid:* margin sub-heading.

Corymbus est extremitatis caulis ita subdivisa ..... : Ray describes a corymb as 'the end of a stem so subdivided and laden with flowers or fruits that a spherical shape develops'; he gives as examples *Hedera arborea, Sambucus aquatica, Cepa* and *Porrum,* and as a corymb, which hangs down, *Sambucus aquatica* or *rosea.* In his introductory glossary to *Historia Plantarum*, he has three entries for corymbus:[553]

1 corresponds to lines 31-34 of chapter 7.

2 corresponds to lines 28-30; here in the glossary Ray attributes this definition to Jung, and he also adds that the term is sometimes used as a synonym for umbel:

Alii Umbellæ synonymum faciunt.

3 corresponds to lines 36-37, but with the addition in the glossary of:

qualis in Chrysanthemo, Bellide, Chrysocome, &c.

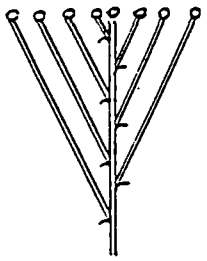
552 *Penguin Dictionary of Botany:* 262.

553 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

cernitur: Nam hujusmodi flores in latum extensi umbellam seu corymbum quodammodo æmulantur.

A corymb is now defined as a simple racemose inflorescence, in which the flowers are formed on lateral stalks of different lengths, the longest at the base, resulting in a flat-topped cluster of flowers. This form of inflorescence is frequently found in the *Cruciferæ* (Cress family), such as *Iberis* (Candytuft).[554]

Diagram of a corymb, as it is now defined:



Corymbus / Corymb

Line 29. *Hederā arboreā: Hedera arborea.*

This is presumably *Hedera helix*, which can climb to 30 metres up the bark of trees. There is now no distinction between Climbing Ivy and *Hedera helix*. A species of the *Hedera* genus of the *Araliaceæ* or Ivy family.

For *Hedera* see above Cap.4, line 119.

H.P. 1505:

Hedera communis major & minor J.B. *arborea* C.B. *item major sterilis* ejusdem & Ger.

Climbing, or berried Ivy; also barren, or creeping Ivy.

Line 29. *Sambuco aquaticā: Sambucus aquatica:* [C.T.& M. 434] *Viburnum opulus* (L.), Guelder Rose; a species of the *Viburnum* genus of the *Caprifoliaceæ* or Honeysuckle family.

554 *Penguin Dictionary of Botany:* 89.

B.& G.-W. 380: B.& H. 208: Linn.*Sp.Pl.* 268:
Syn.Meth.St.Br. 460: *H.P.* 1586: *H.P.III* - no ref.: *Tri.* - no ref.:
Cat.Angl. 264: *Camb.* 109.
H.P. 1586:

Sambucus aquatilis sive palustris Ger. *palustris sive aquatica* Park. *aquatica* J.B. *aquatica flore simplici* C.B. ***Water Elder.***

Line 29. *Cepã: Cepa:* see above Cap.3, line 12.

Line 29. *Porro: Porrum.*

[C.T.& M. 539-540] *Allium porrum* (L.), Leek; a species of the *Allium* genus of the *Liliaceæ* or Lily family.
B.& G.-W. 460: B.& H. 465: Linn.*Sp.Pl.* 295:
Syn.Meth.St.Br. - no ref.: *H.P.* 1226 - incorrect reference in index to *Historia Plantarum*: reference should be 1126: *H.P.III* - no ref.:
Tri. 9.55: *Cat.Angl.* - no ref.: *Camb.* - no ref.
H.P. 1126:

2 species given, including:
Porrum Park. J.B. *capitatum* Ger. *commune capitatum* C.B. ***Leeks or Porret.***
Tri. 9.55: *sectile* only.

Cives: *Porrum, -i, sectile*, n.: *Πράσον, -ου*, n.

Line 30. *sambuco aquaticã, seu rosea*: see above Cap.7, line 29.
Linnaeus, *Species Plantarum:* 268, gives another species of *Viburnum opulus - roseum,* which is presumably the plant Ray means here:
Sambucus aquatica, flore globoso pleno. Bauh.pin. 456.

Line 31. *Corymbi nomen latius patet:* Ray says that the word corymb is also used more widely for a top of any sort.

Line 31-32. *Nam prima notio, τοῦ κορύμβου est, in capite veterum Atticorum, tutulus seu meta suggestus capillorum, autore Scaligero.*

Ray says that the first mention of corymb is '*τοῦ κορύμβου* in 'the chapter by the old Attic people' by the author Scaliger'; he quotes him as saying that it means 'piled up hair' or ' the top of the pile of hair'.

κόρυμβος, 'the uppermost point'. The earliest reference that I can find is in Homer, *Iliad* 9, line 241, *νηῶν .... ἄκρα κόρυμβα*, the high-pointed sterns of ships.

κόρυμβος is also used in classical Greek for 'a cluster of the Ivy fruit', e.g.*κόρυμβα ἀμφὶ κρητὶ κίσσιν' ἔστεπτο,* Herodas 8.33. It is also used generally for a cluster of fruit or flowers.

Line 32. *autore Scaligero: Scaliger.*[555]

Julius Cæsar Scaliger, 1484-1558: Italian humanist scholar, whose main interests were in the fields of natural philosophy, medicine and botany. He also engaged in controversy with Erasmus and wrote several commentaries on classical writers. Aristotle's theories of tragedy became known to the French 17th century dramatists through his discussion of them in the *Poetice* of 1561.

Scaliger's works on botany include:

1. *In libros duos, qui inscribuntur de plantis, Aristotele autore, libri duo* (Paris 1556; Geneva 1566; Marburg 1598).

2. *Commentarii et animadversiones in sex libros de causis plantarum Theophrasti* (Geneva 1566).[556]

555 Compare Cap.22, line 50 - *Julius Scaliger.*

556 Ray owned a copy of this work, as is seen from the sale catalogue of his library: *in 6 libros de causis Plantarum,* edition of 1566 [no place of publication given]; British Museum: *S-C 326* (6): 4, *Libri in Latine &c. in Folio,* number 154.

3. *Animadversiones in Theophrasti historias plantarum* (Lyons 1584, 1644).[557]

Although Ray is probably referring to the natural historian Julius Cæsar Scaliger, since this is a classical reference, he could be meaning Joseph Justus Scaliger, son of the above, 1540-1609; born in France. An outstanding classical scholar,[558] who also published many works of historical scholarship, notably the *Opus de emendatione tempore* of 1583, a scientific study of chronology.

Line 33. *Hederæ: Hedera*: see above Cap.4, line 119.

Line 33. *Plin. lib.16. cap.34:* Ray is quoting Pliny directly here, as he gives his words in italics. The whole quotation is as follows:

> *fructum quoque candidum ferentium aliis densus acinus et grandior, racemis in orbem circumactis qui vocantur corymbi:* [559]

Line 34. *hederæ: Hedera:* see above Cap.4, line 119.

Line 34. *Dioscorides in capite de Hippophæ ..... :* according to the German edition of *De Materia Medica*, the *Kreuterbuch*, of 1610, Ray is quoting from chapter CLVII.[560]

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557 *DSB XII*: 134-136; Myriam Billanowich, Benedetto Bordon e Giulio Cesare Scaligero, *Italia mediovale e umanistica*, 1968: 187-256; Charles B. Schmitt, Theophrastus, *Catalogus Translationum: Mediaeval and Renaissance Latin Commentaries and Translations*, edited by P.O Kristeller and F. Edward Cranz, Washington, D.C., 1971: 239-275; *Mac.Enc.*: 1082; Raven: 424 and 460.

558 One of Joseph Justus Scaliger's classical writings in Ray's possession, according to the sale catalogue, was:
de causis Linguæ Latinæ, edition published in 1623; British Museum: *S-C 326* (6): 17, *Libri in Latine &c. in 8° & 12°*, number 374.

559 Pliny, *Historia Naturalis* XVI, lxii: 146: Loeb edition IV: 482.
[also in some of those bearing white fruit the berry is closely packed and rather large, hanging in round bunches which are called 'clusters']

560 Dioscorides *Krauterbuch, (Περὶ Ὕλης Ἰατρικῆς, de Materia Medica)*: 319.

Line 34. *in capite de Hippophæ: Hippophæs.*

[C.T.& M. 260] *Hippophæ rhamnoides* (L.), Sea Buckthorn; a species of the *Hippophæ* genus of the *Eleagnaceæ* or Eleagnus family.

B.& G.-W. 244: B.& H. 388-389: Linn.*Sp.Pl.* 1023: *Syn.Meth.St.Br.* 445: *H.P.* 1915: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - 253: *Camb.* - no ref.

Linn.*Sp.Pl.* 1023:

Rhamnoides:

Hippophæ foliis lanceolatis.

Hippophæ. Fl.lapp.372. Fl.suec.815. Hort.cliff.454. Roy.lugdb.207.

Rhamnus salicis folio angustiore, fructu flavescente. Bauh.pin.755.

Rhamni species. Cam.epit.81.

Rhamnoides florifera, salicis folio. Tournes.cor.53.

Habitat in Europæ maritimis arenosis.

H.P. 1915:

Hippophæs Anguillaræ & Dodonæi sive Spina purgatrix J.B. *Hippophæs quibusdam* Ἄκανθα νακαθαρίση,[561] *i.e. Spina purgatrix Anguill.* C.B. *Item Rhamnus catharticus Oleæ folio* ejusdem.

Cat.Angl. 253:

Rhamnus secundus Clusii. Ger.emac. *primus Dioscoridis Lobelio, sive litoralis* Park. 4, *sive Salicis folio angusto, fructu flavescente* C.B. *Rhamnus vel Oleaster Germanicus* J.B. ***Sallow-Thorn, or Sea-Buckthorn.***

561 NB There is no word νακαθαρίση in Liddell and Scott; καθαρίση could mean 'cleansing' (cf. *purgatrix*). Is the 'να' a kind of diplography? Or did Ray mean 'ναρ'?

Line 35. *Hederæ: Hedera:* see above Cap.4, line 119.

Line 36. *Corymbi alia acceptio:* margin sub-heading.

Corymbus etaim alias sumitur apud recentioes Botanicos pro flore composito discoide, qui in pappum non resolvitur, 'the corymb is even assumed among more recent botanists to be a flower formed in a disc-like way, which does not resolve into a tuft'. Ray is here giving what is now regarded as the modern defintion of a corymb.[562]

Line 38. *Caulis indeterminatus quis:* margin sub-heading.

Caulis indeterminatus est ..... : Ray describes an irregular stem as 'one which bears flowers on stems projecting from the side of the stem'.

This is what is now known as a cymose inflorescence. It is defined as an inflorescence in which the apical tissues of the main stem and laterals lose their meristematic capacity and differentiate into flowers. New growth arises from continued cell division in the axillary meristems. Older flowers are usually found near the stem apex.[563]

Line 40. *Differentiæcaulium respectu figuræ:* margin sub-heading.

Respectu *figuræ* Caulis vel *angulosus* est, vel ..... : Ray defines a stem shape as being either *angulosus* (angular) or *teres* (rounded); each of these can be either *solidus* (solid) or *cavus* (hollow).

As with most of this chapter Ray has taken this material from Jung; Morton summarises Jung's comments on stem shape:

The different forms of stem (terete, angled, striate, with

562 *Penguin Dictionary of Botany:* 89.
563 *ibid.:* 95.

or without nodes) are described.[564]

Line 41. *Angulosus caulis vel triquetrus est .... vel quadrangulus .... vel quinquangulus .... vel sexangulus:* Ray subdivides the stem shapes into three, four, five or six-sided.

Line 41. *triquetrus est, ut in ..... :* three-sided as in *Cyperus, Gramen Cyperoides* and *Papyrus.*

Line 41. *Cypero: Cyperus.*

[C.T.& M. 592] *Cyperus* (L.), Galingale; a genus of the *Cyperaceæ* or Sedge family.

B.& G.-W. - no ref.: B.& H. 478: Linn.*Sp.Pl.* 44-47: *Syn.Meth.St.Br.* 417-428: *H.P.* 1299: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 87-88: *Camb.* 59.

H.P. 1299:

12 species given, including:

Cyperus longus Ger. *longus odoratus* Park. *odoratus radice longa, sive Cyperus Officinarum* C.B. *panicula sparsa speciosa* J.B.

The ordinary sweet Cyperus or English Galingale.

Line 41. *Gramine Cyperoide: Gramen Cyperoides.*

C.T.& M./B.& G.-W./B.& H. - no ref.

Linn.*Sp.Pl.* 43-47, 50-52, 58, 972, 979: *Syn.Meth.St.Br.* 417: *H.P.* 1293-1295: *H.P.III* 618: *Tri.* - no ref.: *Cat.Angl.* 87: *Camb.* 69-70.

H.P. 1293-1295:

15 species given of *Gramen cyperoides polystachyon.*

17 species given of *Gramen cyperoides cum spicis aut paniculis*

564 Morton: 170.

in summitate caulis.

Camb. 69-70:

5 species given, after which Ray says (Tr.):

> We have in addition two other species of *Gramen cyperus*, which we think have not yet been described, and we have not been able to distinguish accurately enough those whose synonyms we have given, since there is an astonishing confusion and discrepancy among authors in their descriptions of this group.

See in addition the entry above at Cap.7, line 41, on *Cyperus*.

H.P.III 618:

Ad.cap. de Cypero: 21 additional species given.

Cyperi & Gramina Marilandica: 16 additional species given.

Cyperi & Gramina Cyperoide Jamaicansia a D.Sloane observata & descripta: 58 additional species given.

Line 41. *Papyro: Papyrus.*

[C.T.& M. 592] *Cyperus papyrus* (L.), Papyrus; a species of the *Cyperus* genus of the *Cyperaceae* or Papyrus family.

B.& G.-W. - no ref.: *Mac.Enc.* 924: B.& H. - no ref.:

Linn.*Sp.Pl.* 47: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1796:

H.P.III - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1796:

Papyrus arborea tenuissima ex Java J.B. *Papyrus ex Java* C.B.

Line 42. *Ad triangulum caulem etiam .....* : he further defines a three-sided stem as 'one with three projections of leaves or thorns, such as *Carduus chrysanthemus*'.

Line 43. *Carduus chrysanthemus.*

[C.T.& M. 515] *Scolymus hispanicus* (L.), Spanish Oyster Plant; a

species of the *Taraxacum* genus of the *Compositæ* or Daisy family.
B.& G.-W. 428: B.& H. - no ref.: Linn.*Sp.Pl.* 813:
Syn.Meth.St.Br. - no ref.: *H.P.* 257: *H.P.III* - no ref.:
Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.
H.P. 257:

> *Carduus chrysanthemus* Dod. *Scolymus Theophrasti Hispanicus* Clus. *Scolymus Chrysanthemus annuus* Horti Regii Paris. *Carduus Chrysanthemus Hispanicus* Ger.emac.

Line 44. *Quadrangulus:* four-sided as in *Salvia, Mentha, Lamium, Marrubium* and *Rubia,* and six hundred others.

Line 44. *Salviã: Salvia.*
[C.T.& M. 409-411] *Salvia verbenaca* (L.), *[Salvia clandestina* (L.), *Salvia horminioides* (Pourret), *Salvia marquandii* (Druce)]; a species of the *Salvia* genus of the *Labiatæ* or Mint family.
B.& G.-W. 346: B.& H. 344: Linn.*Sp.Pl.* 23-27:
Syn.Meth.St.Br. 245: *H.P.* 509-512: *H.P.III* 273: *Tri.* 13.168:
Cat.Angl. 264: *Camb.* - no ref.
H.P. 509-512:

> *Salvia latifolia* J.B. *major* Ger. *major vulgaris* Park. *major an Sphacelus Theophrasti.* C.B.
> ***The greater or common Sage.***

H.P.III 273:

> 18 additional species given, plus 9 'which are similar to *Salvia* in some respects'.

Tri. 13.168:

> Sage: *Salvia, -æ,* f.:*'Ελελίσφακος, –ου,* m.

Line 44. *Menthã: Mentha*: see above Cap.3, line 25.

Line 44. *Lamio: Lamium.*

[C.T.& M. 413-414] *Lamium* (L.), Deadnettles; a genus of the *Labiatæ* or Mint family.

B.& G.-W. 336: B.& H. 358: Linn.*Sp.Pl.* 579:

Syn.Meth.St.Br. 240/237/242: *H.P.* 559-562: *H.P.III* 304:

Tri. 8.7: *Cat.Angl.* 179-180: *Camb.* 78.

H.P. 559-562:

17 species given, including:

Lamium album Ger. *vulgare album sive Archangelica flore albo* Park. *album non fœtens folio oblongo* C.B. *Galeopsis sive Urtica iners floribus albis* J.B.

White Archangel or Dead Nettle.

H.P.III 304:

13 additional species given.

Tri. 8.7:

Archangel: *Lamium, -ii*, n.: *Γαλίοψις, -εως,*[565] f.

Line 44. *Marrubio: Marrubium.*

[C.T.& M. 417] *Marrubium vulgare* (L.), White Horehound; a species of the *Marrubium* genus of the *Labiatæ* or Mint family.

B.& G.-W. 332: B.& H. 354: Linn.*Sp.Pl.* 582-584:

Syn.Meth.St.Br. 239: *H.P.* 555-557: *H.P.III* 302: *Tri.* 11.93:

Cat.Angl. 197: *Camb.* 83.

H.P. 555-557:

15 species given, including:

Marrubium album J.B. Ger. *album vulgare* C.B. Park.

White Horehound.

H.P.III 302:

13 additional species given.

Also: *Post speciem 12am adde*, 8 species either *Pseudo-*

565 NB The ancient Greek is γαληόψις but Ray definitely has Γαλίοψις with ί in *Trilingue.*

dictamnus or *Pseudo-Marrubium.*

Tri. 11.93:

Horehound: *Marrubium, -ii,* n.: *Πρασιον, -ιου,* n.

Line 44. *Rubiā: Rubia.*

[C.T.& M. 433] *Rubia peregrina* (L.), Wild Madder; a species of the *Rubia* genus of the *Rubiaceæ* or Bedstraw family.

B.& G.-W. 316: B.& H. 210: Linn.*Sp.Pl.* 109:

Syn.Meth.St.Br. 223: *H.P.* 478-486:

H.P.III 262 / *Cynanchica* 265: *Tri.* 11.112: *Cat.Angl.* 257-258: *Camb.* - no ref.

H.P. 478-486:

Rubia tinctorum Ger. *sativa* J.B. *major sativa sive hortensis* Park. *tinctorum sativa* C.B. ***Madder.***

Rubia sylvestris aspera, quae sylvestris Dioscoridis C.B. *sylvestris Monspessulana major* J.B. *sylvestris* Park.

Wild Madder.

H.P.III 262 / *Cynanchica* 265:

Ad cap. de Rubia: 15 additional species given.

Ad cap. de Aparine: 11 additional species given, including *Rubia cynanchica.*

Ad cap. de Rubia spicata: 3 additional species given.

Tri. 11.112:

Madder: *Rubia, -æ,* f.:*'Ερυθρόδανον, -ου,* n.

Line 45. *Quinquangulus:* five-sided as in *Campanula* and *Polyacantha vulgaris.*

Line 45. *Campanulā: Campanula.*

[C.T.& M. 422-424] *Campanula* (L.), Bellflower; a genus of the

Campanulaceæ or Bellflower family.

B.& G.-W. 388-390: B.& H. 274: Linn.*Sp.Pl.* 163-169: *Syn.Meth.St.Br.* 276-277: *H.P.* 731-742: *H.P.III* - in Index to Vol.III but no page number given*: Tri.* - no ref.: *Cat.Angl.* 49-50: *Camb.* 50.

H.P. 731-742:

26 species given *De Trachelio sive Campanula hirsuta.*

24 species given of *Rapunculi & Campanulæ glabræ.*

5 species given of *Campanula vasculo oblongo in siliquam producto, Speculum Veneris dicta.*

8 species given of *Rapunculi corniculati.*

7 species given of *Rapunculi [sic] flore galeato.*

Line 45. *Polyacanthã vulgari: Polyacantha vulgaris.*

[C.T.& M. 482] *Carduus crispus* (L.), closely resembles *Carduus acanthoides* (L.), the Welted Thistle; a species of the *Carduus* genus of the *Compositæ* or Daisy family.

B.& G.-W. 422: B.& H. 250 *(Carduus acanthoides)*: Linn.*Sp.Pl.* 821 *(Carduus acanthoides* includes *Carduus polyacanthos)*: *Syn.Meth.St.Br.* 194: *H.P.* 309: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref. as *Polyacantha vulgaris* but see under *Carduus polyacanthos primus* and *secundus* 53-54: *Camb.* - no ref.

Linn.*Sp.Pl.* 821:

Carduus acanthoides:

Carduus foliis sinuatis decurrentibus margine spinosis, calycibus pedunculatis solitariis erectis villosis.

Carduus foliis laciniatis: subtus tomentosis ex margine spinosis, capitulis sessilibus congestis aculeatis. Hall.helv.677.

Dalib.paris.248.

Carduus acanthoides. Bauh.hist.3.p.59. It.scan.297*

Carduus spinosissimus, capitulis minoribus. Raj.angl.3.p.194.

Carduus polyacanthos, capitulis longioribus & tenuioribus, foliis albicantibus. Moris.hist.3.p.153.

Habitat in Europæ ruderatis.

Syn.Meth.St.Br. 194:

Carduus caule crispo J/B.III 59. *spinosissimus angustifolius vulgaris* C.B.Pin.385. *polyacanthos* Park.982. *polyacanthos primus* Ger.Em.1173. *Aculeosa Gazæ* Ad.374. *& Polyacantha* Tab.Ic.701. ex sententia Johnsoni. ***Thistle upon Thistle.***

*H.P.*309:

Carduus polyacanthos Park. *primus* Ger.emac. *Aculeosa Gazæ* Ad. *& Polyacantha* Tab.i.ex sententia Johnsoni. *Carduus caule crispo* J.B. ***Thistle upon Thistle.***

Line 46. *Sexangulus:* six-sided as in *Lysimachia purpurea trifolia.*

Line 46. *Lysimachiã purpureã trifoliã: Lysimachia purpurea trifolia*: see above Cap.7, line 22.

See also Ray, *Synopsis Methodica Stirpium Britannicarum:* 367:

Lysimachia purpurea trifolia, caule hexagono Spiegel.Isag. *varietas potius præcedentia est, quam species distincta.*

Ray, *Catalogus Plantarum Angliæ: 194:*

Lysimachia purpurea trifolia caule hexagono Spigel. isag. ***Three-leaved purple Loose-strife.*** *Hæ est varietas præcedentis potius quam species distincta.*

The preceding plant in both cases is:

Salicaria vulgaris purpurea foliis oblongis Inst.R.H.253.

Lysimachia purpurea Ger.386. Park.546. *purpurea, quibusdam spicata* J.B.II.902. *spicata purpurea, forte Plinii* C.B.Pin.246. ***Purple spiked Willow-herb, or Loose-strife.***

Line 47. *Inter angulatos & teretes caules ambigunt striati;* he says that between angled and round stems are striated ones, such as in *Siciliana.*

Line 47. *Sicilianã: Siciliana.*

[C.T.& M. 114] *Hypericum androsæmum* (L.), Tutsan; a species of the *Hypericum* or St. John's Wort genus of the *Guttiferæ* or *Hypericum* family.

B.& G.-W. 246: B.& H. 79: Linn.*Sp.Pl.* 784:

Syn.Meth.St.Br. 343: *H.P.* 1020: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref. under *Siciliana* but under *Hypericum majus* 167-168: *Camb.* - no ref.

*H.P.*1020:

Androsæmum vulgare Park. *maximum frutescens* C.B. *Siciliana aliis Cæciliana vel Androsæmon* J.B. *Clymenum Italorum* Ger. ***Tutsan or Park-leaves.***

Line 48. *Caulis teres seu rotundus est* ....: he gives as examples of smooth and rounded stems *Anagallis aquatica* and *Nummularia,* plus 'many others especially bulbous plants'.

Line 48. *Anagaliide aquaticã: Anagallis aquatica.*

[C.T.& M. 378] *Veronica beccabunga* (L.), Brooklime: *Veronica anagallis-aquatica* (L.), Blue Water-speedwell; both are species of the *Veronica* genus of the *Scrophulariaceæ* or Figwort family.

B.& G.-W. 362: B.& H. 335: Linn.*Sp.Pl.* 12:

Syn.Meth.St.Br. 280 and 283: *H.P.* 852: *H.P.III* 496: *Tri.* 8.23:

*Cat.Angl.*19-20 - 4 species given, all *aquatica:*

Anagallis aquatica minor folio subrotundo

Anagallis aquatica minor folio oblongo

Anagallis aquat. rotundifolia

Anagallis aquatica angustifolia

Camb. 42.

H.P. 852:

Veronica aquatica Anagallis aquatica dicta.

6 species given all with *Anagallis aquatica* in their names:-

1. *Anagallis rectius Veronica aquatica minor folio subrotundo* C.B. *aq. flore cæruleo, folio rotundiore minor* J.B. *aq. vulgaris sive Beccabunga* Park. *aq. sive Beccabunga* Ger. ***Common Brooklime.***
2. *Anagallis rectius Veronica aquatica folio rotundiore major* J.B. *aquat. major folio subrotundo* C.B. *aquat. sive Beccabunga major* Park. *Anagallidis sive Beccabungæ varietas major* Ger.
   The greater round-leaved Brooklime.
3. *Anagallis, rectius Veronica, aquatica major folio oblongo* C.B. *aquat. flore cæruleo, folio oblongo major* J.B. *aquat. major* Ger. *aquat. folio oblongo crenato* Park.
4. *Anagallis, rectius Veronica aquatica minor* Ger. *aq. min. folio oblongo* C.B. *aq. flore purpurescente, folio oblongo minor* J.B. *aq. folio oblongo crenato* Park.
   The lesser long-leaved Brooklime, or Water Pimpernel.
5. *Anagallis rectius Veronica, aquatica angustifolia* J.B. *angustifolia scutellata* C.B. *aquatica 4 Lobelii* Ger.emac. *aquat. angustifolia sive 4 Lobelii* Park.
6. *Anagallis aquatica, Pulegio similis, caulibus quadratis* Trag. *Anag. aquat. foliis Pulegii* Park. *foliis Pulegii, Serpyllive* C.B.

H.P.III 496:

Many examples given, but none called *aquatica*: however he

does say that they love water.

Tri. 8.23:

Brooklime: *Anagallis aquatica*, f.: *Ἀναγαλλὶς, -ίδος,* f.

Line 48. *Nummulariã:Nummularia.*

[C.T.& M. 347] *Lysimachia nummularia* (L.), Creeping Jenny: a species of the *Lysimachia* genus of the *Primulaceæ* or Primrose family.

B.& G.-W. 300: B.& H. 291: Linn.*Sp.Pl.* 148:

Syn.Meth.St.Br. 283: *H.P.* 1099: *H.P.III* 507:

Tri. - no ref.: *Cat.Angl.* 211-212: *Camb.* 87.

H.P. 1099:

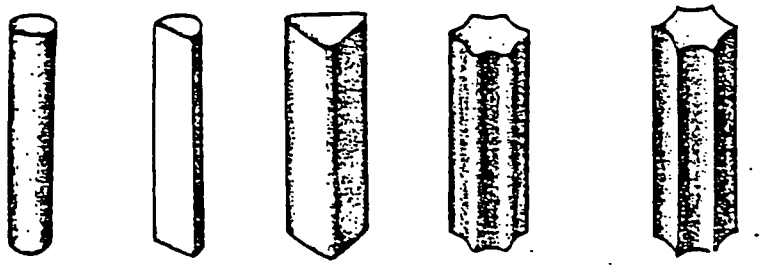
3 species given, including:

Nummularia Ger. *vulgaris* Park. *major lutea* C.B. *Num. sive Centimorbia* J.B. ***Money-wort or Herb Two-pence.***

H.P.III 507:

4 additional species given.

Diagram of stem sections after J.Lindley, *Introduction to Botany,* 1832:[566]



Line 50. *Caulis ~~inanis~~ vel totus inanis est, vel in nodis seu geniculis consolidatus:* he says that a hollow stem is either hollow throughout

566 Stearn, *Botanical Latin:* 321.

or hollow with joints at intervals, as in *Arundo, Frumentum, Gramen, Fœniculum* and *Gentiana.*

Line 50. *Arundine: Arundo.*

[C.T.& M. 648] *Phragmites australis* ([Cav.] Trin. ex Steudel), Common Reed: *[Phragmites communis* (Trin.): *Arundo phragmites* (L.)]; a species of the *Phragmites* (Adanson) genus of the *Gramineæ* or Grass family.

B.& G.-W. - no ref.: B.& H. 546: Linn.*Sp.Pl.* 81-82: *Syn.Meth.St.Br.* 401: *H.P.* 1275-1280: *H.P.III* 614: *Tri.* 13.159: *Cat.Angl.* 29: *Camb.* 45.

*H.P.*1275-1280:

16 species given, including:

Arundo vallatoria Lob. Ger. *vulgaris palustris* J.B. *vulgaris sive phragmites Dioscoridis,* κάλαμος *Theophrasti* C.B. *Harundo vulgaris sive vallatoria* Park. ***Common Reed.***

H.P.III 614:

8 additional species given.

Tri. 13.159:

Reed: *Arundo, -inis,* f.: κάλαμος, -άμου, m.

Line 50. *Frumentis: Frumentum.*

[Mac.Enc. 763] Maize, *Zea mays.* C.T.& M./ B.& G.-W./ B.& H. - no ref. See below under *Maiz,* Cap.10, line 3, and below under *Zea,* Cap.21, line 10.

Line 51. *Graminibus: Gramen.*

[C.T.& M. 613] *Gramineæ,* the Grass family. B.& G.-W. - no ref.: B.& H. 503: Linn.*Sp.Pl.* - many references throughout the text to plants described as *Gramen:*

Syn.Meth.St.Br. 386-437: *H.P.* 1255-1310: *H.P.III* 598-618:
Tri. 10.83: *Cat.Angl.* 136-153: *Camb.* 69-72.

H.P. 1255-1310:

Many references to various grasses here, the first given being: *Gramen repens, Officinarum forte, spica Triticae aliquatenus simile* J.B. *An Gramen caninum* Ger? *caninum vulgatius* Park? *caninum arvense, seu Gramen Dioscoridis* C.B. ***Common Dogs-grass, or Quich-grass, or Couch-grass.***

H.P.III 598-618:

Many additional species given.

Tri. 10.83:

Grass: *Gramen, -inis*, n.: *Ἄγρωστις, -εως*, f.

Line 51. *Fœniculo: Fœniculum.*

[C.T.& M. 286] *Fœniculum vulgare* (Miller), [*Fœniculum officinale* (All.)], Fennel; a species of the *Fœniculum* genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 276: B.& H. 190: Linn.*Sp.Pl.* 263:
Syn.Meth.St.Br. 217: *H.P.* 457-458: *H.P.III* 257: *Tri.* 10.71:
Cat.Angl. 111: *Camb.* - no ref.

H.P. 457-458:

Fœniculum vulgare Ger. Park. *vulgare minus acriore & nigriore semine* J.B. *vulg. Germanicum* C.B. *item vulg. Italicum, semine oblongo, gusto acuto* ejusdem. *Item Fœnic. sylvestre* ejusdem. *Hæc enim tris non aliter differunt, quam accidentibus a loco & cultura ortis.* ***Common Fennel or Finckle.***

H.P.III 257:

1 additional species given.

Tri. 10.71:

Fennel: *Fœniculum, -i,* n.: *Μάραθρον, -άθρου,* n.

Line 51. *Gentianã: Gentiana.*

[C.T.& M. 353-355] *Gentiana* (L.), Gentian; a genus of the *Gentianaceæ* or Gentian family.

B.& G.-W. 306-308: B.& H. 301: Linn.*Sp.Pl.* 227-232:

Syn.Meth.St.Br. 274-275: *H.P.* 716-722: *H.P.III* 368-369:

Tri. 10.78: *Cat.Angl.* 128-129: *Camb.* 67.

H.P. 716-722:

20 species given, including:

Gentiana major Ger. *major lutea* C.B. Park. *vulgaris major Ellebori albi folio* J.B.

The most common great Gentian, or Felwort.

H.P.III 368-369:

Ad Gentianas majores: 6 additional species given.

Ad Gentianas minores seu Gentianellas: 12 additional species given.

Tri. 10.78:

Gentian or Felwort: *Gentiana, -æ,* f.: *Γεντιανὴ, -ῆς,* f.

Line 52. *Differentiae caulium situs respectu:* margin sub-heading.

Tandem Caulis situs respectu vel rectus est, vel repens; Ray defines a stem's position or habit as either 'upright' or 'creeping'.

Line 52. *vel adminiculis indiget*: he says that an upright stem needs supports *quibus vel circumvolvendo sese implicat* ('around which to entwine itself by twisting') as in the *Lupulus* and *Convolvulus.*

An interesting note, to add to what Ray says, is that the *Lupulus* twists itself round its support in a clockwise direction and

the *Convolvulus* in a counter-clockwise direction.[567]

Line 53. *Lupulus.*

[C.T.& M. 310] *Humulus lupulus* (L.), Hop; a species of the *Humulus* genus of the *Cannabaceæ* or Hemp family.

B.& G.-W. 58: B.& H. 400: Linn.*Sp.Pl.* 1028:

Syn.Meth.St.Br. 137: *H.P.* 156: *H.P.III* 104: *Tri.* 11.92:

Cat.Angl. 191-192: *Camb.* 81.

H.P. 156:

> *Lupulus mas & fœmina* J.B.I. *seu mas* & II. *seu fœmina* C.B. 1 *sive sativus* & 2. *sive sylvestris* Park. *nec enim aliter differunt quam magnitudine & exilitate aliisque accidentibus a cultura ortis. lupus salictarius* Ger.
>
> ***Hops, the Male and Female.***

H.P.III 104:

> 5 additional species given, but Ray says that out of these species no true and genuine species of *Lupulus* is to be seen, but they are referred to as *Lupuli* because of some similarity in external appearance to the *Lupulus*.

Tri. 11.92:

> Hops: *Lupulus, -i,* m.: [No Greek].

Line 53. *Convolvuli: Convolvulus:* see above Cap.1, line 50.

Line 53. *vel claviculis se alligat:.....:* he says that 'some upright stems tie themselves with tendrils to their supports'.

A tendril is defined as a modified leaf, leaflet, branch or inflorescence of a climbing plant, which coils round suitable objects, such as other nearby plants, and helps to support and elevate the plant.[568] Ray gives two examples: *Vitis*, in which the tendrils

567 Clapham, Tutin and Moore: 310 and 318.

568 *Penguin Dictionary of Botany:* 357.

resemble climbing roots in being negatively phototropic and hence growing into cracks on the support:[569] and *Bryonia alba*, which has branch tendrils which twine around the support.[570] He also cites most legumes as having such tendrils.

Line 54. *Vitis*: see above Cap.5, line 26.

Line 54. *Bryonia alba*.

[C.T.& M. 294] *Bryonia cretica*: subsp. *dioica* ([Jacq.] Tutin), White or Red Bryony; a species of the *Bryonia* genus of the *Cucurbitaceæ* or Gourd family.

B.& G.-W. 256: B.& H. 157: Linn.*Sp.Pl.* 1012:
Syn.Meth.St.Br. 261: *H.P.* 659: *H.P.III* - no ref.: *Tri.* 8.24:
Cat.Angl. 44-45: *Camb.* 48-49.

H.P. 659:

> *Bryonia alba* Ger. *alba vulgaris* Park. *aspera, sive alba baccis rubris* C.B. *Vitis alba sive Bryonia* J.B. ***White Bryony.***

Tri. 8.24:

> Bryony: *Bryonia, -æ,* f.: *Βρυονία, -ας,* f.

Line 54. *vel foliorum pediculis annectit*: note that *pediculis* is used here in the text, although the term indicated is the petiole. A petiole is now defined as the stalk, which attaches the leaf lamina to the stem.[571]

Ray correctly says that *Nasturtium Indicum* and *Fumaria* attach themselves to their supports by twisting their leaf-stalks round the support.

569 *Penguin Dictionary of Botany:* 357.
570 *ibid.*
571 *ibid.:* 268.

Line 54. *Nasturtium Indicum.*

[R.H.S., P.& F. 583] *Tropæolum majus* (L.), Garden Nasturtium or Indian Cress; a species of the *Tropæolaceæ* or Nasturtium family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 345: *Syn.Meth.St.Br.* - no ref.: *H.P.* 487: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 487:

Nasturtium Indicum Park. Ger. *Indicum majus* C.B. *Indicum folio peltato scandens* J.B.

Indian Cress, Yellow Larks-spur.

Line 55. *Fumaria.*

[C.T.& M. 62-65] *Fumaria* (L.), Fumitory; a genus of the *Fumariaceæ* or Fumitory family.

B.& G.-W. 130: B.& H. 21: Linn.*Sp.Pl.* 699-701: *Syn.Meth.St.Br.* 204: *H.P.* 404-405: *H.P.III* 475: *Tri.* 10.76: *Cat.Angl.* 116-118: *Camb.* 65.

H.P. 404-405:

3 species given, including:

Fumaria vulgaris J.B. Park. *non bulbosa, seu Officinarum & Dioscoridis* C.B. *purpurea* Ger. *Caphos* Lob. *Herba melancholifuga* Cat. Altd. ***Fumitory.***

H.P.III 475:

Siliquosa: 11 additional species given.

Tri. 10.76:

Fumitory: *Fumaria, -æ,* f.: *Καπνὸς, -οῦ,* m.

Line 55. *cirris adhaerescit:* he says that some upright stems stick to their supports with tufts of hair as in *Hedera.* Ray's *cirris* or 'tufts of hair' are in fact adventitious roots growing on the stem, with which

the plant attaches itself to its support.[572]

Line 55. *Hedera:* see above Cap.4, line 119.

Text page 12.

Line 56. *Repens est quæ horizontaliter extensus .....:* Ray describes a creeping stem as 'extending horizontally and putting out leaves and roots at intervals'; he gives as examples *Fragaria, Pentaphyllum* and *Ranunculus.*

Fragaria or Strawberry is a stoloniferous perennial: that is, it produces long runners or stolons, which, unable to carry the weight of the plant, bend and touch the ground, where they put out roots at the nodes and thus develop new plants.

Ray's *Pentaphyllum*, the *Potentilla* or Cinquefoil, is also a stoloniferous perennial.

As Ray is using *Ranunculus* here as an example of a creeping stem, he must be referring to *Ranunculus repens* (L.), the Creeping Buttercup, which is a species of the *Ranunculus* genus of the *Ranunculaceae* or Buttercup family.

Line 56. *Fragariã:Fragaria.*

[C.T.& M. 217] *Fragaria vesca* (L.), Wild Strawberry, *Fragaria* x *ananassa* (Duchesne), Garden Strawberry, *[Fragaria chiloensis* x *virginiana].* Both are species of the *Fragaria* genus of the *Rosaceæ* or Rose family.

B.& G.-W. 192: B.& H. 135: Linn.*Sp.Pl.* 494-495:
Syn.Meth.St.Br. 254: *H.P.* 609-610: *H.P.III* 325:
Tri. 13.186 / *Tri.* 19.111: *Cat.Angl.* 111-112: *Camb.* 64.
H.P. 609-610:

6 species given, including:

572 Clapham, Tutin and Moore: 266.

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B.& G.-W. 192: B.& H. 135: Linn.*Sp.Pl.* 494-495:
Syn.Meth.St.Br. 254: *H.P.* 609-610: *H.P.III* 325:
Tri. 13.186 / *Tri.* 19.111: *Cat.Angl.* 111-112: *Camb.* 64.
H.P. 609-610:

6 species given, including:

572 Clapham, Tutin and Moore: 266.

Fragaria Ger. *vulgaris* Park. C.B. *Fragaria ferens fraga alba & rubra* J.B. ***Common Strawberry.***

H.P.III 325:

Ad cap. de Fragaria fertili: 3 additional species given.

Ad cap. de Fragaria sterili: 4 additional species given.

Tri. 13.186:

Strawberry: *Fragaria, -æ,* f.: *Κόμαρον, -άρου,* n.

*Tri.*19.111:

A Strawberry: *Fragum, -i,* n.: *Κόμαρον, -άρου,* n.

Line 57. *Pentaphyllo: Pentaphyllum.*

[C.T.& M. 212-216] *Potentilla* (L.), Cinquefoil; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 184-188: B.& H. 136: Linn.*Sp.Pl.* 497-500: *Syn.Meth.St.Br.* 255: *H.P.* 611-615: *H.P.III* 325: *Tri.* 9.41: *Cat.Angl.* 227-228: *Camb.* 93.

H.P. 611-615:

22 species given, including:

Pentaphyllum vulgatissimum Park. *pentaphyllum sive Quinquefolium vulgare repens* J.B. *Quinquefolium vulgare* Ger. *majus repens* C.B.

Common Cinquefoil or Five-leaved Grass.

H.P.III 325:

16 additional species given.

Tri. 9.41:

Cinquefoil: *Pentaphyllum, -i,* n.: *Πεντάφυλλον, -ου,* n.

Line 57. *Ranunculo: Ranunculus.*

[C.T.& M. 38-49] *Ranunculus* (L.), Buttercups and Crowfoots; a genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 114-120: B.& H. 6: Linn.*Sp.Pl.* 548-556:
Syn.Meth.St.Br. 247-251: *H.P.* 581-595: *H.P.III* 314-315:
Tri. 9.51: *Cat.Angl.* 248-251: *Camb.* 100-101.

H.P. 581-595:

Many species of Crowfoot listed:

Meadow Crowfoot - 11 species.

Wood Crowfoot - 4 species.

Spiny Crowfoot - 4 species.

Water Crowfoot - 10 species.

Grass-leaved Crowfoot - 4 species.

Mountain Crowfoot (differing in colour of flower or shape of leaf from other genera) - 12 species.

Tuberous-rooted Crowfoot - 15 species.

Crowfoot described by C.Bauhin and Parkinson - 9 species.

H.P.III 314-315:

30 additional species given.

Tri. 9.51:

Crowfoot: *Ranunculus, -i,* m.: *Βατράγιον, -ίου,* n.

Line 57. *Quibus caules ..... appellat Jungius:* Jung says that plants with creeping stems are *Plantas plurimum fundorum* ('plants of many foundations'). For Jung see above Cap.1, line 1.

This is an accurate way of describing a stoloniferous plant; for full definition see above Cap.7, line 56.

Line 58. *Plerœque autem hujus generis plantæ duum generum caules emittunt, alterum erectum, alterum repentem:* Ray is correct in saying that most stoloniferous plants produce both upright and creeping stems. The stolons develop from the lower axillary buds, whereas the apical and upper axillary buds form the flower stems. He gives

as examples *Fragaria, Bugula* and *Ranunculus.*

Line 59. *Fragariã: Fragaria:* see above Cap.7, line 56.

Line 59. *Bugulã: Bugula.*

[C.T.& M. 419] *Ajuga reptans* (L.), Bugle; a species of the *Ajuga* genus of the *Labiatæ* or Mint family.

B.& G.-W. 332: B.& H. 361: Linn.*Sp.Pl.* 561:

Syn.Meth.St.Br. 245: *H.P.* 575: *H.P.III* 312: *Tri.* - no ref.:

Cat.Angl. 46: *Camb.* 49.

H.P. 575:

3 species given, including:

Bugula Dod. Ger. *vulgaris flore cæruleo* Park. *Consolida media pratensis cærulea* C.B. *Consolida media quibusdam Bugula* J.B. ***Bugle.***

H.P.III 312:

5 additional species given.

Line 59. *Ranunculo: Ranunculus:* see above Cap.7, line 57.

Chapter Eight:

On buds, especially what is written by the most illustrious Malpighi and Grew.

In this chapter Ray defines a bud, citing especially the work of Malpighi[573] and Grew. It has been said that 'Some of the most important observations of Grew and Malpighi were those on the origin and nature of buds'.[574] Both took advantage of the development of the microscope for this work.

> This investigation of the structure of buds and their growth was particularly illuminating for the further progress of morphology; the recognition of the developmental aspect gave a more objective and widely applicable method of analysing plant form.[575]

Text page 12.

Line 1. *Gemmæ dicuntur ..... :* Ray/Malpighi defines buds as the new embryos of trees and shrubs. Malpighi had described a bud as 'like an undeveloped plant in miniature'.[576] Ray defines a bud in his introductory glossary and refers the reader to this chapter of *Historia Plantarum:*

> *Gemma in Phytologia idem est quod Oculus. Anglice* ***A Bud.*** *Id quod in arboribus tumescit cum papere incipiunt. Gemmæ pleniorem descriptionem vide lib.1. cap.8. p.12.*[577]

A bud is now defined as an undeveloped condensed region of a shoot consisting of a short stem terminated by a meristem, which

573 Malpighi's definition and analysis of buds are given in his *Anatome Plantarum:* 22-31.
574 Morton: 182.
575 *ibid.*:183.
576 For Malpighi on buds see *Anatome Plantarum:* 22-31.
577 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

will develop into either a leaf or flower. Buds are either apical/terminal (at the tip of a stem) or axillary/lateral (in the leaf axils on the stem).[578]

Line 2. *veluti secundis obvoluti:* Ray describes the scaly coverings of buds as being like afterbirths. Malpighi had observed that bud-scales were specialised leaves, 'with the same mode of origin and fundamental morphology as foliage leaves'.[579] The dormant winter buds of deciduous trees and shrubs possess protective, often resinous, bud scales or cataphylls to resist dessication.[580]

Line 3. *Hæ (inquit Malpighius) in nostris hisce regionibus circa Junium mensem .....e tenello surculo erumpunt;* this is almost a direct quotation from Malpighi.[581]

Line 4. *(serius apud nos in Anglia):* Ray's aside that the spring begins earlier in Malpighi's native Italy and is later in Britain.

Line 4. *intra folii axillam cubantes:* Malpighi is meaning axillary or lateral buds rather than apical or terminal buds.

Line 6. *a quibus excoquitur & derivatur non tantum seminum materia, sed & Spermatica organa:* Malpighi is talking of flower buds rather than leaf buds.

Line 7. *Non enim idem uterus perpetuo viget:* he gives an analogy with the uterus of animals here, explaining that unlike animals a plant 'uterus' is fertile for only one season and cannot be re-used like that

578 *Penguin Dictionary of Botany:* 50.
579 Morton: 182.
580 *Penguin Dictionary of Botany:* 50.
581 Malpighi, *Anatome Plantarum:* 22.

of an animal.

Line 8. *sed singulus quique ramus anno quo luce fruitur propriis gaudet spermaticis organis* ....: Malpighi is saying that plants only flower and produce fruit on the current year's growth. Many flowering trees and shrubs in fact form both kinds of buds in the summer or early autumn, which will develop the following spring.[582]

Line 9. *reliquum vero suae vitæ infœcundum transfigit:* he is talking of flowering shoots. generally the stem apex of a woody plant is capable of growing indefinitely year after year; this is called monopodial growth. In some monopodial species. as long as their growth is vegetative (leaves only) they will continue to grow, but, if they produce an inflorescence or flower cluster, the end of the stem will cease to grow. Growth then becomes sympodial or lateral. Some plants, however, lose the ability to grow monpodially even without producing flowers from the terminal bud; such a plant is the Lime *(Tilia)*, where the terminal bud is always lost, growth being continued by the axillary bud of the last foliage leaf of the year, that nearest to the tip of the stem.[583]

Line 12. *Gemma cum sit compendium surculi, seu tenellus surculus cum futorum foliorum inchoamentis compendio quasi conclusus.* Ray here gives a definition very similar to Grew, who 'describes how the youngest leaves cluster round the stem tip with the "central and minutest ..... five hundred times smaller than the outer"'.[584]

582 *Lowson's Botany:* 63; Allen, *Pruning and Grafting:* 14.
583 *Lowson's Botany:* 65-66.
584 Morton: 182.

Line 13. *Media enim ....*: he seems to be describing leaf buds[585] here, which contain many leaf primordia (immature parts in early stages of development appearing as microscopic projections, which will change into the leaf),[586] leaf buttresses (the earliest stage in the development of a leaf primordium, which later forms the leaf base, the remainder of the leaf growing upwards and outwards from the buttress),[587] and young rolled or folded leaves.

Line 14. *utriculisque:* for *utriculi* see above Cap.3, line 83.

Line 15. *frequentissime candidis pilis obsitum:* the dormant winter buds of trees and shrubs may have, within the inner bud scales or cataphylls, a lining of fine hairs which gives them a silvery appearance and may help prevent transpiration.[588]

Grew had noted that

> the youngest and most delicate leaves are protected by the older leaves and bud-scales, as well as by the frequent presence of hairs among them.[589]

Line 17. *ut multis exemplis ostendit D.Malpighius:* Malpighi 'studied the buds of more than twenty different species in section, including oak, fennel and beet'.[590]

Line 18. *non tantum interioribus & conclusis custodiam pariunt*: the cataphylls (see line 15 above), which are often resinous, are protective bud scales resisting dessication.[591]

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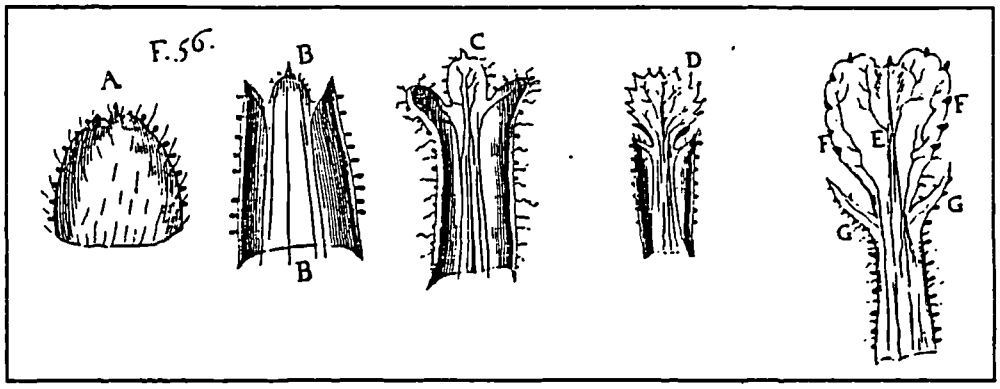
585 *Penguin Dictionary of Botany:* 50.
586 *ibid.:* 292.
587 *ibid.:* 206.
588 *ibid.:* 50; Cooke, Burkitt and Barker: 197.
589 Morton: 182.
590 Malpighi, *Anatome Plantarum:* 22-31. Also Morton: 182.
591 *Penguin Dictionary of Botany:* 50.

Line 21. *unde hujusmodi gemmarum folia non unicam costulam, ut in stabilibus foliis fere semper miramur per mediam productam possident, sed multiplices fasciculi a basi assurgentes in proprios appensos utriculos desinunt.*

Ray is paraphrasing Malpighi here, as in most of this section.

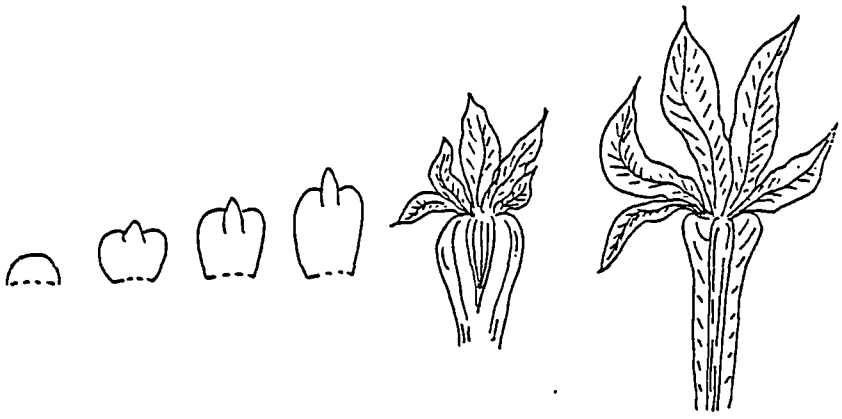
Malpighi gives a beautiful diagram to illustrate this:[592]



Line 16-25. *foliola hæc gemmarum*: the bud scales or cataphylls, for which see above Cap.8, line 2.

Line 25. *vel gracilescendo in petioli formam absumuntur*: is he referring here to the development of a bud scale, as in the Sycamore *(Acer pseudoplatanus)* and Horse Chestnut *(Æsculus hippocastanum)*, when the base of the bud scale becomes the leaf base?

See diagram below of a dissected Horse Chestnut bud showing the transition from bud scales to foliage leaves:[593]



592 Malpighi, *Anatome Plantarum:* Tab.XI, fig. 56.

593 Drawn from *Lowson's Botany:* 64.

Line 26. *Non autem una perpetuo est naturæ methodus in augendis gemmarum foliis ....*: dormant winter buds are covered by cataphylls, which are for protection and do not photosynthesise,[594] but buds produced in a current season do not need this protection and so the bud scales can develop into leaves or flowers.

Line 27. *sed passim in pluribus arboribus gemmarum folia ....*: sometimes some of the inner scales of a Sycamore *(Acer pseudoplatanus)* bud carry at the tip a short green tuft, which shows division into four or five lobes, and is a rudimentary leaf blade. The occurrence of these rudiments of the leaf blade suggests that the bud scales represent modified leaf bases. As Ray says, many trees have buds of this type; the inner scales of the Horse Chestnut *(Æsculus hippocasatnum)* bud are of this type, and those of the Beech *(Fagus)* contain small foliage leaves with a pair of scale-like stipules attached at the base. The gradual transition from bud scales (modified stipules) to foliage leaves is clearly shown if the bud of the Bird Cherry *(Prunus padus)* is dissected.[595] For bud scales, which develop into leaves, see diagram above Cap.8, line 25, of a Horse Chestnut bud.

Line 30. *Naturæ pariter methodus in producendis stabilibus foliis mirabilis est.* Ray comments on the wonders of leaf formation. Grew had studied in detail the growing point of the bud.

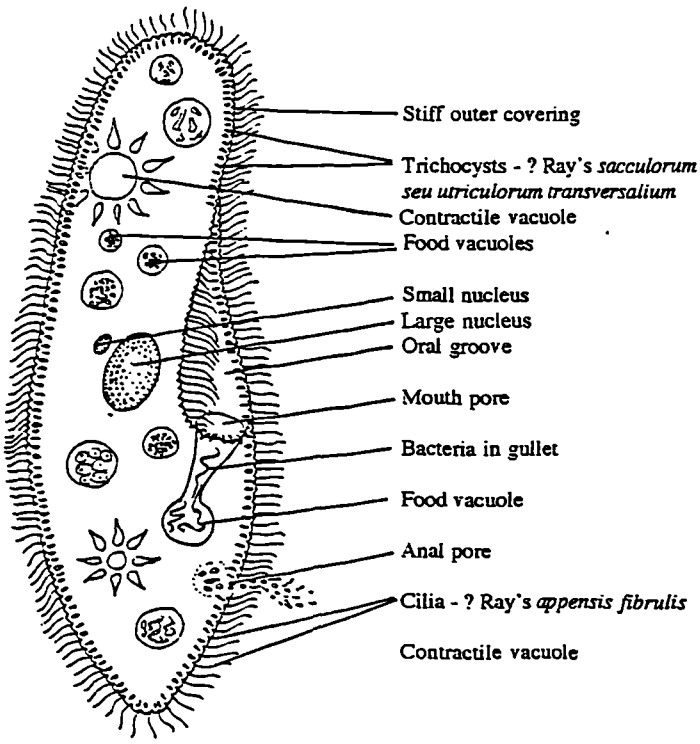
> He conceived growth in a physiological way as a movement of sap into the growing point, proceeding with a "motion most even and gradual so as not to cause the least breach of its parts", whilst the growth of branch and leaves takes place by "accretion of new, and partly

594 *Lowson's Botany:* 63.
595 Cooke, Burkitt and Barker: 198.

the extention [*sic*] of its already existent parts".[596]

Line 30. *Primo enim costula seu petiolus ....:* he is probably referring here to the leaf buttresses and leaf primordium, for which see above Cap.8, line 13.

Line 32. *ut in Animalium primæva delineatione observatur:* is he referring to the structure of primitive animals such as the unicellular Protozoon *Paramecium? Paramecium* has all over the outside of its 'skin' hair-like cilia for locomotion and driving in food to the oral groove, and beneath the 'skin' has trichocysts, which look rather like a small bladder. See diagram below:[597]



596 Morton: 183.

597 Drawn from Ralph Buchsbaum, *Animals Without Backbones, An Introduction to the Invertebrates*, Penguin Books, London 1957: 32.

Line 35. *Foliorum stabilium situs intra gemmæ claustra mirabilis pariter est:* Ray next remarks on the position of the leaves within the bud; Grew describes in detail their complex folding (vernation), 'and was the first to observe this phenomenon'.[598]

Line 37. *Lapathio: Lapathum.*

[C.T.& M. 306-309] *Rumex hydrolapathum* (Hudson), Water Dock: *Rumex obtusifolium* (L.), Broad-leaved Dock; both are species of the subgenus *Rumex* of the genus *Rumex* of the *Polygonaceæ* or Dock family.

B.& G.-W. 68-70: B.& H. 379: Linn.*Sp.Pl.* 333-338:

Syn.Meth.St.Br. 140-143: *H.P.* 169-177: *H.P.III* 114: *Tri.* 10.62: *Cat.Angl.* 180-182: *Camb.* 78.

H.P. 169-177:

18 species given, including:

Lapathum vulgare folio obtuso J.B. *sylv. folio subrotundo* C.B. *sylv. vulgatius* Park. *sylv. folio minus acuto* Ger.

Round-leaved wild Dock, rather ***The most common great broad-leaved wild Dock.***

H.P.III 114:

8 additional species given.

Tri. 10.62:

Dock: *Lapathum, -i*, n.: Λάπαθον, -άθου, n.

Line 37. *Acetosã: Acetosa*

[C.T.& M. 306] *Rumex acetosa* (L.), Common Sorrel; a species of the subgenus *Acetosa* of the genus *Rumex* of the *Polygonaceæ* or Dock family.

B.& G.-W. 68: B.& H. 379: Linn.*Sp.Pl.* 337:

Syn.Meth.St.Br. 143: *H.P.* 177-181: *H.P.III* 115: *Tri.* 13.179:

598 Morton: 182.

Cat.Angl. 5-6: *Camb.* 38.

H.P. 177-181:

Ray says:

(Tr.) *Acetosa* is so-called by more recent scholars because of its acid taste and sap; it is likewise called *Oxalis* by the Greeks because of its acid sap.[599]

Acetosa vulgaris Park. *Acetosa pratensis* C.B. *Oxalis vulgaris folio longo* J.B. *Oxalis seu Acetosa* Ger. ***Wild Sorrel.***

H.P.III 115:

Various species given, mostly *rotundifolia* (as *Acetosa rotundifolia repens Eboracensis folio in medio deliquium patiente* Morison. *An Cambro-britannica montana* Park? ***Round-leaved Mountain Sorrel***) and *montana.* No *ovilla.*

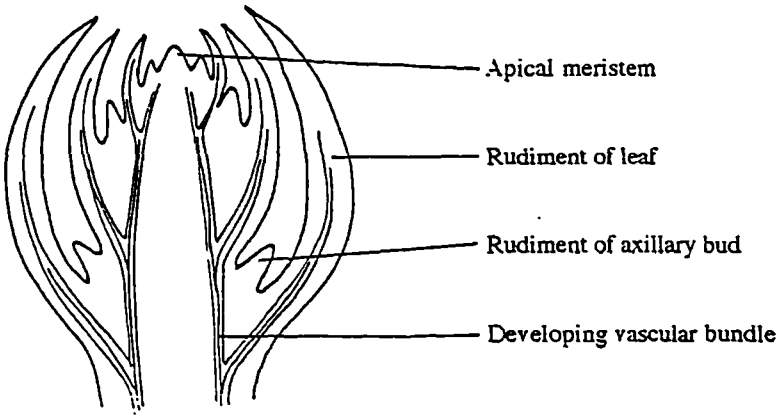
Tri. 13.179:

Sorrel: *Acetosa, -æ,* f.:*'Οξαλὶς, -ίδος,* f.

Line 37. *Bistortā: Bistorta*: see above Cap.7, line 11.

Line 44. *deinde utraque ..... usque ad maxima:* diagram to explain Ray's overlapping leaves in a bud:

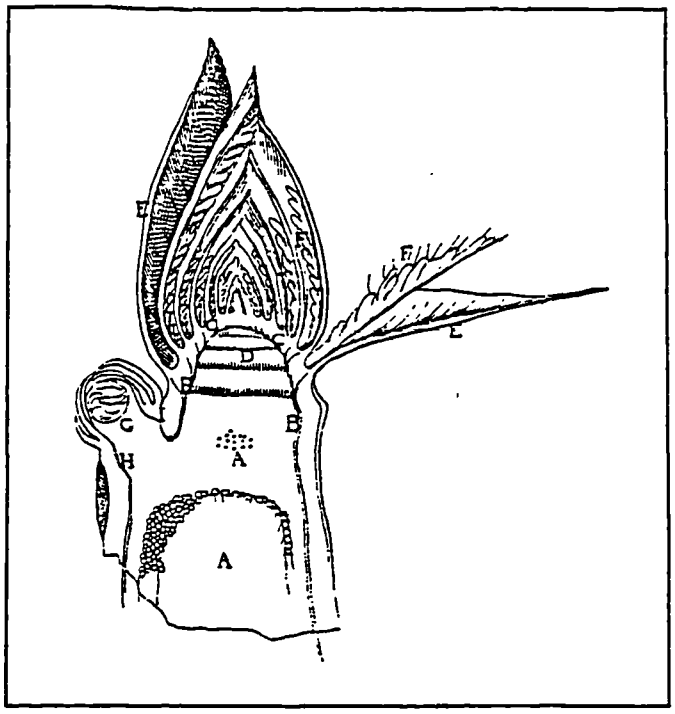
In simplified form:[600]



599 ὄξος = sour wine or vinegar: ὀξέως = sharply.

600 Drawn from Cooke, Burkitt and Barker: 162.

From Malpighi:[601]



See also overlapping bud leaves in the diagrams already given of Tulip and Daffodil, Cap.3, line 72.

Lines 45 and 47. *pediculi/pediculorum:* as in the previous chapter [see Cap.7, line 14] Ray is using the term pedicel where he should be using petiole.

Line 50. *Grevium lib. de Anatome Plantarum, cap.4.*

Line 51. *itemque lib.4, de Anat. foliorum, cap.1.* - Grew.

Line 53. *quae facile ab illis veris initio magnitudine sua discernuntur*: it is usually easy to distinguish vegetative buds, which will produce leaves, from flower buds, which are almost always larger and fatter than vegetative ones. Both kinds of bud are visible on a single stem in winter. For example, in Peach trees *(Prunus persica)* buds often

601 Malpighi, *Anatome Plantarum:* Tab.XIV, fig.75.

grow in clusters of three: the centre one will be vegetative, producing a leafy shoot, and the other two will produce flowers and eventually fruit.[602]

Line 60. *Mezerei: Mezereum.*

[C.T.& M. 259] *Daphne mezereum* (L.), Mezereon; a species of the *Daphne* genus of the *Thymelaeaceæ* or Daphne family.

B.& G.-W. 244: B.& H. 387: Linn.*Sp.Pl.* 356:

Syn.Meth.St.Br. - no ref.: *H.P.* 1587: *H.P.III D.* 53: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1587:

> *Chamælæa Germanica sive Mezereon* Ger. *Germanica, sive Mezereon vulgo* Park. *Laureola folio deciduo, flore purpureo, officinis Laureola fœmina* C.B. *Laur. fol. decid. sive Mezereon Germanicum* J.B. ***Mezereon.***

H.P.III D. 53:

> 5 additional species given, including:
> *Mezereon Africanum folio crasso Bocken-boom dictum* D.Sherard.

Line 62. *apices:* Ray is presumably using the term *apex* for the anther of a stamen as in Chapter 10: see note Cap.10, line 51.

Text page 13.

Line 65. *Lunariã min.: Lunaria minor.*

[C.T.& M. 7] *Botrychium lunaria* ([L.] Swartz), Moonwort; a species of the *Botrychium* genus of the *Filicopsidæ* or fern family.

B.& G.-W. - no ref.: *G.F.M.& L.* 107: B.& H. 557:

Linn.*Sp.Pl.* 1064: *Syn.Meth.St.Br.* 128: *H.P.* 127:

H.P.III - no ref.: *Tri.* - no ref.: *Cat.Angl.* 190-191: *Camb.* - no ref.

602 Allen, *Pruning and Grafting*: 14.

H.P. 127:

4 species given, including:

Lunaria minor Ger. Park. *L.botrytis* J.B. *racemosa minor vulgaris* C.B. ***Moon-wort.***[603]

Line 65. *F. Columnã* / Fabio Colonna, 1567/8-1650.

Unusually for a botanist of his time, he was not medically trained. His father, a nobleman, collected and edited the fragments of Ennius, and he himself studied the classics, music, mathematics, optics and the law. As a young man he suffered from epilepsy and this led him to study herbs in the hope of finding a cure. He recovered and thought at first it was due to the herb Valerian. He became a judge in Apulia where he continued his interest in botany. He published in 1592 his *Phytobasanos*, a study of some of the plants in Dioscorides. His most important work was *Minus Cognitarum Rariorumque Nostro Cœlo Orientium Stirpium Ekphrasis* (1606, but in the main edition 1616). he used a lens to look at the floral parts and was probably the first to do so. He did his own plant drawings and copper engravings; it is probable, however, that the published engravings in *Phytobasanos* and *Ekphrasis* were done by a professional.[604]

He was the first to use the word πέταλον (a leaf) in the specialised sense of petal or inner floral leaf. In 1628 he edited the plant section of F.Hernandez's account of the plants, animals and minerals of Mexico, which was in the Accademia dei Lyncei in Rome. In his notes to this work he proposed the use of the word 'petal' in its modern botanical sense. This suggestion was taken up in 1686 by Ray.[605] Ray , in a letter to John Aubrey, dated May 8th,

603 See footnote below at Cap.12, line 170.

604 Morton: 163, note 62; Raven: 191, 194, 432, 442; Arber: 97-100, 134, 152, 168, 219, 243, 281-282.

605 Morton: 163, note 62; *Phytobasanos* Cap.1 and *Ekphrasis* Part I, Cap.92.

1678, mentions the difficulties he had in finding the works of Columna:

> *Phytobasanos*, wch I have not, the other *Minus cognitarum variorumq in nostro coelo stirpium Ecphrasis*, wch I owe to ye generosity of my honoured friend Chr. Hatton Esquire.[606]

He continues that:

> I enquired diligently for them in Italy, in those cities where they were printed and elsewhere, but could hear no news of them: nor doe I think they are any where to be found but in publick libraries & some curious persons hands.[607]

In his writings the generic concept was clearly developed. In the *Ekphrasis* he lists some 200 rare Italian plants; this list contains many groups of species, truly botanically related, each group listed under a single generic name. For example, under *Ranunculus* he gives seven species, albeit with rather unwieldy descriptive names, not binomial ones such as Caspar Bauhin used. His illustrations are accurate portrayals of *Ranunculus* (L.).[608]

Line 67. *Ari: Arum:* see above Cap.3, line 35.

Lines 66-69. *In hac specie (inquit) omnes plantæ ..... sed integro racemo convolutam.* Ray certainly intends this sentence to be regarded as a quotation from Colonna, but it is difficult to decide whether the rest of the material in this chapter can be considered to be from Colonna also.

606 There is no indication from the sale catalogue of Ray's library that he ever owned any of Colonna's works. British Museum: *S-C 326* (6).

607 *Further Correspondence:* 162.

608 Morton: 148.

Lines 55-73. *Flores autem omnes ..... suo tempore proferendum.*

Flower buds do, as Grew says, contain the immature flower. The amount of development varies, however, from plant to plant. In October or November the buds of Horse Chestnut *(Æsculus hippocastanum)* or Laburnum *(Laburnum)* have well-developed leaves in the foliage buds but their flowers at the bud stage, although recognisable, are very immature. At the same time of year a Hyacinth *(Scilla)* bulb contains fully formed flowers with pollen grains almost ready for dispersal; this makes possible rapid growth in spring.[609]

609 *Lowson's Botany:* 61.

Chapter Nine:

On the leaves of plants according to Joachim Jung and other writers.[610]

Ray defines the purpose of leaves in *The Wisdom of God:*

> The *Leaves* before the *Gemma* or Bud be explicated to embrace and defend the Flower and Fruit, which is even then perfectly formed; afterwards to preserve the Branches, Flowers and Fruit from the Injuries of the Summer-Sun, which would too much parch and dry them, if they lay open and exposed to its beams without any shelter: The Leaves, I say, qualifie and contemper the Heat, and serve also to hinder the too hasty Evaporation of the Moisture about the Root: But the principal Use of the Leaves (as we learn of Seignior *Malpighii*, Monsieur *Perault* and Monsieur *Mariotte*)[611] is to concoct and prepare the Sap for the Nourishment of the Fruit and the whole Plant, not only that which ascends from the Root, but that which they take in from without, from the Dew, moist Air, and Rain. This they prove because many Trees, if despoiled of their Leaves, will die .....[612]

Ray continues by expounding on the beauty of leaves and their use in the decorative arts, especially in architecture.[613]

Text page 13.

Line 1. *Folium, definiente Jungio:* margin reference - *In Isag. Phytoscopica.*

Ray here quotes Jung's definition of a leaf in terms of its three dimensions. He describes the surface, now called the adaxial surface, as

610 One of the 'other writers' cited by Ray in this chapter is Marcello Malpighi, whose writings on leaves may be found in his *Anatome Plantarum:* 32-39.

611 Note that in *The Wisdom of God* Ray does not attribute his information mainly to Jung as he does in *Historia Plantarum*, but to Malpighi, Perault and Mariotte.

612 *The Wisdom of God:* 77.

613 *ibid.:* 78-80.

superficies folii interna, quæ & superior, item supina dicitur, est quæ caulem respicit, ideoque vel cavitatis aliquid obtinet, vel saltem minus convexa est quam altera exterior[614]

A modern definition of adaxial is:

> Describing the side of lateral organs facing towards the stem or main axis, i.e. the upper surface.[615]

He describes the surface now called the abaxial surface as *exterior, sive inferior sive prona superficies* ['the external, inferior or prone face']. A modern definition of abaxial is:

> Describing the side of leaves, petals, etc. facing away from the stem or main axis, i.e. the lower surface.[616]

Morton says that Jung was the first 'who formally recognized this essential foliar characteristic';[617] however, Theophrastus also mentions this: πάντα δὲ τὰ φύλλα διάφερει κατὰ τὰ ὕπτια καὶ τὰ πρανῆ.[618] Jung notes that the difference between adaxial and abaxial surfaces helps to differentiate between a compound leaf and a shoot with several leaves. Theophrastus also comments on the characteristics of a compound leaf: καὶ εἰ δὴ πόλλα ἐκ τοῦ αὐτοῦ.[619] Grew and Malpighi took this idea a stage further by recognising a bilateral symmetry in anatomical structures.[620] Ray gives this definition in more concise terms in his introductory

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614 Jung's definition of a leaf in terms of its dimensions:
> [the internal face of a leaf, which is also called the upper or supine, is that which looks back at the stalk, and so either makes something of a cavity or at least is less convex than the external face.]

615 *Penguin Dictionary of Botany:* 7.

616 *ibid.:* 1.

617 Morton: 170.

618 Theophrastus, *Περὶ Φυτῶν Ἱστορίας [Enquiry into Plants]* I. x: 2.
['All leaves differ as to their upper and lower surfaces']

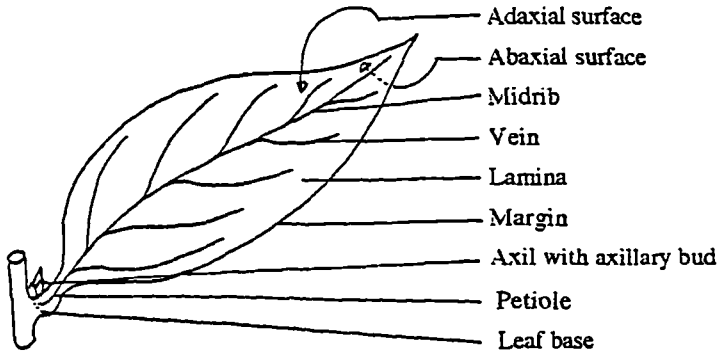
619 *ibid.:* 8. ['several leaves may be attached by the same leaf-stalk']

620 Morton: 182.

glossary to *Historia Plantarum*.[621]

A leaf is now defined as the main food producing or photosynthesising organ of green plants; it consists of the lamina or broad expanded part furthest from the stem, the petiole or leaf stalk, and the leaf base which is nearest to the stem. A leaf consists of conducting tissues and photosynthetic cells; its epidermis, which is covered by a waxy layer, is broken up by stomata through which the leaf transpires.[622]

Diagram of a basic leaf:[623]



Line 6. *Folium aliud est simplex, aliud compositum:* Ray and Jung correctly define leaf shapes as simple, or compound or composite. A simple leaf, as opposed to a compound leaf, is not divided into leaflets.[624]

Morton summarises Jung's leaf forms as follows:

> Leaves may be simple (as in beech, grasses, lily, etc.), or concave (as in onion or leek), or compound.[625]

621 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.
622 *Penguin Dictionary of Botany:* 206; *Oxford Dictionary of Botany:* 226.
623 Drawn from *Longman Dictionary of Botany:* 96.
624 *Longman Dictionary of Botany:* 97.
625 Morton: 170.

Line 7. *Folium compositum quid:* margin sub-heading.

Folium compositum: est ..... : Ray describes a compound leaf as 'one with several leaflets attached to a single petiole, all of which fall from the plant at the same time as this petiole'. He seems to be disagreeing with Jung, who defines these leaflets as individual simple leaves, preferring to count them (correctly) as parts of a single leaf. As Ray says here, Theophrastus made this distinction on the grounds that the whole compound leaf is shed at once from the plant: τὸ δὲ ὅλον, ὅπερ εἴποι τις ἂν φύλλον τῷ ἅμα φυλλορροεῖν, ἀφ' ἑνὸς μίσχου. καὶ περὶ μίαν οἷον ἵνα κατὰ γόνυ καὶ συζυγίαν τὰ φύλλα καθ' ἕκαστον πέφυκε, συχνῶν διεχουσῶν τῶν συζυγιῶν, ὁμοίως καὶ ἐπὶ τῆς οἰῆς.[626]

Line 8. *ut Theophrastus nos docuit:* Theophrastus: c.370-286 B.C. Greek philosopher and scientist. He studied under Plato and became Aristotle's closest friend, succeeding him as head of the Lyceum. He established botany as a science and lectured and wrote on a vast number of subjects.[627]

Theophrastus was born at Eresos on the island of Lesbos in 373 or 370 B.C., and is believed to have gone to Athens as a young man to study at the Academy. He probably accompanied Aristotle to Asia Minor in 347 and may have been with him in Macedonia whilst Aristotle was tutor to the young Alexander. It is certain that he was back in Athens with Aristotle in 335 when the Lyceum was founded, and he became its director in 322 when

626 Theophrastus, *Περὶ Φυτῶν Ἱστορίας [Enquiry into Plants]* III.xi: 3.
[The whole leaf (if one may consider this as a 'leaf' because it is all shed at once) grows on a single stalk; on either side of a single fibre, as it were, the leaflets grow at a joint in pairs, which are numerous and distinct, just as in the sorb.]
Translated here by A.F.Hort in the Loeb edition, Volume I: 231.

627 *DSB XIII:* 328-334; *Mac.Enc.*: 1204.

Aristotle left for Chalcis. He remained head of the Lyceum until his death in 285 B.C. In his will he directed that he should be laid to rest quietly in a corner of his garden, which he bequeathed in trust to a group of friends. It is an interesting point that both he and Aristotle were metics (i.e. immigrants) in Athens, and were never full citizens.[628]

There is evidence that the text of Theophrastus used by Pliny and Plutarch was fuller than the one which has come down to us;[629] Diogenes Laërtius lists the writings of Theophrastus.

In his *Historia Plantarum* Theophrastus is concerned with description, classification and analysis, and in the *De Causis Plantarum* with etiology (the science of causes).[630]

Line 9. *Juglande: Juglans*: see above Cap.4, line 144.

Line 9. *Fraxino: Fraxinus*: see above Cap.4, line 144.

Line 9. *Sorbo: Sorbus.*

[C.T.& M. 236-243] *Sorbus* (L.), Service tree; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 194: B.& H. 146: Linn.*Sp.Pl.* 477: *Syn.Meth.St.Br.* 452-453: *H.P.* 1456-1458: *H.P.III* - in Index to Vol.III but no page number given: *Tri.* 17.78: *Cat.Angl.* 278-279: *Camb.* - no ref.

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628 Morton: 49, note 31. For Theophrastus see also: *DSB XIII*: 328-334; O. Regenbogen, Theophrastus, Sonerabdruck, *Pauly-Wisowa Realencyclopädie*, Stuttgart 1950; G.Senn, *Die Entwicklung der biologischen Forschung in der Antike und ihre grundsätzliche Förderung durch Theophrast von Eresos*, Aaran 1933; R.Strömberg, *Theophrastea - Studien zur botanischen Begriffshildung*, Göteborg 1937; Arber: 2-7 *et passim;* Sachs: 15-17 *et passim.*

629 Morton: 80, note 38.

630 *ibid.:* 31-32 *et passim.*
There is no indication from the sale catalogue of Ray's library that he himself owned either *Historia Plantarum* or *De Causis Plantarum* of Theophrastus.
British Museum: *S-C 326* (6).

H.P. 1456-1458:

2 species given, including:

Sorbus J.B. Ger. *sativa* C.B. *legitima* Park.

The true Service-tree or Sorb.

Tri. 17.78:

Service or Sorb-tree: *Sorbus, -i,* f.: *Ὄη, -ης,* f.

Line 11. *Petiolus quid:* margin sub-heading.

Petiolus: sive pediculus folii pars est ..... : Ray describes the petiole as attaching the leaf to the stem, the lamina or leaf blade is often attached to the stem by a strengthened part of the petiole, the leaf base. The petiole carries the vascular tissue (the xylem and the phloem) to the leaves. A petiole is similar in structure to the stem, although the vascular and strengthening tissues are not arranged regularly.[631] Ray does not mention that some plants have leaves attached directly to the stem at the base of the lamina; these are known as sessile leaves (literally 'seated' leaves) - many monocotyledons are of this type.

Line 12. *id quod inter folia est nervus sæpius aut costa dicitur:* Ray again quoting Jung, here differentiates between the petiole and the midrib of a leaf, which is the vein running along the centre of a leaf from the petiole to the tip of the leaf.[632]

Line 14. *dividente Jungio.*

Ray gives Jung's classification for compound leaf shapes: 'digitate, pinnate and triangulate', giving almost the same examples.

Morton again summarises this section of Jung:

Compound leaves may be digitate (clover, strawberry,

631 *Lowson's Botany:* 58, 78, 148; Gibbons: 41; *Penguin Dictionary of Botany:* 268.

632 *Longman Dictionary of Botany:* 97; *Penguin Dictionary of Botany:* 231.

lupin), paripinnate (bean, pea), imparipinnate (rose, ash) or triangulate (celery, paeony).[633]

Ray defines the differences in leaf shape in his glossary to *Historia Plantarum,* but without attributing them to Jung as in the main text, although he does refer the reader to this chapter:

> *Folii differentias, quidque per folium digitatum, pennatum & triangulatum intelligimus vide lib.1. cap.9. p.13.*[634]

Line 15. *Folium digitatum est ..... :* Ray/Jung define and give examples of a digitate or palmate leaf, which is a compound leaf of four or more leaflets arising from a single point.[635]

Line 16. *Trifoliis: Trifolium.*

[C.T.& M. 195-199] *Trifolium* (L.), Clover, Trefoil; a genus of the *Leguminosæ* or Pea family.

B.& G.-W. 216-220: B.& H. 109: Linn.*Sp.Pl.* 764-773: *Syn.Meth.St.Br.* 327-331: *H.P.* 941-950: *H.P.III* - no ref.: *Tri.* 10.57 / *Tri.* 14.197: *Cat.Angl.* 289-293: *Camb.* 118-120.

H.P. 941-950:

1. *Trifolium pratense montanum album*: 8 species.
2. *Trifolia floribus purpureis in capitula vel globolos congestis:* 17 species.
3. *Trifolia calyculis in vesicas intumescentibus seu spumosis, Fragifera dicta*: 8 species.
4. *Trifolia spica molli & villosa Lagopi dicta*: 8 species.
5. *Trifolia spicata flore luteo*: 6 species.

633 Morton: 170.

634 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

635 *Penguin Dictionary of Botany:* 258.

Tri. 10.57:

Claver-grass: *Trifolium, -ii, majus sativum,* n.: *Τρίφυλλον μεῖζον.*

Tri. 14.197:

Trefoil: *Trifolium, -ii,* n.: *Τρίφυλλον, –ου,* n.

Line 16. *Pentaphyllis: Pentaphyllum:* see above Cap.7, line 57.

Line 16. *Trifoliis & Pentaphyllis:* rather than indicating specific plants, Ray may be meaning literally 'with three' or 'with five' leaflets here, as the text has & between *Trifoliis* and *Pentaphyllis*, followed by a list of plants, *Fragaria, Lupino* etc., which are examples of plants with such leaflets.

Line 16. *Fragariã: Fragaria:* see above Cap.7, line 56.

Line 16. *Lupino: Lupinus:* [C.T.& M. 186] *Lupinus polyphyllus* (Lindley), Common Lupin; a species of the *Lupinus* genus of the *Leguminosæ* or Pea family.

B.& G.-W. 202: B.& H. 101: Linn.*Sp.Pl.* 721:
Syn.Meth.St.Br. - no ref.: *H.P.* 906: *H.P.III* 449: *Tri.* 11.111:
Cat.Angl. - no ref.: *Camb.* - no ref..

H.P. 906:

Ray gives the characteristics of a Lupin as (Tr.) 'digitate leaves, smooth stems, flowers dispersed on the tops of the stems and stalks in spikes, and with erect pods'.

9 species given, including:

Lupinus sativus Ger. *sativus flore albo* C.B. *sativus albus* Park. *vulgaris, semine & flore albo, sativus* J.B. ***White Lupines.***

H.P.III 449:

7 additional species given.

Tri. 11.111:

Lupines: *Lupinus, -i,* m.: *Θέρμας, -ου,* m.

Line 16. *Cannabe: Cannabis*: [C.T.& M. 310] *Cannabis sativa* (L.), Hemp; a species of the *Humulus* genus of the *Cannabaceæ* or Hemp family. B.& G.-W. 58: B.& H. 399 (under *Urticaceæ*, the Nettle family): Linn.*Sp.Pl.* 1027: *Syn.Meth.St.Br.* 138: *H.P.* 158: *H.P.III* - no ref.: *Tri.* 10.88: *Cat.Angl.* 50: *Camb.* 50.

H.P. 158:

Cannabis sativa C.B. *mas & fœmina* J.B. *sativa mas & fœmina* Park. I. *seu mas* & 2. *seu fœmina* Ger.emac.

Hemp the male and female, or Winter and Summer Hemp.

Tri. 10.88:

Hemp: *Cannabis, -is,* f.: *Κάνναβις, -εως,* f.

Line 16. *Vitice: Vitis:* see above Cap.5, line 26.

Line 17. *Folium pennatum est*: Ray and Jung describe a pinnate leaf as one with the leaflets in two rows, one either side of the midrib. Jung states that the leaflets are in pairs directly opposite to each other, but Ray correctly says that he has observed examples where the leaflets alternate on the midrib.

Line 19. *ut in multis Filicum speciebus aliisque observavimus.*[636]

Filix: the Fern: a perennial leafy pterodophyte plant of the class *Pteropsida* (or *Filicinæ* according to some classification

636 Note that elsewhere in Book I of *Historia Plantarum* Ray uses the term *Capillares* for Ferns: e.g. Cap.13, line 21.

schemes). About 9000 to 15000 species, most abundant in shady, damp, tropical regions but also widely distributed elsewhere. The life cycle of a fern shows alternation of generations. The fern plant itself is the asexual (sporophyte) generation, which has a creeping underground stem (rhizome) bearing roots and aerial fronds, which reach a height of 25 metres in the tree ferns. The fronds are feather-like and usually divided one or more times into leaflets. Asexual spores are produced in spore capsules, which usually occur in clusters (sori) protected by a covering (indusium) on the underside of the leaflets. The spores develop into the inconspicuous sexual (gametophyte) generation - a tiny heart-shaped plant (called a prothallus) producing egg and sperm cells. The fertilised egg cell develops into a new sporophyte plant, which grows up from the prothallus.[637]

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. 554-571: Linn.*Sp.Pl.* 1061-1100: *Syn.Meth.St.Br.* 118-127: *H.P.* 131-153: *H.P.III* - no ref.: *Tri.* 10.72: *Cat.Angl.* 107-108: *Camb.* 63-64.

H.P. 131-153:

> Many species given, including:
>
> *Filix mas vulgaris* Park. *Filix non ramosa* J.B. F. *mas non ramosa, pinnulis latis, densis, minutim dentatis* Ger.emac.
>
> ***Common male Fern.***
>
> *Filix femina* Ger. *fem. vulgaris* Park. *major & prior Trago, seu ramosa repens* J.B. *ramosa major, pinnulis obtusis non dentatis* C.B. ***Female Fern or common Brakes.***

Tri. 10.72:

> Fern or Brakes: *Filix, -icis*, f.: *Πτέρις, –ιδος,* f.

Line 19. *vel pariter vel impariter:* compound pinnate leaves are sometimes, as Ray says, *pariter pennata* (paripinnate) or *impariter pennata*

637 *Penguin Dictionary of Botany:* 134; *Mac.Enc.:* 440.

(imparipinnate). Ray gives examples of paripinnate leaves without really defining them - Broad Bean *(Faba)*, Vetches *(Vicia)* and Peas *(Pisum)*: these have compound pinnate leaves, in which all leaflets are paired.

Line 20. *Fabā: Faba.*

[C.T.& M. 183] *Fabaceæ* or *Leguminosæ* [C.T.& M. 190] *Vicia faba*, Broad Bean; a species of the *Vicia* genus of the *Leguminosæ* or Pea family.

B.& G.-W. 206: B.& H. 121: Linn.*Sp.Pl.* 737:
Syn.Meth.St.Br. 323: *H.P.* 909: *H.P.III* - no ref.: *Tri.* 8.15:
Cat.Angl. 103-104: *Camb.* 63.

H.P. 909:

Here Ray gives an interesting derivation for the Latin and English names of this plant. He says:

(Tr.) *Faba*, to the Greeks κύαμος, is called *Haba* by the Falisci, a people of Etruria, whence the word seems to be taken. Martinus derives it from πάω, i.e. *vescor, pascor*,[638] and thus it becomes *Faba*. Isidorus derives it from φάγω.

This type of legume is called in Latin *Boona* by Dodonaeus, who thought this a new name, supported by the German, and idiomatically abused in German, but seeming more learned than the others (says J. Bauhin). Otherwise the name of *Boona* or Bean seems to come from *Baiana* in Italian.

Κυάμοι are believed by the Greeks to be so-named because they are εἰς τὸ κυεῖν δεινοὶ καὶ

638 *vescor, pascor* = 'I eat'.

αἰτίοι τοῦ κυεῖν. 639

The characteristics of beans are straight fat pods: very large seed, which is oblong and compressed towards the sides, with a little one at the very end: and angular, firm, hollow stems.

2 species given, including:

Faba C.B. *Faba, Cyamos leguminosa* J.B. *major hortensis* Ger. Park. ***Garden-beans.***

Faba minor sive equina C.B. *minor sylvestris* Park. 3. *sive communis* Ger.emac. ***Field-beans or Horse-beans.***

Tri. 8.15:

A Bean: *Faba, -æ,* f.: *Κύαμος, -άμου,* m.

Line 20. *Viciã:Vicia.*

[C.T.& M. 188-190] *Vicia* (L.), Vetch or Tare; a genus of the *Leguminosæ* or Pea family.

B.& G.-W. 206-208: B.& H. 120: Linn.*Sp.Pl.* 734-737: *Syn.Meth.St.Br.* 320-321: *H.P.* 900-901: *H.P.III* 448: *Tri.* 14.192: *Cat.Angl.* 303-305: *Camb.* 123-124.

H.P. 900-901:

25 species given, including:

Vicia Ger. *vulgaris sativa* Park. J.B. *sativa vulgaris semine nigro* C.B. ***Common Tare or Vetch.***

H.P.III 448:

Ad cap. de Lathyro: 20 additional species given.

Also: *ad cap. de Vicia:*

post septimam speciem: 3 additional species given.

post decimam speciem: 10 additional species given.

639 εἰς τὸ κυεῖν δεινοὶ καὶ αἰτίοι τοῦ κυεῖν = 'wonderful for conception and responsible for it'.

Tri. 14.192:

Tares or Vetches: *Vicia*, -..., f.: *Βίχιον, -ίου,* n.

Line 20. *Piso: Pisum.*

[C.T.& M. 192] *Pisum* (L.), Pea; a genus of the *Leguminosae* or Pea family.

B.& G.-W. 210-212: B.& H. 124: Linn.*Sp.Pl.* 727:

Syn.Meth.St.Br. 318-319: *H.P.* 890-893: *H.P.III* Index reference to page 444, but correct reference should be 447: *Tri.* 12.142: *Cat.Angl.* 235-236: *Camb.* 94.

H.P. 890-893:

17 species given, including:

Pisum vulgare, parvum, album, arvense J.B. *sylvestre primum* Park. *arvense flore candido, fructu rotundo albo* C.B.

Common white Field-pease. *Pisum minus* Ger.

H.P.III 447:

20 additional species given.

Tri. 12.142:

Pease: *Pisum, -i,* n.: *Πίσον, -ου,* n.

Line 20. *Lentiscus.*

[Mac.Enc. 789] *Pistacia lentiscus*, Mastic; a species of the *Pistacia* genus of the *Anacardiaceæ* family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.:

Linn.*Sp.Pl.* 1026: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1579:

H.P.III D. 52: *Tri.* 17.54: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1579:

Lentiscus Lob. Ger. Park. J.B. *vulgaris* C.B.

The Mastick-tree.

H.P.III D. 52:

3 additional species given.

Tri. 17.54:

A Mastick-tree: *Lentiscus, -i,* f.: Σχῖνος, *-ου,* f.

Line 21. *Impariter pennata*: Ray, however, does here define an imparipinnate leaf,[640] which has a centrally placed unpaired terminal leaflet,[641] as is seen in the Milk Vetches *(Astragalus)*, and, as Ray says, in the Rose *(Rosa)*, Walnut *(Juglans)* etc.

Line 22. *Rosā: Rosa.*

[C.T.& M. 225-230] *Rosa* (L.), Rose; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 178-180: B.& H. 142-144: Linn.*Sp.Pl.* 491-492:
Syn.Meth.St.Br. 454-455: *H.P.* 1467 &c.: *H.P.III D.* 25:
Tri. 17.73: *Cat.Angl.* 255-257: *Camb.* 105.

H.P. 1467 &c.:

37 species given, including:

Rosa sylvestris inodora sive canina Park. *canina inodora* Ger. *sylv. vulgaris, flore odorato incarnato* C.B. *sylv. albo cum rubore, folio glabro* J.B.

The common wild Briar or Dogs Rose,

Cynosbatos & Cynorhodos Officinarum, quibusdam

The Hep-tree.

H.P.III D. 25:

1 additional species given, with notes.

Tri. 17.73:

A Rose: *Rosa, -æ,* f.: Ῥόδον, *-ου,* n.

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640 See note above Cap.9, line 19.
641 *Penguin Dictionary of Botany:* 186.

Line 22. *Juglande: Juglans:* see above Cap.4, line 144.

Line 22. *Fraxino: Fraxinus:* see above Cap.4, line 144.

Line 22. *Potentillā: Potentilla.*

[C.T.& M. 212-217] *Potentilla* (L.), Cinquefoil; a genus of the *Rosaceæ* or Rose family: *Potentilla anserina* (L.), Silverweed; a species of the above.

B.& G.-W. 184-188: B.& H. 135: Linn.*Sp.Pl.* 495-500:

Syn.Meth.St.Br. 256: *H.P.* 617: *H.P.III* - no ref.: *Tri.* - no ref.:

Cat.Angl. 242 with ref. to see *Argentina* 26-27: *Camb.* - no ref.

H.P. 617:

> *Argentina* Ger. *Potentilla* Park. C.B. *Potentilla seu Argentina* J.B. ***Wild Tansy, Silver-weed.***

Line 22. *Sorbo: Sorbus*: see above Cap.9, line 9.

Line 23. *Folium pennatum porro vel est, uniforme, vel difforme:* he distinguishes between pinnate leaves with equally and unequally sized leaflets. He gives three examples, *Ulmaria, Agrimonia* and *Filipendula*, all members of the *Rosaceæ* family with unequally pinnate leaves, having pinnate leaves with small pinnae between the large ones.

Line 24. *Ulmariā: Ulmaria.*

[C.T.& M. 204] *Filipendula ulmaria* ([L.] Maxim.), [*Spiræa ulmaria* (L.), *Ulmaria pentapetala* (Gilib.)], Meadowsweet; a species of the *Filipendula* genus of the *Rosaceæ* or Rose family.

B.& G.-W. 176: B.& H. 130: Linn.*Sp.Pl.* 490:

Syn.Meth.St.Br. 259: *H.P.* 623: *H.P.III* 330: *Tri.* 11.121:

Cat.Angl. 308: *Camb.* 125.

H.P. 623:

Ulmaria J.B. *vulgaris* Park. *Regina prati* Ger. *Barba capri floribus compactis* C.B. ***Meadow-sweet.***

H.P.III 330:

2 additional species given.

Tri. 11.121:

Meadow-sweet: *Ulmaria, -æ,* f.: [No Greek].

Line 24. *Agrimoniã: Agrimonia.*

[C.T.& M. 219] *Agrimonia* (L.), Agrimony; a genus of the *Rosaceæ* or Rose family.

B.& G.-W. 182: B.& H. 141: Linn.*Sp.Pl.* 448:

Syn.Meth.St.Br. 202: *H.P.* 399-400: *H.P.III* 247: *Tri.* 8.2:

Cat.Angl. 10: *Camb.* 39.

H.P. 399-400:

3 species given, including:

Agrimonia Ger. *vulgaris* Park. *Agrim. seu Eupatorium* J.B. *Eupatorium veterum sive Agrimonia* C.B. ***Agrimony.***

H.P.III 247:

Agrimonia lappacea inodora, folio subrotundo, dentato Slon.Cat.Jamaic. *Lappula Bermudensis Althæoides spicata, fructu orbiculari majore* Pluk.Phytogr.T.245,F.7.

Eupatorium odoratum Santonicum seu Blaesense Moris.hist. 614.

Tri. 8.2:

Agrimony: *Eupatorium, -ii,* n:*Ευπατώριον, -ίου,* n.

Ray's footnote, *Tri.* 8.2, says 'This is usually called also in Latin *Agrimonia*'.

Line 24. *Filipendulã: Filipendula.*

[C.T.& M. 204] *Filipendula vulgaris* (Mœnch),

Dropwort:*Filipendula ulmaria* ([L.] Maxim.) [*Spiræa ulmaria* (L.), *Ulmaria pentapetala* (Gilib.)], Meadowsweet; both are species of the *Filipendula* genus of the *Rosaceæ* or Rose family.

B.& G.-W. 176: B.& H. 130: Linn.*Sp.Pl.* 490:

Syn.Meth.St.Br. 259: *H.P.* 623: *H.P.III* 329: *Tri.* - no ref.:

Cat.Angl. 106-107: *Camb.* 63.

H.P. 623:

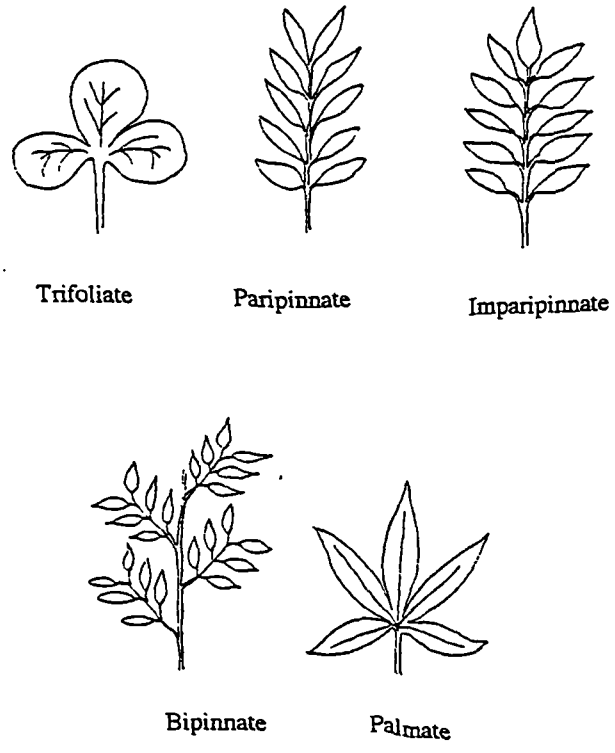
2 species given, including:

Filipendula Ger. J.B. *vulgaris* Park. *vulgaris, an Molon Plinii* C.B. ***Common Dropwort.***

H.P.III 329:

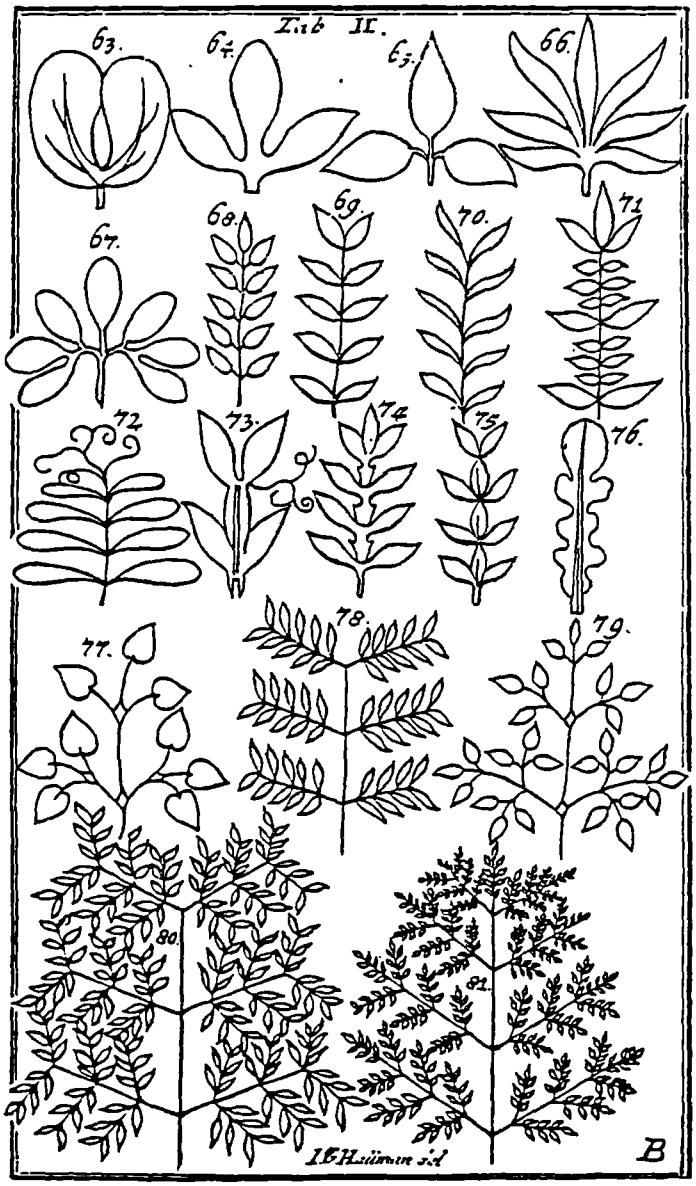
1 additional species given.

Lines 14-34. Some common compound leaf shapes:[642]



642 Drawn from *Penguin Dictionary of Botany:* 202.

also from Linnæus, *Philosophia botanica*, 1751:



Types of compound Leaves as illustrated in Linnaeus, *Philosophia botanica* (1751)

63, Binatum; 64, Ternatum *foliolis sessilibus*; 65, do. *petiolatis*; 66, Digitatum; 67, Pedatum; 68, Pinnatum *cum impari*; 70, do. *alternatim*; 71, do. *interrupte*; 72, do. *cirrhosum*; 73, do. *conjugatum*; 74, do. *decursive*; 75, do. *articulate*; 76, Lyratum; 77, Biternatum, *Duplicato-ternatum*; 78, Bipinnatum (*Sauvag.*), *Duplicato-pinnatum*; 79, Triternatum, *Triplicato-ternatum*; 80, Tripinnatum (*Sauvag.*), *sine impari*; 81, do. *cum impari*

Line 25. *Folium triangulatum:* Jung's description of this leaf type, given here by Ray, is rather ambiguous but he is probably describing a palmately lobed or palmatifid leaf of the sycamore *(Acer)* type.

Line 27. *Verum nos cum oculatissimo F. Columna Lynceo Folium compositum malumus dividere in ..... :* Ray says that he agrees with Colonna that a compound leaf should be divided into:

1. *digitatum* or digitate,
2. *pennatum seu τεταρσωμένον* or pinnate,
3. *multifidum seu πολυσχιδὲς* or multi-sided.

Lynceo: this may be a reference to Colonna's edition of F.Hernandez's account of the plants etc. of Mexico, which was in the Accademia dei Lyncei in Rome, or Ray may be using the word as an adjective from *lynceus*, meaning 'sharp-eyed' or 'sharp-sighted' ['Lynx-eyed', derived from the name of Lynceus, who was a Messenian, one of the Argonauts, brother of Idas and son of Aphareus, famed for the sharpness of his sight].[643]

Line 30. *quæ latos habent lobos seu lacinias folia πλατυπολυσχιδῆ:* Ray further subdivides these leaves into those with broad leaflets such as *Apium, Cicuta, Angelica, Sphondylium* and the like.

Line 31. *Apii: Apium.*

[C.T.& M. 288-289] *Petroselinum* (Hill), Parsley; a genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 278: B.& H. 180: Linn.*Sp.Pl.* 264: *Syn.Meth.St.Br.* 214: *H.P.* 447-448: *H.P.III* 256: *Tri.* 12.140: *Cat.Angl.* 24-25: *Camb.* 44.

643 Lewis and Short: 1090.

H.P. 447-448:

10 species given, including:

Apium hortense Ger. *hortense seu Petroselinum vulgo* C.B. *hortense multis, quos vulgo Petroselinum, Palato gratum* J.B. *Petroselinum vulgare* Park. ***Common Parsley.***

H.P.III 256:

3 additional species given.

Tri. 12.140:

Parsly: *Apium, -ii,* n.: *Σέλινον, -ίνου,* n.

Line 31. *Cicutæ: Cicuta.*

[C.T.& M. 287] *Conium maculatum* (L.), Hemlock; a species of the *Conium* genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 276: B.& H. 201: Linn.*Sp.Pl.* 243:

Syn.Meth.St.Br. 215: *H.P.* 450: *H.P.III* - no ref.: *Tri.* 10.87: *Cat.Angl.* 70-71: *Camb.* 54.

H.P. 450:

8 species given, including:

Cicuta Lob. Ger. *major* C.B. *vulgaris major* Park. *Cicuta Veteribus & neotericis* J.B. ***Hemlock.***

Tri. 10.87:

Hemlock: *Cicuta, -æ,* f.: *Κώνειον, -είου,* n.

Line 31. *Angelicæ: Angelica.*

[C.T.& M. 291] *Angelica sylvestris* (L.), Wild Angelica: *Angelica archangelica* (L.) [*Archangelica Officinalis* (Hoffm.)], Garden Angelica; both are species of the *Angelica* genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 282: B.& H. 193: Linn.*Sp.Pl.* 250-251:

Syn.Meth.St.Br. 208: *H.P.* 434-435: *H.P.III* 255: *Tri.* - no ref.:

Cat.Angl. 22: *Camb.* 43.

H.P. 434-435:

7 species given, including:

Angelica sativa J.B. C.B. Ger. Park. ***Garden Angelica.***

Angelica sylvestris Ger. Park. *sylv. major* C.B. *sylv. magna vulgatior* J.B. ***Wild Angelica.*** *rectius Angelica aquatica* i.e. ***Water-Angelica.***

H.P.III 255:

8 additional species given.

Line 31. *Sphondilii: Sphondylium.*

[C.T.& M. 292] *Heracleum sphondylium* (L.), Cow Parsnip, Hogweed, Keck; a species of the *Heracleum* genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 284: B.& H. 195: Linn.*Sp.Pl.* 249:

Syn.Meth.St.Br. 205: *H.P.* 4080409: *H.P.III* 251: *Tri.* - no ref.: *Cat.Angl.* 280: *Camb.* 116.

H.P. 408-409:

Sphondylium Ger. *vulgare* Park. *vulgare hirsutum* C.B. *Sphondylium quibusdam sive Branca ursina Germanica* J.B. ***Cow-Parsnep.***

H.P.III 251:

Ray here gives different characteristics for three species already listed in the earlier work.

Line 32. *quæ vero angustioribus lobis seu segmentis dividuntur, λεπτοπολυσχιδῆ dici possunt:* Ray again gives another subdivision of multi-sided leaves, in this case those with narrower leaflets, such as *Ligusticum, Thapsia, Ruta* etc.

Line 32. *Ligustici: Ligusticum.*

[C.T.& M. 291] *Ligusticum* (L.), Lovage; a genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 282: B.& H. 191: Linn.*Sp.Pl.* 250:

Syn.Meth.St.Br. 214: *H.P.* 437: *H.P.III* 255: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 437:

1 species only given:

Levisticum vulgare Ger. Park. *Ligusticum vulgare foliis Apii* J.B. *Lig. vulgare, an Libanotis fertilis Theophrasti* C.B.

Lovage.

H.P.III 255:

4 additional species given.

Line 32. *Thapsiæ: Thapsia*

[Flowers G.& B. 352.906c][644] *Thapsia* (L.), a genus of the *Umbelliferæ* or Carrot family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.:

Linn.*Sp.Pl.* 261-262: *Syn.Meth.St.Br.* - no ref.: *H.P.* 417-420:

H.P.III 252: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 417-420:

8 species given, including:

Thapsia vulgaris Ger. *Carotæ folio* C.B. Park. *Carotæ facie* J.B. *An Thapsia Gesneri seu Turbith Garganicum.*

H.P.III 252:

An Thapsia. Ad lineam 51am post hæc verba Botan. Monspel. adde,

Plantas proximo descriptas sub titulis Thapsiæ latifoliæ Hispanicæ Park. *& Thapsiæ quorundam hirsutæ & asperæ, Cicutæ folio, flore luteo, semine lato, aliis Seseli Peloponnense*

644 Polunin: 352.906c.

J.B. *D.Plukenet diversas facit; & pro secundæ Synonymis ponit Thapsiam Latifoliam villosam* C.B. *Seseli Peloponnense majus* Lob.ico.

Idem Thapsiam Thalictri folio pag. sequenti Thapsiæ seu Turbith Garganici semine latissimo J.B. *Synonym facit: cui & nos consentimus. A Thapsia Carotæ folio* C.B. *valde differt.*

Thapsia Apii folio Lusitanica fœidissima, flore albo Tournefort, Elem.Bot.

Thapsia glutinosa, segmentis densioribus subhirsutis, alterno situ positis Pluk.Phyt.T.66.F.1.

Line 32. *Rutæ: Ruta.*

[C.T.& M. 51-52] *Thalictrum flavum* (L.), Common Meadow Rue; a species of the *Thalictrum* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 122: B.& H. 4: Linn.*Sp.Pl.* 546:

Syn.Meth.St.Br. 203: *H.P.* 874-878: *H.P.III* 87/434/525:

Tri. 13.162: *Cat.Angl.* 260 with a ref. to see *Thalictrum* 283:

Camb. - no ref.

H.P. 874-878:

5 species given, including:

Ruta sativa vel hortensis J.B. *hortensis latifolia* C.B. *hortensis major* Park. *hortensis* Ger. ***Garden Rue.***

H.P.III 87/434/525:

Ruta mururaria 87:

see also page 147 (not indexed) - *adde Ruta muraria* -

4 additional species given with this name out of many called *Adiantum. Ruta sativa* 434:

see also page 874 - *Ad cap. de Ruta* - 4 additional species given.

Ruta sylvestris 525:

Under *Nigella:*

Ruta sylvestris non ramosa, tenuiori caule minori folio & flore, seu Angustifolia Hort.Catb.194. *In ramulo sicco nobis a D.Sherard oblato folia tenuis dissecta erant minora & angustiora quam in Ruta sylvestri vulgari. Floret circa margines fimbriati videbantur.*

Tri. 13.162:

Rue: *Ruta, -æ,* f.:*Πήγανον, -ου,* n.

Line 32. *quæ denique in capillares omnino lacinias dividuntur, τριχοσχιδῆ merito appellantur:* Ray's final subdivision of multi-sided leaves into those with hair-like leaflets such as *Ferulacea, Ammi* and *Millefolium.*

Line 33. *Ferulacea.*

[Polunin 351, 897][645] *Ferulago campestris* (Besser); a species of the *Ferulago* genus of the *Umbelliferæ* or Carrot family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 246-247: *Syn.Meth.St.Br.* - no ref.: *H.P.* 420: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

Linn.*Sp.Pl.* 247:

Ferulago:

Ferula foliis pinnatifidis: pinnis linearibus planis trifidis. Hort.cliff.95. Roy.lugdb.99.

Ferula latiore folio. Moris.hist.3.p.309.s.9.t.15.f.1.

Ferulago latiore folio. Bauh.pin.148.

H.P. 420:

Ferula folio glauco, semine lato oblongo, quibusdam Thapsia ferulacea J.B. *An Ferulago latiore folio* C.B? *Libanotis Fœniculi-folio, semine foliaceo* ejusdem. *Ferula latiore folio*

645 Polunin: 351.

Park? *Panax Asclepium* Ang. & Cam.eidem. *Ferulago* Ger.

Broad-leaved Fennel-giant.

Line 33. *Ammi.*

[C.T.& M. 290] *Ammi majus* (L.), Bullwort; a species of the *Ammi* genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 280: B.& H. 177: Linn.*Sp.Pl.* 243:

Syn.Meth.St.Br. - no ref.: *H.P.* 454: *H.P.III* 256: *Tri.* - no ref.:.

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 454:

4 species given:

1. *Ammi vulgare Ger. vulgarius Lob. Park. majus* C.B.*vulgare majus latioribus foliis, semine minus odorato.*

   Common broad-leaved Bishop's Weed.

2. *Ammi odore Origani* J.B. *alterum semine Apii* C.B. *Creticum* Park. Ger.
3. *Ammi semine tenuissima & odoratissimo* J.B. *Ammi parvum foliis Foeniculi* C.B. Park. *Ammi perpusillum* Ger.emac.
4. *Ammiodes* C.B. *Ammi pusillum* Caes.

H.P.III 256:

Incorrect reference given in index to volume III.

Line 33. *Millefolii: Millefolium.*

[C.T.& M. 473] *Achillea millefolium* (L.), Yarrow, Milfoil; a species of the *Achillea* genus of the *Compositæ* or Daisy family.

B.& G.-W. 408: B.& H. 240: Linn.*Sp.Pl.* 899:

Syn.Meth.St.Br. 183: *H.P.* 345-346: *H.P.III* 219: *Tri.* 14.212: *Cat.Angl.* 200-201: *Camb.* 85.

H.P. 345-346:

Ray says of this plant, (Tr.) '*Millefolium* is called *Μυριόφυλλον* and *Χιλιόφυλλον* by the Greeks because of its many leaves, and Achillea *Ἀχίλλειος* from its first discoverer'.[646]

11 species given, including:

Millefolium vulgare Park. *vulgare album* C.B. *terrestre vulgare* Ger. *M.Stratiotes pennatum* J.B.

Common Yarrow or Milfoil.

H.P.III 219:

9 additional species given.

Tri. 14.212:

Yarrow: *Millefolium, -ii,* n.: *Χιλιόφυλλος, -ου,* m.

Line 34. *Fœniculi: Foeniculum:* see above Cap.7, line 51.

Line 35. *Folium simplex est:* Ray gives in great detail (lines 35-57) the characteristics of a simple leaf, whereas we would describe it as a leaf whose lamina is a single section of tissue however complicated its outline might be.[647]

Line 40. *Angulatum folium inter integri & scissi marginis folium ambigit ...:* Ray here describes an angular leaf as being between a whole one and one with a torn margin.

Morton summarises Jung's description of leaf margins:

> The leaf margin may be entire or dissected, and in the latter case may be further characterized as laciniate, serrate, crenate, dentate.[648]

646 NB Achilles was taught medicine by the centaur Chiron; Smith: 169.
647 *Lowson's Botany:* 58.
648 Morton: 170.

Line 40. *Hederæ adultæ: Hedera:* see above Cap.4, line 119.

Line 40. *Bryoniæ: Bryonia.*

[C.T.& M. 294] *Bryonia* (L.), Bryony; a genus of the *Cucurbitaceæ* or Gourd family.

B.& G.-W. 256: B.& H. 157: Linn.*Sp.Pl.* 1012-1013: *Syn.Meth.St.Br.* 261-262: *H.P.* 659-661: *H.P.III* 346-349: *Tri.* 8.24: *Cat.Angl.* 44-45: *Camb.* 48-49.

H.P. 659-661:

3 species of *Bryonia* given, including:

Bryonia alba Ger. *alba vulgaris* Park. *aspera, sive alba baccis rubris* C.B. *Vitis alba sive Bryonia* J.B. ***White Bryony.***

4 species of *Bryonia nigra* given, including:

Bryonia nigra sylvestris Ger. *sylvestris nigra* Park. *laevis, sive nigra racemosa* C.B. *Vitis nigra quibusdam sive Tamus Plinii, folio Cyclamini* J.B. *Sigullum B.Mariae Offic.*

Black Bryony.

H.P.III 346-349:

26 additional species given.

Tri. 8.24:

Bryony: *Bryonia, -æ,* f.: *Βρυωνία, -ας,* f.

Line 41. *Smilacis: Smilax.*

[Mac.Enc. 1078] *Smilax aristolochiæfolia*, Sarsaparilla; a species of the *Smilax* genus of the *Liliaceæ* or Lily family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 1028-1030: *Syn.Meth.St.Br.* - no ref.: *H.P.* 655: *H.P.III* 344: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 655:

3 species given, including:

Smilax aspera Peruviana sive Salsaparilla C.B. *aspera Peruviana* Park. *smilaci affinis Salsaparilla* J.B. *Smilax Peruviana, Salsaparilla* Ger. ***Sarsaparilla.***

H.P.III 344:

14 additional species given.

Line 43. *Lacinia est portio folii inter duas fissuras (fissura est profundior scissura) inclusa.* ***A Jag.*** Ray gives this as his definition of *lacinia*, 'a leaflet', in his glossary to *Historia Plantarum.*[649]

Line 44. *Juncis: Juncus.*

[C.T.& M. 542-549] *Juncus* (L.), Rush; a genus of the *Juncaceæ* or Rush family.

B.& G.-W. - no ref.: B.& H. 469: *G.F.M.& L.* 12-17: [650]

Linn.*Sp.Pl.* 325-330: *Syn.Meth.St.Br.* 431-434: *H.P.* 1302: *H.P.III* - listed in index to volume III but no page reference given: *Tri.* 13.164: *Cat.Angl.* 172-174: *Camb.* 76-77.

H.P. 1302:

24 species given, including:

Juncus acutus Ger. *acutus vulgaris* Park. *acutus panicula sparsa* C.B. *An Juncus soliceus* J.B.? ***Common hard Rush.***

Juncus lævis vulgaris panicula sparsa nostras. An Juncus panicula arundinacea J.B.? *Jun. lævis panicula sparsa major* C.B.? Park.? *Juncus lævis* Ger.? ***Common soft Rush.***

Tri. 13.164:

Rush: *Juncus, -i,* m.: *Σχοῖνος, -ου,* m.

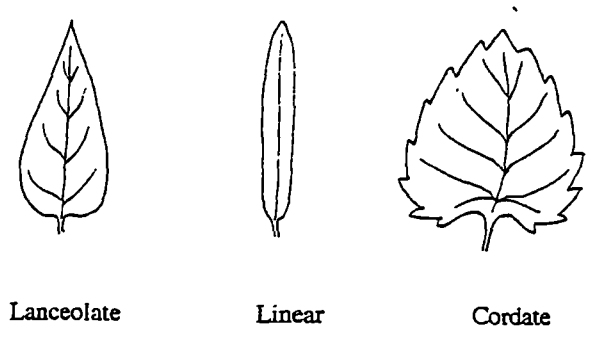
649 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

650 Phillips, *Grasses:* 12-17.

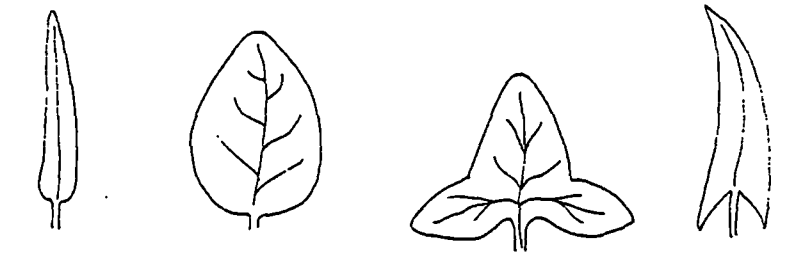
Line 44. *Cepā: Cepa:* see above Cap.3, line 12.

Lines 46-57. *Folium simplex est vel ..... :* Ray expresses his complicated subdivisions in tabular form here:

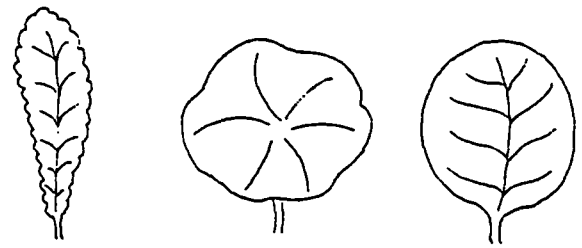
The following diagrams show various simple leaf shapes and margins:[651]



Lanceolate Linear Cordate



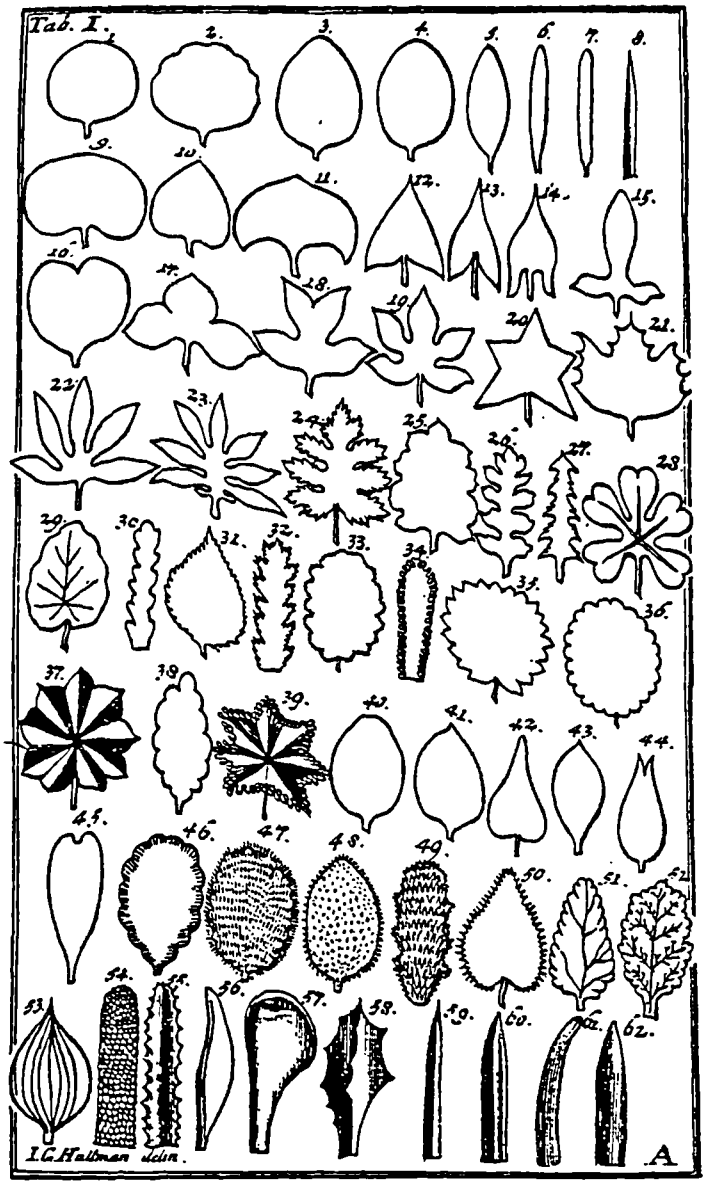
Acicular Ovate Hastate Sagittate



Spatulate Peltate Orbicular

651 Adapted from the *Penguin Dictionary of Botany,* pages 202-203: and from the end papers of *Longman Illustrated Dictionary of Botany.*

Simple leaves from Linnæus *Philosophia botanica*, 1751.



Types of simple Leaves and Indumentum as illustrated in Linnaeus, *Philosophia botanica* (1751)

1, Orbiculatum; 2, Subrotundum; 3, Ovatum; 4, Ovale s. *Ellipticum*; 5, Oblongum; 6, Lanceolatum; 7, Lineare; 8, Subulatum; 9, Reniforme; 10, Cordatum; 11, Lunulatum; 12, Triangulare; 13, Sagittatum; 14, *Cordato-sagitattum*; 15, Hastatum; 16, Fissum; 17, Trilobum; 18, Praemorsum; 19, Lobatum; 20, Quinquangulare; 21, Erosum; 22, Palmatum; 23, Pinnatifidum; 24, Laciniatum; 25, Sinuatum; 26, *Dentato-sinuatum*; 27, *Retrorsum sinuatum*; 28, Partitum; 29, Repandum; 30, Dentatum; 31, Serratum; 32, *Duplicato-serratum*; 33, *Duplicato-crenatum*; 34, Cartilagineum; 35, *Acute crenatum*; 36, *Obtuse crenatum*; 37, Plicatum; 38, Crenatum; 39, Crispum; 40, Obtusum; 41, Acutum; 42, Acuminatum; 43, *Obtusum acumine*; 44, Emarginatum acute; 45, *Cuneiforme emarginatum*; 46, Retusum; 47, Pilosum; 48, Tomentosum; 49, Hispidum; 50, Ciliatum; 51, Rugosum; 52, Venosum; 53, Nervosum; 54, Papillosum; 55, Linguiforme; 56, Acinaciforme; 57, Dolabriforme; 58, Deltoides; 59, Triquetrum; 60, Canaliculatum; 61, Sulcatum; 62, Teres

Table 47. *Bryoniã: Bryonia*: see above Cap.9, line 40.

Table 49. *Smilace: Smilax*: see above Cap.9, line 41.

Table 56. *Gramine junceo: Gramen junceum*: see *Juncus* Cap.9, line 44.

[C.T.& M. 545-548] *Juncus squarrosus* (L.), Heath Rush; a species of the *Juncus* genus of the *Juncaceæ* or Rush family.

B.& G.-W. - no ref.: B.& H. 471-472: Linn.*Sp.Pl.* 327-328: *Syn.Meth.St.Br.* 428-435: *H.P.* 1306: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 147-148:*Camb.* 71.

Linnæus *Sp.Pl.* 327-328 lists as *Gramen junceum* the following:

Juncus squarrosus: Juncus articulatus: Juncus bulbosus: Juncus bufonius.

Syn.Meth.St.Br. Juncus, Rushes: 428-435:

Gramen junceum capsulis triangulis minimum Syn.II.275.3, H.Ox.III.227, S.VIII.T.9.f.3, *graminis juncei varietas minor* Ger.Em.4. ***The least Triangular-seeded Rush-grass.*** *In palustribus & ad rivulos; ut in aquosis ericeti Hamstediensis prope Londinium.*

H.P. 1306:

(Tr.) *Gramen junceum* is distinguished from the *Juncus* by its jointed leafy stems. Also its leaves are not always rounded, but in some species are compressed, yet all are spongy.

20 species given, including:

Gramen junceum capsulis triangulis minimum, Graminis juncei veriatas minor Ger.emac.

The least Rush-grass, with triangular Seed-vessels.

Gramen junceum aquaticum magis sparsa panicula Park. *An Gr. junceum sylvaticum* Ger? *junceum folio articulato sylvaticum* C.B? ***Water-Rush-Grass, with a sparsed panicle and***

jointed leaves, the greatest.

Cat.Angl. 147-148 gives the following species:

Gramen junceum aquaticum Bauhini

Gramen junceum capsulis triangulis minimum

Gramen junceum aquaticum magis sparsa panicula

Gramen junceum leucanthemum

Gramen junceum parvum sive Holostium Matthioli

Gramen junceum maritimum

Gramen junceumspicatum seu triglochin

Camb. 71:

Gramen junceum, Toad-grasse, because it occurs where toads are found. [*Juncus bufonius*, Linnæus]

Table 57. *Cepā: Cepa:* see above Cap.3, line 12.

Text page 14.

Lines 58-71. *Possunt etiam folia aliter multis modis dividi, ut v.g.:* Ray gives many other characteristic subdivisions of the leaves of plants with examples of each.

Line 59. Betæ: Beta.

[C.T.& M. 159] *Beta vulgaris* (L.), Sea Beet; a species of the *Beta* genus of the *Chenopodiaceæ* or Fat Hen family.

B.& G.-W. 72: B.& H. 376: Linn.*Sp.Pl.* 222:

Syn.Meth.St.Br. 157: *H.P.* 204: *H.P.III* - listed in index to Vol. III but no page reference given: *Tri.* 8.17: *Cat.Angl.* 38-39:

Camb. - no ref.

H.P. 204:

7 species given, including:

Beta alba Ger. *communis alba* Park.par. *alba vel pallescens, quae Cicla offic.* C.B. *candida* J.B. ***White Beet.***

Beta rubra Ger. *communis rubra* Park. *rubra vulgaris* J.B. C.B. ***Red Beet.***

Beta sylvestris maritima C.B. Park. *communis seu viridis* C.B. ***Sea-Beet.***

Tri. 8.17:

Beet: *Beta, -æ,* f.: *Τεῦτλον, –ου,* n.

Line 59. *Lapathi: Lapathum*: see above Cap.8, line 37.

Line 60. *Verbasci: Verbascum:* see above Cap.7, line 22.

Line 60. *Lychnidis: Lychnis*: see above Cap.3, line 35.

Line 61. *Buglossum.*

[C.T.& M. 359] *Anchusa arvensis* ([L.] Bieb.), [*Lycopsis arvensis* (L.)], Bugloss; a species of the *Anchusa* genus of the *Boraginaceæ* or Borage family.

B.& G.-W. 324: B.& H. 313: Linn.*Sp.Pl.* 138-139: *Syn.Meth.St.Br.* 227: *H.P.* 493-494: *H.P.III* 268: *Tri.* 9.26: *Cat.Angl.* 45: *Camb.* 49.

H.P. 493-494:

11 species given, including:

Buglossum vulgare J.B. Park. *angustifolium majus* C.B. *Buglossa vulgaris* Ger. ***Bugloss.***

Buglossa sylvestris minor Ger.emac. *Buglossum sylvestre minus* C.B. Park. *Echium Fuchsii sive Borago sylvestris* J.B. ***Small wild Bugloss.***

H.P.III 268:

14 additional species given.

Tri. 9.26:

Bugloss: *Buglossum, -i,* n.: *Βούγλωσσον, -ου,* n.

Line 61. *Echium.*

[C.T.& M. 364] *Echium vulgare* (L.), Viper's Bugloss; species of the *Echium* genus of the *Boraginaceæ* or Borage family.

B.& G.-W. 320: B.& H. 308: Linn.*Sp.Pl.* 139-140:

Syn.Meth.St.Br. 227: *H.P.* 498-500: *H.P.III* 269: *Tri.* - no ref.:

Cat.Angl. 93-94: *Camb.* 60.

H.P. 498-500:

13 species given, including:

Echium vulgare J.B. C.B. Park. Ger.emac. ***Vipers Bugloss.***

H.P.III 269:

13 additional species given.

Line 61. *Carduorum: Carduus:* see above Cap.4, line 151.

Line 62. *Agrifolii: Agrifolium:* see above Cap.4, line 144.

Line 62. *Scorpius.*

[C.T.& M. 185] *Genistaanglica* (L.), Petty Whin, Needle Furze; a species of the *Genista* genus of the *Leguminosæ* or Pea family.

B.& G.-W. 200: B.& H. 102: Linn.*Sp.Pl.* 709-711:

Syn.Meth.St.Br. 475: *H.P.* 1729: *H.P.III* - no ref.: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 1729:

Genista spinosa vulgaris Ger.emac. *spinosa major longioribus aculeis* C.B. *spinosa major vulgaris, seu Scorpius Theophrasti, quem Gaza Nepam transtulit.* Park. *Genistellæ spinosa affinis Nepa quibusdam* J.B. ***Furz, Whins or Gorss.***

Line 71. *Salviã: Salvia:* see above Cap.7, line 44.

Line 71. *Urticã: Urtica.*

[C.T.& M. 309-310] *Urtica dioica* (L.), Common Nettle, Stinging Nettle; a species of the *Urtica* genus of the *Urticaceæ* or Nettle family.

B.& G.-W. 60: B.& H. 399: Linn.*Sp.Pl.* 983-985: *Syn.Meth.St.Br.* 139-140: *H.P.* 159: *H.P.III* 105: *Tri.* 12.133: *Cat.Angl.* 309-310: *Camb.* 126.

H.P. 159:

7 species given, including:

Urtica major vulgaris J.B. *major vulgaris & media sylvestris* Park. *Urens prima & secunda sive urens maxima & altera urens* C.B. ***Common stinging Nettle.***

H.P.III 105:

15 additional species given.

Tri. 12.133:

Nettle: *Urtica, -æ,* f.: *Ἀκαλύφη, -ης,* f.

Κνίδη, -ης, f.

Lines 72-81. *Notand. Plantas quadrato caule præditas ..... ut in Vermicularia, Tithymalo & similibus.* Here Ray discusses the relative positions of leaves on the stem with various examples. Morton comments that Jung's final words on the leaf:

> the various types of phyllotaxy, the arangement of leaves on the stem, are accurately described and designated.[652]

Line 77. *Bugula:* see above Cap.7, line 59.

652 Morton: 170.

Line 77. *Brunella.*

[C.T.& M. 411] *Prunella vulgaris* (L.), Selfheal; a species of the *Prunella* genus of the *Labiatæ* or Mint family.

B.& G.-W. 340: B.& H. 352: Linn.*Sp.Pl.* 600-601:

Syn.Meth.St.Br. 238: *H.P.* 551-552: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 243-244 (under *Prunella*): *Camb.* 99.

H.P. 551-552:

6 species given, including:

Prunella Ger. *vulgaris* Park. *flore minore vulgaris* J.B. *Brunella major folio non dissecto* C.B. ***Common Self-heal.***

Line 78. *Lysimachiã luteã: Lysimachia lutea.*

[C.T.& M. 347] *Lysimachia vulgaris* (L.), Yellow Loosestrife; a species of the *Lysimachia* genus of the *Primulaceæ* or Primrose family.

B.& G.-W. 298: B.& H. 290: Linn.*Sp.Pl.* 146:

Syn.Meth.St.Br. 282-283: *H.P.* 1021: *H.P.III* 526: *Tri.* - no ref.:

Cat.Angl. 194: *Camb.* 82.

H.P. 1021:

3 species given, including:

Lysimachia lutea J.B. Ger. *lutea major, quæ Dioscoridis* C.B. *lutea major vulgaris* Park.

Yellow Willow-herb, or Loose-strife.

H.P.III 526:

Lysimachia lutea, non papposa erecta minor, flore luteo pentapetalo, fructu Caryophylloide Slon.Cat.Jamaic. *An Nir Carambu* H.M. Part 2, p.99.

Ad Plantam Lysimachia lutea fruticescens dictam, seu Camarabayo Brasiliensibus Marcgrav. *nota.*

Line 78. *Lysimachiã cæruleã: Cat.Angl.*193.

Line 78. *Lysimachiā purpureā: Lysimachia purpurea:* see above Cap.7, line 22.

Line 78. *Cruciatā: Cruciata.*

[C.T.& M. 432] *Cruciata laevipes* (Opiz.), [*Valantia cruciata* (L.), *Galium cruciata* ([L.] Scop.), *Cruciata chersonensis* (auct.), Crosswort, Mugwort; a species of the *Cruciata* (Miller) genus of the *Rubiaceæ* or Bedstraw family.

B.& G.-W. 316: B.& H. 212: Linn.*Sp.Pl.* 1052:

Syn.Meth.St.Br. 223: *H.P.* 879-880: *H.P.III* 261: *Tri.* - no ref.: *Cat.Angl.* 84-85: *Camb.* 58.

H.P. 879-880 [This is an incorrect reference in the index to *Historia Plantarum;* it should read 479-480.]

5 species given, including:

Cruciata Ger. *vulgaris* Park. *hirsuta* C.B. *Gallium latifolium, Cruciata quibusdam flore luteo* J.B.

Cross-wort or Mugweed.

H.P.III 261:

5 additional species given.

Cruciata: in the *Cambridge Catalogue* [p.58], Ray has a note on the arrangement of the leaves of *Cruciata:*

Cruciata, Crosswort or Mugweed, [*Cruciata chersonensis* (Willd.) Ehrend].

In hedegerows and woods.

N. On the square stem there are always two leaves placed alternately on opposite sides (thus called winged); it is possible to see at a short distance two others at right angles to the first two; thus four arise from the four sides as in *Cruciata dodonæi* and *Erythrodano* which they call *Rubia tinctorum.* You will never find three or five or more. *Spigel Isag. lib.*1, *cap.*11.[653]

653 *Camb:* 58.

Line 79. *Gallio: Gallium.*

[C.T.& M. 427-432] *Galium* (L.), Bedstraw; a genus of the *Rubiaceæ* or Bedstraw family.

B.& G.-W. 312-316: B.& H. 211: Linn.*Sp.Pl.* 105-108: *Syn.Meth.St.Br.* 224: *H.P.* 482: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 124-126: *Camb.* 66.

H.P. 482:

2 species given, including:

Gallium lutea C.B. Ger. Park. *Gallion verum* J.B.

Yellow Ladies Bedstraw, Cheese-rening.

Line 79. *Rupiã: Rupia.*

[C.T.& M. 530-531] *Ruppia* (L.), Tasselweed; the only genus of the *Ruppiaceæ* or Tasselweed family.

B.& G.-W. 450: B.& H. 425: Linn.*Sp.Pl.* 127: *Syn.Meth.St.Br.* 134: *H.P.* 190: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

Linn.*Sp.Pl.* 127:

Ruppia. Hort.cliff.436. It.wgoth.186. Guett.stamp.2.p.416. *Buccaferrea maritima, foliis acutissimis.* Mich.gen.72.t.35. *Potamogeton maritimum, gramineis longioribus foliis, fructu fere umbellato.* Raj.angl.3.p.134.t.6.f.1[654] *Fucus folliculaceus, fœniculi folio longiore.* Bauh.pin.365.

Syn.Meth.St.Br. 134:

Potamogiton maritimum gramineis longioribus foliis, fructu fere umbellato Pluk.Alm.305. *maritimum pusillum alterum* Raj.Hist.I.190.10. *maritimum pusillum alterum, seminibus singulis longis pediculis insidentibus* Ejusd.Syn.II.62.10. Pluk.Ph.T.248.f.4. *comosum* Pet.H.B.6.1.

654 This reference given by Linnaeus to Ray does not mention *Ruppia/Rupia.*

H.P. - no reference in the index, but the references given by Ray in the *Synopsis* is correct.

H.P. 190.10:

Potamogiton maritimum pusillum alterum.

Line 79. *Aparine: Aparine.*

[C.T.& M. 431-432] *Galium aparine* (L.), Goosegrass, Cleavers, Hairif, Sticky Willie; a species of the *Galium* genus of the *Rubiaceæ* or Bedstraw family.

B.& G.-W. 316: B.& H. 214: Linn.*Sp.Pl.* 108:

Syn.Meth.St.Br. 225: *H.P.* 484: *H.P.III* 264: *Tri.* 10.81:

Cat.Angl. 23-24: *Camb.* 43.

H.P. 484:

5 species given, including:

Aparine Ger. J.B. *vulgaris* Park. C.B. *Philanthropon Dioscoridis & Plinii Lappago Plinii lib.26, cap.10* J.B.

Cleavers or Gosse-grass.

H.P.III 264:

11 additional species given.

Tri. 10.81:

Goosegrass or Cleavers: *Aparine, -es,* f.: Ἀπαρίνη, -ης, f.

Line 81. *Vermicularia: Vermicularia.*

[C.T.& M. 245-247] *Sedum* (L.), Stonecrop; a genus of the *Crassulaceæ* or Stonecrop family.

B.& G.-W. 164-166: B.& H. 159: Linn.*Sp.Pl.* 430-432:

Syn.Meth.St.Br. 269-271: *H.P.* 1041: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 301: *Camb.* - no ref.

*H.P.*1041:

32 species of *Sedum* given here, including *Vermicularia* as follows:

Sedum parvum acre flore luteo J.B. *Sempervivum minus vermiculatum acre* C.B. *Vermicularia sive Illecebra minor acris* Ger. *Illecebra minor sive Sedum 3, Dioscoridis* Park.
Wall-pepper, or Stonecrop.

Line 81. *Tithymalo: Tithymalus:* see above Cap.4, line 23.

Lines 82-120. *Partes folium integrantes:* margin sub-heading.
Quod ad partes folium componentes attinet ..... & utriculi quidam eminent diversos continentes succos. Malpigh. Ray gives the characteristics of the parts of a leaf. He begins correctly by saying that the vascular system in a leaf, his woody fibres and lymph ducts, our phloem and xylem, is the same as that of the trunk or stem.[655]

Line 83. *Vasa succum specificum deferentia, tracheas:* Ray uses *tracheae* here to mean 'sap-bearing' vessels, whereas earlier (Cap.3, line 136) he uses the term for 'air-carrying' vessels. A tracheary element is a water-conducting cell in the xylem.[656]

Line 83. *utriculos spatia replentes:* Ray's description of *utriculi* here seems to indicate that he is referring to air spaces in the spongy mesophyll or central layer of the leaf below the thick outer palisade layer of cells, but his description in lines 105-109 seems to indicate that he means the cells of the spongy mesophyll themselves.[657] See below Cap.9, line 105.

Line 84. *fibrarum reticulariter contextarum:* Ray is referring here to the vascular tissue, which is carried through the petiole to the lamina of

655 Gibbons: 41.
656 *Penguin Dictionary of Botany:* 363.
657 Gibbons: 42.

the leaf, where it branches out into the net of veins visible in the leaf of a typical dicotyledon.[658]

Line 84. *folii petiolum fistulis ligneis una cum tracheis & vase peculiari .....:* Ray believes that the vascular vessels in the petiole derive from those of the young shoot rather than older wood. This 'peculiar vessel' runs along the underside of the leaf into the leaf base, or thickened base of the petiole, beside the bud in the leaf axil, and is part of the continuous vascular system from stem to leaf, which is in fact asymmetrically arranged to carry the weight of the lamina.[659] Although Ray cites Jung as his main source for this chapter, the work of Malpighi and Grew also had considerable influence on him. They had observed that the vascular bundle of the leaf is connected to those of the stem 'through leaf-trace bundles, which in each particular species are definite in number and follow a characteristic course'.[660]

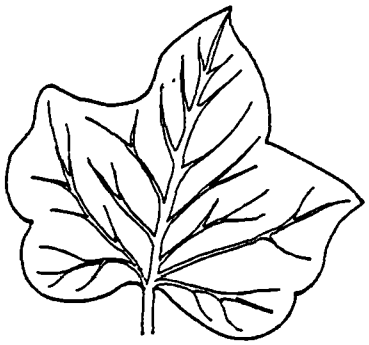
Line 88. *in ramos & surculos scinditur:* he continues with a description of the venation of a leaf and its variants - either a net-like or fan-like pattern.

The vascular strands, which spread out in particular patterns on the lamina of a leaf, are, as Ray says, easily visible on many leaves and on others can be seen 'when the cuticle has decayed', i.e. when the leaf has become a 'skeleton' leaf.

658 Gibbons: 41-42.
659 *Penguin Dictionary of Botany:* 207, 268 and 342.
660 Morton: 182.

Line 91. *Hederā: Hedera:* see above Cap.4, line 119.

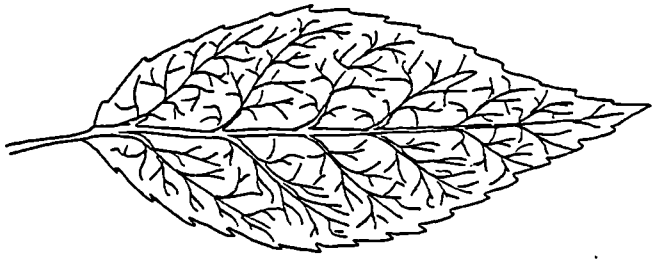
The venation of the *Hedera* leaf, as described by Ray:[661]



Line 92. *pediculum:* it is difficult to understand which part of the leaf Ray means here; he is probably referring to the leaf base, but could be referring to the end of the petiole immediately before the vascular system branches out into the lamina.

Lines 94-99. *Petiolo appenditur folium dilatatum ..... conspicui sunt.* Ray accurately describes here the net-like or reticulate veining of a leaf (now termed reticulodromous), which is characteristic of a dicotyledonous plant.[662]

In diagrammatic form:



Line 98. *Salviæ: Salvia*: see above Cap.7, line 44.

661 Drawn from Blamey and Grey-Wilson: 266.

662 Gibbons: 41; *Penguin Dictionary of Botany* :376 and 313; *Longman Dictionary of Botany:* 97 and 131; *Lowson's Botany:* 60.

Lines 100-104. *Vasa Succifera peculiaria dari probatur:* margin sub-heading.

Fistulas & tracheas concomitari peculiaria vasa ..... cum tamen adesse analogia evincit. Ray describes the differing colours and consistencies of sap, as he does in Cap.5, lines 126-141.

Line 102. *Tithymali: Tithymalus:* see above Cap.4, line 23.

Line 102. *Cichorii: Cichorium*: see above Cap.1, line 36.

Line 102. *Chelidonio: Chelidonium.*

[C.T.& M. 60] *Chelidonium majus* (L.), Greater Celandine; a species of the *Chelidonium* genus of the *Papaveraceæ* or Poppy family.

B.& G.-W. 126: B.& H. 19: Linn.*Sp.Pl.* 505:
Syn.Meth.St.Br. 309: *H.P.* 858: *H.P.III* 425: *Tri.* - no ref.:
Cat.Angl. 68: *Camb.* 53.

H.P. 858:

Chelidonium majus Ger. *majus vulgare* C.B. Park. *Chelidonia* J.B. ***The Greater Celandine.***

H.P.III 425:

Chelidonium majus arboreum foliis Quercinis Slon.Cat.Jamaic.
Cocoxihuitl seu Herba acris Hernandez.

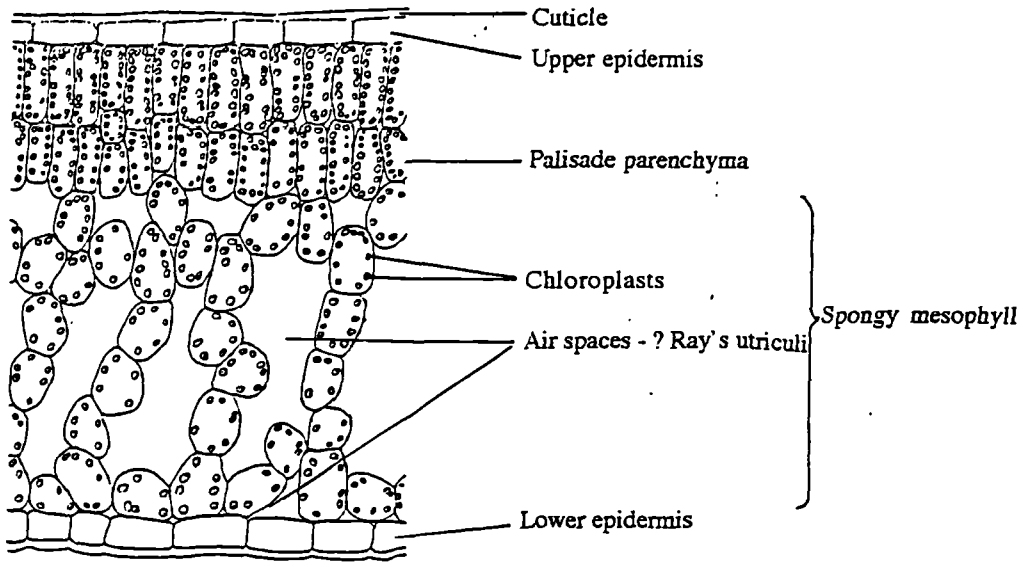
Its sap would now be described as orange[663] rather than *subluteus* or 'yellowish' as here in Ray's text.

Line 105. *Utriculi quales:* margin sub-heading.

Reticularium plexuum maculas seu areas utriculorum series .....: he now gives his definition of *utriculi.*

663 Clapham, Tutin and Moore: 60.

Lines 110-113. *Inter utriculos* ....: Ray describes in more detail his *utriculi;* assuming he is using this term for the same parts of the leaf as in line 83 above, then it seems that he is describing the cells of the spongy mesophyll, for which see diagram below:[664]



Line 110. *Inter utriculos & fibrorum rete in plerisque foliis peculiares foliculi ..... vel humorem fundunt. ..... vide apud Malpighium:* There is also a margin reference *Anat. Plant. pag. 37.*[665]

Lines 115-118. *Foliorum extremus unguis seu margo quasi zona seu crassiore linea circundatur. ..... interius vero ligneæ fibræ reliquis continuatæ excurrunt. Malpig.* This is again virtually quoted *verbatim* from Malpighi, although with a few changes of word order and omitting Malpighi's examples.[666]

664 Gibbons: 42.

665 The quotation comes from page 36 not page 37 of Malpighi's *Anatome Plantarum*, as Ray states.

666 *ibid.:* 37.

comes from its black colour, which as a food makes men angry. However the grammarians wish Ατραφαξιν to mean πέρα τὸ ἀθρόως αὔξειν;[671] for it bursts from the earth on the eighth day after sowing. Theophr. lib.7, cap.1.

We do not have room here for all plants from the genus *Atriplex*, which have been given this name by botanists, but we do however include those which have their seeds enclosed in follicles composed of two follicles coming together, and with individual seeds in individual containers. We consider that the remainder of the *Atriplex* genus should be differentiated by the name of *Blitis* or *Amarans*.

11 species given, including:

Atriplex alba hortensis J.B. Park. *hortensis alba, sive pallide virens* C.B. *sativa alba* Ger.emac.

White Garden Orache or Arrach.

Atriplex sylvestris folio hastato seu deltoide. An Atriplex sylv. altera Ger.emac? C.B. ***Broad-leaved wild Orache.***

H.P.III 122:

11 additional species given.

Tri. 12.138:

Orrache [*sic*]: *Atriplex, -icis*, f.: Ἀτράφαξις, -εως, f.

Line 121. *Amarantis: Amarans/Amaranthus.*

[C.T.& M. 154] *Amaranthus* (L.), Amaranth; a genus of the *Amaranthaceæ* or Amaranth family.

B.& G.-W. 80: B.& H. 371: Linn.*Sp.Pl.* 989:

Syn.Meth.St.Br. 157: *H.P.* 201-203: *H.P.III* 125-128:

671 πέρα τὸ ἀθρόως αὔξειν = 'to grow more than usually'.

Tri. - no ref.: *Cat.Angl.* 42-43 (under *Blitum*):

Camb. 48 (under *Blitum*).

H.P. 201-203:

Ray says:

(Tr.) *Amarantus* is commonly but wrongly written *Amaranthus*. For in Greek it is Ἀμάραντος, which is referring to the flower, which is significant because it is unfading, from Greek μαραίνω with α.[672]

3 species given, including:

Amaranthus maximus C.B. *panicula sparsa* Ger. *purpureus major paniculis sparsis* Park. *Blitum maximum sive Amaranthus major, semine albo.* J.B.

Amaranthus sylvestris maximus Novae Angliae, spicis purpureis carneis aut viridibus.

H.P.III 125-128:

many additional species given.

Camb. 48:

Blitum album minus. ***The lesser wild white Blite.***

[*Amaranthus albus* (L.)]

Blitum rubrum minus, ***The small wild red Blite.***

[*Amaranthus albus* (L.)]

Line 125. *Brassicis: Brassica.*

[C.T.& M. 69-78] *Brassica* (L.), Brassica; a genus of the *Cruciferæ* or Cress family.

B.& G.-W. 158-160: B.& H. 35: Linn.*Sp.Pl.* 666:

Syn.Meth.St.Br. 293: *H.P.* 794-795: *H.P.III* 410: *Tri.* 9.52: *Cat.Angl.* 43-44: *Camb.* - no ref.

672 μαραίνω ('to fade') with the negative 'α'.

Ray has an interesting section here in the main body of the *Historia Plantarum*[673] on the naming of *Brassica.* He says:

> (Tr.) *Brassica*, the panacea of Cato, seems to have been given its name by Festus or Verrius from *præsecando.* The etymology will seem surely troublesome, but easier if we understand two things: one is that in compound words the *e* in *seco* is accustomed to change to an *i*, whence *dissico, subsico* and others which Aldus in his *Orthography* gives in profuse detail. The other is that *B* in many cases was once pronounced as *P*, for which matter see Lipsius on the *Pronunciation of the Latin Language*, Chapter 12. It pleases some that *Brassica* be pronounced as if *Passica*, because it is cut off from the stem and becomes *passa.*[674] Indeed Grapaldus, Raderus and others attribute this etymology to Varro himself. But Varro wrote the same as Festus. For thus he wrote in Book 4 of *The Latin language, Brassica* as *Præsica*, because 'it is cut off from the stem'. For the same is read not only in recent editions, but also in the Aldine edition of 1513, and in the *Mediolanensis* of 1500. A third opinion is that of those, who derive it from Βράσσω, i.e. *voro*, because the Ancients used to eat them with enthusiasm. The fourth is the etymology of Joseph Scaliger. He teaches in his *Commonplace Book* that *Brassica* is named from the Greek πρασικὴ, in as much as it is a garden vegetable. For πρασιὰ indicates garden plots, from which the word *pratum*[675] gets its name.

673 *Historia Plantarum:* 794-795.
674 *passa* = 'dead' or 'separate'?
675 NB πρασιά is singular in Greek; *pratum* ='field'.

This etymology would be satisfying at first sight, if there were not a word *brassica* from Magna Græcia, which gives Βράσκη instead of it. Hesychius gives Βράσκη, Κράμβη,'Ιταλιῶται, where'Ιταλιῶται are not Latins but Tarentines and others. Vossius says all of this in his Etymology.

Brassica is called by more recent scholars *Caulis*, because it grows with a more exceptional stem than other herbs. Hence we call it Cole and Colewort.[676]

The characteristics of *Brassica* are leaves, which are the greatest of their type, being grey or bluish and fleshy, and round seeds, which are not at all bitter.

24 species given, including:

Brassica capitata alba J.B. C.B. Park. Ger. ***White Cabbage.*** *Brassica campestris albo flore* Clus. *campestris perfoliata flo. albo* C.B. *Perfoliata siliquosa* J.B. Ger. *Perf. siliquosa vulgaris, seu Brassica campestris* Park.

H.P.III 410:

13 additional species given.

Tri. 9.52:

Colewort: *Brassica, -æ,* f.: *Κράμβη, -ης,* f.

Line 125. *ctucis capitatis:* is he describing a particular species of Brassica here? Perhaps one with a densely packed head of leaves.

Line 127. *Lactucam: Lactuca*: see above Cap.4, line 46.

Line 127. *Endiviam: Endivia.*

[C.T.& M. 490] *Cichorium endivia* (L.), Cultivated Endive; a

676 Cf the modern salad Coleslaw, prepared from cabbage.

species of the *Cichorium* genus of the *Cichorioideæ* sub-family of the *Compositæ* or Daisy family.

B.& G.-W. 428 (*C.intybus* only): B.& H. 270: Linn.*Sp.Pl.* 813: *Syn.Meth.St.Br.* - no ref.: *H.P.* 254: *H.P.III* - no ref.: *Tri.* 10.67: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 254:

De Intybo sive Endivia Cichoreoque.

Intybus sativa Ger. *sativa latifolia sive Endivia vulgaris C.B. Endivia sativa Park. Intybum sativum latifolium* J.B.

Garden or Broad-leaved Endive.

Intybus crispa Park. ***Curled Endive.***

Tri. 10.67:

Endive: *Endivia, -æ,* f.: *Σέρις, -ιδος,* f.

Line 127. *Cichoreum: Cichoreum*: see above Cap.1, line 36.

Line 127. *Myrrhidem: Myrrhis.*

[C.T.& M. 281] *Myrrhis odorata* ([L.] Scop.), Sweet Cicely; a species of the *Myrrhis* genus of the *Umbelliferæ* or Carrot family.

B.& G.-W. 270: B.& H. 196: Linn.*Sp.Pl.* 256: *Syn.Meth.St.Br.* 207: *H.P.* 431: *H.P.III* 254: *Tri.* - no ref.: *Cat.Angl.* 210: *Camb.* 86.

H.P. 207:

6 species given, including:

Myrrhis magno semine, longo, fulcato J.B. *major vel Cicutaria odorata* C.B. *major vulgaris, sive Cerefolium majus* Park. *Cerefolium magnum sive Myrrhis* Ger.

Sweet Cicely or Great Sweet Chervil, by some Sweet Fern.

H.P.III 254:

7 additional species given.

Line 127. *Apium dulce: Apium:* see above Cap.9, line 31.

Text page 15.

Line 131. *Aliud adhuc experimentum ad hanc opinionem confirmandam producit D.Grevius:* Grew's evidence for green sap-bearing vessels.

Line 132. *Althææ: Althæa.*

[C.T.& M. 167-168] *Althæa officinalis* (L.), Marsh Mallow; a species of the *Althæa* genus of the *Malvaceæ* or Mallow family.

B.& G.-W. 244: B.& H. 86: Linn.*Sp.Pl.* 686-687:

Syn.Meth.St.Br. 252: *H.P.* 601-603: *H.P.III* 320: *Tri.* - no ref.: *Cat.Angl.* 18: *Camb.* 41.

H.P. 601-603:

5 species of *Althæa* or *Hibiscus* given, including:

Althæa vulgaris Park. *Althæa Ibiscus* Ger. *Dioscoridis & Plinii* C.B. *Althæa sive Bis-Malva* J.B. ***Marsh Mallows.***

He also has a section on *Malva* and fruiting and woody *Althæa*: 4 species given.

H.P.III 320:

51 additional species given.

Lines 136-147. *Quod plantæ Aerem liberum & apricum affectent luculento experimento ostendit *D.Sharrocus ..... :* Ray gives one of Sharrock's experiments here, describing in careful detail the phototropic nature of plants. Phototropism is a movement made in response to light; shoots exposed to light from one side grow towards that light. Experiments done with *Avena* (Oats) show that the stimulus is received in the growing tip and that the increased growth, triggered by auxins, is on the relatively shaded side away from the main light. Leaf petioles grow in such a way as to set the

leaves at right angles to the light. Many roots are negatively phototropic although some are quite insensitive to light.[677]

Line 136. *D. Sharrocus Lib. de Histor. propagationis Vegetabilium.* - margin reference.[678]

Robert Sharrock: Fellow of New College, afterwards Archdeacon of Winchester: died 1684. He was well versed in the classical works on plants and in current ideas on horticulture. He was the author of *The History of Improvement and Propagation of Vegetables by the Concurrence of Art and Nature*, Oxford 1660; the date given by Morton for this publication is 1672.[679] It was re-published in Oxford in 1666 and 1672, which could account for Morton's date, and again re-published in London in 1694, this time with the title *An Improvement to the Art of Gardening*. He dedicated this work to Robert Boyle. He was said to be 'very knowing in vegetables and all pertaining thereunto',[680] and showed in this work that he understood many forms of propagation - by seeds, vegetative reproduction, budding and grafting - and also that soil could be improved by cultivation, especially of leguminous crops.

In May 1658 he found that cuttings of some 20 to 30 different plants grew and rooted in water alone and increased in weight. Some species continued their growth from year to year, but there were also some which failed to grow in these conditions and rotted away.[681]

677 *Penguin Dictionary of Botany:* 275; also *Lowson's Botany:* 288.

678 Ray owned both the Latin and English versions of this work, as can be seen from the sale catalogue of his library:
Hist. Propagat. Vegetabilium de Officiis, edition published in Oxford in 1660; *Catalogue:* 13, *Libri Latine &c. in Octavo*, number 173.
History of Vegetables, edition published in Oxford in 1660; British Museum: *S-C 326* (6): 26, English Books in Octavo, number 51.

679 Morton: 230.

680 Raven gives the source of this quotation as Wood, *Athenæ IV:* 147; Raven: 222.

681 Morton: 230.

Sharrock mentions many horticultural and agricultural experiments which he performed, including a whole series on the alleged effects of treatments claimed to speed up the germination of seeds; but any acceleration was inconsiderable, and he found that the only sure method was in hot beds made with horse manure and with fine loam above. He tried grafting many different species of roses and showed that, contrary to the statements of Kircher, the colour of the flowers of the scion is not influenced by the nature of the stock; he also showed that grafting a red rose onto a white did not produce the striped *Rosa mundi*.[682]

If Sharrock had devoted himself solely to botany, he could have become, because of his experimental approach, one of the greatest contemporary botanists. He also wrote on law, religion and political philosophy, and contributed prefaces to three of Boyle's treatises on physics.[683]

Line 148. *Nobis tamen non tam aer quam lumen ....*: Ray states that he believes that light rather than air to be the cause of the green colour in plants. Although Ray and his contemporaries had begun studying plant physiology, the first real advance in the study of photosynthesis was made by Stephen Hales, who went up to Cambridge in 1696. He used Ray's *Flora of Cambridgeshire* in his wanderings in the county and would no doubt have read, and been influenced by, at least Book I of *Historia Plantarum*.[684] Morton, without giving the actual source, quotes Hales as saying, 'May not light also, by freely entering the expanded surfaces of leaves, contribute to the ennobling of the principles of vegetables?'[685] Although vague, the idea of photosynthetic nutrition was beginning

682 Morton: 230.
683 *DSB XII:* 357.
684 Raven: 188.
685 Morton: 253.

to develop. It was to be another hundred years before it was realised that both light and the green pigment of plants were involved in plant nutrition.[686] For a brief account of the development of studies in plant nutrition, including photosynthesis, see the introduction to chapter 17 below.

Line 150. *mimosã: Mimosa*: see above Cap.1, line 10.

Line 169. *semipalis:* Ray's contraction of *semipedalis,* 'half a foot' in length or width.[687] Used in all types of measurements; in natural history it is used by Pliny of *truncus*:

semipedales ramorum truncos relinquentes[688]

Line 182. *Cæsalp.*/ Andrea Cesalpino, 1519-1603,[689] was born in Arezzo and, after studying medicine under Ghini at Pisa, remained there teaching anatomy, botany and philosophy for almost forty years. In 1592 he went to Rome as papal physician. His philosophical teaching, published as *Quæstionum Peripateticarum* in 1569 may have put him at one time in danger from the Inquisition. In anatomy he rejected Galen's view that the blood vessels originated from the liver; he believed that blood flowed from the heart through veins and arteries alike, but there is no real evidence to suggest that he anticipated Harvey. He was also interested in minerals and wrote on their classification. For many years he had studied the localities where many different plants grew; he also had his own Herbarium, dated from 1563, which is now preserved in Florence; this contains 768 plants mounted on 260 sheets, each plant being given in his

686 Beckett: 53.
687 Lewis and Short: 1666.
688 Pliny, *Historia Naturalis* XIII, viii: 37; Loeb edition IV: 120.
['leaving the stumps of the branches six inches long']
689 *DSB XV Supplement:* 80-81; Cesalpino as a botanist is discussed in K.Mägdefrau, *Geschichte der Botanik,* Stuttgart 1973: 37-38 and 41-43; Sachs: 42-57.

own handwriting its Greek, Latin and Italian name.[690]

In his *De Plantis libri XVI* published in 1583,[691] Cesalpino gives a very full statement of contemporary botanical theory. The first book consists of fourteen chapters giving a statement of the principles of botany as he knew them. The remaining fifteen books list, with a descriptive account, about 1500 plants, arranged according to his own classification system. Both Ray and Linnæus later admitted their indebtedness to Cesalpino.[692]

He demonstrated in his botanical work how both the ancient Greek and new ideas could continue to exist side by side in early Renaissance botany, when he based some of his ideas on the Aristotelian analogy of plants with animals. He also made a great contribution to botany in his work on plant physiology. and was the first to try to define the principles on which a comprehensive natural classification of plants could be constructed.[693]

In his *Mehodus* of 1682 Ray pays tribute to Cesalpino as

> the first so far as I know to classify plants by the number of seeds and seed-vessels developed from each flower and from the position of the corculum seminale or point at which germination starts.

At the end of the book, where he gives Cesalpino's *Synopsis*, he goes on to say why he thinks it incorrect, but he admits a great obligation to him nevertheless.

690 Morton: 157.

691 *ibid.:* 128.

692 There is, however, no indication from the sale catalogue of his library that Ray himself owned the writings of Cesalpino.
British Museum: *S-C 326* (6).

693 For Cesalpino's own definition of his principles of botany see Morton: 158, note 46.

Line 183. *A natura, inquit, fabrefacta videntur ut coctioni alimenti inserviant. ..... ut facilius inutilia transpirata evolent.* Again a direct quotation from Malpighi;[694] Malpighi, like Ray (cf. line 148), is feeling his way towards the concept of photosynthesis. Malpighi experimented by removing the leaves of growing plants, which resulted in a reduction of growth and fruiting, and thus he concluded that the leaves have a nutritional function - *taliter excitata folia videntur a Natura fabrefacta, ut coctioni alimenti, quæ præcipua est, inserviant.*[695]

Line 192. *Ɛndíviā: Endivia*: see above Cap.9, line 115.

Line 192. *Ƥeponibus: Pepo.*

[C.T.& M. 294] *Cucurbita pepo* (L.), Marrow, Ornamental Gourd; a species of the *Cucurbita* genus of the *Cucurbitaceæ* or Gourd family.

B.& G.-W. - no ref.: *Flowers G.& B.* 345:[696] B.& H. 157: Linn.*Sp.Pl.* 1011: *Syn.Meth.St.Br.* - no ref.: *H.P.* 639-640: *H.P.III* 332: *Tri.* 13.155: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 639-640:

> *Pepo vulgaris, Cucurbita foliis asperis sive Zuccha flore luteo J.B. Cucurbita major rotunda, flore luteo, folio aspero* C.B.
>
> ***The common Pumpion, called by the vulgar, The Melon.***

H.P.III 332:

> 1 additional species given.

Tri. 13.155:

> Pumpion: *Pepo, -onis*, m.: *Πέπων, -ονος*, m.

694 Malpighi, *Anatome Plantarum:* 38.
695 *ibid.*
696 Polunin: 345.814.

Line 192. *Cucurbitã: Cucurbita.*

[C.T.& M. 294] a genus of the *Cucurbitaceæ* or Gourd family.

B.& G.-W. 256: B.& H. 157: Linn.*Sp.Pl.* 1010:

Syn.Meth.St.Br. - no ref.: *H.P.* 638: *H.P.III* 331: *Tri.* 10.82:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 638:

5 species given, including:

Cucurbita longa, folio molli, flore albo J.B. *oblonga, flore albo, folio molli* C.B. *longa* Park. *anguina* Ger. ***The Long Gourd.*** *Pepo vulgaris, Cucurbita foliis asperis sive Zuccha flore luteo J.B. Cucurbita major rotunda, flore luteo, folio aspero* C.B. ***The common Pumpion, called by the vulgar, The Melon.***

H.P.III 331:

Ad Cucurbitæ vires adde:

(Tr.) 'It is useful for the thirst and heat of fevers'.

5 additional species given.

Tri. 10.82:

Gourd: *Cucurbita, -ae,* f.: Κολόκυνθα, -ας, f.

Text page 16.

Line 203. *Idem ministerium præstant probabiliter folis seminibus &c.* This is taken directly from Malpighi, although instead of Ray's *&c* he continues with *cum hac tamen distinctione* .....[697]

Line 206. *Hæc omnia D.Malpighius, quæ & nobis probantur:* Ray credits Malpighi with the contents of this chapter and states his approval of its contents.[698]

697 Malpighi, *Anatome Plantarum:* 39.
698 *ibid.:* 32-39.

Chapter Ten:

Concerning the flowers of plants and firstly concerning their parts.

Ray begins this chapter with Jung's definition of a flower, which he then goes on to qualify, before listing the various parts of a flower and their functions. Ray later, in 1691, describes the wonder of the flower in the following way:

> The *Flowers* serve to cherish and defend the first and tender Rudiments of the Fruit; I might also add the masculine or prolifick Seed contained in the Chives or *Apices* of the *Stamina.* These, besides the Elegancy of their Figures, are many of them endued with splendid and lovely Colours, and likewise most grateful and fragrant Odours. Indeed such is the Beauty and Lustre of some Flowers, that our Saviour saith of the Lilies of the Fields (which some, not without Reason, suppose to have been *Tulips*) that *Solomon in all his Glory was not arrayed like one of these.*[699] And it is observed by Spigelius,[700] That the Art of the most skilful Painter cannot so mingle and temper his Colours, as exactly to imitate or counterfeit the native ones of the Flowers of *Vegetables.*[701]

One of the sections of *Methodus Nova* of 1682 is entitled *De Floribus Plantarum, eorumque partibus et differentiis.* In content this is very similar to chapters 10 and 11 of *Historia Plantarum,* being 'an outline of the morphology of the flower based upon Jung's *Isagoge*'.[702] Ray brought into popular usage

699 *St.Matthew's Gospel:* 28.
700 Spigel, *Isagoge ad rem Herbariam.*
701 *The WIsdom of God:* 80.
702 Vines: 35. Ray had received Jung's *Isagoge* in MS. form from Dr John Worthington who had obtained it from Samuel Hartlib, as is explained in the Preface to the *Methodus.*

the terminology of Jung,[703] based on sound morphological principles, although he modified and extended it by his own researches.

Malpighi and Grew had also contributed much to the study of the flower, as is evident from Ray's frequent references to them both. It has been said that they were:

> in a sense merely trying out their new microscopic technique on flowers, but in so doing they did much to reveal the regularities of floral structure and to bring certain less "typical" flowers into relation with the rest.[704]

Morton considers that Malpighi's contribution to the nomenclature of floral parts was greater than that of Grew 'since he adopted the vocabulary that was coming into use by continental botanists and was derived from Latin, whereas the English terms invented by Grew (e.g. empalement for calyx, attire for stamen, semets for anther etc.) were a confusing diversion'.[705]

In this chapter Ray also raises the question of sexuality in plants; this had remained virtually neglected since the time of Aristotle and Theophrastus. Even with the revival of botany in the sixteenth century little attention had been paid to the possibility of sexual reproduction, most botanists being content to accept Theophrastus' opinion that 'seed formation took place after and within the flower'[706] although 'the true nature of the flower, like the answer to the related problem of sex in plants, eluded him'.[707] The increase in horticulture and increased knowledge of plant morphology in the seventeenth century revived interest in the reproductive methods of plants. As Morton says, 'It seems likely that the almost universal presence of stamens and pollen in flowers began to lead more than one botanist or observant gardener to suspect

703 See the section in Stearn, where he discusses many examples of Jung's terminology; Stearn, *Botanical Latin:* 31-32. He cites Arber as observing that:

> it is remarkable how often the words of Jung's terminology have survived though sometimes changed in meaning, as for example *perianthium* ..... They owe this largely to their employment by Ray and Linnæus.

704 Morton: 183.
705 *ibid.:* 185.
706 *ibid.:* 37.
707 *ibid.*

that stamens and pollen correspond to the male organ and semen in animals'.[708]

Text page 16.

Line 1. *Flos, definiente Jungio, est .....*

Ray gives here Jung's definition of a flower, which he follows at line 13 with his own definition. A flower is now defined as the reproductive unit of the angiosperms (flowering plants). It consists of four sets of modified leaves arranged in a whorl - the sepals, petals, stamens (male organs) and carpels (female organs). There may be male and female parts in the same flower or they may develop in separate flowers.[709]

Line 3. *frumento Indico Maiz dicto: Frumentum Indicum.*

[Mac.Enc. 763] *Zea mays* (L.), Sweetcorn, Indian Corn; a species of the *Zea* genus of the *Gramineæ* or Grass family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 971-972: *Syn.Meth.St.Br.* 386-389: *H.P.* 1249: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1249:

Triticum indicum J.B. *Frumentum indicum Mays dictum* C.B. *Item Frumentum Indicum Mays dictum alterum* ejusdem. *Milium Indicum maximum Mays dictum, seu Frumentum Indicum* Park. *Frumentum Turcicum & Indicum* Ger.

H.P.III 597:

1 additional species given.

Line 3. *Maiz:* or *Frumentum Indicum*: see above Cap.10, line 3.

Line 3. *Palmã Christi:* or *Ricinus*: see below Cap.10, line 4.

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708 Morton: 213.

709 *Oxford Dictionary of Botany:* 162.

Line 4. *Ricino: Ricinus.*

[Mac.Enc. 238] *Ricinus communis*, Common Castor Oil Plant; a species of the *Ricinus* genus of the *Euphorbiaceæ* or Spurge family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.:

Linn.*Sp.Pl.* 1007: *Syn.Meth.St.Br.* - no ref.: *H.P.* 166:

H.P.III 110-111: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 166:

Ricinus vulgaris J.B. C.B. *Ric. sive Cataputia major vulgaris* Park. *Ricinus sive Palma Christi, vel Kiki* Ger.

Palma Christi.

H.P.III 110-111:

Many additional species given.

Line 4. *Bardanā minore: Bardana minor.*

[C.T.& M. 480] *Arctium minus* (Bernh.), [*Lappa minor* (Hill)], Lesser Burdock; a species of the *Arctium* genus of the *Compositæ* or Daisy family.

B.& G.-W. 420: B.& H. 247: Linn.*Sp.Pl.* 987:

Syn.Meth.St.Br. 140: *H.P.* 165: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 36-37: *Camb.* 47.

H.P. 165:

Xanthium sive Lappa minor J.B. Ger.

The Lesser Burr-Dock.

Also see *Xanthium* below, line 4.

Line 4. *Xanthio: Xanthium.*

[C.T.& M. 480] *Arctium minus* (Bernh.) [*Lappa minor* (Hill)], Lesser Burdock; a species of the *Arctium* genus of the *Compositæ* or Daisy family.

B.& G.-W. 420: B.& H. 247: Linn.*Sp.Pl.* 987:

Syn.Meth.St.Br. 140: *H.P.* 165: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 310-311: *Camb.* 47.

H.P. 165:

Bardana i.e. Xanthium seu Lappa minor.

(Tr.) *Xanthium* is so-called by the Greeks ἀπὸ τοῦ ξανθὰς ποιεῖν τὰς τρίχας, because it makes the hair yellow; *Lappa*[710] *minor* equally is given its name by botanists because the flowers and fruits stick to clothes. C.Hofmann says thast this plant is also called in pharmacies *Bardana,* either from the Gallic or Hispanic languages.

The characteristics of *Xanthium* are stamineous sterile flowers not adjacent to the fruits, a hard prickly fruit, two seeds within two cells, that is, containing one seed in each.

Xanthium sive Lappa minor J.B. *Lappa minor, Xanthium Dioscoridis* C.B. *Bardana minor* Ger.

The Lesser Burr-Dock.

H.P.III 109:

7 additional species given.

Line 4. *Heliotropio tricocco: Heliotropium tricoccum.*

[B.& G.-W. 320] *Heliotropium europæum* (L.), Heliotrope; a species of the *Heliotropium* genus of the *Boraginaceæ* or Borage family.

C.T.& M. - no ref.: B.& H. 308: Linn.*Sp.Pl.* 130-131: *Syn.Meth.St.Br.* - no ref.: *H.P.* 501: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 501:

(Tr.) We have given the reason for the name above in the

710 *Lappa* = 'a bur'.

chapter on *Heliotropium tricoccum*, which is included among the herbs with imperfect flowers.

Heliotropium was so-called by the ancients because it turned its leaves around with the movements of the sun.

But Dodonaeus asserts that this plant is called Heliotrope, not because it turns towards the daily motion of the sun, but because it flowers at the summer solstice.

H.P. 165:

For *Heliotropium tricoccum* Ray agrees with Pliny for the explanation of the name, quoting him, Book XXII, 57 (Tr. of *Historia Plantarum*):

> I have spoken more than once of the wonder of Heliotrope, which turns round with the sun even on a cloudy day, such a love has it for that star. At night it closes its blue flower as though in mourning.[711]

Ray goes on to say that:

> in the plant called by more recent scholars Heliotrope no turning of this kind towards the sun is observed, nor is it in any other species of plant known to us.

In other respects *Heliotropium tricoccum* however conforms with common Heliotrope in its size, and also in the shape of its stem and leaves; yet its flowers and seeds would argue for a completely different genus.'

---

711 Pliny, *Historia Naturalis* XXII, xxix: 57-61; Loeb edition VI: 332-336.
Heliotropi miraculum sæpius diximus cum sole se circumagentis etiam nubilo die, tantus sideris amor est. noctu velut desiderio contrahit cæruleum florem. genera eius duo: tricoccum et helioscopium.
[I have spoken more than once of the marvel of Heliotropium, which turns round with the sun even on a cloudy day, so great a love it has for that luminary. At night it closes its blue flower as though it mourned. There are two varieties - tricoccum and helioscopium.]

Heliotropium tricoccum C.B. J.B. Ger. Park.

Ray himself admits that despite its similarities this may not be a related plant.

Line 4. *Lachrymā Jobi: Lachryma Jobi.*

[O.D.B. 96: Names 59][712] *Coix Lachryma Jobi*, Job's Tears, a cultivated cereal of subtropical Asia, named from the tear shaped, grey-white seeds. Native of south East Asia. A species of the *Gramineæ* or Grass family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 972: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1252: *H.P.III* 598: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1252:

Milium arundinaceum, multis Lachryma Jobi J.B. *Lachryma Jobi* Ger. Park. *Lithospermum arundinaceum* C.B.

Job's Tears, or Reed Millet.

H.P.III 598:

Not listed in the index to volume III, but details given under *Gramineæ*.

Lachryma Jobi maxima H.J.B.*:* page 1252 *Historia Plantarum. Milium Indicum, angustiore folio, semine flavo Tenna Etta ab incolis dictum* Moris.hist.p.3. *Qu. annon idem sit cum Milio Indico Arundinaceo caule, granis flavescentibus* H.L.B?

Also *Milium Virginianum* etc.

Line 4. *Ambrosiā: Ambrosia.*

[C.T.& M. 449-450] *Ambrosia* (L.), Ragweed; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 406: B.& H. - no ref.: Linn.*Sp.Pl.* 987-988: *Syn.Meth.St.Br.* 304: *H.P.* 164: *H.P.III* 108: *Tri.* - no ref.:

712 *Oxford Dictionary of Botany:* 96; Coombes: 59.

Cat.Angl. - no ref. to this plant as *Ambrosia: Camb.* - no ref.

H.P. 164:

1 species only given:

Ambrosia Dod. Ger. *quibusdam* J.B. *hortensis* Park. *maritima* C.B.

H.P.III 108:

6 additional species given.

However, from the description given here by Ray of the position of the fruit in relation to the flower it would appear that he could be referring to *Coronopus Ruelli,* which he calls *Ambrosia* in the *Catalogus Angliæ,* rather than the modern *Ambrosia,* which is also given the name *Ambrosia* by Ray in *Historia Plantarum.*[713]

[C.T.& M. 81] *Coronopus squamatus* ([Forskal] Ascherson), *Cochlearia coronopus* (L.), *Senebiera coronopus* ([L.] Poiret), *Corponopus procumbens* (Gilib.), *Coronopus ruellii* (All.), Swine-cress, Wart-cress; a species of the *Coronopus* genus of the *Cruciferæ* or Cress family.

B.& G.-W.156: B.& H. - no ref.:

Linn.*Sp.Pl.* 648: *Syn.Meth.St.Br.*304: *H.P.* 843:

H.P.III - no ref.: *Tri.* - no ref.: *Cat.Angl.* 19 with a ref. to see *Coronopus Ruelli* 80: *Camb.* 56.

Linn.*Sp.Pl.* 648:

Coronopus:

Cochlearia foliis pinnatifidis. Hort.cliff.331. Fl.suec.539. Roy.lugdb.335. Dalib.paris. 195. Sauv.monsp.254.

Ambrosia campestris repens. Bauh.pin.138.

Pseudo ambrosia. Cam.epit.596.

H.P. 843:

Coronopus Ruellii Ger. *recta vel repens Ruellii* Park. *Coron. Ruellii sive Nasturtium verrucosum* J.B. *Ambrosia campestris*

713 See immediately above in the same entry.

repens C.B. ***Swines Cresses.***

Lines 3-5. Diagram of the flower of *Arctium minus* to illustrate the above;[714]

Line 5. *Juglande: Juglans:* see above Cap.4, line 144.

Line 5. *Corylo: Corylus:* see above Cap.4, line 145.

Line 6. *Quercu: Quercus:* see above Cap.4, line 145.

Line 7. *Sed etiam in eadem specie ..... :* Ray is presumably using the word *species* in its modern technical sense of a group or class of plants, a sub-division of a genus, which has certain common and permanent characteristics, clearly distinguishing it from other groups;[715] the word was first used in English in this way in 1608.[716]

Lines 7-12. *Quinimo non in eadem tantum planta florem a fructu removit natura ..... inque Malo & Pyro manifeste cernitur.* The sexual differences between plants: as Ray / Jung realised, although most flowers contain both male and female parts, some species produce them on separate flowers of the same plant.[717]

714 Drawn from Blamey and Grey-Wilson: 420.
715 *Penguin Dictionary of Botany:* 336; also *Oxford Dictionary of Botany*: 383-384.
716 *OED:* 2067.
717 Gibbons: 69.

Line 9. *quae fœcunde, flores non producerunt:* Ray is obviously confused here by the fact that all flowers do not carry the visible 'signs' of a flower, that is, petals. Flowers relying on wind or water for pollination may be lacking petals, as, for example, Shoreweed *(Littorella uniflora).*[718]

Line 12. *ut in Pomiferi, Pepone ..... manifeste cernitur.*
He gives here a list of plants bearing both male, that is, non-fruit-bearing, and female flowers.

Line 12. *Pepone: Pepo:* see above Cap.9, line 180.

Line 12. *Cucurbitã: Cucurbita:* see above Cap.9, line 180.

Line 12. *Melone: Melo.*
[C.T.& M. 294] *Cucumis melo* (L.), Melon; a species of the *Cucumis* genus of the *Cucurbitaceæ* or Gourd family.
B.& G.-W. 256: Mac.Enc. 798: B.& H. 157: Linn.*Sp.Pl.* 1011: *Syn.Meth.St.Br.* - no ref.: *H.P.* 644: *H.P.III* 333: *Tri.* 12.123: *Cat.Angl.* - no ref.: *Camb.* - no ref.
H.P. 644:
4 species given, including:
Melo Ger. J.B. Park. *vulgaris* C.B. ***The Musk-melon.***
H.P.III 333:
1 additional species given.
Tri. 12.123:
Melon, *Melo, -onis,* m.: [No Greek].

Line 12. *Malo: Malus*: see above Cap.4, line 145.

718 Gibbons: 68.

Line 12. *Pyro: Pyrus*: see above Cap.4, line 145.

Lines 13-15. *Rectius mea sententia definitur flos:* Ray elaborates on Jung's definition, given at line 1 above. He repeats this definition in his glossary at the beginning of Book I.[719]

Line 14. *eique plurimum cohærens & tenello tegendo fovendoque inserviens:* Ray is saying that a flower usually covers and protects a young fruit. As such he seems to be describing a hypogynous or perigynous flower, in which is seen the most common arrangement of floral parts, with sepals, petals and stamens inserted below the ovary.[720]

Line 16. *amentacei:* catkin-like flowers. A catkin is a hanging inflorescence evolved for wind pollination. It is a loose spike made up of many sessile, usually unisexual flowers. The calyx and corolla are usually reduced or absent to allow for maximum air circulation around the plant. Some of the flowers are not, as Ray implies, 'useless', since the male flowers, although not producing fruit, scatter pollen on to the female ones, which have long hairy styles and stigmas to enable them to trap the pollen, and thus develop fruit.[721] This type of flower, having both male and female reproductive organs separated in different floral structures on the same plant, is called monoecious.[722] Ray has already observed in line 6 that some catkins are distinct from the fruit.

719 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.
720 *Penguin Dictionary of Botany:* 185.
721 *ibid.:* 61-62.
722 *ibid.:* 233.

Line 18. *Partes floris sunt ..... :* Ray now lists the parts of a flower; like Jung, he includes as the *flos* or flower, the petals *(folia)*, stamens *(stamina)* and stylus *(stilus)*, and also includes the calyx *(perianthium)* covering the *flos*.[723]

Line 19. *quæ nos ad Homonymiam vitandam cum Columna petala appellare solemus:* Ray states here that he has decided to use the new term *petalum* instead of *folium* for the 'floral leaf' or 'petal'. Colonna, as he says, had used the Greek word πέταλον for the floral leaf [in *Phytobasanos* Cap.1, and in *Ekphrasis* Part I, Cap.92].

Ray summarises his description of the petal in his glossary at the beginning of *Historia Plantarum:*

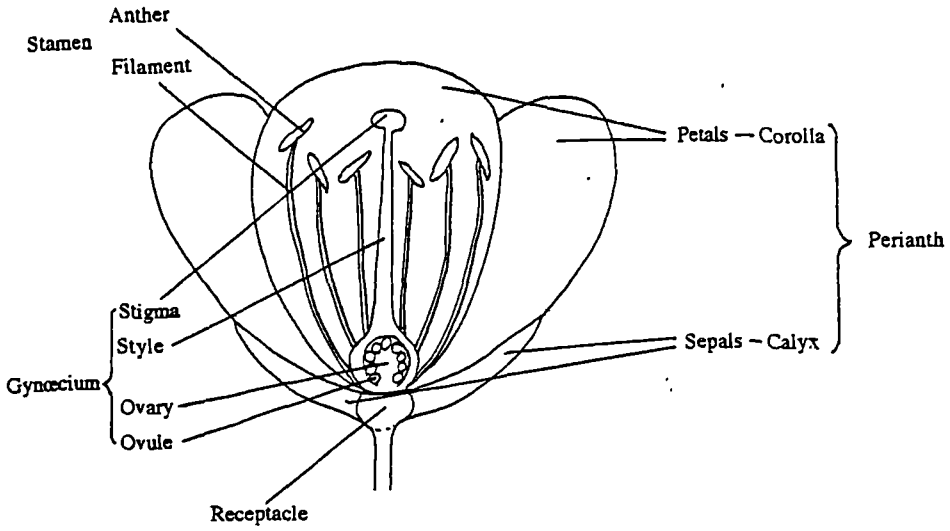
> *Petala nobis F. Columnam sequutis dicuntur floris folia. seu laminæ illæ tenellæ colre insignes & fugaces. Hoc autem nomine partem ob brevitatem, partim ad Homonymiam evitandum pro floris folio utimur. Hinc monpetalæ herbæ nobis dicuntur quorum flos unico folio seu lamina constat, tripetalæ, tetrapetalæ, pentapetalæ &c. quorum flos tribus, quatuor, quinque &c. foliis componitur.*[724]

Lines 18-20. *Partes floris sunt ..... :* Ray gives the parts of a flower as calyx or perianth, petals, stamens and stylus.

723 Morton: 171.

724 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

A typical flower in cross section would appear thus:[725]



Line 21. *flores perfecti..... imperfecti:* he gives his definitions of 'perfect' and 'imperfect' flowers. Again this agrees with Jung.[726]

Line 23. *Calthæ palustris: Caltha palustris.*

[C.T.& M. 33] *Caltha palustris* (L.), Kingcup, Marsh Marigold, May Blobs; a species of the *Caltha* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 106: B.& H. 11: Linn.*Sp.Pl.* 558:

Syn.Meth.St.Br. 272: *H.P.* 700: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 49: *Camb.* 50.

H.P. 700:

Caltha palustris J.B. *palustris vulgaris simplex* Park. *palustris flore simplici* C.B. *palustris major minor* Ger.

Marsh-Marigold.

Line 23. *Anemones: Anemone:* see above Cap.1, line 50.

725 Based on Beckett: 192.
726 Morton: 171.

Line 24. *imperfectum qui apetalos est* ..... : Ray's statement agrees with that of Jung.

Line 25. *Hunc stamineum etiam vocamus*.....: Ray is perhaps correct in his definition of a 'staminate' or 'stamineous' flower. He, like Jung, calls 'imperfect' a flower which lacks petals and which consists of only stamens and calyx.[727] A staminate flower does lack petals and has only male parts or stamens, with no female parts or stigma and ovaries.[728]

Lines 25-26. *Sub staminibus etiam stylum* ..... : he does, however, realise that some flowers lack female parts, that is, as Ray says, lack a stylus, which is the section of the female organ between the ovary and the stigma.[729]

Line 27. *CALYX:* margin sub-heading.

Calyx est ..... : Ray describes the calyx, but disagrees with Cesalpino that it is always of the same colour as the herb itself (i.e. as the leaves and stems) and that it does not fall with the petals. Ray gives a succinct defintion of the calyx in his introductory glossary to *Historia Plantarum:*

> *Calyx, folliculus seu involucrum floris priusquam dehiscat, præcipue Rosæ: interdum flos ipse rosæ connivens & nondum expansus. At nunc frequentissime accipitur pro folliculo, quo flos primum deinde semen herbarum & fructus arborum cooperitur. The Cup*

727 It is perhaps coincidental that both Ray and Jung happen to agree in terminolgy with the modern definition of a staminate flower *(flos stamineus)*, since they also use the term for non-petaloid flowers with both stamens and stylus, as, for instance, in Jung's examples of *Ulmus* and *Sanguisorba*.
Cf. Morton: 171.

728 *Penguin Dictionary of Botany:* 341.

729 *ibid.:* 346.

enclosing, or containing the flower.[730]

As with other definitions from this glossary, one feels that perhaps Ray wrote the glossary after completing the rest of the work, when his ideas had been refined and modified.

He gives *perianthium* as a synonym for *calyx* in his glossary:

Perianthium est quod florem tegit, & dicitur etiam calyx.[731]

We would define the calyx as being a collective name for the sepals, which form a protective, leaf-like whorl enclosing and protecting the bud before it opens. Although the calyx is normally green it can be the same colour as the petals.[732]

Line 30. *Ranunculo: Ranunculus*: see above Cap.7, line 57.

Line 30. *Lysimachiā siliquosā: Lysimachia siliquosa.*

[C.T.& M. 262] *Epilobium hirsutum* (L.), Great Hairy Willow-herb, Codlins and Cream; a species of the *Epilobium* genus of the *Onagraceæ* or Willowherb family.

B.& G.-W. 262: B.& H. 150: Linn.*Sp.Pl.* 347:

Syn.Meth.St.Br. 310-311: *H.P.* 860: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 194-195: *Camb.* 82.

H.P. 860:

Lysimachia siliquosa hirsuta majore flore purpureo J.B. *Siliquosa hirsuta magno flore* C.B. *Filius ante patrem* Dod. Lob. *Lysimachia siliquosa* Ger.

Great hairy codded Loose-strife or Willow-herb, called also Codlins and Cream.

730 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

731 *ibid.*

732 *Penguin Dictionary of Botany:* 56.

Line 30. *vel etiam ante florem, ut in Papavere:* Ray proves Cesalpino to be wrong by correctly observing that the calyx of the poppy drops off shortly after the flower has opened and before the petals fall.[733]

Line 30. *Papavere: Papaver.*

[C.T.& M. 57-59] *Papaver* (L.), Poppy; a genus of the *Papaveraceæ* or Poppy family.

B.& G.-W. 124-126: B.& H. 17: Linn.*Sp.Pl.* 506: *Syn.Meth.St.Br.* 308-309: *H.P.* 853, 854, 1807, *Rhoeas* 855, *spinosum* 856, *corniculatum* 857, *spumeum i. Lychnis* 998: *H.P.III* 425: *Tri.* 12.152: *Cat.Angl.* 221-224: *Camb.* 91.

H.P. 853 etc.:

17 species given, including:

Papaver sativum J.B. ***Poppy.***

H.P.III 425:

3 additional species given.

*Tri.*12.152:

Poppy: *Papaver, -eris,* n.: *Μήκων, -ωνος,* f.

Line 31. *Calyces seu Perianthia:* Ray uses the term perianth as a synonym for calyx, whereas we now use the term for the calyx and corolla combined, that is, for the sepals and petals, not for the sepals alone.[734]

Basically Ray again agrees with Jung here.[735]

Line 33. *Fegopyri: Fegopyrum.*

[C.T.& M. 304] *Fagopyrum esculentum* (Moench.), [*Fagopyrum sagittatum* (Gilib.), *Polygonum fagopyrum* (L.)], Buckwheat; a

733 Gibbons: 68.
734 *Penguin Dictionary of Botany:* 265.
735 For a discussion on Jung's descriptions of the calyx see Morton: 171.

species of the *Fagopyrum* genus of the *Polygonaceæ* or Dock family.

B.& G.-W. 66: B.& H. 384: Linn.*Sp.Pl.* 363-365:

Syn.Meth.St.Br. 144: *H.P.* 181-182: *H.P.III* 116: *Tri.* 9.25: *Cat.Angl.* 105: *Camb.* 63.

H.P. 181-182:

> (Tr.) Its characteristics are small five-petalled showy flowers in spikes coming out from the angles of the leaves. It compares with similar ones in its three-cornered seed, yet differs from them in its more sordid colour and floury meal.

2 species given, including:

Fegopyrum Dod? *Tragopyron* Ger.emac. Park. *Fagotriticum* J.B. ***Buck-wheat or Brank.*** *Erysimum Theophr. folio hederaceo* C.B.

H.P.III 116:

4 additional species given.

Tri. 9.25:

Buckwheat: *Fegopyrum, -i,* n.: *Τραγόπυρον, –ύρου,* n.

Ray's footnote in *Trilingue*:

> This is known by several names in several parts of England, as 'Brank' in Essex, &c, 'Crap' in Worcestershire.

Line 33. *Potamogitonis angustifolii: Potamogiton angustifolium*

[C.T.& M. 302] *Polygonum amphibium* (L.), Amphibious Bistort; a species of the *Polygonum* genus of the *Polygonaceæ* or Dock family.

B.& G.-W. 64: B.& H. 386: Linn.*Sp.Pl.* 361:

Syn.Meth.St.Br. 145: *H.P.* 184: *H.P.III* 121: *Tri.* - no ref.:

Cat.Angl. 241: *Camb.* 97.

H.P. 184:

Persicaria salicis folio, Potamogiton angustifolium dicta. Potamogiton angustifolium Ger. 2. *sive Salicis folio* C.B. *Potamogiton sive Fontalis Persicaria foliis* J.B. *Fontalis minor longifolia* Park. ***Narrow-leaved Pondweed or Arsmart.***

H.P.III 121:

9 additional species given.

Line 33. *Bistortæ: Bistorta:* see above Cap.7, line 11.

Line 34. *Calyces enim voco ..... :* he is saying that he recognises as a calyx leaf-like structures of the same colour as the petals, *quis nec deciduae sunt, nec fugaces* ('because they are neither deciduous nor transient'). This contradicts what he has just said in line 30 about the calyx of the *Papaver*, which he himself has observed to be deciduous.

Line 36. *PETALA: margin sub-heading.*

Petala seu floris folia: sunt .... : Ray defines a petal as 'thin, distinctive in colour and deciduous', whereas some petals can be of almost the same colour as the leaves of the plant and all are not deciduous:[736] see below Cap.10, line 40.

Line 39. *Ob defectum primæ conditionis ..... :* Ray correctly realises that, merely because they are deciduous, the calyces of *Ranunculus* and *Papaver* cannot be defined as petals.

Line 39. *Ranunculi: Ranunculus*: see above Cap.7, line 57.

Line 39. *Papaveris: Papaver*: see above Cap.10, line 30.

736 *Penguin Dictionary of Botany:* 267.

Line 40. *Bistortæ: Bistorta*: see above Cap.7, line 11.

Line 40. *Persicariæ:Persicaria.*

[C.T.& M. 303] *Polygonum persicaria* (L.), Red Shank, Willow-weed, Persicaria; a species of the *Polygonum* genus of the *Polygonaceæ* or Dock family.

B.& G.-W. 64: B.& H. 386: Linn.*Sp.Pl.* 361:

Syn.Meth.St.Br. 144-146: *H.P.* 182-183: *H.P.III* 117:

Tri. - no ref.: *Cat.Angl.* 230-231: *Camb.* 93.

H.P. 182-183:

Persicaria vulgaris acris sive Hydropiper J.B. *vulgaris acris sive minor* Park. *P. urens, sive Hydropiper* C.B. *Hydropiper* Ger. ***Lakeweed or Arsmart.***

H.P.III 117:

17 additional species given.

Line 40. *ob secundæ carentiam .....:* Ray refuses to admit as such the petals of the *Bistorta* and *Persicaria*, because their perianth segments are persistent, that is, they do not fall away.

Line 42. *Quod ad petalorum texturam & compositionem attinet:* Ray accepts Malpighi's teaching that the vascular system of a petal is the same as that of the stem etc. In fact a petal, although believed to be a modified leaf, has a simplified internal structure with only one vascular bundle as opposed to the several existing in leaves and sepals.[737]

737 *Penguin Dictionary of Botany:* 267.

Line 43. *Interioris cauliculi seu ligni (docente Malpighio) substantia ..... & productis ramis in omnem dimensionem elongantur.* This is a lengthy quotation from Malpighi, although Ray makes two changes of verb and corrects one spelling or typographical mistake in Malpighi's text. He uses *integrantur* where Malpighi has *excitantur* and *exurgunt* for Malpighi's *assurgunt;* he corrects *teuni* in Malpighi's text to the correct spelling of *tenui.* There is a correct margin reference to *Anat. Plant. p.55.*[738]

Line 48. *Quod ad colores ..... omnes in floribus spectantur:* as Ray is unsure of the sexual functions of the parts of a flower,[739] his observations have not led him to notice that 'insect-pollinated plants tend to have large, often yellow or white, scented petals frequently with a nectary at the base and honey guides patterning the surface. The petals of wind-pollinated plants, when present, tend to be small and dull-coloured.'[740]

Line 48. *excepto nigro & viridi:* he is probably correct in saying that there are no flowers with truly black petals, but there are certainly many with petals in varying shades of green, as for example various members of the *Alchemilla* or Lady's Mantle genus of the *Rosaceae* or Rose family and members of the *Cannabaceæ* or Hemp family.

Line 49. *STAMINA:* margin sub-heading.

Stamina seu capillamenta: Ray accurately describes the stamen here, giving it the alternative name of *capillamentum*, a hair; in the translation I have left this term in Latin as a technical term, where it

738 Malpighi's chapter *De Floribus* is to be found in his *Anatome Plantarum:* 40-56. This quotation is from page 55 as Ray says.

739 *Cf.* Cap.10, lines 100-146.

740 *Penguin Dictionary of Botany:* 267; Beckett: 193-194.

first occurs, but have translated it as 'hair' thereafter.[741]

Ray gives definitions of both *stamina* and *capillamenta* in his introductory glossary to *Historia Plantarum;* that for *stamina* is an exact reproduction of his definition given here, although he elaborates somewhat on *capillamenta:*

> *Capillamenta sunt filamenta illa tenuia, in florum medietate surgentia, apicibus plerunque domnata.*
>
> ***Threads.***[742]

The stamen, or male reproductive organ of a flowering plant, consists of a filament bearing an anther, which is attached to the receptacle, that is, to Ray's *umbilicus*, between the petals and the pistil or female reproductive organ,[743] described here in lines 51-52 as similar in appearance but *crassiorem atque e centro umbilici emergentem ambiunt*, 'thicker and emerging from the centre of the *umbilicus*'.

Arber states that the term *stamen* was first used in its modern sense by Pliny in describing the lily:[744] Pliny's actual words are:

> *resupinis per ambitum labris tenuique pilo et stamine, stantibus in medio crocis.*[745]

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741 NB The term *stamen* in Latin originally means 'a thread hanging from the distaff' and thence came to mean 'threads' of other sorts such as the botanical stamen. Lewis and Short: 1750.

742 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

743 *Penguin Dictionary of Botany:* 340-341.

744 Arber: 12.
It must be noted, however, that there is some discrepancy in the various texts of Pliny here, which could affect the meaning, for which see the following footnote.

745 Pliny, *Historia Naturalis* XXI, xi: 23; Loeb edition VI: 176.
[The lips curve outward and upwards all round; the slender pistil and stamens, the colour of saffron, standing upright in the centre.]
Translated by Jones in the Loeb edition.
stamine Detlefsen: *semine* codd.: *staminis* (*sine commate*) Mayhoff.
Jones, in his footnote to the Loeb text, thinks that:
> *pilo* refers to pistil and *stamine* to the stamen. The reading here is doubtful, as is the construction of the ablatives. Possibly: "the croci (anthers) standing in the centre with slender filaments and pistil."

Morton[746] notes that Malpighi and Grew had both observed

> the almost universal presence of the stamen, and of its structure, having a sac at the tip (the anther) which opened to liberate a mass of dust or globules (the pollen)..... The constant presence of the stamen as a morphological unit contributed to strengthen the thought, undoubtedly beginning to arise in more than one mind about this time, that here was the organ in plants corresponding to the male generative organ in animals, producing pollen, which must therefore correspond to the spermatic fluid. ..... Grew came to accept the probability that the stamen is the male organ of the plant; he stated this supposition hesitantly in his work on the anatomy of flowers in 1676 and more definitely in the final edition of his *Anatomy* in 1682.[747] Malpighi, strangely enough, seems never to have entertained the idea, although he made elaborate analogy between the animal uterus and the plant ovary, to which he also gave the name uterus.[748]

Line 49. *describente Spigelio:* margin reference to Spieghel: *Isag. ad rem Herbariam.*[749] Ray gives this reference in more detail as *Isag.t.1.c.6* in his introductory glossary to *Historia Plantarum,* when defining stamina,[750] for which see above line 49.

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746 Morton: 184-185.

747 Grew himself attributed this discovery to Sir Thomas Millington, who is otherwise unknown as a botanist; Arber: 160.

748 Malpighi, *Anatome Plantarum:* 50-51.

749 The sale catalogue of Ray's library indicates that he owned several of Spieghel's works, including this one:
In rem Herbariam, edition published in Padua in 1606; British Museum: *S-C 326* (6): 9, *Libri in Latine &c. in Quarto,* number 188.

750 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

Adriaan van den Spieghel: born in Brussels 1578: died in Padua 1625. His main interests were in botany, anatomy and medicine.[751] He published in 1606 his *Isagoge in rem herbariam libri duo,* in which detailed instructions for forming a collection of dried plants were given.[752] Although a native of Brussels, he finally occupied the chair of botany at Padua.[753]

In his *Isagoge,* which is a general treatise on botany, he gives the method of pressing plants between sheets of good paper under gradually increasing weights. When they are dry they are to be laid on sheets of inferior paper *(charta ignobilior)* and painted with a special gum, for which he gives the recipe. Then they are to be transferred to sheets of white paper, linen laid over them and rubbed steadily until they adhere to the paper. Finally the sheets are to be placed between paper, or in a book, and subjected to pressure until the gum dries.[754]

He realised the value of herbaria; he calls such a collection a 'winter garden' (*hortus hyemalis*), while other early writers call it 'lebendig Kreuterbuch', '*herbarius vivus*' or '*hortus siccus*'.[755]

His complete works were published in Amsterdam in 1645.[756]

Line 49. *quod umbilicus appellatur*: this term is used by Pliny and by Palladius Rutilius Taurus in the same way for 'a projection in the middle of plants', meaning presumably 'a projection in the middle of

751 *DSB XII:* 577-578; Raven: 104.
752 Arber: 282.
753 *ibid.:* 142.
754 *ibid.*
755 *ibid.*
756 Raven: 473. That Ray owned a copy of this work is indicated from the sale catalogue of his library:
Opera Omnia, edition published in Amsterdam in 1645; British Museum: *S-C 326* (6): 4, *Libri Latine &c. in Folio,* number 174.

the flower'.[757]

Ray, following Spieghel, uses the term *umbilicus* to describe the central depression of a flower, which resembles a mammal's navel. The term is now used in botany variously for:[758]

1. the hilum of a seed, which is the point on the seed indicating the point where the funicle or ovule stalk was attached to the ovule.[759]
2. the ostiole in certain Fungi, or aperture through which spores escape.[760]
3. a much-branched rhizoid, or thread-like cell, in some Lichens.[761]
4. the boss on the valves of some Diatoms, or algae of the division *Bacillariophyta*.[762]

Line 51. *apicibus frequenter præditæ*: the apex or anther attached to the top of the filament of the stamen.
From line 79, I have translated *apex* as 'anther'.

Line 53. *Stamina pediculo constant & capitulo seu apice:* a correct observation of filament and anther.

Line 54. *Pediculi staminum:* I have given Ray's term 'pedicel' *(pediculus)* in the translation for line 53, but thereafter use the modern technical term 'filament'.

757 Pliny, *Historia Naturalis* XV, xxiv: 89 [Loeb edition IV: 350], XVI, x: 29 [Loeb edition IV: 406] and XVIII, xxxvi: 136 [Loeb edition V: 276]; Palladius, *November Mensis*, or *Liber XII*, 7.8.
758 Jackson, *Glossary:* 397.
759 *Penguin Dictionary of Botany:* 178.
760 *ibid.:* 253.
761 *ibid.:* 313.
762 *ibid.:* 36.

Lines 54-55. *Pediculi staminum ..... seu dilatata petioli substantia (ut cum D. Malpighio loquar) oriuntur:* Ray and Malpighi seem to be referring to the receptacle, which is the term used for the top of the stalk of a flower carrying the perianth, stamens and pistil.[763] Ray is quoting here, but with omissions, from Malpighi's text.[764]

Line 55. *Digitali: Digitali.*

[C.T.& M. 377] *Digitalis* (L.), Foxglove; a genus of the *Scrophulariaceæ* or Figwort family.

B.& G.-W. 360: B.& H. 332: Linn.*Sp.Pl.* 621-622:

Syn.Meth.St.Br. 283*: *H.P.* 767-768: *H.P.III* 396-397:

Tri. 10.75: *Cat.Angl.* 90-91: *Camb.* - no ref.

H.P. 767-768:

> (Tr.) *Digitalis* is so-called from its flower's resemblance to a finger or container for rings, nor does any creation other than one of this kind have a generic characteristic with a concave, labiate, pendulous flower with a bivalve seed capsule.
>
> 5 species given, including:
>
> *Digitalis purpurea* J.B. Ger. *purp. vulgaris* Park. *purp. folio aspero* C.B. ***Purple Fox-glove.***

H.P.III 396-397:

> 23 additional species given.

Tri. 10.75:

> Foxglove: *Digitalis, -is,* f.: [No Greek].

Line 57. *Symphyto majore: Symphytum majus.*

[C.T.& M. 358-359] *Symphytum officinale* (L.), Common Comfrey; a species of the *Symphytum* genus of the *Boraginaceæ* or Borage family.

763 *Longman Dictionary of Botany:* 72.
764 Malpighi, *Anatome Plantarum:* 48.

B.& G.-W. 322: B.& H. 314: Linn.*Sp.Pl.* 136:
Syn.Meth.St.Br. 230: *H.P.* 504-505: *H.P.III* 266: *Tri.* 9.53:
Cat.Angl. 281 with a ref. to see *Consolida major* 77-78:
Camb. - no ref.

H.P. 504-505:

Consolida major Ger. *Symphytum magnum* J.B. *majus vulgare* Park. *Symphytum, Consolida major* C.B. ***Comfrey.***

H.P.III 266:

No reference to *S. majus* as such, but:

Ad cap. de Pulmonaria maculosa species addendæ:

8 additional species given, including 4 named as *Symphytum.*

One is described as:

Symphytum maculosum seu Pulmonaria maxima, foliis quasi saccharo incrustatis. Pluk.Phytogr.T.227.F.4. *An Symphytum latifolium maculatum asperius, flore cæruleo* H.R.P?

Tri. 9.53:

Comfrey: *Symphytum, -i,* n.: *Σύμφυτον, -ύτου,* n.

Line 57. *Lithospermo: Lithospermum.*

[C.T.& M. 363] *Lithospermum* (L.), Gromwells; a genus of the *Boraginaceæ* or Borage family. *Lithospermum officinale* (L.), Common Gromwell; a species of the above genus.

B.& G.-W. 320-324: B.& H. 310: Linn.*Sp.Pl.* 132-133:
Syn.Meth.St.Br. 228: *H.P.* 502-503: *H.P.III* 270: *Tri.* 10.84:
Cat.Angl. 189-190: *Camb.* 81.

H.P. 502-503:

5 species given, including:

Lithospermum sive Milium Solis J.B. *Lith. majus erectum* C.B. *minus* Ger. *vulgare minus* Park. ***Gromill, or Gromwell.***

Ray has an interesting comment on the origin of the name, including that of the English name:

(Tr.) *Lithospermum* receives its name from the stony hardness of its seed. It is called *Milium Solis* by chemists, although perhaps it should more correctly be called *Milium Soler* in imitation of the Mauritani, since (as Serapio writes) *Soler* frequently grows in the mountains; moreover it is called *Milium* from the likeness of its seed both in splendour and hardness to the seed of *Milium*, It is called by us corruptly Gromill or Graymill, that is, *Milium Griseum.*[765] Its characteristics are a stony, gleaming seed and a flower spread out into five segments.

H.P.III 270:

13 additional species given.

Tri. 10.84:

Gromil or Gromwel: *Lithospermum, -i,* n.:

Λιθόσπερμον, ου, n.

Line 57. *Polygonato: Polygonatum.*

[C.T.& M. 534] *Polygonatum* (Miller), Solomon's Seals; a genus of the *Liliaceæ* or Lily family.

B.& G.-W. 462: B.& H. 457: Linn.*Sp.Pl.* 315:

Syn.Meth.St.Br. 263: *H.P.* 664-665: *H.P.III* 350: *Tri.* - no ref.: *Cat.Angl.* 238: *Camb.* - no ref.

H.P. 664-665:

13 species given, including:

Polygonatum Ger. *vulgare* Park. *latifolium vulgare* C.B. *Polygonatum vulgo Sigullum Solomonis* J.B.

Solomon's Seal.

H.P.III 350:

9 additional species given.

765 *Milium Griseum.* = 'grey meal'.

Line 58. *Jungius sic persequitur:* margin reference to *Isag. Phytoscop. c.20.*

Morton summarises Jung's work on stamens:

> Of the interior part of the *flos*, the stamens are stated to consist of filament *(pediculus)* and head *(capitulus)*, but pollen, rather strangely, is not mentioned, although its presence in the anthers was common knowledge by this time, having been well described by Albertus Magnus in the thirteenth century. Jung gives a very precise and detailed account of the range of variation in number, form and position of the stamens, with many references to named species. The style *(stilus)* is defined as the part occupying the centre of the *flos* and attached to the rudiment of the fruit or seed: the range of form of style and stigmatic head is described with examples.[766]

Line 59. *ornithogalis: Ornithogalum.*

[C.T.& M. 537] *Ornithogalum* (L.), Stars of Bethlehem; a genus of the *Liliaceæ* or Lily family. *Ornithogalum umbellatum* (L.), Star of Bethlehem; a species of the above genus.

B.& G.-W. 456: B.& H. 462: Linn.*Sp.Pl.* 306-308:

Syn.Meth.St.Br. 372: *H.P.* 1151: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 219: *Camb.* - no ref.

H.P. 1151:

17 species given, including:

Ornithogalum vulgare & verius J.B. *vulgare* Ger. Park. *umbellatum medium angustifolium* C.B.

766 Morton: 172.

Line 59. *ut in ornithogalis:* Ray has correctly observed that the stamens of the *Ornithogalum* are flattened, being now described as lanceolate and acuminate.

Text page 17.

Line 62. *ut in galeatis floribus:* for Ray's correct observation of the curved filaments in helmet-shaped flowers see the diagram of the *Lamium* flower below at Cap.11, line 40.

Line 62. *Salviã: Salvia*: see above Cap.7, line 44.

Line 62. *Lamio: Lamium*: see above Cap.7, line 44.

Line 62. *Sclaræã: Sclaræa.*

[C.T.& M. 410} *Salvia verbenaca* (L.), [*Salvia clandestina* (L.), *Salvia horminoides* (Pourret), *Salvia marquandii* (Druce)], Wild Clary, Guernsey Clary; a species of the *Salvia* genus of the *Labiatæ* or Mint family.

B.& G.-W. 346: B.& H. 345: Linn.*Sp.Pl.* 596:

Syn.Meth.St.Br. 237: *H.P.* 543: *H.P.III* 291: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 543:

(Sclarea i. Horminum vulgare).

Horminum Sclarea dictum C.B. *Sativum vulgare, sive Sclarea* Park. *Gallitrichum sativum* J.B. *Gallitrichum sive Horminum* Ger. ***Common garden Clary.***

H.P.III 291:

4 additional species given.

Line 62. *Papilionaceis: Papilionaceæ:* literally 'butterfly' flowers.

Another name for the *Leguminosæ* family of plants (herbs, shrubs

and trees), which consists of about 7000 species worldwide. It includes many important crop plants such as peas, beans, clovers and alfalfa. They all have compound leaves and the fruit is a pod containing a single row of seeds. Both pods and seeds are rich in protein. Most species possess root nodules which contain nitrogen-fixing bacteria and so leguminous crops replenish nitrogen in the soil.[767]

Line 64. *Staminum .... interdum hirsuti; ut in Blattaria:* Ray has correctly observed that *Verbascum blattaria*, and indeed all Mulleins *(Verbascum)*, have filaments clothed in hairs.

Line 64. *Blattariā: Blattaria.*

[C.T.& M. 371]*Verbascum blattaria* (L.), Moth Mullein; a species of the *Verbascum* genus of the *Scrophulariaceæ* or Figwort family.
B.& G.-W. 354: B.& H. 325: Linn.*Sp.Pl.* 178:
Syn.Meth.St.Br. 288: *H.P.* 1096: *H.P.III* 523: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1096:

9 species given, including:

Blattaria lutea J.B. *lutea minor seu vulgaris* Park. *lutea folio oblongo laciniato* C.B. *flore luteo* Ger.

Yellow Moth-mullein.

H.P.III 523:

1 additional species given.

Line 65. *Napello: Napellum*: see above Cap.3, line 70.

Line 65. *Coluteā: Colutea.*

[C.T.& M. 187] *Colutea arborescens* (L.), Bladder Senna; a

767 *Mac.Enc.:* 711.

species of the *Colutea* genus of the *Leguminosæ* or Pea family.

B.& G.-W. 202: B.& H. 101: Linn.*Sp.Pl.* 723:

Syn.Meth.St.Br. - no ref.: *H.P.* 923-925:

H.P.III 451-452 (*Colutea vesicaria D.* 122): *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 923-925:

9 species given, including:

Colutea Scorpioides Ger. J.B. *Scorpioides major* Park. *siliquosa sive Scorpioides major* C.B.

H.P. III 451-452:

19 additional species given.

Line 65. Ray refers to both *Colutea* and *Scorpioides* in the same sentence, as having the same characteristics. In *Historia Plantarum*,[768] he uses the name *Scorpioides* for *Colutea*. Therefore, does he mean *Colutea* for *Scorpioides* below, and not *Myosotis scorpioides?*

Line 65. *Scorpiode: Scorpioides.*

[C.T.& M. 361] *Myosotis scorpioides* (L.), [*Myosotis palustris* ([L.] Hill)], Water Forget-me-not; a species of the *Myosotis* or Forget-me-not / Scorpion Grass genus of the *Boraginaceæ* or Borage family.

B.& G.-W. 326: B.& H. 311: Linn.*Sp.Pl.* 131:

Syn.Meth.St.Br. 229: *H.P.* 930-931: *H.P.III* 270 *(Echium)*:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* 86.

H.P. 930-931:

7 species given, including:

Scorpioides siliquis singularibus villosis: an Scorpioides majus Park.parad? ***The great rough Caterpillars.***

768 *Historia Plantarum:* 923.

H.P.III 270 *(Echium):*

4 additional species given.

Line 67. *in Lauro ramosi:* Ray is presumably indicating that the stamens are fused in the lower section so that they appear to be branched.

Line 68. *Staminum numerus plerunque foliis aut laciniis ambitus respondet:* Grew had emphasisied 'the regularity in the number of stamens in many species, and the fact that the number of stamens and petals is so often the same'.[769]

Line 69. *Rutæ: Ruta*: see above Cap.9, line 32.

Line 69. *Cervicariæ: Cervicaria.*

B.& G.-W. 388] *Campanula cervicaria* (L.), [no English name given]; a species of the *Campanula* genus of the *Campanulaceæ* or Bellflower family.

C.T.& M. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 167:

Syn.Meth.St.Br. - no ref.: *H.P.* 733: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref..

H.P. 733:

1. *Trachelium sive Cervicaria major lævior, flore albo magno* J.B.
2. *Campanula repens flore minore cæruleo* J.B. *Camp. hortensis Rapunculi radice* C.B. *cervicaria 4.* Dod. *qui eam recte descripsit.*
3. *Campanula sive Cervicaria Boboniensis parvo flore* J.B.

Line 70. *Iride*: *Iris*: see above Cap.3, line 36.

769 Morton: 184.

Line 70. *Gladiolo Ital.: Gladiolus Italicus.*

[C.T.& M. 556] *Gladiolus communis* (L.), [*Gladiolus byzantinus* (Miller)], Gladiolus; a species of the *Gladiolus* genus of the *Iridaceæ* or Iris family.

B.& G.-W. 468: B.& H. 450: Linn.*Sp.Pl.* 36-37:

Syn.Meth.St.Br. 273/287/375: *H.P.* 1168-1170: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl. Gladiolus* but not this species 132:

Camb. 67.

H.P. 1168-1170:

7 species given, including:

Gladiolus sive Xiphion J.B. *Gladiolus Narbonensis* Park. *Italicus* Ger. *Glad. floribus uno versu dispositis major* C.B.

Corn-flag.

Line 72. *tam copiosa habentes stamina:* Ray correctly credits *Ranunculus* and *Papaver* with numerous stamens; the term staminose, Ray's *staminosus,* is now used when the stamens form a marked feature of the flower.[770]

Line 73. *Ranunculo: Ranunculus*: see above Cap.7, line 57.

Line 73. *Papavere: Papaver*: see above Cap.10, line 30.

Line 74. *APICES:* margin sub-heading.

Capitula ..... Apices dicuntur: in the translation of this line I have left Ray's technical term of 'apex', but thereafter use the modern term 'anther'.

Lines 74-99. *Capitula sive cacuminula staminibus incumbentia ..... iisdem etiam particulis necessario componuntur.* Ray gives here a

770 Stearn, *Botanical Latin:* 518.

lengthy discussion on the colours and positioning, as well as composition, of the anthers. In the introductory glossary to *Historia Plantarum,* he defines both *anthera* and *apex* as being the same:

> *Antheræ Offic. sunt summitates seu cacuminula in florum medio staminibus incumbentia, q. ἄνθος ῥόδου, i.e. flos rosæ.* ***The Chives.***
>
> *Apices idem significant quod Antheræ.*[771]

An anther is now defined as the apical part of a stamen, which produces pollen in pollen sacs; these sacs are joined by connective tissue to the filament, which is itself attached to the receptacle. Anthers are hollow organs, which dehisce along one side to release pollen.[772]

Line 74. *Malpighio: staminum capsulæ:* Malpighi uses the term capsule for the anther.[773]

Line 77. *Hepaticæ trifoliæ: Hepatica trifolia.*

[C.T.& M. 37] *Hepatica nobilis* ([L.] Miller), *Anemone hepatica* (L.), *Hepatica triloba*; a species of the *Anemone* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 110: B.& H. 4: Linn.*Sp.Pl.* 538:

Syn.Meth.St.Br. - no ref.: *H.P.* 580: *H.P.III* 47-48:

Tri. - no ref.:[774] *Cat.Angl.* - no ref.: [775] *Camb.* - no ref.

H.P. 580:

> *Trifolium hepaticum flore simplici* C.B. *Tri. hepat. sive*

771 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at the beginning of Volume I.

772 Steam, *Botanical Latin:* 385-386; *Penguin Dictionary of Botany:* 22.

773 Malpighi, *Anatome Plantarum:* 49.

774 The only reference in *Tri.* is to the Lichen *Hepatica* (see below), but in *Historia Plantarum* Ray is referring to *Hepatica trifolia* as above.*Tri.* 11.108: Liverwort: *Hepatica, -æ,* f.: Λειχῆν, -ῆνος, m.

775 *Cat.Angl.:* the only reference is to the Lichen *Hepatica* 184-185.

Trinitatis herba flore cæruleo J.B. *Hepatica nobilis sive trifolia* Park. *Hepaticum trifolium* Ger.

Hepatica or noble Liver-wort.

H.P.III 47-48:

Hepatica trifolia: 2 additional species given.

Line 77. *quam Parkinsonus albam ..... :* John Parkinson, 1567-1650, was the last of the old herbalists. He cultivated a famous garden in Long Acre, in what is now the heart of London. He was given the title of 'herbarist' to Charles I.[776]

His earlier book, *Paradisi in Sole Paradisus Terrestris,* was more a gardening book than a herbal:

> A Garden of all sorts of pleasant flowers which our English ayre will permitt to be noursed up; .... together With the right orderinge planting and preserving of them and their uses and vertues.

His title *Paradisi in Sole Paradisus terrestris* is a pun on his own name: 'the Park on earth of the Park in sun'. The preface to this work is quite contrary to the notion that scientific knowledge has been acquired by careful study. In Parkinson's words:

> God, the Creator of Heaven and Earth, at the beginning when he created Adam, inspired him with the knowledge of all naturall things (which successively descended to Noah afterwardes, and to his Posterity): for, as he was able to give names to all the living Creatures, according to their severall natures; so no doubt but hee had also the knowledge, both what Herbes and Fruits were fit, eyther for Meate or Medicine, for Use or for Delight.

The work contains lists of plants cultivated at the time, with some mention of their uses. It is illustrated with indifferent wood

776 Arber: 135-138.

engravings, some original, but others taken from de l'Ecluse, de l'Obel and others.[777]

Parkinson later published a larger work dealing with plants in general called *Theatrum botanicum, the theater of plants, or, an herball of a large extent.* He had intended this to be a supplement to the *Paradisus Terrestris*, but it grew into a much broader work, without however losing its predominantly medical character. Although he seems almost positively mediæval in some of his attitudes (see the section on the unicorn), his work is an improvement on those of Gerard (and Johnson). He did record for the first time *Meconopsis cambrica*, the Welsh Poppy (Vig.); *Arbutus unedo*, the Strawberry Tree (L.); and *Cypripedium calceolus*, the Ladies' slipper (L.).[778]

Line 78. *Gramine Leucanthemo: Gramen leucanthemum.*

[C.T.& M. 138] *Stellaria graminea* (L.), Lesser Stitchwort; a species of the *Stellaria* genus of the *Caryophylaceæ* or Pink family.
B.& G.-W. 86: B.& H. 74: Linn.*Sp.Pl.* 422:
Syn.Meth.St.Br. 346: *H.P.* 1027-1028: *H.P.III* - no ref.:
Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.
H.P. 1027-1028:

Caryophyllus holosteus arvensis glaber flore minore C.B.
Gramen leucanthemum alterum Ger. *leucanthemum minus* Park.
Gramini Fuchsii leucanthemo affinis & similis herba J.B.
The lesser Stitchwort.

777 Arber: 135-138.
That Ray owned a copy of this, but not *Theatrum Botanicum*, is indicated by the sale catalogue of his library:
Paradise, edition of 1656 [no place of publication given]; British Museum: *S-C 326* (6): 21, English Books in Folio, number 26.

778 Arber: 135-138; also Raven: 76.

Line 78. *Alsine pulchro flore*: *Alsine*.

[C.T.& M. 142-144] *Minuartia* (L.), Sandworts; a genus of the *Caryophyllaceæ* or Pink family.

B.& G.-W. 84: B.& H. 67: Linn.*Sp.Pl.* 272:

Syn.Meth.St.Br. 346-353: *H.P.* 847-848: *H.P.III* - no ref.:

Tri. 9.40: *Cat.Angl.* 15-18: *Camb.* 40-41.

H.P. 847-848:

1. Speedwell-Chickweed.
   Alsine foliis Veronicæ Ger. *foliis subrotundis Veronicæ* Park. *Veronicæ foliis, flosculis cauliculis adhærentibus* C.B. *Serrato folio hirsutiore flosculis & loculis cauliculis adhærentibus* J.B.
2. Germander-Chickweed.
   Alsine foliis Trissaginis Ger. Park. *Chamædryfolia, flosculis pediculis, oblongis insidentibus* C.B. *Alsine serrato folio glabro* J.B.
3. Ivy-Chickweed or Small-Henbit.
   Alsine hederacea Ger. *hedurulæ folio* C.B. *hedurulæ folio minor* Park. *Alsine genus Fuchsio folio hedurulæ hirsuto* J.B.
4. *Alsine recta triphyllos sive laciniata* Park. *tryphyllos cærulea* C.B. *folio profunde secto, flore purpureo seu violaceo* J.B. *Alsine recta* Ger.

Tri. 9.40:

Chickweed: *Alsine, -es,* f.: Ἀλσίνη, -ης, f.

Line 79. *affirmat Grevius:* margin reference to *De florum Anat. cap.c.3 & 5.*

Line 79. *Apicum colorem*: here translated as 'anther': see Cap.10, lines 51 and 74.

Line 83. *Tulipis: Tulipa:* see above Cap.3, line 12.

Line 83. *Iridibus: Iris:* see above Cap.3, line 36.

Line 86. *Tulipis: Tulipa:* see above Cap.3, line 12.

Line 88. *Boragine: Borago.*

[C.T.& M. 359] *Borago officinalis* (L.), Borage; a species of the *Borago* genus of the *Boraginaceæ* or Borage family.

B.& G.-W. 324: B.& H. 314: Linn.*Sp.Pl.* 137-138:

Syn.Meth.St.Br. 228: *H.P.* 492: *H.P.III* - no ref.: *Tri.* 8.22:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 492:

Borago floribus cæruleis & albis J.B. *Buglossum latifolium, Borrago* C.B. *Borago hortensis* Ger. *Borago* Park. ***Borage.***

Tri. 8.22:

Borage: *Borago, -inis*, f.: *Βούγλωσσον, –ώσσου,* n.

Line 88. *Solano: Solanum.*

[C.T.& M. 367-368] *Solanum* (L.), Nightshades; a genus of the *Solanaceæ* or Potato family.

B.& G.-W. 350: B.& H. 318: Linn.*Sp.Pl.* 184-188:

Syn.Meth.St.Br. 265: *H.P.* 671: *H.P.III* 351: *Tri.* 12.134:

Cat.Angl. 275-277: *Camb.* 114.

H.P. 671:

14 species given, including:

Solanum vulgare Park. *hortense* Ger. *S. hort. sive vulgare* J.B. *Bacciferum I, sive Officinarum* C.B. ***Common Night-shade.***

H.P.III 351:

65 additional species given.

Tri. 12.134:

Nightshade: *Solanum, -i,* n.:*Στρύχνος, -ου,* m.

Line 88. *Dulcamarã:Dulcamara.*

[C.T.& M. 367] *Solanum dulcamara* (L.), Bittersweet, Woody Nightshade; a species of the *Solanum* genus of the *Solanaceæ* or Potato family.

B.& G.-W. 350: B.& H. 318: Linn.*Sp.Pl.* 185:

Syn.Meth.St.Br. 265: *H.P.* - incorrect index reference, which should read 672: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 92 with a ref. to see *Solanum lignosum* 277: *Camb.* 114.

H.P. 672:

Solanum lignosum sive Dulcamara Park. *Solan. scandens seu Dulcamara* C.B. *Amara dulcis* Ger. *Glycypicros sive Amara dulcis* J.B. ***Woody Nightshade or Bittersweet.***

Line 89. *Eupatorio cannabino vulgari: Eupatorium cannabinum vulgare.*

[C.T.& M. 471] *Eupatorium cannabinum* (L.), Hemp Agrimony; a species of the *Eupatorium* genus of the *Compositæ* or Daisy family.

B.& G.-W. 394: B.& H. 226: Linn.*Sp.Pl.* 838:

Syn.Meth.St.Br. 179: *H.P.* 293: *H.P.III* 225 (page numbered as 227): *Tri.* 8.2: *Cat.Angl.* 101: *Camb.* 63.

H.P. 293:

Eupatorium cannabinum Park. C.B. *cannabinum mas* Ger. *adulterinum* J.B. *Avicennæ creditum* Gesn. *Herba S. Kunigundis* Trag.

Common Hemp-Agrimony or Dutch Agrimony.

H.P.III 225:

Ad cap. de Eupatorio cannabino fœmina seu Bidente simpliciter dicto:

(Tr.) 'Substitute for the title of this chapter in place of

Eupatorium cannabinum, Chrysanthemum foliis plerunque bijugis, semine bidente.'

26 additional species given.

Tri. 8.2:

Agrimony: *Eupatorium, -ii,* n.:'*Ευπατώριον, -ίου,* n.

Ray's note in *Tri.* says, 'This is also in Latin *Agrimonia*'.

Line 90. *Agerato: Ageratum.*

[C.T.& M. 472] *Achillea* (L.), Sneezeworts; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 408: B.& H. 225: Linn.*Sp.Pl.* 897:

Syn.Meth.St.Br. - no ref.: *H.P.* 364: *H.P.III* - no ref.: *Tri.* 11.119:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 364:

Ray has some interesting comments on the flower of *Ageratum* here in the main text of *Historia Plantarum*:

(Tr.) The 'Αγήρατον of Dioscorides, 1.4.c.59, to which the name is given διὰ τὸ ἐπιπολὺ τὸ ἄνθος ὁμοιοειδὲς φυλάττεσθαι,[779] since the colour of the flower is preserved <u>for a long time,</u>[780] as if you were to say that he is inexperienced in old age, because he is called ἀγήρατος, or as Pliny, lib.27, c.4, says, 'since it does not wither for a very long time.

Its characteristics are golden, bare flowers disposed in the shape of an umbel with leaves deeply serrated.'

779 διὰ τὸ ἐπιπολὺ τὸ ἄνθος ὁμοιοειδὲς φυλάττεσθαι = 'because the flower is preserved in the same form for a long time'.

780 "because the flower is preserved <u>for a long time</u>." The text actually gives <u>*dilutissime*</u> 'very weakly' or 'very softly', but presumably intends <u>*diutissime*</u> 'for a very long time'.

4 species given, including:

Ageratum vulgare sive Costus hortorum minor Park. *Ager. foliis serratis* C.B. *Ageratum plerisque, Herba Julia quibusdam* J.B. *Balsamita fœmina sive Ageratum* Ger.

Maudlin or Maudlin Tansy.

Tri. 11.119:

Maudlin-tansie: *Ageratum, -i,* n.: *Ἀγήρατον, –ου,* n.

Line 90. *Centauriomajore: Centaurium majus.*

[C.T.& M. 352-353]. No reference to a species as *majus* in the modern sources. C.T.& M. and B.& G.-W. give the names *Centaurium* (Hill), [*Erythræa* (Borkh.)], Centaury; a genus of the *Gentianaceæ* or Gentian family.

B.& G.-W. 304: B.& H. 300 - Large-flowered Centaury (no Latin name given): Linn.*Sp.Pl.* 910: *Syn.Meth.St.Br.* 196 - *Centaurium collinum,* Great Knapweed or Matfellon: *H.P.* 329-330:

H.P.III - no ref.: *Tri.* 9.37 (not *majus*):

Cat.Angl. 59-60 (not *majus*): *Camb.* 52 (not *majus*).

H.P. 329-330:

6 species given, including:

Centaurium magnum Ger. *majus vulgare* Park. *majus Juglandis folio* J.B. *Majus folio in lacinias plures diviso* C.B.

Great Centory.

Tri. 9.37:

Centory: *Centaurium, -ii,* n.: *Κενταύριον, –ίου,* n.

Line 90. *Scabiosis: Scabiosa*: see above Cap.7, line 19.

Line 90. *Cyanis: Cyanus*: see above Cap.7, line 19.

Line 90. *Jaceis: Jacea:* see above Cap.7, line 19.

Line 90. *Carduis: Carduus:* see above Cap.4, line 151.

Line 91. *Flore solis: Flos solis.*

[C.T.& M. 447] *Helianthus annuus* (L.), Common Sunflower; a species of the *Helianthus* genus of the *Compositæ* or Daisy family.

B.& G.-W. - no ref. except for *Helianthus rigidus*, the garden Sunflower: B.& H. 225: Linn.*Sp.Pl.* 904-906:

Syn.Meth.St.Br. - no ref.: *H.P.* 334-335: *H.P.III* 209:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 334-335:

> (Tr.) The plant called *Flos Solis*, which was brought from the New World, was unknown to the Ancients; it was given its name by more recent scholars from its likeness to the sun, resembling the vault of heaven itself with its central disc and barbs surrounding it like the sun's rays.
>
> Its is distinguished as a plant by having the largest flower of all, with yellow cuspid barbs surrounding a central swelling.

Flos solis Ger. *Chrysanthemum Peruvianum, sive Flos solis* Park.parad. *Helenium Indicum maximum* C.B. *Herba maxima* J.B. ***The Sun-flower.***

H.P.III 209:

5 additional species given.

Line 91. *Helenio: Helenium.*

[C.T.& M. 460] *Inula helenium* (L.), Elecampane; a species of the *Inula* genus of the *Compositæ* or Daisy family.

B.& G.-W. 402: B.& H. 233: Linn.*Sp.Pl.* 886:

Syn.Meth.St.Br. 176: *H.P.* 273: *H.P.III* - no ref.: *Tri.* 10.66:
Cat.Angl. 157 with a ref. to see *Enula campana* 95-96:
Camb. - no ref.
H.P. 273:

> (Tr.) In other respects *Helenium* with its whole-leaved discoid flowers is distinguished from the remaining *Papposæ* by the size of all of its parts, the roots, leaves and flowers.
>
> *Helenium* Ger. *vulgare* C.B. *Helenium sive Enula campana* Park. J.B. ***Elecampane.***

Tri. 10.66:

> Elecampane: *Helenium, -ii,* n.: *Ἑλένιον, -ίου,* n.

Line 91. *Ptarmicã: Ptarmica:* see above Cap.3, line 25.

Line 91. *Millefolio: Millefolium:* see above Cap.9, line 33.

Line 91. *Tanaceto: Tanacetum*: see above Cap.3, line 35.

Line 91. *Acanthio: Acanthium.*

[C.T.& M. 485] *Onopordum acanthium* (L.), Scotch Thistle, Cotton Thistle; a species of the *Onopordum* genus of the *Compositæ* or Daisy family.
B.& G.-W. 424: B.& H. 253: Linn.*Sp.Pl.* 827:
Syn.Meth.St.Br. 196: *H.P.* 313: *H.P.III* 200: *Tri.* - no ref.:
Cat.Angl. 4: *Camb.* 37.
H.P. 313:

> *Acanthium vulgare* Park. *album* Ger. *Spina alba sylvestris Fuchsia* J.B. *Spina alba latifolia tomentosa sylvestris* C.B. ***Common Cotton-thistle.***

H.P.III 200:

Ad cap. de Acanthio seu Carduo tomentoso:
Carduus tomentosus, Acanthium dictus, Arabicus Hort. Ox. Pluk. Almag. Bot. *tomentosus angustifolius, Acanthium dictus, Syriacus, capitulis majoribus* Moris.hist.p.3.
Carduus tomentosus, seu Acanthium Illyrico accedens, capitulis minoribus H.R.B.

Line 93. *D.Malpighius accuratius, tubun hunc efformari ait ..... qui etiam in capite laciniatur, in nonnullis.* This is a paraphrase of Malpighi's text.[781]

Line 96. *Hæ staminum partes ..... (autore Malpighio) ..... iisdem etiam particulis necessario componuntur.* This is a paraphrase rather than a quotation from Malpighi.[782]

Line 103. *Hinc (inquit Malpighius) fortasse non incongrue derivato nomine, menstruæ purgationes, quæ in mulieribus conceptionis tempora proxime antecedunt:* this is a direct quotation from Malpighi.[783]

Line 110. *spermatis masculini instar seminibus fœcundandis inservire*: Grew first gave this theory of the stamen being the male organ of the plant, which produces pollen comparable to a male animal's spermatic fluid, in his *Anatomy of Flowers* in 1676 and asserted it more forcibly in the *Anatomy of Plants* in 1682.

> According to Grew's account Sir Thomas Millington, a disinguished physician, had told him at a meeting of the Royal Society that "he conceived the attire [stamens] doth serve, as the male, for the generation of seed". To

781 Malpighi, *Anatome Plantarum:* 48.
782 *ibid.:* 49.
783 *ibid.:* 56.

which Grew replied "that I was of the same opinion, and gave him some reasons for it, and answered some objections which might oppose them"[784] .[785]

The sexual theory in plant reproduction began to be unravelled in the later seventeenth century by Camerer and his successors. Before this, from Aristotle's time, it was believed by many that the processes of nutrition and reproduction were associated. But even Jung, who must have known the current ideas on reproduction, does not show that he really believed in the sexuality of plants and 'of the necessity of the co-operation of two sexes in the work of propagation'.[786] That it was a difficult concept for the scholars of the seventeenth cenury to grasp is indicated, again by Sachs:

> It might almost be believed that the most learned and serious men, such as Cesalpino and Jung, were just those, who regarded the hypothesis of sexuality in plants as an absurdity, and shrunk from its consideration. This impression is conveyed too by Malpighi's 'Anatomie des Plantes'.[787]

Line 111. *ac proinde maximam plantarum partem utriusque sexus participem esse.* The idea that plants have both sexes within a single plant goes back to Aristotle.[788]

Line 112. *in Animalium genere nonnulla androgyna observantur, ut v.g. Cochleæ terrestres:* Ray says that one should not be surprised at the existence of androgynous plants, since androgyny is not unknown in the animal world. Androgyny is defined as 'a being with

784 Nehemiah Grew, *Anatomy of Plants:* 5 § 3: 171.
785 Morton: 213.
786 Sachs: 381.
787 *ibid.*
788 See the lengthy discussion on this in Sachs: 376-385.

characteristics of both sexes, hermaphrodite'; the term, as such, was first used in English in 1552. However, as a botanical term, it was not used in English to indicate a plant with both stamens and pistils in the same flower, or on the same plant, until the late eighteenth century [an androgynous plant - 1785, and androgynous as an adjective - 1793].[789]

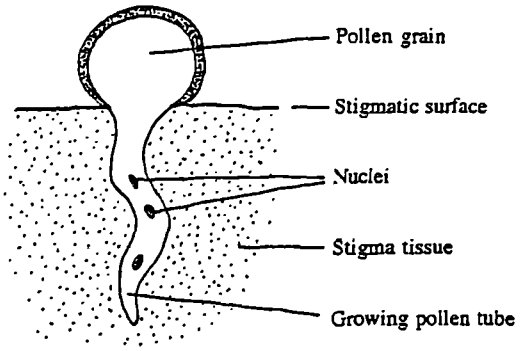
Cochleæ terrestres: land slugs and snails are hermaphrodite, with both male and female in the same individual. 'When they mate, each partner transfers sperm to the other. As far as is known, no snails or slugs reproduce asexually, but some are capable of self-fertilisation.'[790] Ray and his contemporaries would have known of hermaphroditism in snails as it had been discovered earlier in the seventeenth century by J.J.Harder of Basle.[791]

Line 113. *quamvis quidem in seipsis non generent, quo a plantis differunt:* The reproductive methods of plants, as Ray says, certainly differ from snails, which, after fertilisation, lay eggs (usually round) in batches in the soil, cracks of wood or under stones.[792]

Line 114. *quod particulæ hæ (si modo sperma sint aut spermati analogæ) in uterum aut semina non penetrent:* Ray is feeling his way towards the idea of pollen fertilising the ovary, but has not realised that in fact the pollen does have to reach the ovary for fertilisation to take place. He believes that, as in fish, there is no actual union between the male and female reproductive cells.

789 *OED:* 69.
790 Kerney, Cameron and Riley: 19.
791 Morton: 213.
792 Kerney, Cameron and Riley: 20.

Diagram of a pollen grain germinating on the stigma:[793]



Line 115. *in piscibus externe tantum ovis jam editis inspergitur genitura:* as Ray again correctly says, male fish fertilise eggs laid by the female by swimming immediately behind and depositing their sperm on them. However, he does not realise that, after the sperm have been deposited by the male fish, they still must penetrate the eggs before fertilisation can take place.[794]

Line 116. *nec in ullo animalium genere, quod sciam, ovarium intrat:* as he shows here, Ray was unaware of the detailed processes involved in animal conception.

Line 121. *Tales sunt in Arborum genere Palma dactylifera, Salices pleræque ex nostra observatione:* Ray supports his approval of Grew's theories on the male function of the stamen with his own observations on two sexes in the date palm and the willow, plus examples of herbaceous plants.

Camerer's observations[795] on monœcious and dicœcious plants explained the puzzle of the staminate catkins of such trees as hazel, oak and willow; once it was realised that they bear the male organs the reproductive processes made sense.

793 Drawn from Gibbons: 91.
794 Cooke, Burkitt and Barker: 78-80.
795 See notes below at lines 135-136.

Line 121. *Palma dactylifera.*

[Flowers G.& B. 507][796] *Phoenix dactylifera / Palma dactylifera* (L.), Date Palm; a species of the *Phoenix* genus of the *Palmæ / Arecaceæ* or Palm family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 1188: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1352-1354: *H.P.III D.* 2: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1352-1354:

> *Palma* Ger. C.B. *vulgaris* Park. *major* C.B. *dactyilfera major vulgaris* Johnst. ***The common Palm-tree, or Date-tree.***

H.P.III D. 2:

> *Palma dactylifera minor sylvestris, humilis, fructu minore, Hin Indi Zeylanensibus dicta* Pluk.Almagest. P.B.P.

Line 121. *Salices: Salix:* see above Cap.5, line 26.

Line 122. *Cedrus major.* There is no separate reference to this in any of the sources; since Ray describes it as the 'greater Cedar', perhaps it is the *Cedrus libani*, the Cedar of Lebanon, which is the largest of the four European species.

Cedrus: see below Cap.22, line 24.

Line 122. *Lupulus salictarius.*

[C.T.& M. 310] *Humulus lupulus* (L.), Hop; a species of the *Humulus* genus of the *Cannabaceæ* or Hemp family.

B.& G.-W. 58: B.& H. 400: Linn.*Sp.Pl.* 1028: *Syn.Meth.St.Br.* 137: *H.P.* 156: *H.P.III* 104: *Tri.* 11.92: *Cat.Angl.* 191-192: *Camb.* 81.

796 Polunin: 507.1718.

H.P. 156:

Lupulus mas & fœmina J.B. *I, seu mas & II, seu fœmina* C.B. *1. sive sativus & 2. sive sylvestris* Park. *nec enim aliter differunt quam magnitudine & exilitate aliisque accidentibus a cultura ortis. Lupus salictarius* Ger. ***Hops, the Male and Female.***[797]

H.P.III 104:

5 additional species given, but Ray says that out of these species no true and genuine species of *Lupulus* is to be seen, but they are referred to as *Lupuli* because of some similarity in external apearance to the *Lupulus.*

Tri. 11.92:

Hops: *Lupulus, -i,* m.: [No Greek].

Line 123. *Cannabis:* see above Cap.9, line 16.

Line 123. *Cynocrambe.*

[C.T.& M. 296] *Mercurialis perennis* (L.), Dog's Mercury; a species of the *Mercurialis* genus of the *Euphorbiaceæ* or Spurge family.

B.& G.-W. 232: B.& H. 395: Linn.*Sp.Pl.* 1035:

Syn.Meth.St.Br. 138: *H.P.* 163: *H.P.III* 108: *Tri.* - no ref.:

Cat.Angl. 86: *Camb.* 58.

H.P. 163:

Cynocrambe i.e. Mercurialis sylvestris:

(Tr.) For different species of Mercury I have the names *Cynocrambe* and *Phyllon*; and so far as I know there are three species of Mercury, one perennial and two annual:

797 It is perhaps worth noting that until at least the seventeenth century the terms 'male' and 'female' were not used in the correct biological way:

> The idea of a male sex [in plants] was founded only on a difference of habit, and not on the parts which are essential to it.

De Candolle, *Physiologie végétale* II, 1835: 44, quoting Treviranus.

these are:-

1. *Mercurialis perennis repens, Cynocrambe dicta.*
2 *Mercurialis annua glabra vulgaris.*
3. *Mercurialis annua hirsuta, Phyllon dicta.*

Cynocrambe mas & fœmina Ger.emac. *Mas & fœmina, sive Mercurialis repens* J.B. *Merc. sylvestris Cynocrambe dicta vulgaris mas & fœmina* Park. *Merc. montana testiculata, & Merc. montana spicata* C.B. ***Dogs Mercury.***

H.P.III 108:

Ad cap. de Mercuriali adde species sequentes: 9 additional species given.

(Tr.) Also, to the powers of *Cynocrambe* add: "this plant, when mixed with bacon, killed the children and harmed the parents of a family in Shropshire. Dr. Sloane".

Line 123. *Mercurialis.*

[C.T.& M. 296] *Mercurialis* (L.), Mercury; a genus of the *Euphorbiaceæ* or Spurge family. *Mercurialis perennis* (L.), Dog's Mercury: *Mercurialis annua* (L.), Annual Mercury; both are species of the above genus.

B.& G.-W. 232: B.& H. 395: Linn.*Sp.Pl.* 1035-1036: *Syn.Meth.St.Br.* 138: *H.P.* 163: *H.P.III* 108: *Tri.* - no ref.: *Cat.Angl.* 199: *Camb.* 58.

For Dog's Mercury see *Cynocrambe* above Cap.10, line 123.

For Annual Mercury see *Phyllon* below Cap.10, line 123.

H.P.III 108:

9 additional species given.

Line 123. *Phyllon.*

[C.T.& M. 296] *Mercurialis annua* (L.), Annual Mercury; a species of the *Mercurialis* genus of the *Euphorbiaceæ* or Spurge family.

B.& G.-W. 232: B.& H. 395: Linn.*Sp.Pl.* 1035:

Syn.Meth.St.Br. 138: *H.P.* 163: *H.P.III* 102: *Tri.* - no ref.:

Cat.Angl. no ref. but see under *Mercurialis mas & fœmina* 199: *Camb.* 58.

H.P. 163:

> *Mercurialis mas & fœmina* Park. *Merc. mas & Merc. fœmina* Ger. *M.testiculata sive mas Dioscoridis & Plinii, & M. spicata sive fœmina eorundem* C.B. ***French Mercury,*** *(Annual Mercury).*

H.P.III 102:

> 1 additional species given:
>
> *Phyllum fœminificum, Alaterni brevi, glabro folio,*
>
> Boccon.Mus.pl.rar.T.109.

Line 123. *Urtica:* see above Cap.9, line 59.

Line 123. *Spinachia.*

[Kit.Gar. 234][798] *Spinachia oleracea* (L.), Spinach; a species of the *Spinachia* genus of the *Chenopodiaceæ* or Fat Hen family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. 371:

Lin.*Sp.Pl.* 1027: *Syn.Meth.St.Br.* - no ref.: *H.P.* 162:

H.P.III - no ref.: *Tri.* 13.183: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 162:

> *Spinachia* Ger. Park. *Spin. mas & fœmina* J.B. *Lapathum hortense seu Spinachia semine spinoso* C.B. ***Spinache.***

798 Stuart, *Kitchen Garden:* 234.

H.P.III 183:

Spinach: *Spinachia, -æ,* f.: [No Greek].

Line 123. *Sesamoides Clusii.*

[C.T.& M. 107] *Sesamoides canescens* ([L.] O.Kuntze), *[Astrocarpus purpurascens, Astrocarpus Clusii];* a species of the *Reseda* genus of the *Resedaceæ* or Mignonette family.

B.& G.-W. 162: B.& H. 50-51: Linn.*Sp.Pl.* 449:

Syn.Meth.St.Br. - no ref.: *H.P.* 1033 given in the index but should read 1053: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 272 (but not *Clusii*): *Camb.* - no ref.

H.P. 1053:

De Reseda & Luteola:

Reseda alba minor C.B. *Seamoides parvum Salamanticum* Clus. *Muscipula Salamantica minor* Park. *Sesamoides Salamanticum parvum* Ger.

Reseda Linariæ foliis C.B. Park. *an Sesamoides Salamanticense parvum alterum* Clus?

Here Ray uses the name *Salamanticum* for *Reseda. Sesamoides salamanticum* is now *Silene otites*, and not of the same family as *Reseda.* Presumably he is referring to *Reseda* and therefore to *Sesamoides canescens* (L.), O Kuntze, *[Astrocarpus purpurascens, Astrocarpus Clusii].*

Line 125. *D. Grevii sententiam magnopere confirmant.....:* Ray cites in support of Grew's ideas the evidence handed down by 'ancient and more recent scholars'.

Line 125. *Palmã dactyliferã: Palma dactylifera:* see above Cap.10, line 121.

Line 125. *Plin. Hist.Nat.lib.13.c.4.* - margin reference.

Pliny has a lengthy discussion on the qualities of the Palm in Book XIII:[799] the section referred to by Ray on the sexuality and reproduction of the palm is as follows:

> *cetero sine maribus non gignere feminas sponte edito nemore confirmant, circaque singulos plures nutare in eum pronas blandioribus comis; illum erectis hispidum adflatu visuque ipso et pulvere etiam reliquas maritare; huius arbore excisa viduvio post sterilescere feminas.*[800]

Theophrastus also discusses the Date-palm in similar terms.[801]

Line 127. *Ni enim Ægyptii hoc fecerint.....:* as Sachs says 'Prosper Alpino's account (1592) of the pollination of the date-palm contains nothing new, except that he had seen it in Egypt himself'.[802]

Line 128. *inquit *Prosper Alpinus:* margin reference to *Lib. de Plantis Ægyptiacis.*

Text page 18.

Line 131. *Cæterum recte a D.Grevio observatum:* as we have seen above at Cap. 10, line 110, Grew attributed this observation to Sir Thomas Millington, but had his own ideas on the subject, declaring that:

> It would appear that the attire serves to remove some

799 Pliny, *Historia Naturalis* XIII, vi-ix: 26-50; Loeb edition IV: 112-128.

800 *ibid. XIII,* vii: 34-35; Loeb edition IV: 118.
[For the rest, it is stated that in a palm-grove of natural growth the female trees do not produce if there are no males, and that each male tree is surrounded by several females with more attractive foliage that bend and bow towards him; while the male bristling with leaves erected impregnates the rest of them by his exhalation and by the mere sight of him, and also by his pollen; and that when the male tree is felled the females afterwards in their widowhood become barren.]

801 Theophrastus, *Περὶ Φυτῶν Αἰτίων [De Causis Plantarum] [The Explanations of Plants]* XVIII: 1.

802 Sachs gives as his reference: De candolle, *Physiologie végétale:* 47.

superfluous parts of the sap, as a preparatory process to the production of seed..... [803]

Lines 135-136. *Opinio autem hæc de usu pollinis prædicti ulteriori adhuc confirmatione indiget; nos ut verisimilem tantum admittimus*. Ray does, however, voice his doubts on the function of pollen, believing that it still needed confirmation.

Grew and Millington guessed that the anthers provide the male component in fertilisation, but did not follow up Theophrastus' statement that the dust from the anthers of the date palm is shaken over the female to enable fertilisation to occur. They did not experiment and neither did Ray, although he did revive the Theophrastian observation of the methods of pollinating the date palm.[804] Although in 1686 Ray had doubts, by 1694 and the publication of his *Sylloge Europeanarum* he asserts that stamens are necessary and useful parts of plants, even when coloured petals are missing; he emphasises that staminate flowers always shed their pollen and that this precedes the fruit. He concludes with the statement 'in our opinion the pollen is equivalent to the sperm of animals'. The first experiments on the sexuality of plants were carried out by Camerer between 1691 and 1694, but were probably unknown to Ray at the time of writing the *Sylloge Europeanarum;* he set out to prove that a seed capable of germination could not be produced without pollen. Camerer expressed these ideas in a letter, *de Sexu Plantarum*, written to Valentin in Giessen, dated 25th August 1694; in it he states that

> When I removed the male flowers of *Ricinus* before the anthers had expanded, and prevented the growth of the younger ones but preserved the ovaries that were already

803 Nehemiah Grew, *Anatomy of Plants:* 5 § 3: 172.
NB. The confusion shown by Grew in the rest of this passage is analysed by Sachs: 383.

804 For a discussion of this see Morton: 37-38.

> formed, I never obtained perfect seeds, but observed empty vessels, which fell finally to the ground exhausted and dried up.[805]

To summarise the state of ideas on the sexuality of plants by the end of Ray's lifetime, it is perhaps worth giving Camerer's conclusions written in 1694:

> In the vegetable kingdom no production of seeds, the most perfect gift of nature, the general means for the maintenance of the species, takes place, unless the anthers have prepared beforehand the young plant contained in the seed.[806] It appears, therefore, justifiable to give these apices a nobler name and to ascribe to them the significance of male sexual organs, since they are the receptacles in which the seed itself, that is that powder which is the most subtle part of the plant, is secreted and collected, to be afterwards supplied from them. It is equally evident, that the ovary with its style[807] represents the female sexual organ in the plant.[808]

Camerer had also cited Ray and Grew as the only scholars 'with the exception of J.C.Sturm'[809] who supported his idea that sexuality in plants is likely. He made very detailed studies of plant anatomy to enable him to reach these conclusions, including microscopic study of pollen grains; he adopted the term 'pollen', probably from Ray, instead of *pulvis* or *farina*. Because of the presence of both style and stigma in most flowers, he assumed that most flowers are

805 Rudolph Jacob Camerer, *de Sexu Plantarum epistola*, 1694; translated here by Sachs into German and thence into English by H.E.F. Garnsey; Sachs 387.

806 *nisi præcedanei florum apices prius ipsam plantam debite præparaverint.*

807 *seminale vasculum cum sua plumula sive stilo.*

808 Rudolph Jacob Camerer, *de Sexu Plantarum*, 1694; translated here by Sachs into German and thence into English by H.E.F. Garnsey; Sachs 388.

809 J.C.Sturm, Professor of Mathematics and Physics in Altsdorf. Morton comments that he has 'not been able to find out what he wrote about plants'; Morton: 231, note 59.

hermaphrodite and therefore self-pollinating;[810] but he did raise the question [without carrying out any experiments] as to whether they could be pollinated by the pollen of neighbouring flowers. Camerer extended his studies to those plants with stamens and ovaries on separate plants, that is, with male and female flowers, either both on the same plant (monœcious) or on separate plants (dicœcious),[811] and he established that the male organs could be on separate plants from the female.[812] [813]

Line 137. *STYLUS:* margin sub-heading.

Stylus est pars floris medium ejus occupans ..... : Ray gives a definition of the stylus, taken, as he says in the glossary to *Historia Plantarum*, from Jung.[814]

We would now define the style as the sterile portion of the carpel between the ovary and the stigma,[815] whereas Ray uses the term for the style and stigma together.[816]

The term style derives from στῦλος, originally meaning 'pillar'.[817]

Line 139. *Foliosa pars floris modo apici, modo sedi fructus seminisve cohæret:* Ray has accurately observed the position of the perianth of a flower in relation to the gynœcium or female part of the flower.

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810 Camerer assumed that wind was involved in the pollination process, but does not seem to have considered the role of insects.

811 Morton: 214-215.

812 See note at line 121 above.

813 NB. Camerer also considered the problem of such plants as *Lycopodium* and *Equisetum*, which appear to have 'anthers' but not flowers or seed.
For a discussion on this see the footnote to *Lycopodium* below at Table 2, line 8.

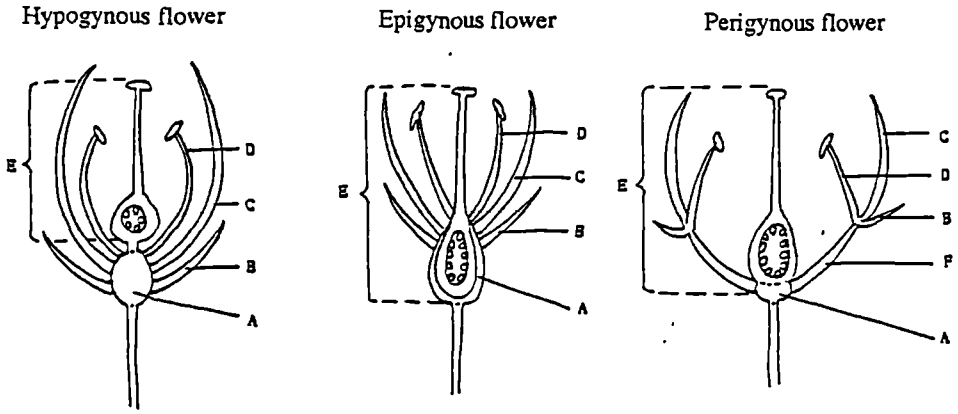
814 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

815 *Penguin Dictionary of Botany:* 346.

816 NB. The modern term pistil *(pistillum)* for the 'central organs of the flower comprising (when present) ovary, style(s) and stigma(s)' was introduced by Tournefort: *Pistillum appello partem eam, quæ floris centrum inter stamina occupare solet.* Morton: 228, note 42.

817 Gilbert-Carter: 79.

In diagrammatic form and with modern terminology this would appear thus:[818]



A = Receptacle
B = Sepal
C = Petal
D = Stamen
E = Gynœcium
F = Hypanthium

Line 142. *D.Malpighius Stylum concavitate sua semen fovere ..... interque stamina ludere ait.* Malpighi says that:

> *Stylus igitur pars est, centrum floris occupans, quæ concavitate semen fovens, appendice assurgit, luditq; inter stamina.*[819]

Malpighi goes further than Ray in using the term *stylus* for the whole gynœcium, including ovary, style and stigma, saying that *concavitate sua semen fovere;* however, his description of it as *interque stamina ludere* would suggest that he is almost using it in the same way as Ray for style and stigma only. This description of the style as 'playing among the stamens' perhaps suggests the elongated or feathery styles of wind-pollinated species.

Line 143. *Vasculum ergo seminale Stylum facere videtur Malpighius:* Malpighi follows the statement discussed at line 142 above with the

818 Drawn from *Longman Dictionary of Botany:* 72.
819 Malpighi, *Anatome Plantarum:* 50.

following, which does, as Ray says, imply that the stylus is a seed bearing vessel: *Hanc uterinis tubis analogam esse.*[820]

Line 145. *Stylus uteri seu vasculi seminalis tubus perpetuo hians, ad semen intus conclusum ventilandum, & halitus expellandos:* Ray gives, and appears to agree with, Malpighi's conclusions that the style is connected to the seed-producing vessel. Although this is a correct observation, they incorrectly deduce that the style is for the passage of air to and from the seed.

Line 149. *Stylus plerunque unicus adest, interdum tamen plures, ut v.g. in Aquilegia quini;* some plants do have more than one separate stylus; others have many fused together.

Line 149. *Aquilegiã: Aquilegia.*

[C.T.& M. 51] *Aquilegia vulgaris* (L.), Columbine; a species of the *Aquilegia* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 122: B.& H. 12: Linn.*Sp.Pl.* 533:

Syn.Meth.St.Br. 273: *H.P.* 705-706: *H.P.III* - no ref.: *Tri.* 9.46: *Cat.Angl.* 25: *Camb.* 44.

H.P. 705-706:

8 species given, including:

Aquilegia flore simplici J.B. *vulgaris flore simplici* Park.parad. *Aquilegia sylvestris* C.B. *item Aquil. hortensis simplex* ejusdem. *Aquilegia cærulea* Ger. ***Single Columbine.***

Tri. 9.46:

Columbine: *Aquilegia, -æ,* f.: [No Greek].

Line 151. *Papaver:* see above Cap.10, line 30.

820 Malpighi, *Anatome Plantarum:* 50.

Line 151. *Tulipa:* see above Cap.3, line 12.

Line 152. *Iride: Iris*: see above Cap.3, line 36.

Lines 153-160. *Stylus proprie dictus terminatur vel cuspide, vel globulo, vel cono, vel cornibus:* Ray differentiates correctly between the style, as we now define it, and the style plus stigma, for which he earlier uses the term *stylus*. He gives in these lines many examples of the differing shapes, which the stigma can take.

Ray does not use a specific term for the stigma; we would now define it as the receptive tip of the carpel, which receives pollen and on which the pollen grain germinates;[821] the shapes, as observed by Ray, are varied for catching and trapping pollen, either from insects or the wind.

Line 153. *Digitali: Digitalis:* see above Cap.10, line 55.

Line 154. *Symphyto majore: Symphytum majus:* see above Cap.10, line 57.

Line 154. *Liliis: Lilium:* see above Cap.3, line 13.

Line 154. *Convolvulo peregrino purpureo:Convolvulusperegrinus purpureus.*
[C.T.& M. 364-365] *Convolvulus* (L.), Bindweeds; a genus of the *Convolvulaceæ* or Bindweed family.
B.& G.-W. 318: B.& H. 305: Linn.*Sp.Pl.* 153-159:
Syn.Meth.St.Br. - no ref.: *H.P.* 727-728: *H.P.III* - no ref.:
Tri. - no ref.: *Cat.Angl.* 78: *Camb.* - no ref.
H.P. 727-728:

Ray uses both *peregrinus* and *purpureus* for *Convolvuli* but not both together in the main text of *Historia Plantarum.*

821 *Penguin Dictionary of Botany:* 344.

Convolvulus minor cœruleus Hispanicus Park.parad. *cœruleus minor folio oblongo* Ger.emac. *peregrinus cœruleus folio oblongo* J.B. C.B.

Convolvulus peregrinus cœruleus Elatine similis n.d. Hort.Lugdb.Bat.

Convolvulus purpureus folio subrotundo C.B. *cœruleus major rotundifolius* Park.par. *cœruleus folio rotundo* Ger.emac. *Campanula Indica* J.B.

Line 155. *Convolvulo vulgari: Convolvulus vulgaris.*

[C.T.& M. 364] *Convolvulus arvensis* (L.), Field Bindweed, Combine; a species of the *Convolvulus* genus of the *Convolvulaceæ* or Bindweed family.

B.& G.-W. 318: B.& H. 305: Linn.*Sp.Pl.* 153-159:

Syn.Meth.St.Br. 275-276: *H.P.* 722-731: *H.P.III* - no ref.:

Tri. 8.19: *Cat.Angl.* 78: *Camb.* 56.

H.P. 722-731:

35 species given, including:

Convolvulus minor vulgaris Park. *minor arvensis* C.B. *Helxine cissampelos multis sive Convolvulus minor* J.B. *Smilax lenis minor* Ger. ***Small Bindweed.***

Tri. 8.19:

Bindweed: *Convolvulus, -i,* m.: *Σμῖλαξ, -ακος,* f.[822]

Line 155. *Eupatorio vulgari: Eupatorium vulgare*: see above under *Eupatorium cannabinum vulgare* Cap.10, line 89.

822 NB In *Trilingue* Ray gives *Σμῖλαξ, -ακος,* f. for Bindweed [without adjectives]. Liddell and Scott [p.1619] have the following meanings:
Σμῖλαξ, Holm Oak, *Quercus ilex:* Theophrastus H.P.3.16.2; Pliny H.N. 16.19.
Σμῖλαξ, Yew, *Taxus baccata;* Dsc. 4.79; Pliny H.N. 16.51.
Σμῖλαξ τραχεῖα, Rough Bindweed, *Smilax aspera;* Dsc.4.142.
Σμῖλαξ λεῖα, Great Bindweed, *Convolvulus sepium;* Dsc.4.143.

Line 156. *Staphylodendro: Staphylodendron.*

[C.T.& M. 180] *Staphylea pinnata* (L.), Bladder-nut; a species of the *Staphylea* genus of the *Staphylaceæ* or Bladder-nut family.

B.& G.-W. 240: B.& H. 96: Linn.*Sp.Pl.* 270:

Syn.Meth.St.Br. 468: *H.P.* 1681: *H.P.III D.* 84: *Tri.* - no ref.: *Cat.Angl.* 281: *Camb.* 116.

H.P. 1681:

> *Staphylodendron* J.B. *Nux vesicaria* Ger. Park. *Pistacia sylvestris* C.B. ***The Bladder Nut-tree.***

H.P.III D. 84:

> (Tr.) 'On trees with fruit which is dry in maturity.'
>
> *Staphylodendron Africanum semper virens, foliis splendentibus* Commel. Cat. Hort. Med. Amst. & Ejusd. Hort. rar. *Staph. Afric. folio lucido* P.B.P. *folio singulari* Herman.Parad.Bat.

Line 157. *Cichoreo: Cichoreum:* see above Cap.1, line 36.

Line 157. *Cervicariã: Cervicaria:* see above Cap.10, line 69.

Line 158. *Lysimachã Virginianã: Lysimachia Virginiana.*

[C.T.& M. 356] *Polemonium paniculata* (L.), Perennial Phlox; a species of the *Polemonium* genus of the *Polemoniaceæ* or Jacob's Ladder family.

B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 151:

Syn.Meth.st.Br. - no ref.: *H.P.* 862: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 193-195 but not this species:

Camb. - no ref.

H.P. 862:

> *Lysimachia lutea Virginiana* Ger.emac. *lutea siliquosa Virginiana* Park. *lutea corniculata* C.B.App. ***Tree Primrose.*** Lys. Americana Col. *Axochiotl* Hernandez.

Line 159. *Salviā: Salvia:* see above Cap.7, line 44.

Line 159. *Æthiopide: Æthiopis.*

[C.T.& M. 410] *Salvia* (L.), Clary or Sage; a genus of the *Labiatæ* or Mint family. No mention of Ethiopian Clary or Sage.

B.& G.-W. 346 - Clary but not *Æthiopis*: B.& H. 344 - Clary but not *Æthiopis*: Linn.*Sp.Pl.* 27 - *Æthiopis:*

Syn.Meth.St.Br. - no ref.: *H.P.* 543: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 543:

> *Æhiopis* Ger. *multis* J.B. *Æth. foliis sinuosis* C.B. *item Æth. foliis in profundas lacinias divisis* ejusdem. *Sclarea Æthiopica, sive Æthiopis laciniatis & non laciniatis foliis* Park.
>
> ***Ethiopian Clary.***

Line 159. *Cichorio: Cichorium:* see above Cap.1, line 36.

Line 159. *Cervicariā: Cervicaria:* see above Cap.10, line 69.

Chapter Eleven:

On the differences of flowers: from Joachim Jung's "Isagoge Phytoscopica", with some additions and changes.

In this chapter, largely taken from Jung's *Isagoge Phytoscopica*, Ray begins by discussing flower morphology and then goes on to discuss the purpose of the flower. Next he discusses the arrangement of the flower on its stem, referring back to his earlier chapter[823] for some of these arrangements, followed by comments on the position of the flower relative to the fruit. He concludes the chapter with notes from Jung on the various forms of the calyx. Much work had also been done by Malpighi and Grew on flower morphology, which were greatly enhanced by their accurate illustrations including the floral organs.[824]

Ray briefly describes the differences in flowers and, in his glossary at the beginning of *Historia Plantarum*, he refers the reader to this chapter where as part of his definition of the flower he states that:

> *Flos simplex & compositus seu aggregatus, uniformis & difformis, discoides, radiatus, &c. quis sit vide Lib.I. cap.11. pag.18, 19.*[825]

The descriptions of flower morphology given in this chapter are of necessity very involved and complicated because of the lack of plates; this is a chapter where one feels the inclusion of plates would have been especially beneficial.

Text page 18.

Line 1. *Flos perfectus .....* : Ray defines a perfect flower as 'either simple or composite'; after this definition he goes into much detail and anlaysis of such flowers. Although he uses slightly different terminology from Jung (for example, 'monopetalous' or 'unifoliate'

823 *Historia Plantarum* Book I, Chapter 7.
824 Morton: 184.
825 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

for Jung's 'simple'), essentially Ray agrees with him. Jung's description of simple and composite flowers is summarised by Morton as follows:

> The united gamopetalous corolla is designated simple *(flos simplex),* since it consists of a single *folium:* the *folium* may be entire or deeply lobed, but its simple nature is always manifest becuase it is shed as a whole. The divided polypetalous corolla is designated as relatively composite *(flos compositus secundum quid),* since it is divided into a number of more or less similar members *(folia).* Thus Jung defines the modern distinction between gamopetaly (sympetaly) and polypetaly, which has since figured with varying degrees of emphasis in most discussions of the classification of flowering plants. His third class of "absolutely composite" flowers *(flos absolute compositus)* contains Compositæ, Dipsaceæ and their like.[826]

We would now define a flower as the reproductive unit of the angiosperms (flowering plants) comprising the reproductive axis together with its associated, often brightly coloured, sepals and petals.[827] Ray is here, however, using the term for what is now popularly termed the 'flower' or very visible part of the reproductive unit. He uses the term 'flower' for a single flower head but also for what we would call the inflorescence or flowering structure consisting of more than one flower.[828]

The term 'perfect' is now used of flowers with both male and female reproductive organs, i.e. hermaphrodite flowers.[829]

826 Morton: 172.
827 *Penguin Dictionary of Botany:* 21.
828 *Oxford Dictionary of Botany:* 162, 211;*Penguin Dictionary of Botany:* 138-139, 189.
829 *Longman Dictionary of Botany:* 79.

Line 2. ..... *in flosculos:* a floret is one of the individual small flowers of a clustered inflorescence.[830] Jung had also used this term.[831]

Line 4. *Compositus seu aggregatus:* a composite flower has a head-like inflorescence and at first sight appears to be a single flower, but is, as Ray says, composed of many small flowers clustered together.[832] That the 'flower' of the Compositæ is a capitulum of many florets is shown very clearly in the illustrations to the works of Malpighi and Grew. Morton remarks that Cesalpino had been unsure of this but that by the time of Jung it was well understood. Malpighi recognized in each floret the five anthers united into a conical tube round the style, a characteristic of this family. Grew described the same structure, calling it the "sheath, but without realizing that it represented the connate anthers.[833]

Line 5. *non tantum folio seu bractea colorata, verum etiam vel staminibus vel stylo ..... :* Ray believes the central portion of a composite flower to be either 'a leaf or coloured bract' or such a bract with stamens or stylus, whereas in fact these central parts are individual small flowers, attached, as he says at the base.[834]

Line 5 *et passim.* *folio:* Ray is still using here the earlier term *folium* for a petal. The term petal had been first used in 1592 for the brightly coloured leaf-like organ or inner floral leaf; Fabio Colonna (Columna) had used the Greek word πέταλον in his *Phytobasanos*, Chapter 1, and later in 1628 in his edition of F.Hernandez' account of the natural history of Mexico. In his notes to this latter work he

830 *Oxford Dictionary of Botany:* 162.
831 Morton: 171.
832 *Oxford Dictionary of Botany:* 99.
833 Morton: 183-184.
834 *Oxford Dictionary of Botany:* 99.

proposed the use of the term petal in its modern sense.[835] Ray adopted this suggestion in the *Historia Plantarum* in 1686, but in this chapter still uses the word *folium;* as Ray was aware of the term 'petal' and did not choose to use it here, I have left 'leaf' in the translation rather than changing to 'petal'. Compare line 12, where he uses the term *petalum* in its modern sense.

Line 6. *Lactucæ: Lactuca:* see above Cap.4, line 46.

Line 6. *Hieracii: Hieracium.*

[C.T.& M. 499-511] *Hieracium* (L.), Hawkweed; a genus of the *Compositæ* or Daisy family.

B.& G.-W. 440: B.& H. 266: Linn.*Sp.Pl.* 799-804:

Syn.Meth.St.Br. 164-167: *H.P.* 230-242: *H.P.III* 137-138:

Tri. 10.86: *Cat.Angl.* 159-162: *Camb.* 73-74.

H.P. 230-242:

58 species given, including:

Hieracium minus præmorsa radice, sive Fuchsii J.B. *Hier. Chondrillæ folio glabro, radice succisa majus* C.B. *minus praemorsa radice* Park.

Hawkweed with bitter roots; Yellow Devil's Bit.

H.P.III 137-138:

Ad cap. de Hieracio Hyoseride.

Ray wants to transfer this section to that in Book II, which contains Composite flowers, naturally full, milk-bearing and with solid seeds.

Ad cap. de Hieracio simpliciter dicto.

Ad Speciem &am Hieracium medio-nigrum Baeticum Park. *pro synon. adde, Hieracium Bœticum* Clus. *cur post. sine descriptione, medio-nigrum, flore majore & mino (?re) Bœlii*

835 Morton: 163-164, note 62.

Ger.emac. *medio-nigrum* D.Pilleterii Lob.Stirp.illustr.

Tri. 10.86:

Hawkweed: *Hieracium, -ii,* n.:Ἱεράκιον, ίου, n.

Line 6. *Carduorum: Carduus:* see above Cap.4, line 151.

Line 8 et passim. *multiplici seu pleno:* Ray uses here for the first time in describing a flower shape the word *plenus*. In most cases he seems to mean 'full in shape', 'rounded', almost 'compact and full'; I have translated *plenus* as 'full' throughout this chapter, except in lines 10-11.

Lines 10-11. *uterque per accidens plenus seu multiplex est; plenus* must mean 'complete in itself' here rather than 'full' as in this instance he is not describing a composite or full flower.

Line 12. *Monopetalos est ..... :* he describes a monopetalous flower as hollow or pipe-like. He seems to be describing here a gamopetalous or sympetalous flower, which has petals fused along their margins to the base to form a corolla tube. Most plants of this type are grouped together in the *Asteridæ*, which includes the families of all the plants listed by Ray as examples.[836]

Line 12. *qui unico petalo continuo constat: :* see note on *folio* at line 5 above.

Line 13. *Polypetalos .....:* we still use the term polypetalous for a flower having separate petals freely inserted on the receptacle.[837]

836 *Penguin Dictionary of Botany:* 147.
837 *ibid.:* 288.

Line 14. *Circæā Lutetianā:Circaea Lutetiana.*

[C.T.& M. 269] *Circæa lutetiana* (L.), Common Enchanter's Nightshade; a species of the *Circæa* genus of the *Onagraceæ* or Willowherb family.

B.& G.-W. 258: B.& H. 154: Linn.*Sp.Pl.* 9: *Syn.Meth.St.Br.* 289: *H.P.* 401: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* 71-72: *Camb.* 54.

H.P. 401:

> *Circæa lutetiana* Ger. Lob. *Lutetiana major* Park. *Solanifolia Circæa dicta major* C.B. *Ocymastrum verrucarium* J.B.
>
> ***Enchanter's Night-shade.***

Line 14. *Hypocoo Clusii:*

[Polunin[838] 245-246] *Hypecoum*, a genus of the *Papaveraceæ* or Poppy family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: Polunin 246-247: B.& H. - no ref.: Linn.*Sp.Pl.* 124: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1328: *H.P.III.* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

In Pliny its name is spelled almost as in Ray's text:

> *Hypecoön in segetibus nascitur foliis rutæ. natura eius eadem quæ papaveris suco.*[839]

The *Hypocoön* of Pliny is identified as *Hypecoum procumbens* in the edition of W.H.S.Jones, revised by A.C.Andrews.[840]

Linn.*Sp.Pl.* 124:

> *procumbens:*
>
> *Hypecoum siliquis arcuatis compressis articulatis.* Hort ups.31.
>
> *Hypecoum.* Bauh.pin 172. Dod.pempt.449. Hort.cliff.38.

838 Polunin: 245-246.276.

839 Pliny, *Historia Naturalis* XXVII, lxviii: 93; Loeb edition VII: 444.
[Hypecoön grows in cornfields and has leaves like those of rue. Its properties are those of poppy juice.]

840 *ibid.:* Loeb edition VII: *Index of Plants:* 515.

Roy.lugdb.402.

That this is the plant indicated here by Ray is confirmed by his own later text in *Historia Plantarum,* where he spells it as in Pliny, with then two instances of the eponym *Clusii.* That Ray, despite his statement here in Book I, had some doubts about whether the flowers of this plant are 'dipetalous' or 'bifoliate' is shown in the main text of *Historia Plantarum,* when he says *Flores ..... (& quantum memini) bifolii, aut saltem foliis duobus adversis .....*[841]

H.P. 1328:

Hypecoon legitimum Clusii Park. *Hypecoon* C.B. *Hypecoon siliquosum* J.B. *Cyminum corniculatum sive Hypecoon Clusii* Ger.

Line 14. *Clusii* / Jules-Charles de l'Ecluse, 1525-1609.

He trained as a lawyer, but on a visit to Provence in 1551 became interested in botany. As a young man he spent three years under Rondelet at Montpellier. He travelled widely in western Europe collecting plants, adding about 600 new species; he was the first botanist to describe and illustrate more than the conventional handful of fungi. The 105 species of fungi given in his *Rariorum Plantarum Historia* of 1601 represent the first substantial contribution to systematic mycology.[842] His excellent knowledge of Latin enabled him to translate several works on natural science, which he frequently expanded and corrected.[843] The most important of these are:

1. *Histoire des plantes* (1557) is the French version of Dodoens *Cruydeboeck;* this translation is mentioned by Gaspard Bauhin

841 *Historia Plantarum:* 1328.
NB Polunin gives this as a three-lobed flower: 245-246.
842 Morton: 162, note 60.
843 *DSB VIII:* 120.

in his *Pinax*.

2. *Aromatum et simplicium aliquot medicamentorum apud iodos nascentium historia* (1567) is taken from Garcia del Huerto's *Coloquios dos simplos*.
3. *De simplicibus medicamentis ex occidentali India delatis quorum in medicina usus est* (1574) is the translation of a work by the Seville physician Nicolas Monardes on the medicinal plants of the West Indies, to which l'Ecluse added a supplement in 1582.
4. *Aromatum et medicamentorum in orientali India nascentium liber* (1582) is the translation of *Tractado de las drogas y medicinas de las Indias orientales* by Cristobal Acosta.
5. A Latin translation of Pierre Belon's voyage to the Orient and the Middle East was published in 1589.
6. A complete edition of the three translations of the medicinal plants of the Indies appeared in 1593.[844]

L'Écluse's original works on botany were:

Rariorum aliquot stirpium per Hispanias observatarum historia (Antwerp 1576).[845]

Rariorum plantarum historia (Antwerp 1601).

Exoticorum libri decem, 3 volumes (Leiden 1605) includes all of L'Écluse's work on rare species.

L'Écluse's works were published together after his death as *Curæ posteriores* (Leiden 1611).[846]

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844 Bibliographical details of de L'Écluse's translations may be found in the *British Museum General Catalogue of Printed Books* CXXXII, cols. 786-787; also in *Nouvelle Biographie Générale* XXX (Paris 1862), cols. 220-221 and in *Biographie Universelle* XXIII: 534-535.

845 NB This work contains engravings done under the author's supervision, which were also used by Dodoens and de L'Obel; *DSB XVIII:* 121.

846 *DSB VIII:* 120-121.
See also L. Legré, *La Botanique en Provence au XVI° siècle* V (Marseilles 1901), C.J.É Morren, *Charles de 'Écluse, sa vie et ses œuvres* (Liege 1875), C.F.A Morren, in *Belgique Horticole*, 3 (1853): 5-19, and *Bulletin, Societé Royale de Botanique de Belgique*, I (1862): 14-15.

De l'Ecluse was the most brilliant of the Netherlands botanists but was not very interested in the problem of plant classification. His first entirely original work, *Rariorum aliquot stirpium per Hispanias observatarum historia* (1576) was written from notes made on his travels in Spain in 1564-1565. His *Flora* of Hungary and Austria was published in 1583. In 1593 he was appointed to the chair at Leiden previously held by Dodoens,[847] where he remained until his death in 1609. *Rariorum plantarum historia* (1601) gives about 100 new species; *Exoticorum libri decem* (1605) is about exotic flora.

De l'Ecluse, together with Dodoens and de l'Obel, who were also born in the Netherlands, contributed considerably to the advance of systematic botany by collecting and describing new species, by good illustration and by their mutual co-operation, which set a standard of scientific behaviour as a pattern for the future. Their work and that of others at the time led to an expansion of botanical knowledge, in which the Herbal was transformed into the Flora.[848]

Line 14. *Alsines: Alsine.*

[C.T.& M. 142-144] *Minuartia* (L.) Sandworts, previously *Alsine*; a genus of the *Caryophyllaceæ* or Pink family.

B.& G.-W. 84: B.& H. 67: Linn.*Sp.Pl.* 272:

Syn.Meth St.Br. 346-353: *H.P.* 847-848: *H.P.III* 497-498 (incorrect reference in index to Volume III: it should read 847-848): *Tri.* 9.40: *Cat.Angl.* 15-18: *Camb.* 40-41.

H.P. 847-848:

4 species given, but not the *Alsine vulgaris* of *Syn.Meth.St.Br.* However, Ray gives English names to three of the species, all including Chickweed in the name:

847 *DSB VIII:* 120-121.

848 *ibid.;* Morton: 144; Arber: 84-87; Raven: 73 and 158; Sachs: 29-31.

1. Speedwell-Chickweed.

Alsine foliis Veronicæ Ger. *foliis subrotundis Veronicæ* Park. *Veronicæ foliis, flosculis cauliculis adhærentibus* C.B. *Serrato folio hirsutiore flosculis & loculis cauliculis adhærentibus* J.B.

2. Germander-Chickweed.

Alsine foliis Trissaginis Ger. Park. *Chamædryfolia, flosculis pediculis, oblongis insidentibus* C.B. *Alsine serrato folio glabro* J.B.

3. Ivy-Chickweed or Small-Henbit.

Alsine hederacea Ger. *hedurulæ folio* C.B. *hedurulæ folio minor* Park. *Alsine genus Fuchsio folio hedurulæ hirsuto* J.B.

4. *Alsine recta triphyllos sive laciniata* Park. *tryphyllos cærulea* C.B. *folio profunde secto, flore purpureo seu violaceo* J.B. *Alsine recta* Ger.

H.P.III 847-848:

83 additional species given.

Tri. 9.40:

Chickweed: *Alsine, -es*, f.: Ἀλσίνη, -ης, f.

Line 15. *Plantagine aquaticã: Plantago aquatica.*

[C.T.& M. 516] *Alisma plantago-aquatica* (L.), Water-Plantain; a species of the *Alisma* genus of the *Alismataceæ* or Water-Plantain family.

B.& G.-W. 442: B.& H. 432: Linn.*Sp.Pl.* 342:

Syn.Meth.St.Br. 257-258: *H.P.* 618: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* 236-237: *Camb.* 95.

H.P. 618:

Plantago aquatica J.B. *aquatica latifolia* C.B. *aquatica major* Ger. Park. ***Great Water-Plantain.***

Ray says of this plant:

(Tr.) It corresponds in habitat and in its three-petalled flower with the *Sagitta*, but differs from it in its leaves, which are like those of *Plantago*.

Line 15. *Sagittariā: Sagittaria.*

[C.T.& M. 517] *Sagittaria sagittifolia* (L.), Arrow-head; a species of the *Sagittaria* genus of the *Alismataceæ* or Water-Plantain family.
B.& G.-W. 442: B.& H. 431: Linn.*Sp.Pl.* 993:
Syn.Meth.St.Br. - no ref.: *H.P.* 921: *H.P.III* 327: *Tri.* - no ref.:
Cat.Angl. 260: *Camb.* - no ref.
H.P. 921:

Sagittaria cordialis Marcgr.

H.P.III 327:

7 additional species given.

Line 15. *Miltaris Aizoides.*

[C.T.& M. 518] *Stratiotes aizoides* (L.), Water Soldier; a species of the *Stratiotes* genus of the *Hydrocharitaceæ* or Frogbit family.
B.& G.-W. 444: B.& H. 434: Linn.*Sp.Pl.* 535:
Syn.Meth.St.Br. 290: *H.P.* 1324: *H.P.III* - no ref.: *Tri.* - no ref.:
Cat.Angl. 199: *Camb.* 85.
H.P. 1324:

Militaris Aizoides Ger. *Stratiotes sive Militaris Aizoides* Park.
Aloe palustris C.B. *Aloe sive Aizoon palustre* J.B.
Water-Sengreen, or Fresh-Water-Souldier [*sic*].

Line 15. *Nymphæa alba minima.*

[C.T.& M. 518] *Hydrocharis morsus-ranæ* (L.), Frogbit; a species of the *Hydrocharis* genus of the *Hydrocharitaceæ* or Frogbit family.
B.& G.-W. 444: B.& H. 434: Linn.*Sp.Pl.* 1036:

Syn.Meth.St.Br. 290: *H.P.* 1320: *H.P.III* 630: *Tri.* - no ref.: *Cat.Angl.* 212: *Camb.* - no ref.

H.P. 1320:

Nymphæa alba minima C.B. *alba minima sive Morsus ranæ* Park. *Nymphæa minor sive Morsus ranæ* J.B.

The least white Water-lily, or Frog-bit.

H.P.III 630:

Various plants here, which could be *N.alba minima.*

1. *Ambel* H.M.p.11T.26. *Nymphæa Indica, flore albo, fructu in ambitu serrato* Commelin. *notis. Lotus* Ægyptia Alpin. *exot. Nymphaea seu Nufar* Aegyptium Vesling in Alp.
2. *Nedel-Ambel,* H.M.p.11,T.28. *Nymphæa aquatica minor Indica, floribus albis pentapetalis, filamentis intus densis obsitis nobis, flore albo piloso* Commelin. *notis.* Slon.Cat.Jamaic.
3. *Nymphæa Indica minor longiore folio, flore albo simplici e* Maderaspatam Ejusdem ibidem.

Line 15. *Leucoio: Leucoium.*

[C.T.& M. 101-102] *Cheiranthus cheiri* (L.), Wallflower; a species of the *Cheiranthus* genus of the *Cruciferæ* or Cress family.

B.& G.-W. 136: B.& H. 26: Linn.*Sp.Pl.* 661:

Syn.Meth.St.Br. 291: *H.P.* 782: *H.P.III* 555:

Tri. 13.185 / 14.205: *Cat.Angl.* 184: *Camb.* 79.

H.P. 782:

7 species given, including:

Leucoium luteum, vulgo Cheiri, flore simplici J.B. *luteum vulgare* C.B. *Keiri sive Leucoium vulgare luteum* Park. *Viola lutea* Ger. ***Wall-flower.***

H.P.III 555:

5 additional species given.

Tri. 13.185:

Stock-gilliflower: *Leucoium, -ii,* n.: *Λευκόϊον, –ου,* n.

Tri. 14.205:

Wall-flower: *Leucoium, -ii,* n. luteum: *Λευκόϊον, –ου,* n.

Line 16. *Brassicā: Brassica:* see above Cap.9, line 113.

Line 16. *Alsine: Alsine:* see above Cap.11, line 14.

Line 16. *Lychnide: Lychnis*: see above Cap.3, line 35.

Line 16. *Caryophyllis: Caryophyllus.*

[C.T.& M. 129] *Dianthus caryophyllus* (L.), Clove Pink, Carnation; a species of the *Dianthus* genus of the *Caryophyllaceæ* or Pink family.

B.& G.-W. 102: B.& H. 59: Linn.*Sp.Pl.* 515:

Syn.Meth.St.Br. 335-338: *H.P.* 986: *H.P.III* 483: *Tri.* 11.98: *Cat.Angl.* 56-57: *Camb.* - no ref.

H.P. 986:

19 species given, including:

Caryophyllus hortensis Park. *Caryophyllus altilis major* C.B. *Betonica coronaria sativa, sive Caryophyllus flos* J.B.

The Clove July-flower.

H.P.III 483:

7 additional species given.

Tri. 11.98:

A July Flower or Carnation: *Caryophyllus, -i,* m.:

Καρυόφυλλος, –ου, m.

Line 17. *Bulbaceae:* literally 'bulbous plants'.

A bulb is a modified underground stem of certain perennial herbaceous plants which serves as an overwintering organ, for example in onions, daffodils and tulips. The bulb consists of a base plate or modified part of the stem, on top of which develop a large number of sheathing non-photosynthesising leaves, surrounded by a papery bract. The leaf stores food materials, and these provide for the growing shoot which emerges from the top when conditions are suitable. Vegetative reproduction takes place when the bulb reproduces itself by growing an additional new bulb.[849]

Line 18. *Trifolium hepaticum*: see above under *Hepatica trifolia* Cap.10, line 77.

Line 18. *Florem Africanum: Flos Africanus.*

[C.T.& M. 452] *Tagetes erecta* (L.), African Marigold; a species of the *Tagetes* genus of the *Compositæ* or Daisy family.

B.& G.-W. - no ref.: B.& H. - no ref, except where African Marigold is mentioned as being a Peruvian species of *Tagetes*: Linn.*Sp.Pl.* 887: *Syn.Meth.St.Br.* - no ref.: *H.P.* 342: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref. *H.P.* 342:

> Ray says of this plant:
>
> > (Tr.) The characteristics of this flower are a whole oblong calyx, broad petals, long compressed seeds and laciniate leaves like those of *Tanacetum.*
>
> *Flos Africanus major polyanthos* Ger. *major sive maximum multiplex* Park. *Tanacetum sive Flos Africanus major flore pleno* C.B. *Tagetes maximus rectus flore pleno multiplicato* J.B.
>
> ***The African Marigold.***

849 *Penguin Dictionary of Botany:* 51; Gibbons: 94-95.

Line 19. *Grnadillam Mexicanam: Granadilla Mexicana.*

[Mac.Enc. 930] *Passiflora quadrangularis,* Passion Flower or Granadilla; a species of the *Passiflora* genus of the *Passifloraceæ* or Passion Flower family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. 157, referrred to incidentally as *Passifloraceæ*, an allied order of *Cucurbitaceæ*, the Gourd family: Linn.*Sp.Pl.* 955-959: *Syn.Meth.St.Br.* - no ref.: *H.P.* 649-651: *H.P.III* 339: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 649-651:

Ray describes the flower of this plant, but does not mention its ten petals here.

(Tr.) This plant, Granadilla, is so-named by the Spaniards from the likeness of its fruit to the Punic Apple or Granato. Murucuia and Maracoc are American words, the former from Virginia, the latter from Brazil, by which names this plant is known to the natives, but whose significance we do not know. Jo. Baptista Ferrari tells why it is called the flower of passion, doubtless, he says, because it is inscribed by the hand of Divine Love with a lifetime's griefs, which are proclaimed profusely by the likeness of parts of the flower to the crown of thorns, the nails, the whip and the rest, with which the slaughtered, tortured and wounded Lord Christ was affixed to the cross.

Granadilla Hispanis, Flos passionis Italis Col.Not in Rech. *Maracoc sive Clematis Virginiana* Park. *Murucuia 3. Maliformis alia* Marcgr. *Clematis trifolia flore roseo clavato* C.B.

H.P.III 339:

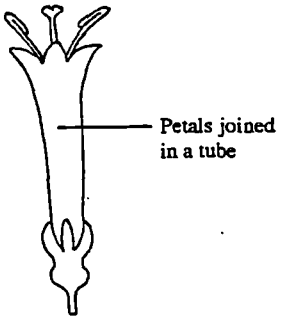
28 additional species given.

Line 21. *vel uniformis est vel difformis:* actinomorphic and zygomorphic.[850]

Lines 22-24. *Monopetalon uniformem. ..... quasi tornatilis est.*

Ray, agreeing with Jung, gives here his definition of what we now call an actinomorphic flower. This is the term used for radial symmetry in flowers; that is, they are symmetrical in all directions when viewed from above.[851] Ray is here describing a gamopetalous flower, but as he says both polypetalous and gamopetalous flowers can be described as actinomorphic, as in the following diagram.[852]

Line 23-24.*sive figuræ quasi tornatilis est.* Ray is describing the tubular shape of a gamopetalous flower here, as in the following diagram:-[853]



Line 28. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Line 28. *Campanulæ: Campanula*: see above Cap.7, line 45.

850 *Longman Dictionary of Botany:* 71.
851 *ibid.*
852 Drawn from *Longman Dictionary of Botany:* 71.
853 *ibid.*

Line 28. *Buglosso: Buglossus:* see above Cap.9, line 49.

Line 28. *Hyoscyamo: Hyoscyamus.*

[C.T.& M. 367] *Hyoscyamus niger* (L.), Henbane; a species of the *Hyoscyamus* genus of the *Solanaceæ* or Potato family.

B.& G.-W. 348: B.& H. 317: Linn.*Sp.Pl.* 179-180:

Syn.Meth.St.Br. 274: *H.P.* 711: *H.P.III* 369: *Tri.* 11.90:

Cat.Angl. 167: *Camb.* 75.

H.P. 711:

Ray describes this plant thus:

(Tr.) Its characteristics are leaves positioned alternately on the stem, seed vessels covered with a lid which falls off in maturity, the calyx distinguished by the four points of an aperture, and it has strong narcotic powers.

Hyoscyamus vulgaris J.B. *niger* Ger. *niger vel vulgaris* C.B. Park. ***Common Henbane.***

H.P.III 369:

4 additional species given.

Tri. 11.90:

Henbane: *Hyoscyamus, -i,* m.:*Ὑοσκύαμος, -άμου,* m.

Line 28. *Tabaco: Tabacum.*

[B.& G.-W. 350] *Nicotiana tabacum* (L.), *[Nicotiana latissima],* Tobacco; a species of the *Nicotiana* genus of the *Solanaceæ* or Potato family.

C.T.& M. - no ref.: B.& H. 317: Linn.*Sp.Pl.* 180:

Syn.Meth.St.Br. - no ref.: *H.P.* 713: *H.P.III* - no ref.: *Tri.* 14.201:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 713:

Tabacco latifolium Park. *Nicotiana major latifolia* C.B. *Nicotiana major sive Tabacum majus* J.B. *Hyoscyamus Peruvianus* Ger. ***Broad-leaved Tobacco.***

Tri. 14.201:

Tobacco: *Tabacum, -i*, n.: [No Greek].

Ray's note, 'This is usually also called *Nicotiana,* after the name of him who brought it first across to France.'

Line 29. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Line 30. *Buglosso: Buglossus:* see above Cap.9, line 49.

Line 32. *Boraginis: Borago*: see above Cap.10, line 88.

Line 32. *Buglossi: Buglossus*: see above Cap.9, line 49.

Line 32. *Sambuci: Sambucus*: see above Cap.4, line 154.

Line 32. *Cyclaminis: Cyclamen.*

[C.T.& M. 346] *Cyclamen hederifolium* (Aiton), [*Cyclamen europaeum* (auct.): *Cyclamen neapolitanum* (Ten.)], Cyclamen or Sowbread; a species of the *Cyclamen* genus of the *Primulaceæ* or Primrose family.

B.& G.-W. 298: B.& H. 290: Linn.*Sp.Pl.* 145:

Syn.Meth.St.Br. - no ref.: *H.P.* 1205-1206: *H.P.III* 574:

Tri. 13.181: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1205-1206:

5 species given, including:

Cyclamen folio rotundiore vulgatior J.B. *Cyclamen orbiculato folio, inferne purpurascente* C.B. *orbiculato folio* Ger.

Autumnale vulgare folio rotundo Park.

Round-leaved Autumnal Sowbread.

H.P.III 574:

1 additional species given.

Tri. 13.181:

Sowbread: *Cyclamen, -inis,* n.: *Κυκλάμινος, -ίνου,* f.

Line 34. *Casia Poetica.*

[Flowers, G.& B. 213][854] *Osyris alba* (L.), Osyris; a species of the *Osyris* genus of the *Santalaceæ* or Sandalwood family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.:

Linn.*Sp.Pl.* 1022: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1489:

H.P.III D. 48-49 / *D.* 112: *Tri.* - no ref.: *Cat.Angl.* - no ref.:

Camb. - no ref.

H.P. 1489:

Casia Poetica Lobelii Ger. *Poetica Monspeliensium* Park. *Osyris frutescens baccifera* C.B. *Osyris Plinii.*

H.P.III D. 48-49:

8 additional species given, five of which have the name *cassia.*

H.P.III D. 112:

2 additional species given of *Cassia.*

Line 34. *Phalangio Virginiano: Phalangium Virginianum.*

[B.& G.-W. 452] *Anthericum liliago* (L.), St. Bernard's Lily; a species of the *Anthericum* genus of the *Liliaceæ* or Lily family.

C.T.& M. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 310:

Syn.Meth.St.Br. - no ref.: *H.P.* 1192: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1192:

(Tr.) It differs from Asphodel in its fibrous roots.

854 Polunin: 213.**70.

Phalangium flore Lilii J.B. *Allobricum* Park. *Allobricum majus* Clus. *magno flore* C.B. *Phal. Antiquorum* Ger.emac.

Spider-wort.

Phalangium Virginianaum Tradescanti Ger.emac. *Ephemerum Virginianum Tradescanti* Park.parad. *Allium sive Moly Virginianum* C.B.app. ***Virginian Spider-wort.***

Text page 19.

Line 36. *Boragine: Borago*: see above Cap.10, line 88.

Line 36. *Hyoscyamo: Hyoscyamus*: see above Cap.11, line 28.

Line 37. *Primulā veris: Primula veris:* see above Cap.7, line 13.

Line 37. *Buglosso: Buglossus:* see above Cap.9, line 49.

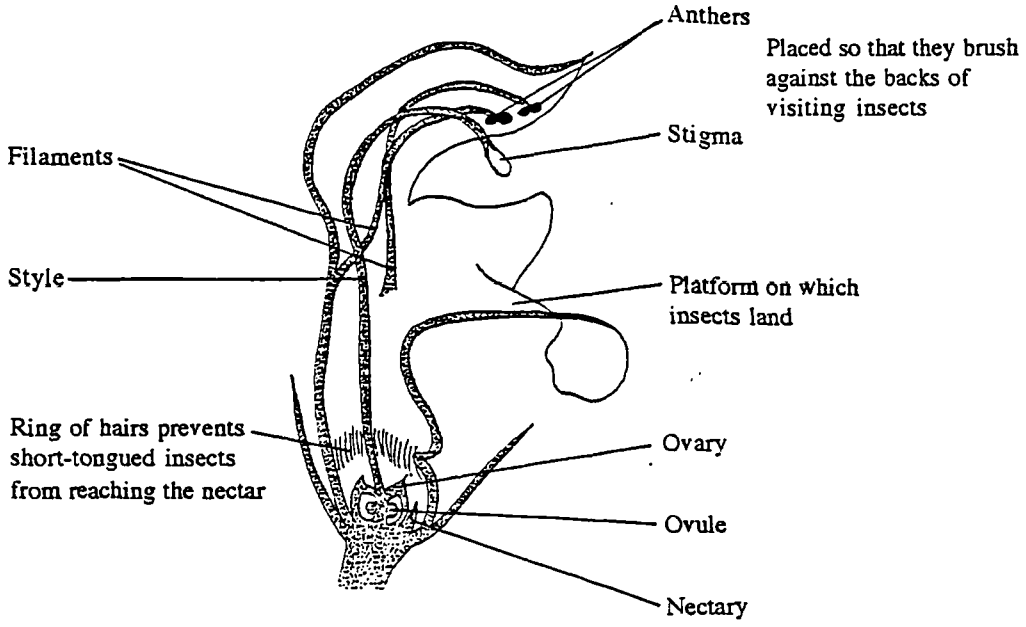
Line 38. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Line 39. *Campanulā: Campanula:* see above Cap.7, line 45.

Line 40. *Monopetalos difformis est ..... anteriora a posticis discrepat.*
Ray is describing a zygomorphic or bilaterally symmetrical flower; that is, a flower which is symmetrical in one direction or plane only, such as the *Lamium* or Deadnettle given as his example. This is often due to differences in sizes and shapes of petals and/or sepals.[855]

855 *Longman Dictionary of Botany:* 71; *Penguin Dictionary of Botany:* 41.

Structure of a zygomorphic *Lamium* flower:[856]



Lines 42-53. *Estque vel .....* Ray goes on to give examples and descriptions of various types of gamopetalous zygomorphic flowers.

Line 41. *Lamii: Lamium:* see above Cap.7, line 44.

Line 43. *Aristolochiã: Aristolochia.*

[C.T.& M. 295-296] *Aristolochia clematitis* (L.), Birthwort; a species of the *Aristolochia* genus of the *Aristolochiaceæ* or Birthwort family.

B.& G.-W. 62: B.& H. 389-390: Linn.*Sp.Pl.* 960-962: *Syn.Meth.St.Br.* - no ref.: *H.P.* 761-764: *H.P.III* 393: *Tri.* 8.20: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 761-764:

Ray describes this flower thus:

(Tr.) The characteristics of *Aristolochia* are a semi pipe-like flower with a horned lip produced in the shape of a

856 Drawn from Beckett: 194.

spade, with a large pericarp split into six compartments.

9 species given, including:

Aristolochia rotunda J.B. Ger. *rotunda vulgatior* Park. *rotunda flore purpurea nigra* C.B. ***Round Birthwort.***

H.P.III 393:

11 additional species given.

Tri. 8.20:

Birthwort: *Aristolochia, -æ,* f.: *Ἀριστολοχία, -ας,* f.

Line 44. *Acantho sativo: Acanthus sativus.*

[C.T.& M. 401] *Acanthus mollis* (L.), Bear's- breech; a species of the *Acanthus* genus of the *Acanthaceæ* or Acanthus family.

B.& G.-W. 422: B.& H. 323: Linn.*Sp.Pl.* 639:

Syn.Meth.St.Br. - no ref.: *H.P.* 1325-1326: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1325-1326:

Acanthus sativus Lob. Ger. Park. *Sativus vel mollis Virgilii* C.B. *Carduus Acanthus sive Branca ursina* J.B.

Brank-ursine, or Bear's-breech.

Line 44. *Scordio: Scordium.*

[C.T.& M. 418] *Teucrium scordium* (L.), Water Germander; a species of the *Teucrium* genus of the *Labiatæ* or Mint family.

B.& G.-W. 332: B.& H. 360: Linn.*Sp.Pl.* 565:

Syn.Meth.St.Br. 246: *H.P.* 576: *H.P.*III 311: *Tri.* - no ref.:

Cat.Angl. 267-268: *Camb.* 112.

H.P. 576:

Scordium J.B. C.B. Ger. *legitimum* Park.

Water Germander.

H.P.III 311:

3 additional species given.

Line 44. *Teucrio communi: Teucrium commune.*

[C.T.& M. 418] *Teucrium* (L.), Germanders; a genus of the *Labiatæ* or Mint family.

B.& G.-W. 332: B.& H. 360: Linn.*Sp.Pl.* 562-566:

Syn.Meth.St.Br. 253 / *285 (*Teucrium alpinum* only here):

H.P. 526 / 1870: *H.P.III* 280-281: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 526:

5 species given, including:

Teucrium C.B. *Teucrium multis* J.B. *majus vulgare* Park. *latifolium* Ger. ***Tree-Germander.***

H.P.III 280-281:

16 additional species given.

Line 44. *Bætico: Baeticum.* No reference to this as a plant in any of the sources. Does he mean a species of *Teucrium* 'from Baetica', the province of southern Spain, which derives its name from the river Baetis [now the Guadalquivir]?

Line 46. *Chamæcisso: Chamæcissus.*

[C.T.& M. 416] *Glechoma hederacea* (L.), *[Nepeta hederacea* ([L.] Trev.), *Nepeta glechoma* (Bentham)*]*, Ground Ivy; a species of the *Glechoma* genus of the *Labiatæ* or Mint family.

B.& G.-W. 340: B.& H. 351: Linn.*Sp.Pl.* 578:

Syn.Meth.St.Br. 243: *H.P.* 566-567: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* 73.

H.P. 566-567:

Hedera terrestris Ger. *terrestris vulgaris* C.B. Park. *Chamaecissus sive Hedera terrestris* J.B.

Ground-ivy, Gill-go-by-ground, Ale-hoof, or Tun-hoof.

Line 48. *Galea, -ae,* f.: a 'helmet'.[857] and *galeatus* - 'helmeted'.

Cucullus, -i, m.: a 'covering': of the head 'a cap', 'hood', (fastened to a garment); of merchandise a 'conical wrapper' or 'case'.[858]

Galericulus: in Latin *galericulum, -i,* n. is 'a small covering for the head', 'a cap'.[859]

Line 52. *Linariā: Linaria.*

[C.T.& M. 372-373] *Linaria* (Miller), Toadflax; a genus of the *Scrophulariaceæ* or Figwort family.

B.& G.-W. 358: B.& H. 327: Linn.*Sp.Pl.* 616:

Syn.Meth.St.Br. *281-282: *H.P.* 752-759: *H.P.III* 390-391:

Tri. - no ref.: *Cat.Angl.* 187: *Camb.* 80.

H.P. 752-759:

Ray says of Linaria:

(Tr.) *Linaria* is so-named from the similarity of its leaves to those of *Linum* (Flax).

Its characteristics are a flower, which has a spur, gaping in a rictus and which is followed by a bi-valve capsule.

37 species given, including:

Linaria lutea vulgaris Ger. J.B. *vulgaris nostras* Park. *vulgaris lutea flore majore* C.B. ***Common yellow Toad-flax.***

H.P.III 390-391:

Ad cap. de Linaria post speciem 2dam: 1 additional species given.

Also:

page 759: *post speciem 33am:* 3 additional species given.

page 755: *Pl.15 adde Synon:* 39 additional species given.

857 Lewis and Short: 800.
858 *ibid.*: 486-487.
859 *ibid.*: 800.

Line 52. *Delphinio: Delphinium.*

[C.T.& M. 36] *Consolida ambigua* ([L.] P.W.Ball and Heywood), [*Delphinium ajacis* (auct.), *Delphinium consolida* (Linnæus sec. Sm.), *Delphinium gayanum* (Wilmott)], Larkspur; a species of the *Consolida* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 108: B.& H. 13: Linn.*Sp.Pl.* 530-531:

Syn.Meth.St.Br. 273: *H.P.* 708: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 708:

> *Delphinium elatius flore simplici diversorum colorum* Park.parad. *item Delph. elat. flo. pleno divers. colorum* ejusdem. *Consolida regalis erectior purpureo sive violaceo flore majore* J.B. *item Consol. reg. erectior flo. purp. sive violaceo pleno* ejusdem. *Consolida regalis sativa* Ger. ***Larks-spur.***

Line 54. *Flos multifolius seu polypetalos uniformis est ..... :* Ray goes on to differentiate with examples between actinomorphic and zygomorphic polypetalous flowers in the same way as he did for gamopetalous: see notes at lines 12, 22-24, 40 and 42-53.

Line 55. *Umbelliferis: Umbelliferae:* the Carrot family.

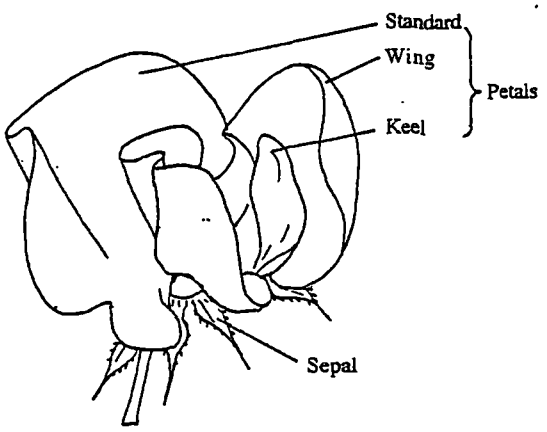
Annual, biennial or perennial herbs, occasionally shrubby, with alternate leaves. Leaves large, usually pinnately divided, but sometimes simple, often with inflated and sheathing bases. Inflorescence an umbel, usually compound, the primary umbel with or without bracts, the main banches (rays) supporting the secondary umbels. Flowers small, five-parted, usually hermaphrodite. Calyx with five small teeth or absent. Petals separate, usually notched and with an incurved point. Carpels 2 joined along a central axis, each ending in a short style. Fruit dry, 2-parted, flattened or rounded in section, usually ribbed and with 4

resin canals (vittae) between the primary ridges. 3000 species in about 300 genera throughout the world but especially in temperate regions.[860]

Line 56. *Iridis: Iris:* see above Cap.3, line 36.

Line 56. *Leguminum:* Ray has doubts about the number of petals in Leguminous flowers, believing that perhaps they have only one petal, which is deep cut.

They do in fact have several petals, as can be see here in this diagram of the leguminous Sweet Pea flower:[861]



Legumines: Legumes or Pulses.

The *Leguminosæ* family of plants (herbs, shrubs and trees), which consists of about 7000 species worldwide. It includes many important crop plants such as peas, beans, clovers and alfalfa. They all have compound leaves and the fruit is a pod containing a single row of seeds. Both pods and seeds are rich in protein. Most species possess root nodules, which contain nitrogen-fixing bacteria and leguminous crops replenish nitrogen in the soil.[862]

860 Blamey and Grey-Wilson: 268.
861 Drawn from Beckett: 193.
862 *Mac.Enc.:* 711.

Tri. 12.143:

Pulse: *Legumen, -inis,* n.:*Ὄσπριον, -ίου,* n.

Line 59. *Simplicem florem appello qui ex flosculis Composito opponitur:* he again reiterates that a simple flower is not composed of many florets: see note at line 4.

Line 63. *Stramoniã Aquilegiã:* Ray's choice of these two flowers as examples here is an odd one, as neither fits his description fully. *Stramonium* does appear to have 'a single blade' as he says, since its petals are fused into a trumpet shape, but it does not have several layers of 'blades' as Ray implies. *Aquilegia,* on the other hand, does have several layers of petals but each is not formed from a single 'blade'.[863]

Line 63. *Stramoniã: Stramonium:* see above Cap.3, line 141.

Line 63. *Aquilegiã: Aquilegia:* see above Cap.10, line 149.

Line 64. *Rosã: Rosa:* see above Cap.9, line 22.

Line 64. *Ranunculo: Ranunculus:* see above Cap.7, line 57.

Line 64. *Anemone: Anemone:* see above Cap.1, line 50.

Line 64. *Papavere: Papaver*: see above Cap.10, line 30.

Line 65. *Caryophyllo: Caryophyllus:* see above Cap.11, line 16.

863 For illustrations of these two flowers see Blamey and Grey-Wilson: *Stramonium* 350 and *Aquilegia* 122.

Line 65. *Leucoio: Leucoium:* see above Cap.11, line 15.

Line 65. *Pæoniã: Pæonia:* see above Cap.3, line 19.

Line 65. *Colchico: Colchicum.*

{C.T.& M. 541} *Colchicum autumnale* (L.), Meadow Saffron, Naked Ladies, Autumn Crocus: a species of the *Colchicum* genus of the *Liliaceæ* or Lily family.

B.& G.-W. 452: B.& H. 468: Linn.*Sp.Pl.* 341-342:

Syn.Meth.St.Br. 373: *H.P.* 1170-1171: *H.P.III* 561: *Tri.* - no ref.: *Cat.Angl.*74-75: *Camb.* - no ref.

H.P. 1170-1171:

12 species given, including:

Colchicum commune C.B. *Colch. Anglicum purpureum, & Anglicum album* Park. Ger. *Colchicum* J.B.

H.P.III 561:

Ad cap. de Colchico: 2 additional species given.

Also, ad cap. de Croco:

Croco affinis vel Colchico, flore obsolete rubro, Dr. Oldenland.

Line 65. *Croco: Crocus:* see above Cap.3, line 18.

Line 65. *Calthã: Caltha.*

In *Historia Plantarum* Ray uses *Caltha* for our Marigold; he also uses *Calendula* for Marigold. Therefore see entry for *Calendula* above Cap.1, line 49.

H.P. 337:

2 species given:

Calendula sativa. Caltha J.B. *Caltha vulgaris* C.B.

Garden Marigold.

Caltha arvensis C.B. *minima* J.B. *sylvestris* Ger.

Wild Marigold.

H.P.III - no ref.

Line 65. *Melanthio: Melanthium.*

[C.T.& M. 35] *Nigella* (L.), Nigella; a genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 106: B.& H. 2: Linn.*Sp.Pl.* 339:

Syn.Meth.St.Br. - no ref.: *H.P.* 1070: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1070:

9 species given, including:

Nigella flore majore pleno cæruleo C.B. *Nigella Damascena flore multiplici* Park. *Melanthium capite vel calice & Flore majore pleno* J.B.

Double blue Nigella, or Fennel-flower.

Lines 67-91. *Superest ut Floris compositi superius descripti differentias adferamus.* Ray now gives the characteristics of various types of composite flower.

Jung had realised that the *capitulum* of a composite flower 'is a collection of many minute but perfect flowers which he called *floscula* [florets], and he was also quite clear about the site of the pappus in *Compositæ*, although he did not equate it with the calyx'.[864]

A composite flower is the term used for an inflorescence where many small flowers are grouped together in a head looking like a large single flower, e.g. in the Daisy or *Compositæ* family.[865]

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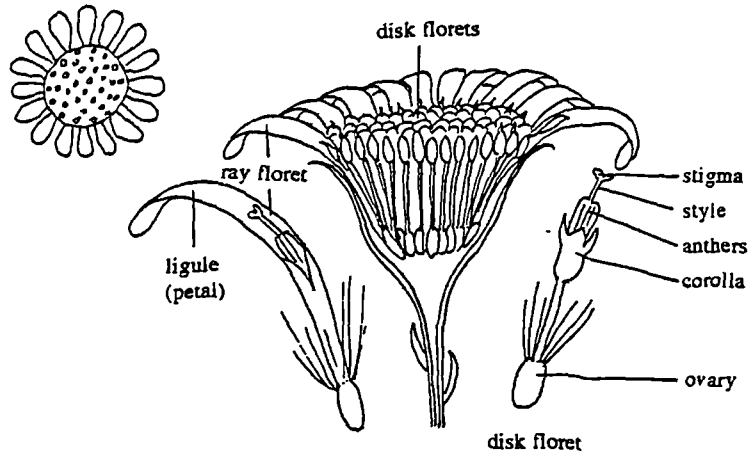
864 Morton: 171.

865 *Longman Dictionary of Botany:* 81.

Diagram of a composite, capitate inflorescence:[866]



The *Compositæ* is the largest family of flowering plants. The flowers are individually small, but are clustered into heads resembling flowers. The florets are seated on receptacles of varying shape and the heads are surrounded by an involucre resembling a calyx. The florets themselves often have no calyx. The corolla is tubular or strap-like. Some *Compositæ* have all florets of similar shape, all tubular or all strap-like, but in some the outer florets are strap-like, as in *Bellis* (the Daisy). The family consists of 1317 genera, with about 21,000 species, spread throughout the world.[867]

Line 69. *Discus est quod ex plurimis compressis & confertis flosculis .....:* Ray gives a fuller definition of *discus* in his glossary to *Historia Plantarum:*

> *Discus est media pars floris compositi ex compressis & confertis flosculis ita ut unam quasi apparentem superficiem constituant, ut in Caltha, Flore Solis, &c. a similitudine disci cujus figura plana erat ac rotunda, ut ex veteri statua apparet. Hinc Sol Græcis Discus appellatur.*

866 Drawn from *Longman Dictionary of Botany:* 81.
867 *Oxford Dictionary of Botany:* 99.

Erat autem Discus moles aliqua e plumbo aliove metallo quam jacientes athletæ inter se decertabant.[868]

Line 73. *Matricariã: Matricaria.*

[C.T.& M. 476] *Tanacetum parthenium* ([L.] Schultz Bip.), [*Matricaria parthenium* (L.), *Chrysanthemum parthenium* ([L.] Sm.), Feverfew; a species of the *Tanacetum* genus of the *Compositæ* or Daisy family.

B.& G.-W. 410: B.& H. 237: Linn.*Sp.Pl.* 890-891: *Syn.Meth.St.Br.* 187: *H.P.* 357: *H.P.III* 224: *Tri.* 10.70: *Cat.Angl.* 197 with a ref. to see *Parthenium* 225: *Camb.* 92.

H.P. 357:

Ray says of this plant:

(Tr.) *Matricaria* is so-called by more recent scholars from *matrix* or *uterus*, because it aids uterine diseases; it is thought to be the *Parthenium* of Dioscorides, which is a diminutive from παρθένος or maiden.

Its characteristics are flowers as if in an umbel, a disk with white petals surrounding a golden centre.

2 species given, including:

Matricaria Ger. *vulgaris* Park. *Matricaria vulgo, minus Parthenium* J.B. *Parthenium I. sive Matricaria vulgaris* C.B. ***Feverfew.***

H.P.III 224:

Ad cap. de Matricaria: 1 additional species given.

Ad cap. de Matricaria seu Parthenio: 6 additional species given.

Tri. 10.70:

Feverfew: *Matricaria, -æ.* f.: Παρθένιον, *-ίου,* n.

868 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

Line 73. *Chamæmelo: Chamæmelum.*

[C.T.& M. 472] *Chamaemelum nobile* ([L.] All.), [*Anthemis nobilis* (L.)], Chamomile; a species of the *Chamaemelum* genus of the *Compositæ* or Daisy family.

B.& G.-W. 408: B.& H. 237-238: Linn.*Sp.Pl.* 891: *Syn.Meth.St.Br.* 184-186: *H.P.* 353-356: *H.P.III* 223: *Tri.* 9.32: *Cat.Angl.* 65-66: *Camb.* - no ref.

H.P. 353-356:

Ray describes this plant thus:

(Tr.) This plant is called *Chamæmelum,* as if it were an earth or small apple, because it has the scent of an apple (Understand *M. Cydonia,* Hofm.). Its is also called *Anthemis* from its abundance of flowers.

Its characteristics are very thinly dissected leaves: sparse flowers, fairly large, having petals with white margins surrounding a yellow disk.'

10 species given, including:

Chamæmelum odoratissimum repens flore simplici J.B. *nobile seu odoratius* C.B. *Romanum* Ger. ***Common Camomile.***

H.P.III 223:

21 additional species given.

Tri. 9.32:

Camomel: *Chamæmelum, -i,* n.:*Ἀνθεμις, -ιδος,* f.

Line 73. *Calendulā: Calendula:* see above Cap.1, line 49.

Line 73. *Bellide: Bellis:* see above Cap.7, line 5.

Line 77. *PtarmicãAustriacã: Ptarmica Austriaca.*

C.T.& M. / B.& G.-W. / B.& H. - no ref: Linn.*Sp.Pl.* 857: *Syn.Meth.St.Br.* - no ref.: *H.P.* 287: *H.P.III / Tri. / Cat.Angl. / Camb.* - no ref.

Linn.*Sp.Pl.* 857:

Xeranthemum foliis lanceolatis patentibus.

Xeranthemum receptaculis palaceis, seminum pappo quiqueseto. Hort.cliff.400.

Xeranthemum oleæ folio, capitulis simplicibus incanis, non fœtens, flore majore violaceo. Moris.hist.3.p.43.s.6.t.2.f.2.

Jacea oleæ folio, capitulis simplicibus. Bauh.pin.272.

Ptarmica austriaca. Clus.hist.2.p.11.

H.P. 287:

Ptarmica Austriaca Ger. *Austriaca Clusii* Park. *Jacea oleæ folio, capitulis simplicibus* C.B. *Xeranthemum aliud sive Ptarmica quorundam* J.B. ***Austrian Sneezwort.***

But see also *Ptarmica* above Cap.3, line 25.

Ray calls this plant *Ptarmica Austriaca Clus.* after Clusius or de L'Écluse.

Line 78. *Flore Solis: Flos solis:* see above Cap. 10, line 91.

Line 78. *Calthã vulgari: Caltha vulgaris.*

See above under *Caltha*, Cap.11, line 65.

Line 79. *Tanaceto: Tanacetum:* see above Cap.3, line 35.

Line 82. *Taraxaco: Taraxacum:* see above Cap.7, line 4.

Line 82. *Sonchis: Sonchus.*

[C.T.& M. 497-498] *Sonchus* (L.), Sow-thistles; a genus of the *Compositæ* or Daisy family.

B.&.G.-W. 432-434: B.& H. 262: Linn.*Sp.Pl.* 793-794:

Syn.Meth.St.Br. 162-164: *H.P.* 224-225: *H.P.III* 136:

Tri. - no ref.: *Cat.Angl.* 277-278: *Camb.* 115.

H.P. 224-225:

11 species given, including:

Sonchus lævis Ger. *lævis laciniatus latifolius* C.B. *laciniatus non spinosus* J.B. *lævis vulgaris* Park.

Common smooth Sowthistle.

H.P.III 136:

Ray numbers the additional species here from 1 to 20, but in fact he lists only 18; numbers 13 and 14 are missing.

Line 82. *Cichoreis: Cichoreum:* see above Cap.1, line 36.

Line 82. *Hieraciis: Hieracium:* see above Cap.11, line 6.

Line 83. *Scorzonerã: Scorzonera.*

[C.T.& M. 495] *Scorzonera humilis* (L.), Viper's Grass; the only British species of the *Scorzonera* genus of the *Compositæ* or Daisy family.

B.& G.-W. 430: B.& H. 256: Linn.*Sp.Pl.* 790-792:

Syn.Meth.St.Br. - no ref.: *H.P.* 248-251: *H.P.III* 148:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 248-251:

16 species given, including:

Scorzonera Hispanica major Park. *latifolia sinuata* C.B. *Viperaria sive Scorzonera Hispanica* Ger. *Tragopogon Hispanicus sive Escorzonera aut Scorzonera* J.B.

Common Viper's grass or Scorzonera.

H.P.III 148:

14 additional species given.

Line 83. *Tragopogone: Tragopogon:* see above Cap.3, line 88.

Line 87. *In floribus compositis flosculi illi* ..... this description by Ray shows that he was beginning to realise that these florets are individual flowers.

Text page 20.

Lines 92-136. *Flos est vel* ..... In this table Ray summarizes his descriptions of the characteristics of flowers.

It is interesting to note that by the end of his life, Ray had substituted for the terms, 'perfect' and 'imperfect', *'floriferæ'* ('plants with flowers') and *'Flore destitutæ'* ('plants without flowers'); he did this because he believed that even the lower plants - *infimi ordinis plantæ* - are perfect in themselves.[869]

Table 94. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Table 95. *Campanulã: Campanula:* see above Cap.7, line 45.

Table 97. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Table 99. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Table 106. *Aristolochiã: Aristolochia:* see above Cap.11, line 43.

869 This is shown in his distinction as a separate class the ferns or *'Capillares'*; see *Historia Plantarum* Book I, Chapter 12, lines 170-171 and Book III, *Pars Secunda:* 131-153 on *Herbarum caule carentium hypophyllospermωn seu Capillarium Tabula.*

Table 108. *Acantho sattvo: Acanthus sativus:* see above Cap.11, line 9.

Table 109. *Scordio: Scordium:* see above Cap.11, line 44.

Table 111. *Chamæcisso: Chamæcissus:* see above Cap.11, line 46.

Table 112. *Lamio: Lamium:* see above Cap.7, line 44.

Table 113. *Verticillatis: Verticillatae:* verticillatus, 'verticillate' or 'whorled'.

Table 115. *Delphinio: Delphinium:* see above Cap.11, line 52.

Table 115. *Linariā: Linaria:* see above Cap.11, line 52.

Table 120. *Circæā Lutetianā: Circaea Lutetiana:* see above Cap.11, line 14.

Table 121. *Plantagine aquaticā: Plantago aquatica:* see above Cap.11, line 15.

Table 122. *Leucoio: Leucoium:* see above Cap.11, line 15.

Table 122. *Brassicā: Brassica:* see above Cap.9, line 113.

Table 122. *Thlaspi: Thlaspi.*

[C.T.& M. 83-84] *Thlaspi* (L.), Penny-cress; a genus of the *Cruciferæ* or Cress family.

B.& G.-W. 152: B.& H. 43: Linn.*Sp.Pl.* 645-647: *Syn.Meth.St.Br.* 305: *H.P.* 830-838: *H.P.III* 416: *Tri.* - no ref.: *Cat.Angl.* 283-285: *Camb.* - no ref.

H.P. 830-838:

37 species given, including:

Thlaspi Dioscoridis Ger. *Drabae folio* Park. *Thl. cum siliquis latis* J.B. *arvense, siliquis latis* C.B.

Treacle-mustard, Penny-cress.

H.P.III 416:

37 additional species given.

Table 123. *Lychnide: Lychnis:* see above Cap.3, line 35.

Table 123. *Caryophyllo: Caryophyllus*: see above Cap.11, line 16.

Table 123. *Alsine: Alsine:* see above Cap.11, line 14.

Table 124. *Bulbosis: Bulbosæ:* see above Cap. 11, line 17.

Table 125. *Violã: Viola.*

[C.T.& M. 107-112] *Viola* (L.), Violet; a genus of the *Violaceæ* or Violet family.

B.& G.-W. 250-252: B.& H. 53: Linn.*Sp.Pl.* 933-937:

Syn.Meth.St.Br. 364-366: *H.P.* 1049-1051: *H.P.III* 510:

Tri. 14.204: *Cat.Angl.* 305-306: *Camb.* 124.

H.P. 1049-1051:

17 species given, including:

Viola Martia purpurea J.B. Ger. *Martia purpurea, flore simplici odoro* C.B. *Simplex Martia* Park.parad. ***Purple Violet.***

H.P.III 510:

20 additional species given.

Tri. 14.204:

Violet: *Viola, -æ,* f.:*Ἴον, –ου,* n.

Table 125. *Papilionaceis: Papilionaceae:* see above Cap.10, line 62.

Table 129. *Calendulã: Calendula:* see above Cap.1, line 49.

Table 131. *Calendulã: Calendula*: see above Cap.1, line 49.

Table 132. *Ptarmicã Austriacã: Ptarmica Austriaca:* see above Cap.11, line 77.

Table 133. *Tanaceto: Tanacetum:* see above Cap.3, line 35.

Table 135. *Jaceã: Jacea:* see above Cap.7, line 19.

Table 135. *Carduo: Carduus:* see above Cap.4, line 151.

Line 137. *Usus floris est ..... :* Ray defines the purpose of the flower; he is using the term 'flower' here for the perianth or calyx and corolla (petals).

He is correct in saying (quoting Cesalpino) that the perianth serves for protecting the developing reproductive parts of the flower. In dicotyledons is usually consists of two distinct whorls, the calyx and the corolla. In monocotyledons the whorls are not differentiated and the perianth units are then called tepals.[870]

Line 139. *D.*Malpighius interdum florum petala ..... :* margin reference to *Anat.Plant. p.55, 56.* This is taken, although not *verbatim*, from Malpighi; Ray has, however, changed the emphasis somewhat by saying that Malpighi 'was of the opinion that ...'; Malpighi, in fact, says *interdum dubitavi*, that is, that he has doubts about the distillation of sap in the petals. It is also interesting to note that

870 *Penguin Dictionary of Botany:* 265.

Malpighi still uses the term *folium floris* for petals, whereas Ray has adopted the term *petalum.*[871]

Lines 139-146. *interdum florum petala .....etiam depurando præparent auctivam seminis materiam.* There is no evidence to suggest that Malpighi's theories on the distillation and purification of sap in the petals is correct.

Line 143. *Tulipã: Tulipa*: see above Cap.3, line 12.

Text page 21.

Line 152. *Caryophylli: Caryophyllus:* see above Cap.11, line 16.

Line 153. *Matricariã: Matricaria:* see above Cap.11, line 73.

Line 154. *Chamæmelo: Chamæmelum:* see above Cap.11, line 73.

Line 156. *Caulis respectu flos aut solitarius est, aut coacervatus.* From line 156 to 165 he discusses the various forms of inflorescence, previously discussed in chapter seven on the differences of stems. Again Ray is citing the work of Jung, who on the arrangement of flowers, is summarised by Morton:

> Coming to the flowering shoot, the types of inflorescence, whether the flowers are solitary, or in clusters of two, three or a few together, or massed in a capitulum, spike, umbel, thyrsus, panicle, corymb, are all described and defined in terms of the site of the flower in relation to the stem.[872]

871 Malpighi, *Anatome Plantarum:* 55.
872 Morton: 170.

Line 158. *Trifolio corniculato: Trifolium corniculatum.*

[C.T.& M. 200] *Lotus corniculatus* (L.), Common Birdsfoot-trefoil, Bacon and Eggs; a species of the *Lotus* genus of the *Leguminosæ* or Pea family.

B.& G.-W. 220: B.& H. 115: Linn.*Sp.Pl.* 766:

Syn.Meth.St.Br. 334: *H.P.* 967: *H.P.III* 462: *Tri.* - no ref.:

Cat.Angl. 290: *Camb.* 118-119.

H.P. 967:

> *Lotus corniculata glabra minor* J.B. *Lotus sive Melilotus pentaphyllos minor glabra* C.B. *Trifolium siliquosum minus* Ger. *corniculatum primum* Dod. ***Birds-foot Trefoil.***

H.P.III 462:

> *Ad cap. de Trifoliis siliquosis:* 24 additional species given, including:
>
> *Trifolium corniculatum minus, supinum & incanum, silqua singulari, Maderaspatanum* Ejusd. ibid. F.4. *An Meliloti Syriacæ seu Chalepensis coronatæ, siliquis biuncialibus* Moris.hist. *species minor & procumbens?*

Line 158. *Dod.* / Rembert Dodoens / *Dodonaeus.* 1517-1585. He practised as a physician in Malines for many years. After a brief spell in Vienna as physician to Maximilian II, who was tolerant of Protestants, Dodoens ended his life as Professor of Medicine at the new university of Leiden. At the beginning of the sixteenth century it was believed that no plants existed other then those listed by Dioscorides in his *Materia Medica,* written in the first century A.D. In classifying plants Dodoens sought only an improved pharmacological classification;[873] however, in his later works he switched from medical botany to a more scientific approach.

873 Arber: 82-84; Morton: 144; *DSB IV:* 138-140.

His main botanical works are:

1. *De frugum historia, liber unus:* Antwerp 1552.
2. *De stirpium historia:* Antwerp 1553.
3. *De stirpium historia:* Antwerp 1554.
4. The last book was published in two volumes in Antwerp in 1559.
5. *The Cruydebœck:* Antwerp 1554, which was a Dutch version of his *De stirpium historia,* devoted to species native to the Flemish provinces. Its merit was that it grouped plants, not alphabetically as Fuchs had done, but according to their medicinal properties.[874]

He also later published several books on specific types of plants, such as *Historia vitis vinique et stirpium nonnullarum aliarum: item medicinalium observationum exempla rara:* Cologne 1580, 1583, 1585, 1621.[875]

Line 165. *Violãaquaticã: Viola aquatica.*

[C.T.& M. 346] *Hottonia palustris* (L.), Water Violet; a species of the *Hottonia* genus of the *Primulaceæ* or Primrose family.

B.& G.-W. 298: B.& H. 288: Linn.*Sp.Pl.* 145-146:

Syn.Meth.St.Br. 285: *H.P.* 1101: *H.P.III* - no ref.: *Tri.* - no ref.:

Cat.Angl. 305 with a ref. to see *Millefolium aquaticum* 200:

Camb. - no ref.

H.P. 1101:

Millefolium aquaticum dictum Viola aquatica J.B. *M. aquat. seu Viola aquat. caule nudo* C.B. *M. aquat. floridum, seu Viola aquatica* Park. *Viola palustris* Ger.

874 Ray owned one of Dodoens' works, as is indicated by the sale catalogue of his library; despite the difference in title in the catalogue, it is possibly *de Stirpium Historia:*
Historia Florum &c., edition published in Antwerp in 1569; British Musuem: *S-C 326* (6): 18, *Libri Latine &c. in 8° & 12°*, number 397.

875 *DSB IV:* 138-140.

Water-Violet, or Milfoil.

Lines 166-173. *Respectu fructus ..... Nymphæa, Arbuto, Tulipa &c.*
He continues with the position of the perianth in relation to the fruit, with many examples.

Line 168. *Velerianā: Veleriana:* see under Valeriana above Cap.3, line 35.

Line 169. *Cucurbitā: Cucurbita:* see above Cap.9, line 180.

Line 169. *Melone: Melo:* see above Cap.10, line 12.

Line 169: *Pomiferis: Pomiferae:* literally 'apple-bearing'.

Line 169. *Bryoniā: Bryonia:* see above Cap.9, line 40.

Line 169. *Periclymeno: Periclymenum.*
[C.T.& M. 435] *Lonicera periclymenum* (L.), Honeysuckle, Woodbine; a species of the *Lonicera* genus of the *Caprifoliaceæ* or Honeysuckle family.
B.& G.-W. 382: B.& H. 205: Linn.*Sp.Pl.* 173:
Syn.Meth.St.Br. 458: *H.P.* 1490: *H.P.III D.* 32: *Tri.* 18.87:
Cat.Angl. 229-230: *Camb.* 93.
H.P. 1490:
4 species given, including:
Periclymenum sive Caprifolium vulgare Park. *non perfoliatum* J.B. *non perfoliatum Germanicum* C.B. *Periclymenum* Ger.
Common Hony-suckle, or Wood-bind.
H.P.III D. 32:
2 additional species given.

Tri. 18.87:

A Woodbind or Honey-suckle: *Periclymenum, -i,* n.:

Περικλύμενον, -ενου, n.

Line 169. *Aristolochiã: Aristolochia:* see above Cap.11, line 43.

Line 169. *Ligustro: Ligustrum.*

[C.T.& M. 350] *Ligustrum vulgare* (L.), Common Privet; a species of the *Ligustrum* genus of the *Oleaceæ* or Olive family.

B.& G.-W. 302: B.& H. 298: Linn.*Sp.Pl.* 7:

Syn.Meth.St.Br. 465: *H.P.* 1603: *H.P.III D.* 65: *Tri.* 17.70:

Cat.Angl. 186: *Camb.* 79.

H.P. 1603:

Ray says of this plant:

(Tr.) It is distinguished from other fruit bushes by its racemes of white flowers, its black double-stoned[876] berries and its pliant twigs.

3 species given,including:

Ligustrum J.B. Ger. *vulgare* Park. *Germanicum* C.B.

Privet, or Primprint.

H.P.III D. 65:

1 additional species given.

Tri. 17.70:

Privet: *Ligustrum, -i,* n.: *Κύπρος, -ου,* f.

Line 170. *Rosã: Rosa:* see above Cap.9, line 22.

Line 170. *Pruno: Prunus*: see above Cap.4, line 23.

876 *dipyrenis,* 'double-stoned' from πυρήν, the stone of a fruit such as an olive; Liddell and Scott: 1556.

Line 170. *Pomo: Pomus*: see above Cap.4, line 12.

Line 170. *Pyro: Pyrus:* see above Cap.4, line 145.

Line 170. *Grossulariā: Grossularia.*

[C.T.& M. 257] *Ribes uva-crispa* (L.), [*Ribes grossularia* (L.)], Gooseberry; a species of the *Ribes* genus of the *Grossulariaceæ* or Gooseberry family.

B.& G.-W. 174: B.& H. 163: Linn.*Sp.Pl.* 201:

Syn.Meth.St.Br. 456: *H.P.* 1484: *H.P.III D.* 26:

Tri. 16.38 / 19.114: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1484:

De Uva crispa sive Grossularia, ***The Gooseberry Bush.***

H.P.III D. 26:

7 additional species given.

Tri. 16.38:

A Gooseberry Bush: *Grossularia, -æ,* f.: Ἴσος, *-ου,* f.

Tri. 19.114:

A Gooseberry: *Grossula, -æ,* f.: [No Greek].

Line 170. *Lysimachiā siliquosā: Lysimachia siliquosa:* see above Cap.10, line 30.

Line 171. *Solanis: Solanum*: see above Cap.10, line 88.

Line 171. *Capsico: Capsicum.*

[Mac.Enc. 225] *Capsicum* (L.), various Peppers; a genus of the *Solanaceæ* or Potato family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. 317:

Linn.*Sp.Pl.* 188-189: *Syn.Meth.St.Br.* - no ref.: *H.P.*676-677:

H.P.III - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 676-677:

1 species only given:

Piper Indicum vulgatissimum C.B. *Piper Indicum sive œlecuticum sive Piper Siliquastrum* J.B. *Capsicum majus vulgatius oblongis siliquis* Park. *Capsicum longioribus siliquis* Ger. ***Guinny Pepper.***

Line 172. *Geraniis: Geranium.*

[C.T.& M. 170-175] *Geranium* (L.), Crane's-bill; a genus of the *Geraniaceæ* or Geranium family. *Geranium pratense* (L.), Meadow Crane's-bill; a species of the above genus.

B.& G.-W. 226-228: B.& H. 88-89: Linn.*Sp.Pl.* 676-683: *Syn.Meth.St.Br.* 356-361: *H.P.* 1055-1063: *H.P.III* 511:

Tri. 9.49: *Cat.Angl.* 129-132: *Camb.* 67.

H.P. 1055-1063:

40 species given, including:

Geranium batrachoides J.B. *Ger. batrachoides flore cæruleo* Park. *batrachoides Gratia Dei Germanorum Lobelio* C.B. ***Crowfoot Cranes-bill.***

H.P.III 511:

47 additional species given.

Tri. 9.49:

Crane's-bill: *Geranium, -ii,* n.: *Γεράνιον, -ίου,* n.

Line 172. *Papavere: Papaver:* see above Cap.10, line 30.

Line 172. *Leguminibus: Legumines:* see above Cap.11, line 56.

Line 172. *Lysimachiã siliquosã: Lysimachia siliquosa:* see above Cap.10, line 30.

Line 172. *Lychnide: Lychnis:* see above Cap.3, line 35.

Line 173. *Ranunculo: Ranunculus:* see above Cap.7, line 57.

Line 173. *Nymphææ: Nymphæa:* see above Cap.7, line 11.

Line 173. *Arbuto: Arbutus.*

[C.T.& M. 334] *Arbutus unedo* (L.), Strawberry-tree; a species of the *Arbutus* genus of the *Ericaceæ* or Heather family.

B.& G.-W. 292: B.& H. 280: Linn.*Sp.Pl.* 395:

Syn.Meth.St.Br. 464: *H.P.* 1576: *H.P.III* - no ref.: *Tri.* 17.80: *Cat.Angl.* 25-26: *Camb.* - no ref.

H.P. 1576:

> *Arbutus* Ger. Park. *Arbutus, Comarus Theophrasti* J.B. *Arb. folio serrato* C.B. ***The Strawberry-tree.***

Tri. 17.80:

> Strawberry-tree: *Arbutus, -i,* f.: *Κόμαρος, -άρου,* f.

Line 173. *Tulipã: Tulipa:* see above Cap.3, line 12.

Lines 174-197. *Superest ut Calycis etiam seu Perianthii differentias ..... :* Ray now goes on to discuss the variations of calyces. He confuses the terms calyx and perianth; we now use the term perianth for the calyx and corolla (petals) together, whereas he uses it as a synonym for calyx alone.[877]

877 The literal meaning of the term perianth is derived from the Greek περιανθέω 'to bloom': περιανθής, -ές, 'with flowers all round'. Liddell and Scott: 1368.

The calyx is the collective name for all the sepals of a flower, consituting the outer whorl of the perianth.It encloses and protects the other floral parts during development.[878]

Line 174. *ex ejusdem Jungii Isagoge Phytoscopica:* reference in text and margin to Jung, *Isagoge Phytoscopica, Cap.24.*

Line 177. *Papavere: Papaver:* see above Cap.10, line 30.

Line 177. *Capparide: Capparis.*

[Flowers G.& B. 247][879] *Capparis spinosa* (L.), Caper; a species of the *Capparis* genus of the *Capparidaceæ* or Caper family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 503-504: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1629: *H.P.III D.* 72: *Tri.* 15.22: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1629:

7 species given, including:

Capparis spinosa folio rotundo Park. *rotundiore folio* Ger. *spinosa, fructu minore, folio rotundo* C.B. *spinosa* J.B. ***Capers.***

H.P.III D. 72:

The only reference is to:

Lycium putatum Indiae orient. capparis rotundioribus foliis, & aculeis ex adverso gemellis Ejusd. ibid. f.4. (i.e. Pluk.Phyt.).

Tri. 15.22:

Capers: *Capparis, -is,* f.: *Κάππαρις, -άρεως,* f.

Line 177. *Palmã dactyliferã: Palma dactylifera:* see above Cap.10, line 121.

878 *Penguin Dictionary of Botany:* 56.
879 Polunin: 247.**283.

Line 177. *Lauro: Laurus:* see above Cap.10, line 67.

Line 179. *Pæoniã: Pæonia:* see above Cap.3, line 19.

Line 180. *Palmã dactyliferã: Palma dactylifera:* see above Cap.10, line 121.

Line 180. *Lauro: Laurus:* see above Cap.10, line 67.

Line 182. *Spergulã: Spergula.*

[C.T.& M. 146] *Spergula* (L.), Spurreys; a genus of the *Caryophyllaceæ* or Pink family.

B.& G.-W. 94: B.& H. 75: Linn.*Sp.Pl.* 440-441:

Syn.Meth.St.Br. 349-351: *H.P.* 1034: *H.P.III* 501: *Tri.* - no ref.: *Cat.Angl.* 279-280: *Camb.* 115.

H.P. 1034:

3 species given, including:

Spergula J.B. *Saginæ Spergula* Ger.emac. *Sag. Spergula major* Park. *Alsine Spergula dicta major* C.B. ***Spurrey.***

H.P.III 501:

83 additional species given, including 4 named as *Spergula.*

Line 183. *Salviã: Salvia:* see above Cap.7, line 44.

Line 183. *Marrubio: Marrubium:* see above Cap.7, line 44.

Line 184. *Verticillatis: Verticillatae:* see above Cap.11, Table 113.

Line 184. *Buglosso: Buglossus:* see above Cap.9, line 49.

Line 184. *Lithospermo: Lithospermum:* see above Cap.10, line 57.

Line 185. *Perianthium deinde vel simplex est, vel compositum.* Ray describes the calyx as simple or composite. A calyx can appear to be simple, that is, composed of one piece, in flowers having a calyx tube, which is formed when the lateral margins of the individual sepals fuse, as in the examples he gives.[880]

Line 186. *Simplex quod utriculus est sola lamina constans:* Ray, as he says, takes this section from Jung's *Isagoge Phytoscopica,* in which Jung calls it a *perianthium simplex,* that is an undivided calyx.[881]

Line 186. *Salviā: Salvia:* see above Cap.7, line 44.

Line 186. *Verticillatis: Verticillatae:* see above Cap.11, Table 113.

Line 186. *Nicotianā: Nicotiana:* see above Cap.3, line 140.

Line 187. *Lychnidibus: Lychnis:* see above Cap. 3, line 35.

Line 187. *Caryophyllis: Caryophyllus:* see above Cap.11, line 16.

Line 188. *Compositum, quod vel foliis pluribus juxta se positis constat:* he continues with Jung's definition of a composite or divided calyx *(perianthium compositum).*[882]

Line 188. *Eupatorio cannabino: Eupatorium cannabinum:* see above Cap.10, line 89.

880 *Penguin Dictionary of Botany:* 56.
881 Morton: 171.
882 *ibid.*.

Line 188. *Scabiosis: Scabiosa:* see above Cap.7, line 19.

Morton comments on Jung's theories:

> He further draws attention to the peculiarity of *Scabiosa* (Dipsaceæ) in which there is a common *perianthium* to the whole head [the involucre] and in addition each floret has its own *perianthium* [the true calyx] in the form of a notched sack *(utriculus crenatus)*. These remarks show that Jung fully understood the nature of the "flower-head" in Compositæ and Dipsaceæ, and was probably the first to do so.[883]

Line 189. *Jaceã: Jacea:* see above Cap.7, line 19.

Line 189. *Cinarã: Cinara.*

[Mac.Enc. 82] *Cynara scolemus* (L.), Artichoke; a species of the *Cynara* genus of the *Compositæ* or Daisy family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. 225: Linn.*Sp.Pl.* 827-828: *Syn.Meth.St.Br.* - no ref.: *H.P.* 299-300: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 299-300:

> 7 species given, including:
> *Carduus sive Scolymus sativus spinosus & non spinosus* J.B.
> *Cinara hortensis foliis non aculeatis* C.B. ejusdemque *Cinara hortensis aculeata.* ***Artichoke.***

Line 190. *Carduis: Carduus*: see above Cap.4, line 151.

Line 191. *Salviã: Salvia:* see above Cap.7, line 44.

Line 191. *Lamio: Lamium:* see above Cap.7, line 44.

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883 Morton: 171.

Line 192. *Priapeiā: Priapeia.*

[C.T.& M. 367] *Hyoscyamus niger* (L.), Henbane; a species of the *Hyoscyamus* genus of the *Solanaceæ* or Potato family.

B.& G.-W. 348: B.& H. 317: Linn.*Sp.Pl.* 179-180 *niger* and *aureus: Syn.Meth.St.Br.* 274: *H.P.* 715: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 715:

> *Priapeia* Gesn. *i. Nicotiana Anglica. Priapeia, quibusdam Nicotiana minor* J.B. *Nicotiana minor & Eyst.* C.B. *Hyoscyamus luteus* Ger. *Tabacco Anglicum* Park.

English Tobacco, by some Yellow Henbane.

Line 193. *Othonnā: Othonna.*

[C.T.& M. 453-455] *Senecio jacobæa* (L.), Ragwort; a species of the *Senecio* genus of the *Compositæ* or Daisy family.

B.& G.-W. 416-418: B.& H. 245: Linn.*Sp.Pl.* 924-926:

Syn.Meth.St.Br. 177-178: *H.P.* 284-286: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - *no ref.: Camb.* 76.

Linn. *Sp.Pl.* 924-926:

> 14 species of *Othonna* given.
>
> But see pages 866-872, where 27 species of *Senecio* are given.
>
> Both seem to be included as Ragworts today, under the heading of *Senecio*; for example, from page 870:
>
> *Senecio Jacobæa* (Common Ragwort).
>
> *Senecio corollis radiantibus, foliis pinnato-lyratis: laciniis lacinulatis, caule erecto.* Hort.cliff.406. Fl.suec.688. Roy.lugdb.174. Dalib.paris.257.
>
> *Jacobæa vulgaris laciniata.* Bauh.pin.131.
>
> *Herba s. Jacobi.* Fuchs.hist.742.
>
> *Habitat in Europæ pratis.*

From page 925:

Othonna maritima (Silver Ragwort - now *Senecio cineraria [Cineraria maritima].*

Othonna foliis pinnatifidis tomentosis, laciniis sinuatis, caule fruticoso.. Hort.ups.273.

Solidago foliis, pinnatifidis, laciniis sinuatis, cory. bis racemosis. Hort.cliff.410.

Jacobæa maritima. Bauh.pin.131.

Cineraria. Dod.pempt.642.

Habitat ad maris inferi littore.

H.P. 284-286:

Jacobæa vulgaris J.B. *vulg.major* Park. *vulg. laciniata* C.B. ***Common Ragwort, Seggrum.***

Jacobæa marina Ger. *maritima* C.B. *marina sive Cineraria* J.B. *marina sive Cineraria vulgaris* Park. ***Sea-Ragwort.***

Line 195. *Geraniis: Geranium*: see above Cap.11, line 127.

Line 195. *Ocymoide: Ocymoides.*

[C.T.& M. 122-126] *Silene dioica* ([L.] Clairv.), Red Campion; a species of the *Silene* genus of the *Caryophyllaceæ* or Pink family.

B.& G.-W. 98: B.& H. 62: Linn.*Sp.Pl.* 437:

Syn.Meth.St.Br. 339-341: *H.P.* 994-995: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 994-995:

Lychnis sylvestris rubello flore Ger. *sylv. flore rubro* Park. *sylv. sive aquatica purpurea simplex* C.B. *Ocymoides purpureus multis* J.B. ***Red-flowered wild Campion.***

Line 195. *Vaccariã: Vaccaria:* [C.T.& M. 130] *Vaccaria hispanica* ([Miller] Rauschert),[*Vaccaria pyramidata* (Medicus), *Saponaria vaccaria*

(L.), *Saponaria segetalis* (Necker)], Cow Basil; a species of the *Vaccaria* genus of the *Caryophyllaceæ* or Pink family.

B.& G.-W. 100: B.& H. 61: Linn.*Sp.Pl.* 409:

Syn.Meth.St.Br. - no ref.: *H.P.* 999: *H.P.III* - no ref.:

Tri. - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 999:

Lychnis segetum rubra foliis Perfoliatæ C.B. *Lych. seg. Vaccaria rubra dicta* Park. *Vaccaria* J.B. Ger.

Red Corn-campion, improperly called Cow-Basil.

Line 195. *Ben albo: Ben album.*

[C.T.& M. 122] *Silene vulgaris* ([Mœnch] Garcke), [*Cucubalus behen* (L.), *Silene Cucubalus* (Wibel), *Silene inflata* (Sm.)], Common Campion; a species of the *Silene* genus of the *Caryophyllaceaæ* or Pink family.

B.& G.-W. 98: B.& H. 62 - *Silene Cucubalus:* Linn.*Sp.Pl.* 418 - *Silene behen: Syn.Meth.St.Br.* 337: *H.P.* 998: *H.P.III* - no ref.: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* 112 - *Papaver spumosum.*

H.P. 998:

Lychnis frutescens myrtifolia, Ben albo similis C.B. *Ben albo Officinarum similis; planta semper virens* J.B. *Lychnis sylv. semper virens, sive Ocymoides arboreum semper virens* Clus.

Line 196. *Caryophyllis: Caryophyllus:* see above Cap.11, line 16.

Line 197. *Othonnã: Othonna:* see above Cap.11, line 148.

Line 198. *Cucurbitæ:Cucurbita:* see above Cap.9, line 180.

Line 198. *Peponum: Pepo:* see above Cap.9, line 180.

Lines 198-201. *Inter nudos ..... perianthii angustifolii exhibent.* Ray is trying to describe the five narrow sepals of the calyx of the *Cucurbitaceæ* here.[884]

Line 200. *[nervi]:* Ray has this word in square brackets, which perhaps implies that he is quoting from another work and adding this term for clarification.

Lines 202-203. *Peculiare etiam ..... vel ex stamine & stylo conflatum obtinent.* Ray seems to have observed that the *Cucurbitaceæ* family usually has two pairs of more or less completely united stamens with one free stamen; often the anthers are borne on a common connective column.[885]

884 Clapham, Tutin and Moore: 294.
885 *ibid.*

Chapter Twelve:

On the fruits and seeds of plants.

Ray begins with a definition of a fruit, which he takes to be either the complete fruit (containing the seeds) or the seeds themselves; he states that, not only is a fruit useful to mankind for food or medicine, but that it is also necessary for the propagation of the plant species. Ray expresses his thoughts on fruits and seeds in more philosophical terms in a later work:

> As for the *Seeds* of *Plants*, Dr. *More*[886] esteems it an evident Sign of Divine Providence, that every Kind hath its Seed: For it being no necessary Result of the Motion of the Matter (as the whole Contrivance of the Plant indeed is not), and it being of so great Consequence that they have Seed for the Continuance and Propagation of their own Species, and also for the gratifying Man's Art, Industry and Necessities (for much of Husbandry and Gardening lies in this), it cannot but be an Act of Counsel to furnish the several Kinds of Plants with their Seeds.[887]

He continues in this work in similar vein to *Historia Plantarum*, describing the physiology of fruits and seeds.[888]

Malpighi and Grew were also studying the development, structure and gemination of seeds at this time. They both realised

> that the mature embryo in the seed was morphologically a rudimentary plant. They described and named the parts of the seed, including the double testa, and showed experimentally that the micropyle is a true opening in the testa; their studies of germination confirmed Ray's observations without adding anything of substance.[889]

886 Sir Thomas More, *Antidote against Atheism:* 1.2.c.2.
887 *The Wisdom of God*, first published in 1691: 81.
888 *ibid.:* 81-82.
889 Morton: 185-186.

Text page 22.

Line 1. *Fructus a fruendo dicitur:* Ray gives the derivation of the term 'fruit'. *Fruor, fructus,* third conjugation deponent verb - 'to derive enjoyment from'.[890] In his introductory glossary to *Historia Plantarum,* Ray gives a similar definition of a fruit, again quoting Jung, although with one difference; Ray, in his main text, gives *aliave commoda matrice excepta,* 'caught up by some other suitable matrix', but in his glossary he gives *aliave commoda nutrice excepta,* a similar analogy using *nutrix,* 'a wet nurse' as opposed to *matrix,* ' a mother' or 'breeding animal'. Apart from the quotation from Jung, his definition is as follows:

> *Fructus sunt grandiores illi ac succulenti plantarum fœtus, seminum receptacula, ut Poma, Pyra, Pruna, &c. a fruendo, sed & latius extenditur nomen fructus ad omnem agrorum proventum.* [... quotation from Jung...] *Angl.* ***The fruit.*** *Sunt ergo fructus, vel pericarpia integra cum seminibus contentis, vel Semina sola in iis quibus pericarpium deest.*[891]

A modern general definition agrees with that of Ray: 'vegetable products fit to be used as food by men and animals', 'the edible product of a plant, consisting of the seed and its envelope, especially the latter when juicy and pulpy as in the apple, orange, plum etc.' - first used thus in Middle English.[892]

Line 6. *novæ plantæ fit initium.* Jung defines a fruit as the origin of a new plant.[893] Strictly speaking he should say that a seed, rather than the fruit containing it, is the origin of a new plant.

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890 Lewis and Short: 785.

891 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

892 *OED:* 812.

893 Cf Morton on Jung's definition: 172.

A modern definition of a fruit would be that it is the ripened ovary or carpel of a plant and its contents. More loosely a fruit can be the ripened ovary and seeds together with any structure with which they are combined such as the fleshy part of an apple, which is derived from the floral receptacle.[894]

Line 7. *Succedere dicitur flori fructus:* fruits do succeed the flower in that they develop from the gynœcium of a flower.[895]

Lines 8-11. *Fructus igitur ..... a planta sua separantur.* Ray describes the maturity of a fruit and its departure from the parent plant, what we call the dispersal of the fruit/seed.

Line 12. *Fructus vel semen est, vel Seminis conceptaculum ..... :*
Ray differentiates between a fruit which is a basic seed and one with an outer covering. Has he realised the difference between gymnosperms and angiosperms? Gymnosperms are plants such as conifers, which carry their seeds bare without any protective covering; such plants evolved earlier than the angiosperms, which have a covering for the fruits.[896]

Jung too considers that:

> The fruit is either a seed or a vessel containing the seed, and no distinction is made between the naked seed and an indehiscent single-seeded fruit.[897]

The list of alternative names for the seed-vessel are taken from Jung, 'but they are not differentiated or given specialized meanings'.[898]

Of these only one is listed by Ray in his glossary to *Historia*

894 *Oxford Dictionary of Botany:* 166; *Penguin Dictionary of Botany:* 144; *Longman Dictionary of Botany:* 83.
895 *Penguin Dictionary of Botany:* 144.
896 *Oxford Dictionary of Botany:* 187 and 22-23; Gibbons: 24-25.
897 Morton: 172-173.
898 *ibid.:* 173.

Plantarum:

Folliculus est theca tenuis quæ granum, vel semen continet involutum. ***A husk or cod.***[899]

Line 14. *Conceptaculum est .... :* he is correct in saying that the covering of a seed is for its protection; it is also to help in the dispersal of the seed, either by attracting animals to eat it or by developing into a structure suitable for wind dispersal as in the Acers which have a wing.[900]

Line 16. ..... *perianthia illa ..... :* he is still using the term perianth for the calyx as in the previous chapter.[901]

Line 17. *Salviā: Salvia:* see above Cap.7, line 44.

Line 17. *Verticillatis: Verticillatae:* see above Cap.11, Table 113.

Lines 20-24. *Semina vel duplici conceptaculo ..... vel simplici:* Ray continues by discussing the outer coverings of seeds, describing them as having 'either a double envelope .... or a simple and single one'. He is differentiating here between indehiscent and dehiscent fruits. In an indehiscent fruit the seeds either germinate within the pericarp or are released only by the accidental processes of breakage and decay such as when eaten by animals;[902] a dehiscent fruit splits along a line to release its seeds.[903]

He begins with indehiscent fruits saying that *Prunus* (Plum) and *Cerasus* (Cherry) have a double covering the 'pericarp

899 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.
900 *Longman Dictionary of Botany:* 83.
901 See note at Chapter 11, line 174.
902 *Lowson's Botany:* 377.
903 *Longman Dictionary of Botany:* 84.

and stone'; these are now described as indehiscent fruits known as drupes, in which the inner layers of the pericarp are stony and the outer fleshy. The pip or stone of a drupe is a seed enclosed in a shell derived from the ovary wall.[904]

He continues with *Malus* (Apple) and *Pyrus* (Pear) saying that they have 'pericarp and cartilage'. In such fruits the ovary makes up only the centre of the fruit (approximately what we call the core) and the rest (the fleshy part) is formed from the receptacle or base of the flower.[905]

Next he cites *Avellana* (Hazelnut), saying that it has 'a membranaceous follicle and stone'; it is now described as a one-seeded indehiscent fruit with a woody or stony pericarp.[906]

Lastly for those with a double covering he cites the *Pinus*, saying that it has a woody cortex and stone. This is more difficult to understand unless he is regarding as the two layers the woody 'core' of a pine cone and the outer scales of the cone enveloping the seeds.[907]

He then goes on to describe dehiscent fruits beginning with various *Legumes*; these are formed from free carpels, which open by splitting along the carpel midrib.[908]

Next he cites '*Leucoium, Brassica* and *Thlaspi* and other podded and four-petalled capsulated plants'. These are all members of the *Cruciferæ* family, having a specialised capsule, called a *siliqua*.[909] The capsule is the commonest form of fruit type and is the product of a flower with several joined carpels. Capsules open by longitudinal splitting; it is basically a dry fruit, the pericarp

904 *Lowson's Botany:* 379.
905 Gibbons: 103-104.
906 *Lowson's Botany:* 378.
907 Clapham, Tutin and Moore: 28.
908 *Lowson's Botany:* 378.
909 Clapham, Tutin and Moore: 65.

being dry before the seeds are shed.[910]

In his glossary to *Historia Plantarum* he cites Schroder's definition of a seed as:

> *Semen in Officinis minutiores plantarum fructus denotat ex quibus simile nasci potest. Schrod.*[911]

Line 21. *Prunis: Prunus*: see above Cap.4, line 23.

Line 21. *Cerasis: Cerasus:* see above Cap.4, line 12.

Line 21. *Malis: Malus:* see above Cap.4, line 145.

Line 21. *Pyris: Pyrus*: see above Cap.4, line 145.

Line 22. *Nucibus Avellanis: Nux Avellana:* see above Cap.5, line 63.

Line 23. *Pinu: Pinus:* see above Cap.4, line 23.

Line 23. *Fabã*: *Faba:* see above Cap.9, line 20.

Line 23. *Piso: Pisum:* see above Cap.9, line 20.

Line 24. *Leucoio*: *Leucoium:* see above Cap.11, line 15.

Line 24. *Brassicã: Brassica:* see above Cap.9, line 113.

Line 24. *Thlaspi: Thlaspi:* see above Cap.11, Table 122.

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910 *Lowson's Botany:* 379.

911 *Historia Plantarum; Terminorum quorundam & vocum generaliorum Interpretatio & Explicatio brevis:* unnumbered pages at beginning of Volume I.

Line 25-34. *Seminum conceptacula sunt vel solitaria seu simplicia ..... vel in plures cellulas seu loculamenta divisa.*

Ray now differentiates correctly, with examples, between seed containers with a single cavity and those with many.

Line 25. *Fabã: Faba:* see above Cap.9, line 20.

Line 25. *Piso: Pisum:* see above Cap.9, line 20.

Line 26. *Lychnide: Lychnis:* see above Cap.3, line 35.

Line 26. *Caryophyllo: Caryophyllus:* see above Cap.11, line 16.

Line 27. *Primulã: Primula:* see above Cap.3, line 36.

Line 28. *Aconito: Aconitum.*

For *Aconitum* see above under *Napellus*, Cap.3, line 70.

Line 28. *Aquilegiã: Aquilegia:* see above Cap.10, line 149.

Line 28. *Delphinio: Delphinium:* see above Cap.11, line 52.

Line 29. *Xanthio: Xanthium:* see above Cap.10, line 4.

Line 29. *Mercuriali: Mercurialis:* see above Cap.10, line 123.

Line 30. *Brassicã: Brassica:* see above Cap.9, line 113.

Line 30. *Leucoio: Leucoium:* see above Cap.11, line 15.

Line 30. *Verbasco: Verbascum:* see above Cap.7, line 22.

Line 31. *Th;aspi: Thlaspi:* see above Cap.11, Table 122.

Line 32. *Ricino: Ricinus:* see above Cap.10, line 4.

Line 32. *Tithymalo: Tithymalus:* see above Cap.4, line 23.

Line 32. *Heliotropio tricocco: Heliotropium tricoccum:* see above Cap.10, line 4.

Line 33. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Line 33. *Violã: Viola:* see above Cap.11, Table 125.

Line 33. *Hyperico: Hypericum.*

[C.T.& M. 113-116] *Hypericum* (L.), St. John's-wort; a genus of the *Hypericaceæ* or Hypericum family.

B.& G.-W. 246-248: B.& H. 79: Linn.*Sp.Pl.* 783-787:
Syn.Meth.St.Br. 342-344: *H.P.* 1017-1018: *H.P.III* 404:
Tri. - no ref.: *Cat.Angl.* 167-169: *Camb.* 75-76.

H.P. 1017-1018:

> (Tr.) The characteristics of *Hypericon*, apart from the position of the leaves opposite to each other on the stem, are yellow flowers with many stamens, a seed vessel composed of three parts, a triple stylus, giving off blood red sap when the head is rubbed.

19 species given, including:

Hypericum Ger. *vulgare* C.B. Park. *vulgare sive perforata caule rotundo, foliis glabris* J.B. ***Saint John's Wort.***

H.P.III 404;

Incorrect reference given in the index to Volume III.

Line 33. *Asaro: Asarum.*

[C.T.& M. 295] *Asarum europæum* (L.), Asarabacca; a species of the *Asarum* genus of the *Aristolochiaceæ* or Birthwort family.

B.& G.-W. 62: B.& H. 390: Linn.*Sp.Pl.* 442:

Syn.Meth.St.Br. 158: *H.P.* 207: *H.P.III* 129: *Tri.* 8.9:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 207:

> (Tr.) The characteristics of *Asarum* are *cytini* [912] divided into three flaps; these flaps form the calyx of the flower, under which is the fruit equally distinctly divided into three compartments, and which when mature splitting into three keels.

Asarum Ger. J.B. C.B. *vulgare* Park. ***Asarabacca.***

H.P.III 129:

1 additional species given:

Asarum Virginianum Pistolochiæ foliis subrotundis, Cyclamini more maculatis Pluk. Phytogr. T.78.f.2.

Tri. 8.9:

Asarabacca: *Asarum, -i,* n.:Ἄσαρον, -άρου, n.

Line 34. *Papavere: Papaver:* see above Cap.10, line 30.

Line 34. *Lino: Linum.*

[C.T.& M. 168-169] *Linum* (L.), Flax; a genus of the *Linaceæ* or Flax family.

B.& G.-W. 230: B.& H. 83: Linn.*Sp.Pl.* 277-281:

Syn.Meth.St.Br. 362: *H.P.* 1072: *H.P.III* 523-524: *Tri.* 10.73:

Cat.Angl. 187-189: *Camb.* 80.

912 Lewis and Short (page 508) give for *cytinus* (κύτινος): the calyx of the Pomegranate blossom - Pliny 23.6.59 § 110.

H.P. 1072:

(Tr.) The characteristics of *Linum* are round seed vessels divided into ten compartments containing as many seeds; the seeds are usually black and the flowers fleeting.

Linum sativum Ger.emac. C.B. Park. *Linum* J.B.

Manured Flax.

H.P.III 523-524:

27 additional species given.

Tri. 10.73:

Flax: *Linum, -i,* n.: *Λίνον, -ου,* n.

Line 35. *Cæsalpinus recte meo judicio unum fructum .... :* Ray agrees with Cesalpino's opinion that 'a single fruit is contained in an single external covering even if there are internal divisions'.[913] This is a correct, if rather vague, definition of a fruit. His examples here are Pæony and Aconite, both members of the *Ranunculaceæ* family, with fruits which are groups of many-seeded follicles.[914]

Line 36. *Pæoniã: Pæonia:* see above Cap.3, line 19.

Line 36. *Aconito: Aconitum:* see above Cap.12, line 28.

Line 39. *Uvarum: Uva:*[915] H.P.III D. 116:

?p.1791, pl.30. *Add. Arbor uvifera Tabacensis* Breyn. Prod.2.

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913 Jung's definition is said to be even less exact:

> Jung's description of the structure of the seed is less thorough than that of Cesalpino: he mentions that some seeds are divided into two parts like hemispheres between which the rudiment of the plant is often plainly seen, and he briefly notes the position of the *cor.*

Morton: 173.

914 Clapham, Tutin and Moore: 35 and 53.

915 Lewis and Short (page 1949) give various meanings for *uva*: 'the fruit of the vine', 'a grape', collectively 'grapes', 'a bunch' or 'cluster of grapes', 'a vine', of other plants 'a bunch' or 'cluster of fruit', 'a cluster'.

Occidentalis folio rotundo. ?Dve vulgo P.B.P.

Line 40. *Semina nuda voco quæ nullo præter perianthium vasculo aut tegmine donantur:* Ray defines a bare seed as having 'no vessel or covering except a perianth'. his distinction between plants with enclosed seeds and naked seeds points to the distinction between Angiosperms and Gymnosperms. He was, however, somewhat confused about this, since he included as naked seeds the whole fruit of plants such as *Valeriana,* given here, which are now described as being a unilocular, one-seeded nut.[916]

Valerianæ: Valeriana: see above Cap.3, line 35.

Lines 41-43. *Pro seminibus etiam nudis .....nobis nuda censentur.*

This is a rather odd statement as in all fruits the ovary or carpel wall matures into a pericarp or fruit wall, usually consisting of exocarp, mesocarp and endocarp.[917] The examples Ray gives here, Mallow and all umbelliferous plants, are of the type of fruit known as schizocarp, which breaks into several pieces almost always one-seeded.[918] These one-seeded sections are what Ray sees as individual seeds, *solitarie &c singulatim decidentia.*

This confusion between naked seeds and indehiscent one-seeded fruits was a very long-standing one; Camerer in the 1690s realised in his studies on the sexual reproduction of plants 'that the "naked" seed is really enclosed in a seed-vessel in all flowering plants'.[919] However, it was not until the late eighteenth century that Josef Gaertner, in his two volume *De Fructibus et Seminibus Plantarum,* published in 1788 and 1791, used the term *pericarpium* to denote the modified ovary and other floral parts

916 Clapham, Tutin and Moore: 437.
917 *Lowson's Botany:* 376; *Longman Dictionary of Botany:* 83.
918 *Lowson's Botany:* 379.
919 Morton: 220.

surrounding the fertilised seed at maturity. Morton cites Gaertner as saying that:

> Nature never produced naked ovules or seeds in plants - it must, of course, be remembered that he is speaking only of flowering plants - but the nature of the pericarp can be very different in different species, one extreme being the exceedingly fine covering of the so-called naked seed.[920]

Line 43. *Malvæ: Malva.*

[C.T.& M. 165-167] *Malva* (L.), Mallow; a genus of the *Malvaceæ* or Mallow family.

B.& G.-W. 242: B.& H. 85: Linn.*Sp.Pl.* 687-690:
Syn.Meth.St.Br. 251-252: *H.P.* 597-601: *H.P.III* 317:
Tri. 11.91 / 11.113: *Cat.Angl.* 195-196: *Camb.* 83.

H.P. 597-601:

17 species given, including:

Malva vulgaris Park. *sylvestris* Ger. *sylvestris folio sinuato* C.B. *vulgaris flore majore, folio sinuato* J.B.

Common Mallow.

H.P.III 317:

37 additional species given.

Tri. 11.91:

Hollyhocks: *Malva, -æ,* f.: *Μαλάχη, -ης,* f.

*Tri.*11.113:

Mallow: *Malva, -æ,* f.: *Μαλάχη, -ης,* f.

Table 44-45. *Semina sunt vel ... Nuda, nullo præter perianthium vasculo aut tegmine donata ..... :* Ray seems to be referring to schizocarps

920 Morton: 325.

here; they are either of capsular origin with a whorl of two or more mericarps (portions) or are pod-like fruits breaking transversely (known as a *lomentum*).[921]

Table 44. *Valerianæ: Valeriana:* see above Cap.3, line 35.

Table 44. *Thalictri: Thalictrum.*

[C.T.& M. 51-52] *Thalictrum flavum* (L.), Common Meadow Rue; a species of the *Thalictrum* genus of the *Ranunculaceæ* or Buttercup family.

B.& G.-W. 122: B.& H. 3: Linn.Sp.Pl. 545-547:

Syn.Meth.St.Br. 203-204: *H.P.* 403: *H.P.III* 249: *Tri.* - no ref.: *Cat.Angl.* 283: *Camb.* 117.

H.P. 403:

9 species given, including:

Thalictrum sive Thalictrum majus Ger. *majus vulgare* Park. *majus siliqua angulosa aut striata* C.B. *nigrius, caule & semine striato* J.B. ***Meadow Rue.***

H.P.III 249:

9 additional species given.

Table 45. *Umbelliferarum: Umbelliferae:*[922] see above Cap.11, line 55.

Table 45. *Verticillatarum:Verticillatae:* see above Cap.11, Table 113.

Table 47. *ut in Leguminibus aliisque plurimis:* since Ray includes with Legumes 'many others' he is presumably not just referring to leguminous fruits here, which are almost unknown outside the *Leguminosæ*, and which split along the carpel midrib, but to others

921 *Lowson's Botany:* 379.

922 Blamey and Grey-Wilson: 268.

such as follicles, which are similar to a legume, opening by splitting along the two fused edges of the carpel.[923]

Table 46-58. *Conceptaculis inclusa ..... :* the rest of the table is taken up with various types and examples of capsular fruits. The capsule is the commonest of all fruit types, being the product of a flower with several joined carpels or female reproductive units. With very few exceptions capsules are many-seeded.[924]

Table 49. *Aconito: Aconitum:* see above under *Napellus*, Cap.3, line 70.

Table 49. *Aquilegiā: Aquilegia:* see above Cap.10, line 149.

Table 49. *Delphinio: Delphinium:* see above Cap.11, line 52.

Table 52. *Xanthio: Xanthium:* see above Cap.10, line 4.

Table 52. *Mercuriali: Mercurialis:* see above Cap.10, line 123.

Table 53. *Brassicā: Brassica:* see above Cap.9, line 113.

Table 53. *Leucoio: Leucoium:* see above Cap.11, line 15.

Table 53. *Verbasco: Verbascum:* see above Cap.7, line 22.

Table 54. *Thlaspi: Thlaspi:* see above Cap.11, Table 122.

Table 56. *Tithymalo: Tithymalus:* see above Cap.4, line 23.

923 *Lowson's Botany:* 378.
924 *ibid.:* 377.

Table 56. *Ricino: Ricinus:* see above Cap.10, line 4.

Table 56. *Heliotropio tricocco: Heliotropium tricoccum:* see above Cap.10, line 4.

Table 57. *Convolvulo: Convolvulus:* see above Cap.1, line 50.

Table 57. *Hyperico: Hypericum:* see above Cap.12, line 33.

Table 57. *Asaro: Asarum:* see above Cap.12, line 33.

Table 57. *Violâ: Viola:* see above Cap.11, Table 125.

Table 57. *Bulbosis omnibus:* see above Cap. 11, line 17.

Table 58. *Papavere: Papaver:* see above Cap.10, line 30.

Text page 23.

Lines 59-171. *De processu Naturæ in generatione seminum e D. Malpighii Plantarum Anatome ..... Vide Caput de Phyllitide.*

In the rest of this chapter Ray explains his theories on the germination of seeds, taken, he says, from the section in Malpighi's *Anatomy of Plants, De Seminum Generatione*,[925] but with his own comments, and ending with some complex calculations on the incredible quantity of seeds produced by some plants.

Line 60. *Stylus in plantis utero in Animalibus respondet.* Malpighi defines the *uterus* and *stylus* as one and the same. Despite Ray's comment in line 59 that he has taken this material from Malpighi's section *De Seminum Generatione*, this is paraphrased from the previous chapter

925 Malpighi, *Anatome Plantarum:* 57-63.

De Floribus.[926] Ray, in his following note, prefers to call the 'receptacle or seed vessel' the uterus of a plant; this is a more exact definition as the stylus itself is the long upgrowth at the top of the carpel on which the stigma is placed to receive pollen.[927] The uterus of animals is, in the primates, the organ in which the young are conceived, developed and protected until birth: that is, the female organ of gestation, the womb. The term was first used botanically in English in 1676.[928]

Ray expresses his wonder at the processes of germination:

> most *Seeds* having in them a Seminal Plant perfectly formed, as the Young is in the Womb of Animals, the elegant Complication thereof in some Species is a very pleasant and admirable Spectacle; so that no Man that hath a Soul in him can imagine or believe it was so formed and folded up without Wisdom and Providence.[929]

Line 63. *quandoque multiplex, totidemque exporriguntur tubæ:*

he is confused here by assuming that 'the uterus' can have many ovaries; he is either thinking of an aggregate fruit, which is derived from a number of ovaries belonging to a single flower and sitting on the same receptacle,[930] as in the Buttercup; or he may be thinking of the numerous single carpels joined together, sometimes with a common style or sometimes with separate styles.[931]

926 Malpighi, *Anatome Plantarum:* 55.
927 *Longman Dictionary of Botany:* 76.
928 *OED:* 2444.
929 *The Wisdom of God:* 82.
930 Gibbons: 104.
931 *ibid.:* 69.

Lines 64-69. *Not. Conceptaculum seu vasculum seminale nobis uterus ..... quod Malpighius stylum facit.* Ray disagrees somewhat with Malpighi here, giving a more accurate definition, in modern terms, of the 'uterus' of a plant. He mentions the various types of ovaries now defined as superior and inferior ovaries: that is, an ovary which is attached to the receptacle above the stamens and the perianth (superior) and one which is beneath the point of attachment of the calyx, corolla and stamens of the flower (inferior).[932]

Diagram to show a superior ovary:[933]

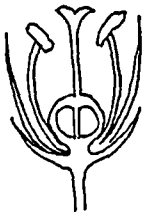
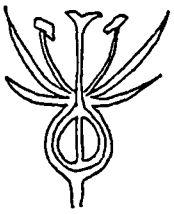


Diagram to show inferior ovary:[934]



Line 65. *Tulipā: Tulipa:* see above Cap.3, line 12.

Line 65. *Papavere: Papaver:* see above Cap.10, line 30.

Line 65. *Caryophyllis: Caryophyllus*: see above Cap.11, line 16.

Line 66. *Pomo: Pomus:* see above Cap.4, line 12.

932 *Longman Dictionary of Botany:* 77.
933 Drawn from *Longman Dictionary of Botany:* 77.
934 *ibid.*

Line 66. *Pyro: Pyrus:* see above Cap.4, line 145.

Line 67. *Verum quem nos stylum dicimus D. Malpighius styl...bam: seu appendicem appellat.* I have been unable to trace *styl...bam* in Malpighi's text, but I have found an instance of him using the term *appendix* for the stylus.[935]

Line 69. *seu corpus cui stylus insidet, quod Malpighius stylum facit:* although Malpighi does describe the stylus as 'occupying the centre of the flower', *centrum floris occupans,* he adds that *appendice assurgit, luditq; inter stamina,* that 'it rises as an appendix and plays among the stamens', which would imply that he visualised it in the same way as Ray.[936]

Line 70. *in aliquibus solo membraneo gracilique corpore:* the 'single membranaceous and thin body which Ray is describing here is that of a dry simple fruit, derived from a single ovary.[937] The 'seeds or embryo' which he mentions here are the ovules or small bodies in the ovary containing the female gamete; after the ovule is fertilised by a pollen nucleus it develops into a seed.[938]

Line 72. *In aliis vegetantium ordinibus, ut in siliquosis, crassiori substantia, quasi pericarpio, constare videtur:* he describes the 'pod' of legumes as being 'like a pericarp'; it is in fact the pericarp or wall of the ripe ovary.[939]

Lines 73-77. *In quibusdam oblongæ .... quod fructus dicitur, conglobatis:*

935 Malpighi, *Anatome Plantarum:* 50.
936 *ibid.*
937 Gibbons: 104.
938 *Longman Dictionary of Botany:* 78.
939 *ibid.:* 83.

he continues with a description of a succulent fruit, in which some tissue is developed for use as food for animals dispersing the fruit.[940]

Lines 77-78. *non dispari ritu ac in Fœminis accidit .... :* he compares the development of succulent fruits to the thickening of the wall of the uterus during the female menstrual cycle.

Lines 78-81. *In aliquibus pericarpii hæc moles .....:* he continues by describing the flesh of apples and pears, and then contrasts this to the 'bone-like structure' of nuts, which have a woody or stony pericarp, which in its early stages of development, as Ray says, is not dry but moist.

Line 80. *pomis: Pomus:* see above Cap.4, line 12.

Line 80. *pyrisque: Pyrus:* see above Cap.4, line 145.

Line 82. *Pericarpium, in iis quibus datur, concoctum fortasse succum contento fœtui subministrat:* he believes wrongly that the pericarp nourishes the seed, but it does, as he goes on to say, protect the developing seed from external forces.

In *The Wisdom of God,* published in 1691, Ray discusses the function of the pericarp:

> Now the *Seed* being so necessary for the Maintenance and Increase of the several *Species*, it is worthy the Observation, what Care is taken to secure and preserve it, being in some doubly and trebly defended. .....
> Neither yet doth the exterior Pulp of the Fruit or *Pericarpium* serve only for the Defence and Security of

940 *Lowson's Botany:* 377.

the Seed, whilst it hangs upon the Plant, but after it is mature and fallen upon the Earth, for the Stercoration of the Soil, and Promotion of the Growth, though not the first germination of the seminal Plant. ..... But besides this Use of the Pulp or *Pericarpium*, for the Guard and Benefit of the Seed, its serves also by a secondary Intention of nature in many Fruits for the Food and Sustenance of man and other Animals.[941]

Lines 83-86. *Quoniam tamen plures uteri pericarpio vel ejus analogo destituuntur* .... because of his belief that the pericarp provides nutrition for the developing seed, Ray has problems with what he considers to be a uterus without a pericarp. He is presumably thinking of dry fruits here with no sap to provide for the seed.

Lines 86-88. *Quod vero pericarpia nonnulla nobis aliisque animantibus gratum cibum ministrent .... :* he holds the opposite view to the modern one that the fleshy pericarps of some fruits have developed for fruit dispersal by animals.[942]

Line 89. *Seminis integumenta seu membranæ semen involventes Secundinis analoga sunt;* he compares the covering of the seed to an afterbirth. We now define the afterbirth as both the placenta and membranes delivered as the third stage of labour,[943] whereas Ray seems to be meaning the amnion or membrane 'sac', which encloses the embryo in the womb.[944]

941 *The Wisdom of God:* 81-82.
942 *Lowson's Botany:* 377.
943 *Harrap's Dictionary of Medicine:* 8.
944 *ibid.:* 14.

Line 91. *Ossicula in Cerasis, malis Persicis & Mespilis .... :*

Malpighi discusses this concept in general terms in his chapter *De Seminum Generatione,*[945] and in his chapter *De Uterorum Augmento, & ipsorum succedente forma.*[946] He expresses his doubts and concerns as to whether the stones of *Cerasus, Malus Persica* and *Mespilus* are uteruses rather than afterbirths in more detail in his chapter *De Secundinis, & contento Plantarum fœtu.*[947] These fruits are all examples of drupes, which are indehiscent fruits, in which the inner layers of the pericarp are stony, the outer layers usually fleshy but occasionally fibrous. They are usually one-seeded. The pip or stone of a drupe is a seed enclosed within a shell derived from the ovary wall or carpel.[948] Malpighi believes (*pro uteris habet D. Malpighius*) the stone of such fruits to be the 'uterus' or carpel itself rather than a layer of the carpel wall or pericarp.

Line 91. *Cerasis: Cerasus:* see above Cap.4, line 12.

Line 91. *malis Persicis: Malus Persic.*

[C.T.& M. 232] *Prunus persica* ([L.] Batsch), Peach; a species of the *Prunus* genus of the *Rosaceæ* or Rose family.

B.& G.-W. - no ref.: *Trees B., E & N.A.* 173:[949] B.& H. 128: Linn.*Sp.Pl.* 472: *Syn.Meth.St.Br.* - no ref.: *H.P.* 1514: *H.P.III* - no ref.: *Tri.* 17.63 / 18.110: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 1514:

Malus Persica J.B. & aliorum. ***The Peach-Tree.***

945 Malpighi, *Anatome Plantarum:* 57-58.
946 *ibid.:* 64.
947 *ibid.:* 75.
948 *Lowson's Botany:* 379.
949 Phillips, *Trees:* 173.

Tri. 17.63:

A Peach-tree: *Malus Persica: Μηλέα, -ας, Περσικὴ,* f.

Tri. 18.110:

A Peach fruit: *Malum Persicum, -i,* n.: *Περσικὸν, -οῦ,* n.

Line 91. *malis Mespilis: Malus Mespilus.*

[C.T.& M. 235] *Mespilus germanica* (L.), Medlar; a species of the *Mespilus* genus of the *Rosaceæ* or Rose family.

B.& G.-W. 196: B.& H. 148: Linn.*Sp.Pl.* 478:

Syn.Meth.St.Br. 453: *H.P.* 1460: *H.P.III* - listed in the index to Volume III but no page number given: *Tri.* - no ref.:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 1460:

Mespilus vulgaris J.B. *vulgaris sive minor* Park. *Germanica folio Laurino non serrato, sive Mespilus sylvestris* C.B.

The Medlar Tree.

Lines 93-94. *Secundinæ autem proprie sunt ..... :* Ray queries Malpighi's definition here and takes as the afterbirth of a seed the testa or seed coat which develops from the integument or coat of the ovule.[950] The testa does, as Ray says, fall with the seed, and so can be compared with the amnion.

Line 95. *cur Avellanarum & Juglandium .... :* Ray wants to agree with Malpighi that the shells of Hazelnut and Walnut are afterbirths and that because of this the stones of Cherry and Medlar should also be afterbirths. In fact Hazelnut and Walnut are different types of fruit, the hazelnut being a true 'nut', the shell being formed from the whole pericarp, whereas the Walnut is, like the Cherry and Medlar,

950 *Oxford Dictionary of Botany:* 211.

a drupe, its shell being a stony inner layer of the pericarp.[951]

Line 95. *Avellanarum: Avellana:* see above Cap.5, line 63.

Line 95. *Juglandium: Juglans:* see above Cap.4, line 144.

Line 96. *Cerasorum: Cerasus:* see above Cap.4, line 12.

Line 96. *Persicorum: Persica:* see above Cap.12, line 91.

Lines 99-116. *In plerisque Secundinis ..... quorum ope extremo caudici debitum auctivum subrogatur alimentum.* Ray and Malpighi have noticed the small opening in the end of the testa of a seed, now called the micropyle, which is where the pollen tube entered the ovule.[952] Water enters the micropyle at the beginning of germination.[953] Ray is feeling his way towards this concept although he proposes two other alternatives as well; he gives as his third possible use for this 'window' *an potius ad humorem nutritium excipiendum*, 'or rather whether it is for taking in nutritional liquid'. He compares it with the fœtus of an animal, which he believes takes in nourishment through both the umbilicus and through the mouth (while still in the womb).[954]

Jung had also commented on the orientation of the micropyle of the seed in relation to the fruit.[955]

Line 107. *Siphones ... :* since he specifies that these 'little pipes' are 'in a line in the afterbirths of most seeds', is he referring to the funicle or

951 *Lowson's Botany:* 380-381.
952 See the introductory notes to this chapter of the commentary.
953 *Longman Dictionary of Botany:* 85.
954 Malpighi discusses this problem in his *Anatome Plantarum:* 57-63.
955 Morton on the fourth fragment of Jung's *Doxoscopiæ:* 174.

stalk of the ovule, which attaches the ovule to the wall of the ovary, and after fertilisation becomes the stalk of the seed?[956] The text is rather confusing here as he goes on to say that these 'little pipes' supply food to the leaves of the plant, which implies that they penetrate the seed itself; could he mean the suspensor or group of cells developed from the fertilised ovum in seed plants, attaching the embryo to the wall of the embryo sac?[957]

Line 99. *Pyri: Pyrus:* see above Cap.4, line 145.

Line 99. *Pomi: Pomus:* see above Cap.4, line 12.

Line 111. *Pomis: Pomus:* see above Cap.4, line 12.

Line 111. *Pyris: Pyrus:* see above Cap.4, line 145.

Line 111. *Ciceribus: Cicero.*

[Mac.Enc. 266] *Cicer arietinum* (L.), Chickpea; a species of the *Cicer* genus of the *Leguminosæ* or Pea family.

C.T.& M. - no ref.: B.& G.-W. - no ref.: B.& H. - no ref.: Linn.*Sp.Pl.* 738: *Syn.Meth.St.Br.* - no ref.: *H.P.* 917: *H.P.III* 551: *Tri.* - no ref.: *Cat.Angl.* - no ref.: *Camb.* - no ref.

H.P. 917:

3 species given, including:

Cicer sativum C.B. Ger. *arietinum* J.B. *sativum sive arietinum, nigrum, rubrum, vel album* Park. ***Chiches, or Chich-Pease.***

H.P.III 551:

Incorrect reference in the index to volume III.

956 *Longman Dictionary of Botany:* 78.
957 *ibid.:* 86.

Line 111. *Fabis: Faba:* see above Cap.9, line 20.

Lines 112-113. *ut regia nutritionis via .... :* Ray has already used the rather appropriate term 'royal road' for an important and major route of nutrition in Chapter 4 (line 124), although referring to the root rather than the seed on this occasion.

Lines 114-116. *His accedat radicis truncum vagina ....* He gives an additional note that 'the trunk of a root is increased [or improved] by a *vagina*', which delivers supplementary food to the root.

Vagina, -ae, f.: a sheath or covering.[958]

Line 117. *Notandum autem naturam non in omnibus Pericarpium exterius collocasse .....:* Ray believes that not all fruits or seeds have a pericarp. A fruit is suurounded by a pericarp, which is the whole wall of the ripe ovary.[959] A seed, on the other hand, does not have a pericarp but has a testa or seed coat which develops from the integument or coat of the ovule.[960]

Line 119. *Fragis*: as Ray says in *Trilingue* 19.111:

A Strawberry fruit: *Fragum, -i,* n.: *Κόμαρον, -άρου,* n.

Fraga: [C.T.& M. 217] *Fragaria vesca* (L.), Wild Strawberry; a species of the *Fragaria* genus of the *Rosaceæ* or Rose family.
B.& G.-W. 192: B.& H. 135: Linn.*Sp.Pl.* 494-495:
Syn.Meth.St.Br. 254: *H.P.* 609-610: *H.P.III* - no ref.:
Tri. 19.111 / 13.186: *Cat.Angl.* 111-112: *Camb.* 64.
H.P. 609-610:

(Tr.) The characteristics of *Fragaria* are veiny leaves,

958 Lewis and Short: 1952.
959 *Longman Dictionary of Botany:* 85.
960 *Oxford Dictionary of Botany:* 211.

which are triple on individual stalks, a fruit consisting of a soft edible pulp, with seeds developing on the outside, with a fragrant scent and creeping runners.

6 species given, including:

Fragaria Ger. *vulgaris* Park. C.B. *Fragaria ferens fraga alba & rubra* J.B. ***Common Strawberry.***

Tri. 13.186:

A Strawberry plant: *Fragaria, -ae,* f.: *Κόμαρον, -άρου,* n.

ut in Fragis præcipue cernitur. he believes that the 'uterus and seed' of the Strawberry 'develops on the pericarp fused into a globular body'. He considers the fleshy interior of a strawberry to be the pericarp, although, as he says, the term indicates a surrounding structure. The strawberry is a fleshy floral receptacle bearing its fruits on the outside in the form of numerous achenes, which are one-seeded indehiscent fruits.[961] Thus strawberry fruits do have a surrounding pericarp (around the achenes) but not in the way Ray thought.

Line 121. *intra secundinas.... :* ' within the afterbirth'. Ray is using the term afterbirth for the testa, which corresponds to the amnion or double membrane sac enclosing the embryo in mammals.[962]

In this paragraph Ray discusses the development of the seedling. Malpighi also made detailed studies with the aid of a microscope of the seeds of apple, pear, flax, pea and other legumes, wheat and hazel, and noted 'the growth of the very young embryo within the embryo sac and its gradual increase in size to fill most of the seed at maturity'.[963]

961 *Lowson's Botany:* 378 and 381.
962 *Harrap's Dictionary of Medicine:* 14.
963 Morton: 185.

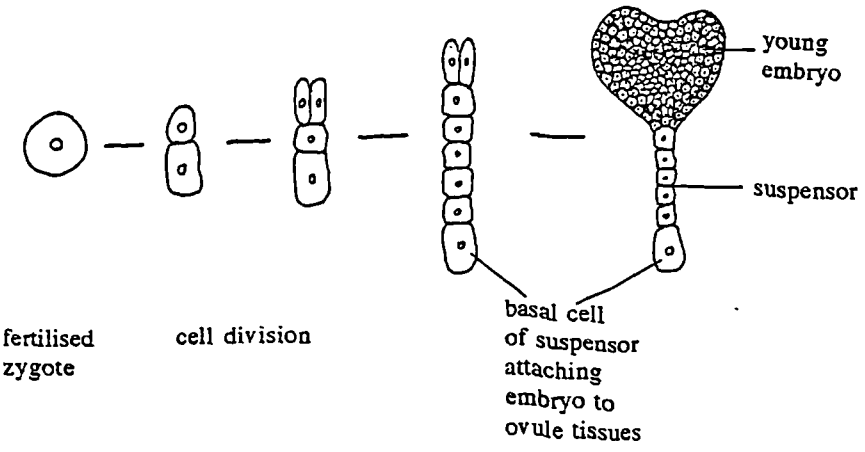
Grew, however, concentrated on the almond but

> was not led astray by analogies with animals,[964] and he illustrates surprisingly well the early stages of growth of the embryo within the embryo sac, showing the suspensor (which he calls the "navle [*sic*] string") with the embryonic bud at the tip from which two cotyledonary lobes arise as it enlarges.[965]

Line 122. *Primo enim umbilicus occurrit .... :* the umbilicus indicated by Ray is the small structure now called the suspensor, developed from the fertilised ovum, and which anchors the embryo to the parental tissue and conducts nutrients to the embryo.[966] See note at line 121 above.

Lines 122-123. *& sensim in extremitate laxatus seu dilatus .....:* he has observed that the suspensor swells at the end; this end growth is the early development of the cotyledons of the embryonic plant.[967]

This can be seen in the following diagram.[968]



964 Malpighi, however, was led astray by such analogies; see Morton 185.
965 Morton: 185.
966 *Penguin Dictionary of Botany:* 351; *Longman Dictionary of Botany:* 86.
967 *ibid.:* 85.
968 Drawn from *Longman Dictionary of Botany:* 85.

Line 123. *Fabis: Faba:* see above Cap.9, line 20.

Line 124. *Tractu temporis semen seu fœtus emergere incipit ..... :* he has observed the first stages of seedling growth, in particular the development of the two seed leaves or cotyledons, and from these the beginnings of the stem and the first true leaves.

Ray had first propounded his ideas on dicotyledons in a paper read to the Royal Society on 17th December 1674 entitled 'A discourse on the seeds of plants'. In it he stated that

> The greatest number of plants, that come of seed, spring at first out of the earth with two leaves, which being for the most part of a different figure from the succeeding leaves, are by our gardeners not improperly called the seed-leaves.
>
> These seed-leaves are for the most part entire or undivided ....
>
> The seed-leaves are for the most part smooth ....[969]

Ray put forward these ideas a year before Malpighi, who also propounded them in his *Anatomy of Plants*, published in two parts in 1675 and 1679.

Lines 127-128. *Successivo incremento .... auget & fovet:* he has observed that the embryo sac and the membranes around it, called integuments, expand as the embryo grows inside them. This layer becomes the seed coat or testa, which, as he says,protects the embryo.[970]

Lines 130-131. *& postremo a plantula .... absumitur.* He is correct in saying that the testa eventually disintegrates when the seedling germinates.

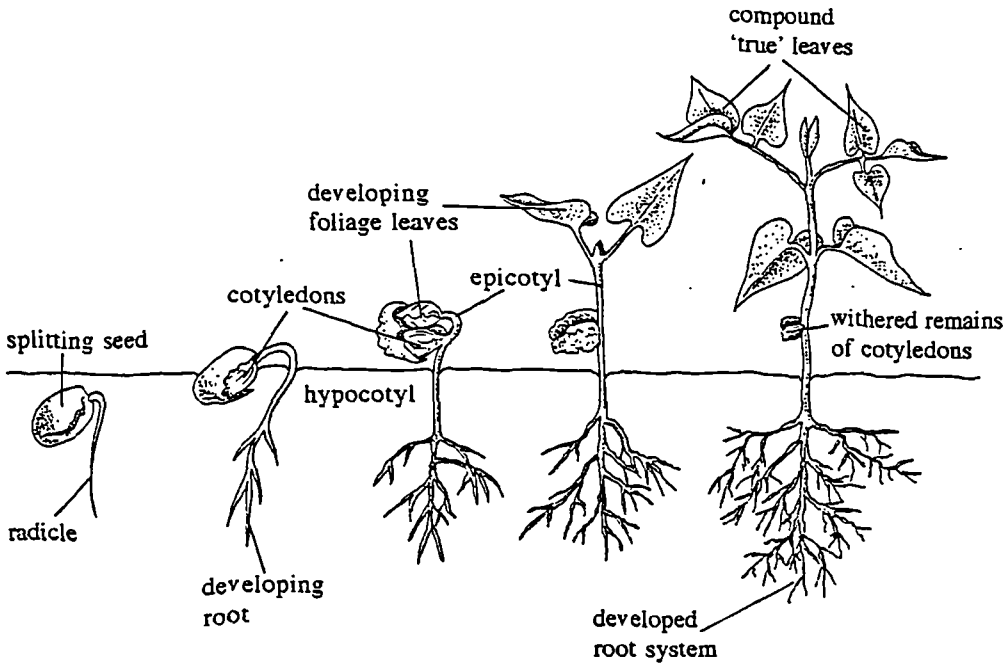
969 *Further Correspondence:* 70-77.
970 *Penguin Dictionary of Botany:* 358-359.

Text page 24

Lines 132-133. *Verum hæc omnia exemplo & iconibus appositis clarius intelligentur.* Ray had hoped that the *Historia Plantarum* would contain illustrations to clarify such points. He had expressed this hope in a letter to Hans Sloane on March 7th 1684,

> to find out infallibly any plant that shall be offered to him, especially being assisted by the figure of it.[971]

Development of a dicotyledon, the common runner bean:[972]



Lines 134-140. *Augetur autem .... :* it is difficult to see what Ray is meaning here in modern botanic terms. He may be referring to the parasitic process in the developing seed, where one tissue provides for the nutrition of another. By the time the seed is ripe a considerable amount of tissue may have been completely absorbed.[973]

971 *Correspondence:* 161.
972 Drawn from Gibbons: 114.
973 *Lowson's Botany:* 374-375.

Lines 141-171. *Mira autem est Plantarum nonnullarum fœcunditas seminis respectu .... :* Ray concludes this chapter with facts and figures, explained in great mathemátical detail, on the incredible quantity of seed produced by certain plants. He gives examples from his own observations and those of Lauremberg, Camerer and Grew.

Referring to the vast numbers of seeds produced by some plants he reiterates his belief in a divine creation in his later work, *The Wisdom of God:*

> The immense Smallness of some Seeds, not to be seen by the naked Eye, so that the Number of Seeds produced at once in some one Plant, as for example, *Reedmace [Tipha Palustris], Harts-Tongue,* and many Sorts of *Ferns,* may amount to a Million, is a convincing Argument of the infinite Understanding and Art of the Former of them.[974]

More modern research on the number of seeds produced by individual plants was published in 1948 by W. B. Turrill. As he says, 'most quantitative work has so far been done on annual or biennial herbs, and there are few or no sound estimates for trees or shrubs, or even totals for the life of perennial herbs';[975] this comment could apply equally to the plants cited by Ray. Turrill gives the following list as an indication of the range in seed-production for single plants:[976]

	Number of seeds
Lepturus filiformis (a grass)	90
Limonium binervosum (a sea-lavender)	400-1,000
Rumex crispus var.*trigranulatus* (a dock)	4,000-25,000
Glaucium luteum (yellow-horned poppy)	24,000

974 *The Wisdom of God:* 82.
975 Turrill: 175.
976 *ibid.*

Linaria vulgaris (toadflax)	29,000
Beta maritima (sea-beet)	130,000
Verbascum thapsus (mullein)	700,000
Digitalis purpurea (foxglove)	750,000

Ray's examples vary from the number of seeds produced by a single flower to the total produced by the whole plant; there are two variables as Turrill says:

> the number of seeds per fruit and the number of fruits per plant. The mean of the products of the mean values of these two variables, plus or minus their probable errors, gives what is known as the *average seed output.*[977]

Line 141. *Verbasci:Verbascum:* see above Cap.7, line 22.

Line 141. *Digitalis:Digitalis:* see above Cap.10, line 55.

Line 142. *Papaveris: Papaver:* see above Cap.10, line 30.

Line 142. *Hyoscyami: Hyoscyamus:* see above Cap.11, line 28.

Line 142. *Nicotianæ: Nicotiana:* see above Cap.3, line 140.

Line 142. *Helenii: Helenium:* see above Cap.10, line 91.

Line 142. *inquit P.Laurembergius:* margin reference *Horticulturæ l.1.c.17.*[978]

Peter[979] Lauremberg: 1665-1721. From Rostock, his main interests were medicine and botany. His *Horticultura,* published at Frankfurt

977 Turrill: 175.

978 There is no indication from the sale catalogue of his library that Ray himself owned a copy of this work. British Museum: *S-C 326* (6).

979 Raven gives his name as Wilhelm not Peter in the index to his biography of Ray.

am Main in 1654, shows the influence of horticulture on botany. he relied heavily on classical sources and recommendations, and he uses the terms of the mediaeval four-element theory.

> However, when he comes to discuss the different theories of the location of the plant soul (anima) - thought be some to be the medulla, by others the cortex, and by Caesalpino 'most fittingly' to be the cor - he comes right down to earth, saying that all must be rejected, because 'horticulturalists knew' that plants could live and reproduce themselves from very small pieces cut from the roots [i.e. rhizomes, stolons etc.] as well as from branches, stems, seeds, and even leaves (as in the case of the Indian Fig). Therefore the soul or vital force *(vigor vitalis)* is not in one part more than another, but diffused through the whole plant body.[980]

There were many gardeners' ideas on how best to position seeds when sown; the wrong way was said to produce dwarf or 'unthrifty' plants. Here Lauremberg made his own observations with seeds of pea, cucurbita, walnut, almond, date and others, finding that the stem grew upwards and the root downwards irrespective of the original orientation, and that the alleged effects of malplacement were 'empty superstition'.[981]

Interestingly Lauremberg published and bound with his *Horticultura* a list of garden plants, almost all ornamental, including 146 varieties of Tulip and 22 of Crocus.[982]

Line 143. *Helenium:* see above Cap.10, line 91.

980 Morton: 222, note 12.
981 *ibid.*.
982 *ibid.*

Line 144. τοῦ[983] *Mayz:* see *Frumentum* above Cap.7, line 50; also see *Frumentum Indicum* above Cap.10, line 3; also see *Frumentum Turcicum* below Cap.12, line 144.

H.P.III 597:

Mayz (Mayez): 1 additional species given.

Line 144. *Frumenti Turcici: Frumentum Turcicum:* see *Frumentum* above Cap.7, line 50; also see *Frumentum Indicum* above Cap.10, line 3; also see *Mayz* above Cap.12, line 144.

H.P.III 597: see *Mayz* above Cap.12, line 144.

Line 145. *flore Solis majore: Flos Solis:* see above Cap.10, line 91.

Line 146. *eodem anno Camerarius exemit circiter 4000 semina.*

Rudolf[984] Camerer, 1665-1721, studied medicine at Tübingen where his father was Professor of Medicine. He travelled for a year in Germany, Holland, England where he met Robert Boyle, France and Italy. On returning to Tübingen in 1687, he took his doctorate and became Extraordinary Professor of Medicine and Director of the Botanic Garden. In 1695 he succeeded his father as ordinary Professor of Medicine and spent the remainder of his life in Tübingen.[985]

Camerer generally used the term 'pollen' (sometimes *pulvis* or *farina*), which he probably took from Ray. His work led to the general adoption of the term even before Linnaeus finally established it.[986] He also showed that ripe seeds form only if the

983 NB: the odd use of a single Greek word here; as it is only the genitive singular of the definite article it can hardly be for emphasis! [Also note that it cannot be the genitive of the indefinite pronoun τις because Ray gives it an accent.]

984 Raven gives his name as Joachim not Rudolf, which could be his second name, although DSB gives his names as Rudolph Jakob.

985 Morton: 231, note 58; *DSB XV Suppl.:* 67-68.

986 *ibid.:* note 60.

stigma has been dusted with pollen, although many botanists continued to deny the sexuality of plants until the nineteenth century and the experiments of Friedrich von Gaertner.[987]

For Camerer on the fertilisation and sexual theory of plants see Morton.[988]

Line 147. *Tabaci: Tabacum.*

[B.& G.-W. 350] *Nicotiana tabacum* (L.), *[Nicotiana latissima],* Tobacco; a species of the *Nicotiana* genus of the *Solanaceae* or Potato family.

C.T.& M. - no ref.: B.& H. 317: Linn.*Sp.Pl.* 180:

Syn.Meth.St.Br. - no ref.: *H.P.* 713: *H.P.III* - no ref.: *Tri.* 14.201:

Cat.Angl. - no ref.: *Camb.* - no ref.

H.P. 713:

4 species given, including:

Tabacco latifolium Park. *Nicotiana major latifolia* C.B. *Nicotiana major sive Tabacum majus* J.B. *Hyoscyamus Peruvianus* Ger. ***Broad-leaved Tobacco.***

Tri. 14.201:

Tobacco: *Tabacum, -i,* n.: [No Greek].

Ray's note here, 'This is usually called also *Nicotiana*, after the name of him who first brought it to France'.

Line 148. *Nicotianæ: Nicotiana:* see above Cap.3, line 140; also see *Tabacum* above Cap.12, line 147.

Line 149. *Tabaci: Tabacum:* see above Cap.12, line 147.

Line 150. *Jam vero ex una planta collegi .... :* Ray uses the first person here implying that he himself collected and counted these seeds.

987 *DSB XV Suppl.:* 68.
988 Morton: 214-220.

However in *A Discourse on the Seeds of Plants* presented to The Royal Society on December 17th 1674 he seems to give credit for this to Lauremberg, although it is slightly odd that Ray gives his figures in terms of weight, that is in 'medical grains', whereas he cites Lauremberg as collecting 360,000 seeds, but the figures are the same:

> .... for example, tobacco, for a plant of that bigness, bears the least seed of any I know, producing the greatest number of seeds; Laurembergius counting from one plant an encrease of three hundred and sixty thousand.[989]

Line 152. *Tabaci: Tabacum:* see above Cap.12, line 147.

Line 153. *supputante D.Grevio:* see above Cap.3, line 16.

Line 161. *Typha major.*

[C.T.& M. 585-586] *Typha latifolia* (L.), Bulrush, Cat's-tail; a species of the *Typha* genus of the *Typhaceæ* or Bulrush family.
B.& G.-W. 472: B.& H. 418: Linn.*Sp.Pl.* 971:
Syn.Meth.St.Br. 436: *H.P.* 1312: *H.P.III* - no ref.: *Tri.* - no ref.:
Cat.Angl. 297: *Camb.* 122.
H.P. 1312:

3 species given, including:
Typha Ger. *palustris major* J.B. C.B. *palustris maxima* Park.
Great Cat's-tail, or Reed-mace.

Lines 170-171. *Verum numerosissima omnium semina producunt herbæ capillares dictæ.* Ray believes the plants producing the most numerous seeds to be the *capillares,* or Ferns, which produce spores not seeds in great quantity. He distinguishes as a separate

989 *Further Correspondence:* 71.

class the ferns or *'Capillares'*; see, for example, Book III, *Pars Secunda:* 131-153 on *Herbarum caule carentium hypophyllospermωn seu Capillarium Tabula.* That these spores had been seen and recognised at all was a result of the advent of microscopes.[990] Ray himself distinguished three groups of fern: those with spores on specialised leaves, those with spores on the reverse of ordinary leaves, and those with spores on the margin of ordinary leaves; these distinctions have been used since as a way of classifying ferns.[991] A spore is a microscopic structure, which is a unicellular reproductive unit. It does not contain an embryo and so differs from a seed.[992]

Morton defines the *Capillares* as 'plants possessing true leaves, but having no flowers, and with only very minute, powdery seeds, borne on the leaves'.[993] Towards the end of his life Ray had improved on his classification system, although in *The Wisdom of God,* published in 1691, he still believed that plants such as ferns and mosses, which reproduce by means of spores, produced very many tiny seeds.[994] In the final edition in 1703 of his classification system, *Methodus Emendata et Aucta,* in the section *De Herbis, Flore Destitutæ* he discusses the ferns. By the end of the seventeenth century it was known that ferns reproduced by means of spores, although it was not until the nineteenth century, when the work of, among others, Nägeli, Leszczye-Suminski and Hofmeister, developed the theory of alternation of generations in the life cycle of

990 'On March 30 1680, Locke recorded that Mr Cole of Bristol "showed me the seedes of fern and Lunaria which are either of them above an hundred times lesse than small sand".'
Morton: 229, note 47.

991 *ibid.:* 205.

992 *Oxford Dictionary of Botany:* 387; *Penguin Dictionary of Botany:* 338-339.

993 Morton: 205.

994 *The Wisdom of God:* 82.

a fern.[995]

Line 170. *Linguæ cervinæ: Lingua cervina.*

[C.T.& M. 13] *Asplenium scolopendrium* (L.), Hart's-tongue Fern, [*Scolopendrium vulgare* (Sm.): *Phyllitis scolopendrium* ([L.] Mewman); a species of the *Asplenium* genus of the *Aspleniaceæ* or Hart's Tongue family.

B.& G.-W. - no ref.: B.& H. 567: Linn.*Sp.Pl.* 1079: *Syn.Meth.St.Br.* 116: *H.P.* 134: *H.P.III* 50-51: *Tri.* 10.85: *Cat.Angl.* under *Phyllitis* 232: *Camb.* - no ref.

H.P. 134:

> *Phyllitis* Ger. *Phyl. sive Lingua cervina vulgi* J.B. *Phyl. sive Lingua cervina vulgaris* Park. *Phyllitis, Lingua cervina Officinarum* C.B. ***Hart's-tongue.***

H.P.III 50-51:

> *Ad caput de Phyllitide præter species seu varietates hic & inferius in Appendice traditas sequentes.* 16 additional species given.

Tri. 10.85:

> Hart's tongue: *Lingua cervina, -æ,* f.: *Φυλλίτις, –ιδος,* f.

Line 171. *Phyllitide: Phyllitis:* see *Lingua cervina* above Cap.12, line 170.

H.P.III 50-51 / 53 / 63.:

> Pages 50-51*: Ad caput de Phyllitide præter species seu varietates hic & inferius in Appendice traditas, Adjiciantur sequentes.*
>
> 16 additional species given.
>
> Page 53: *Phyllitidis scandentes iisque affines.* 4 additional species given.
>
> *Phyllitidis repens scandensve foliis longis angustis.* D. Sherard.
>
> Page 63: *Filices pinnatæ foliis Phyllitidis.* 5 additional species

995 Morton: 394-404.

given.

Filix latifolia nodosa Plumier. *Phyllitidis pinnata, seu Filix pinnata Phyllitidis foliis, latifolia, nodosa.*