OUTLINES

OF

MEDICAL BOTANY.

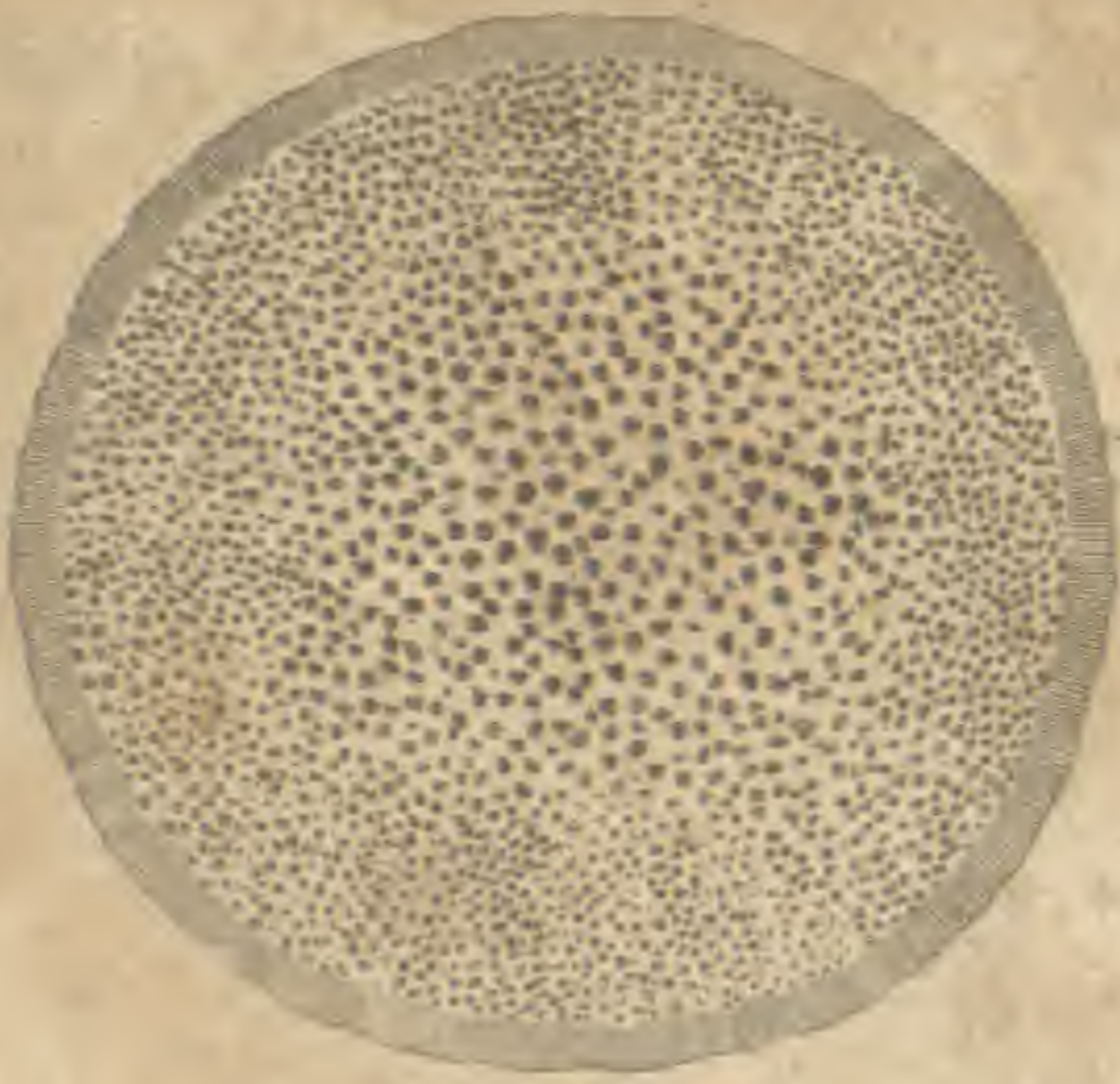

FIG. I

FIG. II

FIG. III

FIG. IV

FIG. VI

FIG. V

Fig: 1. Endogenous Stem — Fig: 2. Exogenous Stem

Fig: 3. ——— Leaf — Fig: 4. ——— Leaf

Fig: 5. Ovary superior (Stamens inferior or hypogynous)

Fig: 6. Ovary inferior (Stamens superior or epigynous)

OUTLINES

OF

MEDICAL BOTANY,

COMPRISING

VEGETABLE ANATOMY AND PHYSIOLOGY,

THE CHARACTERS AND PROPERTIES OF THE NATURAL ORDERS OF PLANTS,

AN EXPLANATION OF THE

LINNÆAN SYSTEM OF CLASSIFICATION,

TABLES OF MEDICINAL PLANTS, ARRANGED IN THEIR LINNÆAN AND NATURAL ORDERS;

AND A GLOSSARY OF TERMS.

BY HUGO REID,

LECTURER ON BOTANY.

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PART II.

SYSTEMATIC BOTANY,

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ADVERTISEMENT.

An elementary work on Botany, adapted for the use of Students of Medicine, has been much wanted. In compiling the present work to meet this desideratum, I have endeavoured to make such a selection from the immense mass of facts which Botany now includes, as shall present a concise but satisfactory view of our present knowledge of the science, and form a proper introduction to the study of the genera and species of plants.

Before commencing the study of genera and species, it is necessary to acquire a knowledge of the structure and functions of the different parts of plants, of the terms employed in botanical descriptions, and of the principles of some method of classification. This work, accordingly, consists of two parts. In the first there is given as minute an account of the structure and functions of the various organs of vegetables, as is consistent with the plan of the work, while care has been taken to avoid too much detail on matters which, in the present state of our knowledge, do not lead to any useful application. The appendix contains an ample Glossary of terms alphabetically arranged.

The second part consists of Systematic Botany; and includes a full explanation of the Natural Method of JUSSIEU, the characters of the most important of the Natural Families which have been pointed out, an account of the uses to which the plants in each family may be applied, and an explanation of DE CANDOLLE'S, LINDLEY'S and the LINNÆAN Systems of Classification.

The ultimate object of all botanical knowledge is an acquaintance with the uses of plants; under each natural order, therefore, I have given an account of the properties of the leading plants which it contains, under the heads of ECONOMICAL, MEDICINAL, and POISONOUS properties, so that at one glance a condensed view may be obtained of the general character of the family, and a list of the most important products which it affords.

Full tabular views of the methods of Linnæus and Jussieu are added, and also tables shewing the medicinal plants arranged in their Linnæan and Natural Orders, so that the situation of any plant in either of these arrangements may be easily found. If the student be well acquainted with these two methods, and know the Natural and Linnæan Orders in which a plant is placed, he will have already acquired much important information regarding it.

A knowledge of the simple and beautiful system of Linnæus is almost indispensable for acquiring a knowledge of plants; but to study Botany as a science,—to view plants as component parts of one great system,—to examine their mutual relations and affinities, the connection between their internal structure and external characters, and between these and their properties, we must have recourse to the comprehensive and philosophical system of JUSSIEU.

Till within these few years, almost all the elementary works on Botany in this country were devoted chiefly to an exposition of the Linnæan method of arranging plants, and hence were very imperfect in a medical point of view, as it is only by means of the Natural Method that Botany, as a science, can be applied to Medicine. Now, however, the importance of natural classification is beginning to be more highly estimated, and a knowledge of it is deemed essential to every student of Botany: the examination of the natural affinities of plants is the principal study of the most eminent botanists, both at home and abroad; and the development of this system forms a prominent part in the best elementary works. It is hoped, therefore, that a work which comprises in a small compass the Anatomy and Physiology of Vegetables, the Principles of Natural Arrangement with the Characters and Medicinal History of the Natural Orders, and an exposition of the Linnæan System, may prove useful to the Student of Medicine.

The present edition has been considerably enlarged, so as to adapt the work to the more extensive knowledge of the science now required of the medical student.

Edinburgh,
May 18, 1839.

OUTLINES

OF

MEDICAL BOTANY.

INTRODUCTION.

1. Botany, from the Greek word βοτάνη *(Botane)*, an herb or plant, is the term applied to the science which treats of plants. It includes, in its widest signification, an account of the Structure, Composition, Characters, Functions, Habits, Methods of Classifying, Properties, and Uses of the objects which compose the vegetable creation,—in short, all knowledge relating to plants. It is truly a science, embracing the description of an extensive series of mutually related phenomena, and the examination of the laws by which they are regulated.

2. In plants we find an apparatus more or less complex, designed for the performance of particular offices, necessary to maintain their existence, advance their growth, and form the various products they are destined to bear. And we observe them undergoing a progressive series of changes during the whole course of their existence. In fact, they resemble a machine consisting of a number of separate parts, each performing some particular action, but all connected

together, and, by their joint operation, conducing harmoniously to one great effect. The offices performed by the apparatus of plants are termed their FUNCTIONS: the various parts of their apparatus are termed ORGANS.

3. In studying any machine, we must make ourselves acquainted with the structure and relation of the separate parts, before we can understand its operation when in action. In like manner, in studying Botany, we must, in the first place, acquire a knowledge of the STRUCTURE OF THE ORGANS OF PLANTS. This is the ground-work of the whole. This department of Botany is termed VEGETABLE ANATOMY, or VEGETABLE ORGANOGRAPHY: and should include, in its fullest extent, the *structure*, *composition*, and *characters* of plants. It makes us acquainted with the size, form, structure of the whole plant, and of its organs, and the relative situation of its different parts; and informs us of what materials the whole is composed.

4. But a plant is a living being, and there are motions and changes going on within it during the whole period of its existence—there are certain actions performed by its organs. Knowing the construction of each part, and the connection of the parts with each other, we can then enter upon the study of the machine when in action, that is, of the uses, or, FUNCTIONS OF THE ORGANS OF PLANTS, the second great division of the study of Botany, termed VEGETABLE PHYSIOLOGY, and including the *Functions* and *Habits* of plants. It is termed "Physiology," from the Greek words *φυσις (Phusis)* Life, and *λογος (Logos)* a discourse—the vital functions being the subject of this branch.

5. These two branches embrace all natural knowledge relating to vegetables—their structure, functions, and all those relations with the external world which affect their condition; and may be included under the term PHYTOLOGY, meaning "knowledge concerning plants," derived from the Greek words *φυτον (Phuton)*, a plant, and *λογος (Logos)*, a discourse.

6. But plants bear a considerable resemblance to each

other in the structure and functions of their leading organs, and there would be a needless repetition in describing fully the anatomy and physiology of each plant. A description of any organ or function in *one* plant, will apply to the same organ or function in a great many plants, and, with some slight variation, to numbers of others. Hence Phytology is conveniently divided into *General Phytology* and *Special Phytology*.

7. General Phytology,* has to do with plants in general. *It describes the structure, functions, habits, &c. of those leading varieties of organs which are common to all plants, or to any considerable class.* It is in a manner, a generalization of the whole phenomena of vegetation. It is, more specially, the *Science* of Plants—selecting the leading features and general laws which pervade the vegetable kingdom.

8. Special Phytology, sometimes termed *Phytography*, or *Descriptive Botany*, gives an account of each particular kind of plant. It embraces those secondary points in structure, &c. in which individual plants differ from each other. It presupposes a knowledge of the general structure and functions of the organs, but describes those peculiarities in which any particular organ may differ from the same organ in other plants. It might be termed *Individual Botany*, as its office is to describe each different kind of plant. It is the subject of those botanical works termed Floras; and is the ultimate aim of the botanist. Before it can be understood, it is obvious that the student must be familiar with General Phytology.

9. In order to understand the descriptions of plants in a *Flora*, or special Phytology, two other branches of botany must be studied—Botanical Terminology (or Glossology); and Botanical Taxonomy (or Systematic Botany.

* It is to General Phytology that the terms, Vegetable Anatomy and Vegetable Physiology are usually applied.

10. BOTANICAL TERMINOLOGY includes an explanation of the terms which are applied in botany to express those peculiarities in form, structure, colour, &c., by which the same organ may differ in different plants, and by which therefore different plants may be described and distinguished from each other. These peculiarities are what are usually termed *the characters* of plants. Most plants, for example, possess the organ called "a leaf"; and it is of the same general structure in all. But in one plant the leaf is *ovate* (oval), in another *lanceolate* (shaped like a lance), in another *downy*, in another *bristly*, &c. BOTANICAL TERMINOLOGY gives the precise meaning attached to these terms in the language of Botany. GENERAL PHYTOLOGY has previously explained the ordinary structure and functions of leaves.

11. BOTANICAL TAXONOMY, from the Greek words, ταξις, *(taxis)* order, and νομος *(nomos)*, a law, unfolds the affinities or relationships found to prevail between different tribes of plants; expounds the principles on which plants are classified, that is, grouped together in divisions and subdivisions, that we may easily acquire a knowledge of them; and describes the characters of the classes and orders in which they are arranged. Besides facilitating the study of plants in general, a grand practical object of Systematic Botany is to make us acquainted with the relations between the properties of plants and their structure, that we may be enabled from the latter indication to judge how far plants that may be new to us, may be rendered serviceable, or how far they are of a noxious nature, and must be avoided.

12. Taken in the widest sense, Botany should include a knowledge of those properties of plants which render them serviceable to man—furnishing him with shelter, clothing, implements, nutriment, and medicine—and those properties which render some plants so dangerous, that he may know which to avoid.

13. The present work on Botany will embrace

VEGETABLE ANATOMY } or GENERAL PHYTOLOGY;
VEGETABLE PHYSIOLOGY }
BOTANICAL TERMINOLOGY;
BOTANICAL TAXONOMY;

constituting the principles of general Botany, and which will enable the student to understand the arrangement and descriptions in any FLORA; and

Those details in the History of the Natural Families, which are interesting to the medical student.*

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14. We have above attempted to convey a general sketch of what the science of Botany embraces, that the student may have some idea of the field of study on which he is about to enter, and the path to be pursued. In commencing the study, it would be desirable if we could also furnish him with a precise definition of a plant in general, the *subject matter* of Botany, that he may know the limits by which plants are separated from other bodies, and have a correct notion of what are to be the objects of examination.

15. This, however strange it may appear, it is impossible to do, except in a general way. There is not one absolute and exclusive character by which a plant can be defined, which would *include all plants, and exclude all objects but plants.* A mathematical figure can be defined with great precision, as for example, a PARALLELOGRAM,—a plane right-lined four-sided figure, of which the opposite sides are parallel to each other. This is precise: it describes that particular figure, and cannot be applied to any other figure. But it is not so with the objects which compose the vegetable kingdom. We cannot define them by positive qualities, as there are none such belonging to plants which are not found in animals. Nor can we distinguish them by negatives, as there are many undoubted animals, which yet ap-

* Besides the characters of the Families, included under Taxonomy.

proximate very closely to vegetables in the absence of those features which characterize the generality of the animal creation.—We must supply the place of a definition of plants, by a general view of their station among the works of nature.

16. The objects which compose the material world have been arranged in two grand divisions, according as they possess or are destitute of that mysterious principle called LIFE, or, VITALITY,—These are, the *Animate* and the *Inanimate* creation, or, *Organic* and *Inorganic* bodies. Of the former we have an example in any plant or animal. A stone, water, the air, are illustrations of the latter.

17. The first, ANIMATE or ORGANIC bodies, are characterised,—1st, by possessing an *organic structure;* that is, being composed of a TISSUE OF CELLS, OR CELLS AND TUBES THROUGH WHICH FLUIDS CAN CIRCULATE; and, in most cases, consisting of a variety of organs, differing from each other in form and structure, and adapted to different uses,—being thus of a *heterogeneous* structure. 2d, By their power of *assimilation*, that is, introducing into their internal parts new matter differing from their own, forming it into tissue similar to their own, and rendering it a part of themselves. They thus grow, or increase in size, by taking new matter within, or *intus-susception.* 3d, By their power of suspending and resisting to a certain extent the usual action of external agents, and of their own elements upon each other. 4th, By performing certain actions or functions, and presenting a continual series of changes during the course of their existence.

18. Where these four features are presented, there is the principle of LIFE: the object is an organized and living being.

19. There are other interesting characteristics of animate bodies. 5. They have the power of reproduction, that is, of forming a being of the same nature as themselves. 6. They possess, within certain limits, the power of repairing parts which have been mutilated by injuries or disease. 7.

They decay or die at some definite period, the same in the same kind, and apparently not from the action of external forces (?), but from the simple exhaustion of their organs; being then decomposed, that is, resolved into the condition of inorganic matter, and obeying the laws to which it is subject. 8. Their integrant parts are (generally) so mutually dependant, that a small portion detached cannot maintain a separate existence. 9. They consist of solid and fluid parts, intermixed according to a regular order. 10. Their chemical composition is very complex. 11. Their bulk is limited in each kind. 12. Their external surface is smooth and rounded, seldom formed into a regular plane or angle —never crystalline. 13. They cannot be formed by artificial means.

20. Inanimate or Inorganic Bodies, constituting what is commonly termed "the Mineral Kingdom," are very different. They are of a *homogeneous* texture, each being all solid, all fluid, or all aerial, and their particles being similar throughout in form, arrangement, and chemical composition. They grow* by the addition of matter already similar to their own, and only at their external surface (by *juxta-position.)* They have no power of resisting external agencies. They have no power of reproduction. They cannot restore any parts that may have been injured. They have no definite period of decay, being capable of existing unchanged for an unlimited period, when not subjected to any external destroying influence. Any part detached possesses the properties which belong to the whole, and can maintain an independent existence. They are comparatively simple in chemical composition. They are unlimited in size. Their external surface is angular, and they tend to a crystalline form. Many of them can be formed by artificial means.

21. The following table will present a more striking view

* By the growth of minerals is meant their increase in size from the adherence of new matter externally, as in the formation of crystals.

of the leading distinctions between Organic and Inorganic bodies:

Organic.	Inorganic.
Structure Heterogeneous.	Structure Homogeneous.
Grow by intussusception and assimilation.	Grow by simple juxtaposition.
Perform a series of actions.	May remain inactive.
Under the influence of *vital laws*, which for a time resist or modify the usual action of the chemical and mechanical laws.	Solely obedient to the ordinary physical laws, (chemical and mechanical.)
Can form a similar being.	Have no reproductive power.
Can repair injured parts.	Cannot repair injured parts.
Duration definite.	Duration indefinite.
Integrant parts are dependent on each other.	Integrant parts can maintain a separate existence.
Consist of fluids and solids.	Consist of fluids alone, or solids alone.
Chemical composition complex.	Chemical composition simple.
Size limited.	Size unlimited.
Form rounded.	Form angular.
Cannot be formed artificially.	May be formed artificially.

22. Such are the leading distinctions between organic and inorganic bodies. The former are divided into two great classes,

Animals, and
Vegetables.

Sensibility, or the consciousness of existence, sensation of impressions from without, and a power of voluntary locomotion, are the general characteristics of Animals. Vegetables, on the other hand, while they are acted upon by air, light, and soil, are destitute of any consciousness of existence, are endowed only with a dull and very limited sensation, and their only motive power is the property of contracting on the application of an external stimulus, termed IRRITABILITY. This property is found in parts of some plants. But no locomotive power is observed in them.

23. As a general distinction, the concise definition by Linnæus is admirable, "Minerals grow; Vegetables grow and live; Animals grow, live, and have feeling." These differences, so well marked in the higher orders of each, as a TREE, a MAN, disappear in the lower grades, where the animal and vegetable kingdoms approximate, and it is often very difficult to distinguish them from each other. It is thus impossible to give diagnostic marks between these two great divisions of animate nature, which shall include all the genera, because some of the tribes resemble each other so much. They meet at the lower series of the scale in each, and pass insensibly into each other. Many of the Polypi are entirely destitute of the power of voluntary motion, and would appear to be almost destitute of sensation; while some of the lower tribes of Algæ, as the Oscillatoriæ, possess irritability in so high a degree that some have proposed to class them in the animal kingdom. The *Polypi vaginanti* were placed among vegetables in Tournefort's arrangement; and *Sponges* are considered as animals by some, while others regard them as plants. Lately, some species of *Confervæ*, formerly regarded as plants, have been removed from vegetables and placed among the simplest tribes of the animal kingdom, by the eminent naturalist, Bory de St. Vincent. It has been conjectured that there are particular forms of organic germs which can produce either animals or vegetables. Some cryptogamic botanists hold the singular doctrine, that in some instances, metamorphoses of plants into animals, and of these animals into plants again, occasionally take place. And Agardh threw out the conjecture, that the mineral kingdom approaches the other two classes of nature, in some of the simpler Algæ, which have somewhat of a crystalline texture.

24. This difficulty of diagnosis, however, occurs only in

the simpler tribes of the animal and vegetable creation. In the HIGHER ORDERS, the differences are marked, as the following table will show :—

PLANTS.	ANIMALS.
Fixed to one spot.	Have the power of locomotion.
Devoid of sensibility or consciousness of existence.	Conscious of their existence.
Have no nervous system or senses for communication with the external world.	Possessed of a nervous system and senses.
May form new individuals from simple division of their trunk.	Cannot reproduce new individuals by division.
Can live on inorganic matter alone.	Feed only on organized bodies —animals and vegetables.
Have no internal cavity or sac (stomach) for receiving their food.	Have a stomach, or internal receptacle, into which their food is first received.
Contain much solid matter.	Contain a large proportion of fluids.
Consist of few elements.	Elements more numerous.
Carbon (charcoal) their leading element, and contain little nitrogen.	Contain a large proportion of nitrogen.
Slowly decomposed when dead.	Decomposed rapidly when dead
Simple in structure, and possessed of few organs.	Complex in structure, and with a great variety of organs.

25. Of the above, perhaps the most characteristic and universal point of distinction is, the absence in vegetables of a stomach or internal cavity, into which the food is introduced and remains a time for the first stage of digestion. This seems to be possessed by almost every animal.

26. Sir James Smith observes, "It is sufficient for the young student of natural history to know, that in every case in which he can be in doubt whether he has found a plant or one of the lower orders of animals, the simple experiment

of burning will decide the question. The smell of a burnt bone, coralline, or other animal substance, is so peculiar, that it can never be mistaken, nor does any known vegetable give out the same odour."

27. A remarkable property of vegetables, though not a means of diagnosis between them and animals, is *their great tenacity of life* ;—the length of time during which they can preserve the vital principle, as exemplified in seeds, bulbs, and grafts ;—the life and growth into a new plant of a part detached from the trunk ;—the readiness with which they throw out new parts, repair what appear to be very serious injuries, and adapt themselves to the most unfavourable circumstances. The operations of grafting, and of propagation by slips and layers, the sprouting of young shoots from trunks which have lost their connection with the soil, and other well known examples, might be adduced. A plant would seem to be a collection of vital germs united together, but not necessarily connected, each being capable of a separate existence when placed in a favourable situation.

28. Another peculiarity of plants may be observed in the extreme simplicity and uniformity of their internal structure, and the small number of separate organs by which their functions are carried on. This might be anticipated, since we have seen that the vital functions of plants are fewer and inferior to those of animals. In animals, we have heart and blood-vessels ; brain, spine, and nerves ; stomach, and intestinal canal ; and several other systems of organs ; which, differing in a marked degree in structure, point distinctly to different vital functions which they perform. Now, distinctly marked organs, or systems of organs, are few in plants. Those performing the most important parts, are spread over the whole plant, (as the bark), and are of an uniform structure every where ; and, such in general is the simplicity and minuteness of the organs which carry on the life of plants, that we have been unable to acquire a very complete knowledge of the functions of vegetables. All the parts

bear, in their minute structure, such an analogy to each other, that we cannot detect those structural differences, which are the first clue to the discovery of differences in function. Except in the case of the flowers, there is no part of the vegetable system in which the adaptation of structure to perform a certain function is exhibited with that clearness which strikes us in contemplating the system for the circulation of the blood, that for digestion, for respiration, for vision, for motion, for hearing, &c. in animals. Plants are much more than animals, of a homogeneous structure. Hence, our knowledge of the physiology of vegetables is very imperfect.

29. A very striking point of distinction between animals and vegetables, is found in the character of the nutriment by which they are supported. Animals derive their sustenance *solely*, from previously organised matter; while vegetables can live and flourish upon inorganic matter alone; and indeed their food may be considered, even when formed from organic substances, as reduced to an inorganic state before being taken in. Animals either live upon vegetables, or upon other animals, whose support has been derived from the vegetable kingdom. Indeed, not only do animals depend upon plants for their immediate subsistence; but it is by the growth and decay of successive series of plants, from the humblest tribes upwards, that a barren rock becomes covered with a soil, and that a poor soil is rendered capable of rearing those higher classes of vegetables which give support to the animal creation. Vegetables may exist (and do) where there are no animals, but without the vegetable creation the race of animals would soon become extinct. It is observed by Mirbel, who pointed out this interesting contrast between the two organic kingdoms of nature, "it should seem to be the office of vegetable life alone to transform dead matter into organized living bodies." In this respect, the vegetable creation forms the link between inert inorganic matter, and the animal or higher order of organic

bodies. Plants may be thus designated—the pioneers of the organic creation—the first links in the great chain of life.

30. Plants, then, occupy a station intermediate between *inorganic matter* and *animals;* differing from the former in possessing LIFE (18), and from the latter in being destitute of the higher and more complex vital functions with which animals are endowed.

31. Generally speaking, a plant may be defined as a living being, destitute of sensation and any power of voluntary motion, arising from the growth of a SEED or BUD, consisting of a tissue of CELLS, or CELLS and TUBES, which contain and circulate fluids, fixed to one spot by a ROOT, from which a stalk or STEM grows upwards, which bears and spreads out to air and light, LEAVES and FLOWERS, from the latter of which proceeds the FRUIT, containing the SEED, similar to that from which the plant sprung, and capable, when placed in a fit situation, of becoming a similar plant. This general description, while it includes most of the familiarly known tribes of plants, still excludes a certain class of vegetables. But it applies to the best known—the *flowering plants.*

PART I.

GENERAL PHYTOLOGY;

EMBRACING

VEGETABLE ANATOMY AND VEGETABLE PHYSIOLOGY.

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32. This first part of our work we shall divide into six Sections.

I. Ultimate Anatomy of Vegetables.
II. Anatomy of the Nutritive Organs.
III. Physiology of the Nutritive Organs.
IV. Anatomy of the Reproductive Organs.
V. Physiology of the Reproductive Organs.
VI. Chemical Composition of Vegetables.

33. As the words of a language are made of varying combinations of a few simple letters; as the chemist forms his endless products of a few simple elements; so the varied organs of the vegetable are made up of a few simple structures or *tissues*, to which, by continued dissection, they may all be reduced. When we have arrived at these, we can go no further. These simple tissues pervade the whole vege-

table, and as they are the ultimate results of the separation of parts and examination of structure which constitutes *Anatomy*; the description of these may be termed the ULTIMATE ANATOMY OF VEGETABLES.

34. The varied organs, familiar to every one as distinct parts of the plant, the root, leaf, flower, seed, &c. are conveniently divided into two sections, the NUTRITIVE and the REPRODUCTIVE Organs; and the physiology of these, treated separately from the Anatomy or simple description of the organs, gives the four Sections, 2d—5th, above.

35. The progress of chemistry has unfolded so much of the chemical constitution of plants, that this branch cannot be overlooked in a general account of the vegetable creation. Accordingly, a sixth section is added, containing an account of the general chemical composition of the leading varieties of organs and secretions of vegetables.

SECTION I.

ULTIMATE ANATOMY OF VEGETABLES.

36. VEGETABLES are composed of solids and fluids. The former give firmness and stability to the vegetable frame; according to their mode of arrangement, determine the peculiar structure and form of the plant; contain and circulate the vegetable juices; and deposit them in their proper places. The fluids support the life, and continue the growth of the vegetable, by supplying it with nutritious matter. This matter is modified, and deposited in appropriate situations by the previously existing solids, excited to action by peculiar stimuli, and regulated by the vital principle; and thus forms successively the various solid parts and fluid secretions which constitute the vegetable.

37. The solid part of plants, from whatever quarter it be taken, when minutely examined, is found to consist of an assemblage of very small cavities, bounded by an extremely delicate film or layer of vegetable matter, termed MEMBRANE. The whole plant consists of a tissue of such cavities, varying in form from a *sphere* to an *elongated tube*, and frequently having an extremely slender vegetable FIBRE crossing or wound round the sides of the cavity. In dissecting any part of a plant, we can proceed no further in the separation of parts; and, accordingly, MEMBRANE and FIBRE are the last (or ultimate) structural constituents of the vegetable tissue.

VEGETABLE MEMBRANE.

38. This is an exceedingly fine delicate film, generally transparent, but occasionally with a greenish hue. It pre-

sents no apertures or passages through it, which can be detected by our present means of examination, though, from the phenomena of vegetation, there can be no doubt that it is capable of giving liquids a passage through its substance. The cavities which it forms frequently contain fluids, which afterwards disappear from them. It does not in general present any tendency to divide in one direction more than another; so that at present it is regarded as a primary or elementary form of vegetable matter.

39. Dots observed on the elementary membrane have sometimes been conjectured to be apertures for the passage of fluids; but it is now generally supposed that these are merely thicker or thinner parts of the membrane, or small grains of vegetable matter adhering to it, or arise from the modification of the vegetable fibre on the membrane, more or less adhering to it at different parts.

VEGETABLE FIBRE.

40. This seems to be another primary form of vegetable matter, appearing as a slender thread, of extreme tenuity, supposed to be somewhat less than 1-1000th of an inch in diameter. It is not determined whether it is more generally solid or hollow. If the latter, it must then be regarded as a form of membrane. It has a general tendency to assume a spiral form, is sometimes straight, and occasionally bent or somewhat hooked at the extremity. Sometimes it is branched.

41. These two elementary textures present the ultimate product of the separation of the parts of vegetables. They are the structural (or anatomical) elements of vegetable organs—the simplest of those parts, which, by the variety of modes in which they are folded or arranged, constitute the plant. The next simplest parts—being the first stage beyond membrane and fibre, are generally termed TISSUES. The tissues may be conveniently arranged under two heads—CELLS and TUBES, as was customary till lately. Now, a

third tissue, intermediate between these two, is generally added; so that there are three vegetable tissues to be described.

Cellular Tissue,
Woody Tissue,
Vascular Tissue.

42. Of these, though ultimately sufficiently distinct, cellular tissue is believed to be the origin or basis: it is the only tissue universally found in plants, and is often the only tissue in parts in which the other forms become afterwards developed; as, for example, in seeds.

I.—CELLULAR TISSUE.

43. The cellular tissue consists of a series of spheres, cells, or short tubes—promiscuously termed Cells—adjoining and adhering to each other, formed of the thin, transparent, and colourless vegetable membrane, and having occasionally fibre wound round their inner surface. Each cell is complete in itself, the wall or partition between two adjoining cells being, therefore, formed originally of two layers of membrane, though sometimes incorporated in one layer. The partitions may often be separated by boiling the cells of pith or soft pulpy fruits in water or in nitric acid. As already mentioned, under membrane, there are no visible pores in the sides of the cells, though there is no doubt that they give passage to fluids. The function of the cellular tissue is to contain fluids, and give them a passage in all directions.

44. The primitive form of the cells is that of a sphere, or spheroid, but the shape is altered by various circumstances, particularly by the pressure to which they are exposed. In the leaf, where the tissue is loose and open, and there is little pressure upon it, the cell is nearly round or globular.

In the medulla or pith, where the cells are exposed to considerable pressure, but that pressure is tolerably equal on every side; each cell being pressed upon by twelve surrounding cells, its sides are flattened at the points of contact, and it becomes the plane twelve sided figure called a *rhomboidal dodecahedron*—a figure which presents a hexagonal section. In the wood and bark, which contain *woody tissue* and *vascular tissue* as well as cells, and where the pressure is chiefly lateral, the cells become elongated, and are stretched out into a tubular or cylindrical form, frequently tapering at the extremity.

45. In many cases the cells or vesicles have a fibre wound spirally round their inner surface. The coils of the fibre are sometimes close to each other, sometimes a little apart; in some instances the coils cross each other, and they are occasionally branched. The coils of the fibre are sometimes closely united at one part, and separate at others, which gives the appearance of slits, or dots on the side of the cell; and Mr. Slack, who has studied with great care the cells with streaks, &c. on their sides, refers the appearances of dots or pores in the sides of the cells, to the different ways in which the vegetable fibre passes over the surface of the membrane, closely incorporated with it at some places, projecting at others, crossing and interlacing, &c.

46. The cellular tissue was formerly called *pulp* or *parenchyma*. To the elongated tapering form of cells which overlap each other at the extremities, found in the wood and bark, LINK applies the term *prosenchyma*. These are also called *fusiform* cells or *closters*. He confines the term *parenchyma*, to the cells of the leaves, pith, medullary rays, &c., in which, though occasionally elongated, they do not taper and overlap at the extremities, but fit more or less compactly to each other. And all the soft succulent parts, as fruits, where the tissue is not much exposed to pressure, contain much parenchymatous cellular tissue.

47. In some forms of elongated cellular tissue, the extremities of the cells become ruptured or obliterated, and they

then form continuous tubes of considerable length; retaining at the sides the marks of the partitions which formerly divided them into short cylindrical cells. These are found chiefly in the wood. They were formerly considered as belonging to the vascular tissue, and were termed *dotted ducts*, *beaded* VESSELS. They are now called VASIFORM *tissue*. They form the largest tubes found in the vegetable tissue; it is the section of the vasiform tissue which presents the large apertures seen in a section of the oak, cane, or other stems of plants. The dots on the sides are *granules*, or are caused by a fibre winding round them, adhering intimately at some parts, and more loose and somewhat detached at other parts. This tissue gives passage to fluids.

48. Besides the cellular tissue formed of membrane, there are some varieties in which a fibre is seen developed on the inner surface of the cell. And even fibre alone has been, in some instances, observed, coiled up into a sort of cell or vesicle. Thus there are three varieties of the cellular tissue—membrane alone—membrane and fibre—fibre.

49. The cellular tissue formed of membrane alone is by far the most abundant. The other varieties, particularly that consisting of fibre alone, are comparatively rare. When cellular tissue is spoken of, it is usually the membranous variety that is meant.

50. In size, the cells vary considerably—usually from 1-300th to 1-1000th part of an inch in diameter. A common size is 1-400th. In plants in general, they are largest in the pith or medulla. They are usually large in aquatic plants, being sometimes found there not less than 1-30th inch in diameter. In the family Cucurbitaceæ also they are large. The tapering cells of the Prosenchyma are sometimes not more than 1-3000th inch in diameter.

51. Frequently the cells do not adhere to each other at every point, in which case, there are spaces between them. These are termed "intercellular spaces." If a number of these spaces are placed successively above one another, they constitute tubes, or passages, termed "intercellular canals."

These were supposed by M. Kieser, to be the principal channels through which the sap ascends. The "vital vessels," or "ducts of the latex" of M. Schultz, which are found in the bark near the surface, and anastomose (branch and join frequently), are considered by some to be intercellular canals.

52. These intercellular passages are frequently distended, and form large cavities, filled with the peculiar secretions of the plant. These were formerly termed *proper vessels*, (vasa propria), from containing the proper juice. They are of various forms, round, cylindrical, &c. The term "receptacles" is now frequently applied to them, as they contain the peculiar secretions, or detached fluids, as oils, belonging to the plant.

53. Some plants, particularly aquatics, present a regular series of cells of a very large size, filled with air. These are termed *air-cells*, or *lacunæ*, and are supposed by some to be caused by rupture of the cellular tissue, by others, to be distensions of the intercellular spaces. They assist in elevating aquatics towards the surface of the water.

54. The contents of the cellular tissue are generally fluids. In many parts they contain small *granules* or *globules*, scattered through the liquid, which remain attached to the sides of the cell after the liquid has disappeared, and the cell is dry. These globules are of a greenish colour, and along with green coloured fluid, are the source of the colour in the parts of a greenish hue. In other parts the colour seems to be entirely owing to the liquid the cells contain, as in the colours of flowers, the sides of the cells themselves being colourless. Granules found in the cellular tissue are regarded by Turpin and Raspail, as the source of the growth of cellular tissue—as young cellules—the seeds, as it were, of the future cells or vesicles. They are called *globuline* by Turpin. They are supposed to constitute starch.

55. Scattered through the cellular tissue, in the intercellular passages, according to some, and in the cells, according to others, needle-shaped crystals are often found, termed *Raphides*. They are composed, some of phosphate of lime,

some of oxalate of lime. They have been observed in the juice of the Hyacinth, the Euphorbiaceæ, some species of Cactus and Rhubarb, the Mirabilis jalapa, and many other plants.

56. The cellular tissue, seems, from the observations of Mirbel, to be formed by the power of each cell in developing new ones, so that they are more or less connected with each other, and may all be the product of one primitive vesicle. The new cellules are in some cases developed with truly wonderful rapidity. From a statement given by Junghuns, that he has seen the mushroon *Bovista giganteum* grow in a single night from a mere point, to the size of a large gourd, Dr. Lindley calculates that " its bladders must have developed at the rate of near 4,000,000,000 per hour, or of more than sixty-six millions in a minute."

57. The membranous cellular tissue is found in all vegetables, forming a very considerable part of their substance; and there are many, as sea-weeds (algae), mushrooms (fungi), lichens, which are composed of it alone.

58. In the flowering (Phenogamic), or cotyledonous plants, it is conjoined with woody tissue, and vascular tissue. The central portion or pith (medulla), of dicotyledonous trees, the medullary rays, which extend transversely from the pith to the bark, and the matter occupying the space between the veins of the leaves, are formed of the cellular tissue. And it is found compressed and elongated in the wood and bark, forming longitudinally, cylindrical layers between each layer of vascular tissue.

59. According to De Candolle, the cells perform in the economy of the plant, the important part of conveying the sap upwards, being possessed of an organic contractility, by which they effect its ascent.

II.—WOODY TISSUE.

60. This form of tissue consists of tubes of extreme tenuity, and great length, varying in diameter from the 1-200th to the 1-3000th of an inch, tapering towards each extremity, exhibiting no visible pores, and possessed of extreme tenacity. It is regarded by many as merely elongated cellular tissue, but differs in three points, the length of the tubes, their extreme tenuity, and their great toughness or strength. It may be termed *fibrous tissue*, as the tubes are arranged in parallel lines in bundles, and readily split into smaller and smaller fibres. As the fibres lie in the direction of the stem, in cutting wood it is easy to split it longitudinally, because we then simply separate adjoining fibres; but if attempting to divide it transversely, this is not so easily effected, as we must then cut them across, and rupture their substance.

61. It is this tissue that gives strength and toughness to vegetable fibre, and it is very abundant in those plants which afford good material for the manufacture of ropes, linen, &c. Of the plants used for this purpose, New Zealand flax *(Phormium tenax)*, affords the strongest material. The following table by Labillardiere, shews the comparative strength of different vegetable fibres, by the comparative weights which threads of each could bear without breaking.

New Zealand Flax, ...	23.8
Hemp *(Cannabis sativa)*, . . .	16.3
Flax *(Linum usitatissimum)*, . .	11.75
Pita Flax *(Agave Americana))* . .	7.

Silk is stronger than either of these, 34. being the proportion of its tenacity to the above. Cotton is composed chiefly of cellular tissue, and is very inferior in tenacity.

62. The most simple form of woody tissue is that of a plain fibre, without glands or any granules adhering to it. In many plants it is found with granules, once considered as

pores, but now looked upon as adhering particles. In other plants, particularly Coniferae, globules, with a darkness towards the centre, are found in the sides of the fibre. These are termed *glands.* Some say that the appearance of glands is owing to thin spaces in the membrane forming the sides of the tubes.

63. Woody tissue forms a principal part of all tough woody parts, as the wood, the bark, the veins of the leaves, &c. It gives strength and tenacity, and also transmits fluids through its fibres.

III.—VASCULAR TISSUE.

64. The vascular tissue consists of bundles of tubes or vessels. Each tube is formed of one layer or more of membrane; tapers, and is conical towards its extremity; and has a fibre developed in a spiral form on its inner surface, or is marked transversely on its sides by streaks or lines, showing a tendency to a spiral arrangement. The conical extremities of the tubes overlap each other; and it has been conjectured that at the point where the extremity of a tube meets another tube, there is a perforation and communication between them. The vessels composing the vascular tissue are of two kinds—spiral vessels, and ducts.

65. Spiral Vessels, or Tracheæ. A spiral vessel consists of a tube of delicate elementary membrane, with a fibre coiled spirally within. If a ribbon be wound spirally round a cane, and the cane be pulled out, the ribbon will then represent the form of the fibre in the tube of a spiral vessel. The membranous side of the tube is exceedingly thin, and the fibre may be easily unrolled, the membrane tearing and adhering to it, and being hardly perceptible, except perhaps at the tapering extremity of the tube, where the distances between the coils of the fibre are greater.

66. Spiral vessels are found chiefly in the medullary sheath, in the veins of the leaves, in the flower, seldom in

the bark or root, and in no flowerless plants, excepting Ferns *(Filices)*, and Club-mosses *(Lycopodiaceæ)*. Plants have been divided into two great classes—*Vasculares*, plants with spirals, and *Cellulares*, plants in which that peculiar form of vessel cannot be detected. Their average diameter is about 1-1000th of an inch; but they are frequently larger or smaller. They contain gaseous fluid, said to be air with about eight per cent. more oxygen than is found in atmospheric air.

67. The spiral vessels may be observed in many plants by tearing the leaves gently. In the leaves of several kinds of Amaryllis, they may be easily detected, or in the Strawberry leaf or its stalk. They are abundant in the stems of the Banana and the Plantain.

68. Ducts, False Spirals, or Sap-vessels. These are a modification of the spiral vessel, having transverse streaks or dots, or a sort of net-work, on their sides, arranged in a somewhat spiral manner; but the tube is not capable of being unrolled like the true spiral. These appearances on the sides of the ducts are most probably owing to the varieties in the course or mode of attachment of the spiral fibre along the membrane forming the side of the tube. Some vessels are true spirals at one part, and false spirals or ducts at another. They are found in the wood in flowering plants, and in Ferns and Club-mosses among the flowerless plants.

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69. Notwithstanding the infinite variety in form and texture observed in the various organs of the objects which compose the vegetable creation, they all consist of these three tissues, which, by their union in various ways, form those distinct parts (familiar to every one as separate parts of the plant) which are called Root, Stem, Leaves, Flowers, Fruit, Seed. These may be called *secondary*, *compound*, or *complex* organs, because they are capable of being resolved into these three primary or simple tissues.

Of the Compound Organs.

70. These are the Root, the Stem, the Buds, the Leaves, the Flower, the Fruit, the Seed. They originate from the growth of a SEED or a BUD, each of which, when exposed in a fit situation to the action of certain stimuli, being endowed with a vital principle, is capable of enlarging and developing a plant presenting the various compound organs. The growth of a seed or bud is termed *vegetation.* The compound organs may be divided into two great classes—the *Nutritive Organs* and the *Reproductive Organs.* The former, consisting of the root, stem, and leaves, serve for the support and growth of the vegetable. The latter, consisting of the several parts of the Flower and Fruit, form the seed, or rudiment of a new plant, similar to that which produced it.

71. Plants are conveniently divided into several great classes, the leading characters of which it may be well to describe briefly before commencing the details.

There are two great divisions, which may each be described by several characters :—

1*st Division.*	2*d Division.*
FLOWERLESS,	FLOWERING,
(Cryptogamic),	(Phenogamic),
ACOTYLEDONOUS,	COTYLEDONOUS,
(without cotyledons in the seed),	(having cotyledons),
ACROGENOUS,	END- or EX-OGENOUS,
CELLULAR.	VASCULAR.

The Flowerless class comprises the Ferns, Mosses, Mushrooms, Lichens, Sea-weeds, &c.

The Flowering class are the common herbs, trees, &c. distinguished by having organs called *stamens* and *pistils,* (usually attended by what is popularly termed a flower,) which produce a seed having seed-lobes or cotyledons; as the Pea, the Lily, Wallflower, the Violet, Oak, Sycamore, Lilac, &c.

The seeds of the Flowerless plants have no cotyledons, being a simple homogeneous mass of vegetable tissue, and grow like buds on the plant, not being preceded by stamens and pistils or a flower.

Flowerless plants are Acotyledonous, Acrogenous (growing by simple addition to the external part of their substance), and mostly cellular; some few are vascular (66). Flowering plants are Cotyledonous, Endogenous or Exogenous (see next paragraph), and all are vascular.

Flowering plants are divided into two great classes:—

1. MONOCOTYLEDONS or ENDOGENS.	2. DICOTYLEDONS or EXOGENS.

The Monocotyledons (*monos*, one) have only one cotyledon or seed-lobe, and have a peculiar manner of growth, termed ENDOGENOUS. Palms, Aloe, Grasses, Rushes, Lilies, Tulips, Hyacinth, Crocus, Iris, illustrate the Monocotyledonous tribe.

The Dicotyledons (*dis*, two) have two cotyledons or seed-lobes, (as in the seed of the common pea or bean,) and increase in diameter in a manner termed EXOGENOUS. Oak, Ash, and all the trees of this country, Lupin, Foxglove, Poppy, Wallflower, Hemlock, Crowfoot, illustrate the Dicotyledonous tribe.

72. All the organs of plants are, with one or two slight exceptions, covered by a thin layer, termed the cuticle, somewhat resembling the scarf-skin or cuticle of animals. This, which is common to them all, must be described before proceeding to the description of the individual organs.

THE CUTICLE.

73. This is a layer of cellular tissue, having a membranous appearance, the cells being condensed and extremely compact, so that there is scarcely any trace of them. It is found on all parts of the plant excepting the extremities of the spongioles, the stigma, and those parts which are con-

stantly submersed. It may be loosened and detached from the leaves after macerating them in water for a day or two.

74. The epidermis or cuticle has been very carefully examined by M. Adolphe Brongniart, who found it to consist essentially of two distinct parts, an outer film or membrane, extremely thin and delicate, apparently without any marks of organic structure, and an interior layer of flattened vesicles in close contact with each other, excepting at the extremities. The lines or marking on the outer pellicle are produced by the cells or vesicles beneath. They are often hexagonal, sometimes sinous (waving), and frequently have an irregular reticulated appearance. This thin membrane has been observed particularly in the cabbage leaf, and in digitalis. At those places where the vesicles are not in contact, there are slits in the thin pellicle above, and beneath these, peculiar passages or apertures which have been termed STOMATA, opening into the intercellular spaces between the vesicles.

75. Each of these apertures or stomata consists of two vesicles, lunate (of the form of the new moon,) or kidney-shaped, touching at the extremities, with the concave sides towards each other, an oval opening being thus left between them. They are in some plants quadrangular. When these semilunar vesicles are distended, with moisture or otherwise, the opening between them will be very much contracted or altogether shut. When they are dry and shrivelled the aperture will be open and larger in proportion to the shrinking of the vesicles. Water, or a moist atmosphere, closes the stomata. They are supposed to be open in dry weather or during sunshine. The pores or stomata give free passage to moisture, and, probably, are the medium through which the important function of respiration is carried on.

76. The stomata are found chiefly on parts exposed to the air, and which evaporate freely. They are very abundant on leaves, chiefly on the lower surface, and on the petals and the sepals of the flower. Roots, fleshy fruits and seeds,

and those parts of aquatics which are submersed, are destitute of stomata. They are absent in many parasitic plants: and mosses, mushrooms, sea-weeds, and lichens also appear to have no stomata.

77. It is considered by some eminent vegetable anatomists, that the stomata are not perforations, but simply thinner and more transparent spots, while others describe them as glands.

78. The cuticle protects the parts beneath from the too direct action of air and water, and prevents too great evaporation of the fluids. It affords little protection from the action of heat or cold, except when covered by a thick hair or wool, as in the great mullein. In young shoots or stems it is distinct and entire: but is soon distended, torn, and pushed off: and dead layers of bark occupy its place.

79. " In forest trees, and in the larger shrubs, the bodies of which are firm and of a strong texture, it is a part of little importance: but in the reeds, the grasses, canes, and the plants having hollow stalks, it is of great use, and is exceedingly strong: and, by the microscope, seems composed of a kind of glassy network, which is principally siliceous earth. This is the case in Wheat, in the Oat, in different species of Equisetum, and, above all, in the Rattan, the epidermis of which contains a sufficient quantity of flint to give light when struck by steel. The siliceous epidermis serves as a support, protects the bark from the action of insects, and seems to perform a part in the economy of these feeble vegetable tribes, similar to that performed in the animal kingdom by the shell of the crustaceous insects. I have ascertained by experiment that siliceous earth generally exists in the epidermis of the hollow plants."* The Bamboo *(Arundo bambos)* contains much silica, called " tabasheer." In the bulbs of some orchideous plants, the epidermis is extremely hard.

* Sir Humphrey Davy's Agricultural Chemistry.

SECTION II.

ANATOMY OF THE NUTRITIVE ORGANS.

80. The nutritive organs have for their object, the growth and preservation of life in the vegetable. The root draws nutritive fluids from the earth. The stem transmits them to the leaves, modifying them probably in their passage through it. The leaves render them fit for the nutrition of the plant. These parts originate from a seed or bud, (70), which, when it begins to grow, enlarges in three directions, downwards, forming the *root*, or descending axis; upwards forming the *stem*, or ascending axis; and these two parts, at the same time, extend laterally. The point between the root and stem, from which the two axes are supposed to elongate, is called the *life-knot*, or *neck*, or *collet*, by the French. This, which is a distinctly marked point in the seed, when first beginning to sprout, becomes afterwards lost in a manner, between stem and root.

CHAP. I.—THE ROOT *(RADIX.)*

81. This is the lower extremity of the plant: fixes it to the soil or to the substance on which it grows, preventing it being rooted up or upset by animals or the wind; absorbs nutritious matter for its support; and excretes or gives out any noxious or useless matters.

82. Almost all plants are provided with distinct roots, except some of the simpler kinds, which absorb nutritious matter at every point, and seem to have stem, leaf, root, all in one homogeneous mass.

83. As commonly spoken of, consisting of all that part which is under the surface of the soil, it may be divided into

three parts:—the caudex, body, or middle part, sometimes much enlarged, as in the Turnip and Carrot;—the collar, collet, crown, or life-knot, the place where the root and stem are joined, which may be considered either the lower part of the stem or upper part of the root, and from which, in perennial roots the bud of the annual stem springs;—and the radicles, fibrils, rootlets, or small fibres, in which the root terminates inferiorly.

84. The radicles or fibrils are always present, and are *essential*, as it is these alone that imbibe nutritious matter from the soil. They constitute the true root. This absorbing power resides in the extremity of each radicle, at which part there is an expansion of the cellular tissue, called a spongiole, provided with numerous pores, through which the fluids pass. A simple experiment, performed by Senebier, shows this. He took a radish, bent it, and placed the curve in water, the extremity of the root being above the surface of the water. It soon began to fade. But on placing the extremity of the fibre in water, the remainder being out of the water, it lived and throve well. The fibrils are composed of cellular tissue and ducts.

85. Roots are divided, according to their duration, into *Annual*, *Biennial*, and *Perennial* roots.

86. Annual roots produce the herbage, flowers, and fruit in one season, and then entirely perish. Barley *(Hordeum)* and the Red Poppy *(Papaver rhœas)* are examples. These often consist merely of a bunch of rootlets, as in the grasses.

87. Biennial roots produce herbage in the first summer, live through the ensuing winter, bring forth flowers and fruit next summer, and then entirely die, Carrot *(Daucus carota)*, Foxglove *(Digitalis.)* They are of a more substantial nature than the preceding.

88. If an annual or biennial do not produce its seed in the usual season, and the ensuing winter be mild, it sometimes survives to the following summer, when it will bear seed and perish. It is after the seed is perfected that annuals and biennials wither and die.

89. Perennial roots are those of plants which bear leaves and flowers during many successive years, as trees, and many herbaceous plants: but the term is more generally applied to those roots which annually send forth herbaceous stems, which flourish and die in one season: Asparagus. The annual stem dies down to the neck or life-knot, from which, in the ensuing season, another arises, the root having retained its vitality.

90. The small fibres, which terminate the plant inferiorly, are supposed, in every case, to be annual, being destroyed by the cold of winter, and renewed in spring to perform their important functions.

91. Hence the proper period for transplantation is during winter, when the plant is in a manner in a torpid state, before it has begun to throw out new fibres. Should the air be full of moisture at the time, new fibres may be formed in time to prevent the injury of the tree by evaporation, as this goes on slowly in a moist atmosphere. In a dry atmosphere, the juices are so quickly dissipated that the plant will be seriously injured before new spongioles can be formed to supply the loss by evaporation.

92. Some annual roots vegetate for two years or more, when transferred to a warmer climate and a richer soil: and perennial plants frequently become annual when transferred from a warm to a cold climate. The Castor-oil plant (*Ricinus communis* or *Palma Christi*), the Mignonette (*Reseda odorata*), and the Indian Cress (*Tropæolum majus*), are perennial, or even woody trees or shrubs in their native countries, but annual in our cold climate.

93. According to their form and structure, roots have been divided into seven kinds, the Fibrous, the Creeping, the Fusiform, the Abrupt, the Tuberous, the Bulbous, and the Granulated. When these kinds of roots are spoken of, it must be borne in mind, that, by the term Root, is meant "all that part of a plant which is under the surface of the earth," the situation and form of the part being referred to,

and not its structure or function. By the term "true root," is meant the fibres which absorb the fluids from the soil.

94. FIBROUS ROOT. This is the most simple of all roots, being composed merely of a great number of small fibres, as in most of the Grasses, Wheat, Oats, Barley, and many other annual herbs. This kind of root is found chiefly in monocotyledonous plants. When a fibrous root grows in a loose sandy soil, it often becomes covered with a fine down, which fixes it better, and increases the number of absorbing mouths. A fibrous root coming in contact with a stream of water, becomes elongated and capillary, presenting what is sometimes termed *foxtail.*

95. CREEPING ROOT (*repens*). This may be considered a kind of subterraneous stem, creeping horizontally under the surface of the ground, and putting out as it goes along numerous fibres, which constitute the true root; Couch Grass *(Triticum repens)*, Mint *(Mentha.)* See Stem.

96. FUSIFORM ROOT, or Tap Root. The Radish, Parsnip, and Carrot, are examples of this kind. The spindle-shaped or tapering part is the caudex or body; and this may be compared to the stem, as it contains the sap and proper juices of the vegetable, the red part of the carrot being analogous to the bark of true stems, while the real roots are the small fibres or radicles which it throws out on all sides, as they alone draw nourishment from the soil.

97. Vertical roots, such as these, are found only in dicotyledonous plants.

98. ABRUPT ROOT *(præmorsa)* appears as if it had inclined to descend perpendicularly, like the Raddish or Carrot, but had met some interruption which caused it to terminate abruptly; Devil's Bit Scabious *(Scabiosa succisa).*

99. TUBEROUS ROOT. This term is applied to roots, or rather subterraneous stems or branches, which have at different points fleshy swellings, enlargements, or tubercles. These are not true roots—they do not draw nutritious matter from the earth. They are stores of nutritious vegetable

matter, intended to nourish the herb of the ensuing season, and accordingly are found only in perennial plants. Potato *(Solanum tuberosa)*, Orchis, Common Dropwort *(Spirea filipendula)*, are examples.

100. Those tubercles which have eyes may be considered thick, short, fleshy, subterraneous stems; the eyes on their surface being analogous to the buds on the stem. The Potato is propagated by means of these fleshy tubercles; and only those parts of the mass which have eyes (concealed buds) have the power of producing new plants.

101. In the Orchis, which has two tubercles, and the stem of which dies annually, one of the tubercles affords nourishment to the annual stem, shrinks, and disappears. The other contains nutritious matter for the growth of the stem of the succeeding season, and disappears in its turn; and gradually a third is formed to serve the same office in the ensuing season: and so on for many successive years.

102. When there are two tubercles, the root is called *twin* or *didymate:* Military Orchis. When the tuber is divided deeply by fissures extending to the middle of its substance, presenting an appearance like the hand and fingers, it is called *palmate:* Spotted palmate Orchis *(Orchis maculata)*. When the tuber is divided still more deeply, it is called *digitate:* White Orchis *(Satyrium albidium, Habenaria albida* of Dr. Hooker.)

103. Bulbous Root. This root is of two kinds; *tunicate* or coated, consisting of concentric hollow spheres, as in Onion *(Allium)*, Squill *(Scilla)*, (See Fig. 7. next page); and *scaly* (squamosus) with scales covering each other like the slates on a house-top, as in the Lily *(Lilium)*. What is usually termed the solid bulb, as that of Buttercup *(Ranunculus bulbosus)*, Crocus, Meadow saffron *(Colchicum)*, is not formed of compressed or adherent scales, but is simply a globular fleshy subterraneous stem. It has been termed a *Cormus.*

Fig. 7.

104. The Bulbous root consists of a flat plate or disc, sending off from its under surface a bundle of fibres, or fibrous root (which is the true root), and supporting on its upper surface the bulb, which is a peculiar kind of bud. The bulb is found in perennial plants, and is a reservoir of nutritious matter for the new plant (which is contained in the centre of the bulb in the form of a bud), during the period when vegetation is suspended, and before the roots are able to draw sufficient nourishment for the development of the bud. Indeed it is a sort of subterranean stem. The scales are thicker and more fleshy the nearer they are to the centre, where the bud is lodged. The bulb was denominated by Linnæus, "the winter quarters of the future plant."

105. The Wild Tulip *(Tulipa sylvestris)* throws out from its root a long stout fibre, at the extremity of which a bulb grows. This bulb or bud soon becomes an entire and independent plant, at a considerable distance from the parent. At the base of the bulbs of the Snow-drop (*Galanthus nivalis*), or Lily, may be observed small bulbs, which afterwards become detached from the parent, and form independent plants. Bulbs often grow on the stem, as in the Orange Lily, in which situation they are termed *bulbils*.

106. In Ranunculus bulbosus, the bulb for the next season is formed above the old one—in Herminium monorchis, the new bulb is produced from the end of the rootlets. The

economy of Poa bulbosa is curious in this respect.—"This grass is peculiarly fitted to inhabit dry sandy ground. The bulbs grow in clusters, resembling little onions, and during most part of summer remain inactive, blown about at random. With the autumnal rains they vegetate, fix themselves by long downy radicles, then produce thick tufts of leaves (a grateful spring food for cattle); and in April or May they flower, having in the meanwhile formed young bulbs, which, as soon as the herbage withers, are dispersed like their predecessors."—*English Botany.*

107. The bulb is sometimes simple, consisting of one bud, as in the Tulip or in the Squill; in other cases several small bulbs are united together, as in Garlic (*Allium sativum*).

108. The bulb is found chiefly in monocotyledonous plants.

109. The tuber with eyes (buds) and bulb with the interior bud, must not be confounded with the tubercles found in the roots of some plants, as the Dropwort, which are mere reservoirs of nourishment. Some plants, which in ordinary situations, have no bulb or tuber, acquire one, as a storehouse, when they are in a dry situation, or one where their supplies of moisture are scanty and irregular; as Alopecurus geniculatus, the roots of which become bulbous, and Phleum pratense, in which the roots become swelled, and very succulent: the plant is then termed Phleum nodosum.

110. Granulated Root. This root has numerous small tubercles capable of reproducing the plant, but containing little nutritious matter: White Saxifrage (*Saxifraga granulata*).

111. This is sometimes called an *articulated root*, but this term is applied with more propriety to those having a jointed appearance, but without tubers.

112. Fibrous and fusiform roots are generally annual, but some tap-roots are biennial, as the Carrot; and a few of each kind are perennial. Creeping, Abrupt, Tuberous, Bulbous, and Granulated Roots, are always perennial; and should be regarded as subterraneous stems.

113. Thus it will be observed that perennial plants, which live during many seasons, have either a bulb, a tubercle, or a woody subterraneous stem, which preserves the vital principle during the suspension of vegetation, and contains a store of nutritious matter for the early growth of the new plant. A mere bundle of fibres would be unable to survive excessive cold or much moisture, could not contain a store of ready formed vegetable matter, and would not be adapted to convert readily the material drawn from the soil into proper nutritious matter. In every instance of the growth of a new plant, whether an entire plant from a seed, bulb, or bud, or herbage and flowers from a perennial root, there must be a stock of proper food ready for the young plant.

114. Plants of the genus Utricularia, present a singular appendage to the root in the form of small bladders, which at times become filled with air, and elevate the plant to the surface of the water in which it grows.

115. Almost all plants are provided with roots, except several of the lower orders, which, vegetating in water or on its surface, absorb nutritious matter at every point. Some plants which have roots float loosely in water, and are not fixed to any thing, as Duckweed *(Lemna.)* Aquatic plants, however, have generally two roots; one is buried in the earth and fixes the plant; and the other floats freely in the water, as Buckbean *(Menyanthes)*, and Water Lily *(Nymphæa)*. The Sea-weed tribe *(Algæ)* are in general fixed to rocks, from which they can draw no nutritious matter. Some plants which adhere to the branches of trees, drop roots into the air, not descending to the ground. These absorb nutritious matter, chiefly moisture, from the atmosphere.

116. Parasitical plants are those which insert their roots in other plants, and draw from them their nourishment: Broomrape *(Orobanche)*, Dodder *(Cuscuta)*, Misseltoe *(Viscum album)*. These are termed *true* parasitical plants. Others, as Lichens, the Ivy, which merely adhere to the plant on which they grow, not drawing nourishment from it, are termed *false* parasitical plants. In the latter, the root

where there is one, remains and absorbs nutriment from the soil. In the true parasite, as Dodder, the original root withers and falls away, as soon as the young plant has fixed itself to the other.

117. The root is formed by the growth of the *radicle*, the little conical body which is well seen between the cotyledons of many dicotyledonous seeds, as the Pea or Bean. It has a natural tendency to grow downwards, which exerts itself in every instance, except perhaps in the Misseltoe, in which the radicle always grows in a direction perpendicular to the axis of the body on which it may be placed.

118. The structure of the root is generally similar to that of the stem. It is destitute, however, of pores or stomata, organs which would be useless on this part of the plant. In exogenous plants it presents the bark and medullary rays, but no pith. It has no buds, scales, or leaves; or rather its buds do not develope as leaves, flowers, or branches, but as roots; and it is said to be destitute of spiral vessels. Some eminent vegetable anatomists, however, have discovered spirals in several roots; but they certainly are more rare in the root. Underground roots are never green. The root is considered to increase in length, only by addition at or very near to its extremity—not by the addition of new matter between parts already formed.

119. All parts of the root possess the power of emitting rootlets; and hence the primary root divides into many branches under ground, in the same manner as the stem does in the air. The root is thus enabled to draw more nutritious matter for the support of the plant, having more absorbing mouths or spongioles, and the command of a greater extent of soil. One of the principal uses of ploughing is to crumble down and divide the masses of earth, and enable the rootlets more easily to penetrate into the soil. The depths to which many roots descend, and the extent to which they spread, are surprising; the Dandelion, Lucern, and Rest-harrow, (so called from the toughness of its long roots,) are good illustrations of this.

120. The extension of the root enables some plants to perform an important office in the economy of nature, namely, protecting banks of rivers and coasts where there is much loose shifting sand, from being broken down by the winds or waves, and also preventing the neighbouring fields from being overrun with sand. The roots of many of the grasses (Carex arenaria, Elymus arenarius, Ammophila arundinacea, and others) run to a great extent under ground; and, being much entangled there, bind the loose sand, and form a coherent bank, which is better able to resist the action of the wind or encroachments of the ocean. In many places in England, the growth of these plants is encouraged with this view; and acts of Parliament have been passed for their preservation.

121. The stem and branches also possess this property of throwing out rootlets: if a branch be placed in the earth, or surrounded with earth on the tree, an incision being made in the bark, it will emit rootlets from its sides, and become, if properly treated, an entire and independent tree; hence the propagation of plants by slips and by layers. Many of the Grasses, as Indian Corn *(Zea mays)*, and the Sugar Cane (*Saccharum officinarum)*, emit from the knots on the stem, when these parts are surrounded with moist earth, rootlets capable of producing new plants. In this way the Sugar Cane is propagated. The famous Banyan tree of India affords a striking illustration of the power of branches in throwing out roots. These descend perpendicularly to the earth, where they take root, spread in the soil, and support the growth of the tree in the usual manner. The part between the branch and the ground increases in diameter after it has taken root, and becomes another stem, giving nutriment and firm support to the part with which it is connected, so that these can extend laterally still further from the main trunk. New roots descend from these extended branches, become new stems, and thus one tree spreads over a great extent of ground. One Banyan tree was found to throw a shadow at noon 1116 feet in circumference—being thus

about 350 feet in diameter. It had about fifty or sixty stems. Another covered a space of about 1700 square yards. On the other hand, roots often throw out stems, ascending into the air, and becoming independent plants, as the Poplar and some Elms, which throw up branches very freely; and particularly those roots called CREEPING—but in fact subterraneous stems—as the Couch grass. This is a very troublesome plant, difficult to eradicate; the root creeps horizontally under ground, shooting out at intervals herbage which takes root, and continuing its subterraneous course, spreads far and wide under ground.

122. The root, then, has three functions to perform,—1*st*, To fix the plant in the soil or to the substance on which it grows; 2*dly*, To absorb the nutritious matter necessary for the growth of the plant; 3*dly*, To discharge noxious or useless matters from the plant: This will be referred to under the Physiology of the Nutritive Organs.

123. I must here remind the reader of the double meaning of the word "root," and this will be best explained by an example: In the bulbous root, when we consider only the situation of the part, the root includes both the bulb or bud and the fibrous root below it; when we refer only to the function, the root is the bundle of small fibres which proceed from the lower part of the bulb. Although, in general, it is proper to consider as root only the radicles, which imbibe nourishment, and although, in many plants, a part which has the function of the stem bears improperly the name of root, we must still make a distinction between that part of the stem which emits no buds and that which does.

CHAP. II.—THE STEM (*CAULIS*).

124. THE Stem is an organ possessed by most plants. It grows upwards from the neck, gives support to the leaves, the flowers, and the fruit, and transmits to them the nutritious fluids absorbed in the earth. These, it is most pro-

bable, undergo some change in their passage through the stem.

125. Almost all phenogamic or flowering vegetables are provided with stems. Those which are destitute of it, or in which it does not distinctly appear, are called *Acaules*,* as the Cowslip (*Primula veris*). The organ which, in the Cowslip and Lily, appears to be the stem, is not a true stem, as it bears no leaves, but merely a flower-stalk springing from the root, and is called a scape (*scapus*).

126. With regard to function, all that part of the plant between the radicles and the leaves is stem, so that every plant is provided with a stem. In bulbous plants the bulb is the stem: it is the part which intervenes between the root (the fibres) and the leaves and flowers. When we consider merely their appearance, the stem and branches appear to be materially different; but if we attend to the structure and functions of these organs, it will be perceived that there is no material difference between them; the organization, mode of formation, and office, being exactly the same; the branches being merely productions of the stem, disposed in their peculiar form for the purpose of exposing a greater number of leaves to the action of air and light.

127. Linnæus divided stems into seven kinds,—the Caulis, the Culmus, the Pedunculus, the Scapus, the Petiolus, the Frons, and the Stipes. Of these seven varieties, the pedunculus and the scapus belong to the reproductive organs, and the petiolus may be considered a part of the leaf; so that, in this place, only the caulis, culmus, frons, and stipes, need be alluded to.

I. CAULIS.

128. This, the most common kind of stem, includes the trunks of trees and the stalks of shrubs, and of most herbs. The stem is called—

* In Botany, as in other sciences, the letter "a" prefixed to a word is called privative, and signifies "without."

129. *Creeping* (*repens*), or a *soboles*, when it lies on the earth, and takes root in many points: Creeping Loosestrife or Moneywort (*Lysimachia Nummularia*). The creeping root, (95), should also be termed a creeping stem. And the *Rhizoma* or *Rootstock* is also a creeping stem.

130. When a branch comes off from a plant beneath the surface, and, on emerging, becomes like a stem, it is termed a *sucker*.

131. *Stoloniferous*, sarmentose, or trailing, when the principal stem gives out laterally smaller ones capable of striking root and producing new plants: Strawberry (*Fragaria vesca*); Common Bugle (*Ajuga reptans*). These lateral stems are called stolons, runners, or scions.

132. *Stems are either Simple or Compound.*—When there are no marked ramifications, the stem is simple, as the Great Mullein (*Verbascum Thapsus*), Foxglove (*Digitalis purpurea*). It is compound when it divides into a greater or less number of branches.

133. The plant is called a *tree*, when there is a distinct trunk or stem, bearing perennial branches,—a *shrub*, when the branches are perennial, but come directly from the surface of the ground,—there being no trunk above ground,—*undershrub*, when the branches are woody and wholly or in great part annual,—*herb*, when the stem is annual and soft and greenish. A low tree is termed an *arbuscle*.

II. CULMUS, OR CULM.

134. This kind of stem is peculiar to the Grasses, Cyperaceæ, and Junceæ. It is a simple stem, generally hollow, and in some divided at various distances by knots, from which sheathing leaves arise. De Candolle applies the term *Calamus* to those hollow stems without knots or articulations, as the Rushes.

III. FRONS.

135. This kind of stem is composed of branch and leaf

united together, and frequently joined to the fructification, as in Ferns (*Filices*). The term *frons* was formerly applied to express a part of the wood with the leaf upon it, or a twig with leaves; and hence Linnæus applied it to the Ferns, in which the fructification is on the back of the leaf. The term is now used only for Cryptogamic plants, as the Lichens, Algæ, &c., or simple plants like Duckweed (*Lemna*).

IV. STIPES.

136. This term is little used, except for the stem of the Palms, and of the Mushrooms (*Fungi*).

137. The term *Rhizoma* is most properly applied to the subterraneous horizontal stems of perennial plants, mostly concealed in the earth, and shooting up new leaves from one extremity while the other perishes. Traces of the leaves of preceding seasons may be found on it, and it grows at the end next to the leaves: Common Solomon's Seal (*Convallaria multiflora*). The rhizoma is found only in Monocotyledonous plants.

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138. With respect to Structure, and this is the only proper basis for a classification, stems may be divided into two great classes, which correspond with the two natural groups into which vegetables are divided,—Cellular and Vascular. (71). And the latter class is subdivided into Endogenous and Exogenous.

I. CELLULAR STEMS.

139. These consist of a homogeneous mass of cellular vegetable matter, covered by a thin cuticle. Some of them are apparently of a fibrous texture, but are composed of elongated cells placed parallel to one another. Mushrooms

(*Fungi*,) Lichens, and all the other lower orders of plants, except the Ferns and one or two others, make up this class, the leading character of which is to consist of cellular tissue alone. The Ferns and Club-mosses (Filices and Lycopodiaceæ) have usually been included in this class from many points of resemblance, particularly the absence of sexual organs: but they possess a distinct vascular tissue, and have spiral vessels. They appear to occupy a middle ground between cellular and vascular plants.

140. Cellular stems are sometimes termed ACROGENOUS, from their manner of growth, the new matter being added at the point or extremity, or by the bases of the leaves uniting. They are called *Cellular* by some, *Acotyledonous* by others, and Linnæus applied to them the term *Cryptogamic*, signifying flowerless.

II. VASCULAR STEMS.

I. ENDOGENOUS STEMS.

141. These consist of bundles of vessels irregularly dispersed through cellular tissue, and covered by a thin cuticle. The sugar-cane (*Saccharum officinarum*), the Lily, the Palm, and the Iris, have this kind of structure, the cellular and vascular tissues being blended together through the entire substance of the stem. A transverse section of the common *Cane* affords a good illustration of this class. See also Frontispiece, Fig. 1.

142. Stems of this kind are called *Endogenous*, from Greek words signifying *increasing* (*or growing*) *interiorly*, because the new matter by which they increase in diameter is added at the centre. Their growth is carried on by means of the thick cluster of leaves by which they are terminated superiorly. From them the new matter descends into the centre, or axis of the stem, and pushes outwards the parts first formed. The new fibres also extend somewhat outwards from

the central line, but chiefly occupy the axis. The upper parts of the leaves perish, having performed their functions; their bases remain, are pressed together, and form the new external part of the stem. In the middle of the crown of leaves is the terminal bud, which is next to be developed, rise a little above the former, become a cluster of leaves, and in its turn be pushed outwards by a succeeding central bud.

143. The oldest and hardest part of such stems is that nearest to the circumference. The more the external parts are pressed by the descent of the new matter, the more close and compact they become, the outer parts being incapable of being much farther pushed out, and the whole being thus condensed very much.

144. From the mode of growth in this stem it never can attain a great thickness, the new matter having to force outwards all the previously formed matter, which is every season increasing in quantity and becoming harder. They often, however, attain a very great height, as is seen in Palms, which are occasionally met with nearly 200 feet high. The prickly Pole Palm is like whalebone externally; and some palms are so hard there as to resist the stroke of an axe, yet quite soft in the centre.

145. From the same cause they have no lateral buds, no branches. Buds, which produce branches, originate from the soft and juicy parts of the tree; but in endogenous trees, this is surrounded by a thick, hard, compact casing, through which the buds cannot penetrate. In most cases, their only branches are the splendid crown of leaves which proceed from their one bud at the moment. From their great height, which renders them tottering, and their manner of growth, which causes them to become hard and compressed, even in the centre, so that they cannot transmit juices from the root, or new matter from the leaves, their age is limited, not exceeding two or three centuries at the utmost.

146. From the absence of concentric layers, each marking an year's growth, it is difficult to determine the age in this group of plants. An approximate estimate may be made of

the age of an endogenous stem by the external rings, each of which indicates the remains of the leaves developed annually at its extremity. This may be seen in the subterraneous stem of the Iris pseudacorus or Yellow-water Flag, an indigenous specimen of the endogenous stem.

147. Stems of this kind are found only in Monocotyledonous plants; and the veins in their leaves proceed in parallel unbranched lines from the base to the summit, not forming a net-work, as in the leaves of the next class.

II. EXOGENOUS STEMS.

148. The third class of stems consists of those in which are observed concentric layers of vascular and woody tissue, arranged symmetrically round a central column of cellular tissue, enclosed by a hollow cylinder of bark, and covered, in annuals, biennials, the annual stems of perennials, and the young stems or shoots of trees, by a cuticle or epidermis. There are also rays observed passing from the medulla (the central column of cellular tissue) to the circumference, termed the Medullary Rays. These parts are well seen on making a transverse section of a Horse-chestnut, Oak, Elm, Plane, Ash tree.—(See Frontispiece, Fig. II.)

The different parts to be described in a stem of the Exogenous structure, are

The Epidermis,
The Herbaceous Integument,
The Bark,
The Wood,
The Pith or Medulla,
The Medullary Rays.

1. *The Cuticle or Epidermis.*

The Epidermis has been already described (73, &c.)

2. *Herbaceous or Cellular Integument.*

149. This is the layer of cellular tissue, which lies immediately under the epidermis, and gives to the leaves and young stems their green colour. It forms the substance of the leaf, and in it the changes effected on the sap by the atmosphere take place; hence it frequently contains the proper juices. It is easily repaired on the young stems of woody vegetables, but never on those of annual plants or on leaves. The green colour does not arise from the sides of the tissue, but from the presence of small granules of globuline.

3. *Liber*, *Cortex*, *or Bark.*

150. This is found immediately under the herbaceous integument, and consists of a network of woody tissue, the spaces between the vessels being filled up by cellular tissue. Spiral vessels are not found in the bark, except in Nepenthes. Air vessels, and the form of intercellular passages termed *vasa propria*, abound in the bark.

151. The bark consists of concentric layers, each being composed of a layer of woody tissue and one of cellular tissue. There is only one layer of each in young shoots one year old, and the layer of cellular tissue is external, or encloses the other. A new layer of each is formed in each succeeding year within the old one; and thus, in trees, the bark is made up of as many woody layers as the tree is years old; the older layers being pushed outwards and destroyed by the growth of the new layers, and becoming a lifeless crust. Hence the bark may be called *endogenous*, or growing from within. The growth of the bark in this manner is ascertained by fixing a thin metallic plate in the bark of a tree. It will be thrown off like the patches of bark, after an year or two.

152. The proper juices and secretions of the plant reside chiefly in the bark, in the innermost layers; and hence it is principally from this part that we extract those vegetable principles so useful in medicine and in the arts.

153. In the newly formed layers of bark, the sap, which has been modified in the leaves by the action of the air, descends to nourish and promote the growth of the plant. The outer bark also serves the purpose of protecting the new layers of wood and bark from injury. The old and hardened layers form an excellent protection from external violence.

154. The bark, being the part in which the sap descends to supply the plant, is essential for its increase. If part of the bark be removed from a tree all round, so as to leave the wood bare, the part beneath will not grow, the medium by which the nutritious fluids were conveyed to it having been removed, and the tree will ultimately perish. A graft will not take if its bark be not in contact with that of the tree in which it is inserted; and a branch will not take root when surrounded with earth, if the part be deprived of its bark.

155. The bark is easily renewed when it has been destroyed, if the injury be not too severe, or too large a quantity removed; while the renovation is going on, it requires to be protected from the access of the air. The renewal of the bark takes place by means of the cambium, which exudes from the wood and edges of the wound, and gradually repairs the injury.

156. The bark not permitting much distension, its fibres are generally ruptured or separated, so as to present a sort of net-work appearance, as in the Ash or Willow. In the Daphne lagetto, or lace bark tree, the fibres assume the appearance of lace.

157. The medulla, or central part of the tree, and the bark, are connected by the rays of cellular tissue (medullary rays), which stretch horizontally from the medulla in diverging lines, and serve for the horizontal diffusion of the vegetable juices.

4. *The Wood.*

158. The wood lies immediately under the bark, and

makes the principal bulk of the trunk and branches. It consists of concentric layers, each of which is composed of a layer of woody tissue or of vasiform tissue, and ducts. At first there is only one layer of vascular tissue, consisting of woody tissue and spiral vessels, enclosing the pith, and termed the *medullary canal* or *sheath.* In each succeeding year there are two layers formed, one of woody or vasiform tissue and one of vascular tissue, of which the latter is the external. Hence the age of a stem of this kind may be known by the number of concentric vascular cylinders in the wood; this is easily seen, as the layers of woody tissue which intervene between the layers of ducts render the latter very distinct.

159. The external woody layers next the bark are called the *alburnum*, and differ from the internal layers or true wood in being younger, softer, more succulent, and of a lighter colour.

160. The true wood is formed by the inner layers of the alburnum, which gradually acquire a greater degree of hardness: the transition from alburnum to true wood is, however, almost imperceptible.

161. A new layer (consisting of a layer of cellular tissue and one of vascular tissue) is formed annually next the bark: it is pushed inwards, and becomes more compact by the deposition of secretions and pressure of each succeeding annual layer, till at last it becomes almost solid, the sides of the vessels and cells being compressed; hence the greater hardness of such trees in the centre. Thus the wood in such stems is *exogenous*, or growing from without.

162. The fasciculi or bundles of vessels which compose the cylindrical layers are separated at different points by masses of elongated cellular tissue, extending from the centre or pith towards the circumference, causing an appearance of alternate rays of vessels and cellular tissue. These are called MEDULLARY RAYS (from their radiated appearance), medullary prolongations or insertions, and *silver grain* by the carpenters. The use of the medullary rays is not precisely determined. It has been conjectured that they serve for the

horizontal diffusion of the fluids, connecting the bark and central parts.

163. The wood gives passage to the sap, from the root to the buds and leaves. It has been supposed that part of the sap rises through that part of the wood next to the pith (the medullary sheath), and is conveyed thence to the buds, being somewhat altered in its properties during its course, and rendered fit for promoting the growth and evolution of the leaves: The rest of the sap rises through the alburnum (the vessels of which, being young, soft, and not compressed, are well adapted for the passage of fluids), and is conveyed to the leaves when formed, there to undergo changes which render it fit to promote the growth of the plant. Little is known with respect to the particular functions of each part of the wood, excepting the alburnum, the latest formed layers of which give passage upwards to the sap. Mr. Knight made a circular incision several inches in depth in a tree, so as to divide completely both the bark and alburnum, which so completely intercepted the ascent of the sap, that no vegetation took place in the tree in the following spring. If the alburnum be removed and the bark left, the plant will also die. Thus it would seem that the new layer of alburnum is formed for the nourishment of the plant, by conveying the sap to the leaves; and this explains why a serious injury of this part is so fatal. The wood also contains many of the secretions of the plant, particularly the older layers.

5. *The Pith or Medulla, and Medullary Canal.*

164. The pith is contained in the *medullary sheath or canal*, which is in the centre of the tree, and the sides of which are composed of vessels, chiefly spiral, disposed in a longitudinal direction. In all plants the pith consists of cellular tissue alone, and is of a light and spongy character. The cells are, in general, very regular, and of an hexagonal form in section: in the young shoots of trees, and in herbaceous plants, these cells are filled with aqueous juices, which disappear as the plant grows older, and then they contain gas alone.

165. In herbs, and in some trees, the pith continues of the same diameter during the whole life of the plant. In many vegetables the pith disappears as the plant grows, and the stem becomes at last perfectly hollow, often, however, lined with a thin coating of pith resembling cotton. This is the case in many of the Umbelliferæ, as in Hemlock.

166. The pith, it is supposed, nourishes the young wood and the buds during the first year of their existence; and it has been observed that it retains its moisture for a longer period near the terminal bud, and at the parts where branches are given off. The medullary sheath is continued into the buds and leaves, forming part of the veins of the leaves; and is believed to contain air with a large proportion of oxygen.

167. Such is the structure of the stems of that very large class of plants which constitutes the third division. They are found only in Dicotyledonous plants, and they are called *Exogenous*, because the wood, which is the principal part of them, increases in diameter by the addition of new matter at its external surface.

168. In exogenous plants, the new matter being added externally, a bark or covering is necessary to protect it, when young and tender, from the action of the atmosphere, and from external injury from other causes: hence an important office of the bark. In endogenous plants, the new matter, being added internally, is provided with an excellent covering, formed of the main substance of the plant, and has no need of a separate protecting integument.

169. In spring there is found between the bark and the alburnum, a viscid gelatinous fluid, called *cambium*, which, it is supposed, is a principal agent in forming the new layers of wood and of bark. This fluid is composed of the residue of the cambium of the preceding season, enriched and renewed by the descending sap, and mixed with some of the secretions of the vegetable.

170. The new wood seems to be formed in temperate latitudes, with distinctly marked seasons, chiefly in spring and the early part of summer, when, according to M. Thouars, the buds in developing, send down roots into the

cambium as soil, which unite and form the new concentric cylinder; while the medullary rays extend outwards at the same time, and connect the new layers with the interior parts.

171. M. Mirbel and others were of opinion that the cambium annually forms a new layer of alburnum and a new layer of bark. We know that the cambium can repair the bark when it has been injured; and, as the new layers of wood and bark are formed where this fluid is found, it is not unreasonable to suppose that it acts an important part in this process.

172. M. Du Petit-Thouars' theory is, that the successive formation of woody layers is caused, by the development of buds, from which, in spring, issue numerous fibres, which descend in the cambium between the liber and the alburnum. In gliding downwards they meet the fibres which descend from other buds, and form a layer of greater or less thickness, which soon becomes solid, and forms a layer of wood.

173. Each bud is regarded as a separate system of vegetation. The buds are considered so many individuals placed upon a common stock, and elongating in two ways—upwards, forming new stems and branches, leaves, &c.—and downwards, forming roots; the descending fibres being the roots which the buds send forth, and the cambium bearing the same relation to the roots of the bud as the soil does to a germinating seed. M. Thouars considers buds as analogous in structure and mode of development to the embryo of the seed, which in germinating produces a young stem analogous to the scion produced by the growth of a bud. He calls the latter a *fixed or adherent embryo*, while he denominates that within the seed a *free embryo*. Thus the wood and bark are considered as formed of the roots of the buds which are annually developed on the surface of the vegetable.

174. Grew, Malpighi, and Duhamel, supposed that the cambium forms annually a layer of liber, which separates into two layers—an external one, which becomes bark—and

an internal one, which is converted into alburnum. A new cambium exudes from the outer surface of the internal layer, and forms a new liber, which undergoes similar changes. "Every year," says Grew, "the bark of a tree is divided into two parts, and distributed two contrary ways: the outer part falleth off towards the skin, and at length becomes skin itself; the inmost portion of the bark is annually distributed and added to the wood." This opinion is now abandoned, and the theory now generally adopted is that of M. Thouars.

175. Whatever may be the mode in which the formation of the new layers takes place, it is known that the new matter which forms them *descends* from the leaf, buds, or leaves, either in the innermost layers of the bark, or between it and the alburnum.

176. If all the buds or leaves be removed from the upper part of a branch, no increase in diameter will take place above those that are left. If a ring of bark be removed from a tree, the part below will not increase in thickness, and the upper lip of the wound will heal quickly, while the lower lip will not. This operation has been recommended for improving the fruit of trees; the descending sap or cambium, being confined to the upper part, increases the size of, and enriches the flowers and fruit developed above the place from which the ring has been removed. This is called ringing; care must be taken to make the ring very narrow, in order that the parts may easily reunite.

177. If a ligature be placed tightly round the bark of a tree, the part above the ligature will swell, but not the part below; and it has been observed that the rate of increase of the diameter of any part of a branch or tree is in proportion to the number of leaf-buds developed above that part.

178. Those trees which have a light spongy texture, as the Poplar and the Willow, grow very rapidly; while those whose tissue is dense require a much longer period to attain any considerable size, as the Oak and Elm: but the latter are capable of acquiring a much greater size and thickness

than the former. Adanson mentions having seen in the Cape Verd Islands some Baobabs about 30 feet in diameter, or nearly 100 feet in circumference. These are the largest trees in the world. Heat and moisture enable trees to grow to a considerable magnitude: and hence the largest trees are found in tropical climes.

CHAP. III.—BUDS.

179. Buds are those little bodies which grow on the surfaces of vegetables, and contain, in a dormant, or rather latent state, the germ or rudiment of an entire plant, or of part of a plant, ready to be developed when the season is favourable, and capable of growing or being enlarged in two opposite directions. Buds are closely connected with or originate from the pith or medullary matter of the stem. They are the first results of vegetation, and the leaves, branches, and flowers are at first contained in buds. The period of their evolution depends principally on the warmth of the season. Those in a hot-house, or in a warm exposure, are first developed. Severe cold destroys them altogether.

180. It is the opinion of many botanists, that germs or rudiments of buds exist within the plant, and are formed at the same time as the stem and branches; that those only become developed which meet with an abundant supply of sap, arising from some obstruction in its course, which causes it to accumulate: that they develope as leaves and branches, or as roots, according to the medium in which they shoot, becoming buds (generally so called) when exposed to light and air, and roots when they strike into the earth; and that the buds arise at the axilla of the leaf (between the leaf and the stem, at the angle formed by their meeting), because the branching off of the fibres of the leaf from the stem impedes the sap in its course at these particular parts. A bud may be observed in the axilla of every leaf. They are also often found in the axilla of a stipule, and a bractea, modifications of leaves: and

may occur in other parts, as in the parts of the flower, which are also modified leaves.

181. If a young tree be inverted, the branches being placed in the earth, it will live: roots will come from the buried branches, and leaves and flowers from the roots. In this case the branches are not changed into roots, nor the roots into branches; but the undeveloped buds or germs in the roots become branches, &c. when exposed to the atmosphere; while those of the branches become radicles or rootlets, when developed in the earth.

182. The bud has sometimes been compared to the embryo of the seed, and termed a *fixed embryo*, as it can originate a new plant. It always, however, reproduces the same individual, while the embryo of the seed only yields the same species.

183. M. Richard enumerates five distinct kinds of buds,—the Proper or Common Bud, the Turio, the Bulb, the Tubercle, and the Bulbil.

184. *The Proper buds* are those commonly called buds, found upon the branches of trees, arbuscles, or shrubs, in the axilla of the leaf, or at the extremity of the twig. They are composed of scales enveloping each other, and frequently, in trees of our climate, covered with a viscid resinous substance, and having a downy texture within, for the purpose of protecting them from cold. These scales consist of leaves similar to those to be afterwards developed, but checked and almost blasted by being put forth before there is a sufficient degree of warmth in the atmosphere. They shrink, harden, and form an excellent protection, till the season is more favourable, for the more internal leaves, which, if exposed while too young and tender, would undergo the same fate. In trees growing in warm climates, these external scales are often absent, the leaf expanding without any such protection, as in the Horse-chestnut (*Æsculus*) in India: in temperate latitudes, its buds are enveloped by a great number of scales, as in the same tree growing in this country—the Beech, the Willow.

185. They are formed in summer, when vegetation is vigorous, and the sap flows freely in the plant, grow a little in autumn, and remain stationary during the winter. In spring, they partake of the general impulse which vegetation receives from the increased heat of the earth and atmosphere, and begin to expand; they become gradually enlarged; their scales, or hybernacula, are pushed aside, and the organs they protected begin to appear. In warm countries where vegetation is more vigorous, and the sap flows freely during the whole year, there is less interval between their formation and evolution. In the axilla of every leaf, however young, though still in the bud, a small conical pointed body may be observed: this is the rudiment of the bud of the succeeding season, thus apparent more than twelve months before it is to be developed.

186. Those which are long and pointed generally produce leaves and branches, and are called *foliiferous.* Those which are larger and more rounded contain flowers, and are called *floriferous.* Some contain both leaves and flowers, and are called *mixt*, as Lilac (*Syringa vulgaris*). The delicate leaves within the bud are folded in many various ways: the manner of fold is termed *foliation* or *vernation.* This will be described under terminology.

187. Buds may develope on all parts of plants. Occasionally they are met with on the leaf.—(See par. 223.)

188. *The Turio* is the bud of perennial roots, growing from the upper part of the root, and producing the new stem.

189. *The Bulb* has been described under the term "bulbous root." It may be considered as a bud, because it contains the rudiment of the future plant; but if we consider it with regard to function, it may, perhaps, with more propriety be viewed as a stem with a bud, as it contains nutritious matter for the development and growth of this bud. Hence, in plants with bulbous roots, the virtues are found in the bulb, as in Onion, Garlic, Squill, &c.

190. *The Tubercle* has been described under the term "tuberous root." It may be considered a short, fleshy,

subterraneous stem, the eyes on its surface being analogous to the buds on the stem.

191. *Bulbils* are small buds growing on different parts of the plant, and capable of independent vegetation, so that when detached from the parent, they grow and produce a plant perfectly similar to that which gave them birth. Plants which bear buds of this kind are called *viviparous.* These are sometimes developed in the axilla of the leaf, as in the Orange Lily (*Lilium bulbiferum*), sometimes in the place of the flowers, as in the Mountain Garlic (*Allium carinatum*); or in the axils of the scales of bulbs, where they are termed *cloves.*

192. Sporules, the small bodies which are developed in different parts of Ferns, Mosses, Lichens, resemble bulbils; being destitute of the radicle, the gemmule, and the cotyledon, to possess which is the distinguishing character of the true seed.

193. Endogenous plants seldom produce more than two or three buds, and frequently only one bud annually, as in the Palm, the bud of which has the appearance of a cabbage, and in the Onion and other bulbous plants. Exogenous plants have a great many buds. Annual and biennial plants do not produce buds: they bear a plentiful supply of seeds for the purpose of propagation.

CHAP. IV.—LEAVES.

194. Leaves are flat greenish organs, of various shapes, growing from the stem or branches, and situated immediately below leaf buds. At first they are concealed in buds, but, as the season advances, they are gradually unfolded, and come forth expanded, presenting a large surface for the action of air and light.

195. Leaves are situated on the axis or stem, and are either *alternate*, *opposite*, or *verticillate*. They are alternate, when one is above another, and on the opposite side of the stem or

branch; opposite, when there are two, which are at the same height, but on the sides opposite to each other; verticillate, or in the form of a *whorl*, when there are several surrounding the stem or axis at the same level. The alternate is considered the normal or regular mode of distribution—the others arising from the non-development of the intermediate parts called *internodes*—the places at which the leaves are developed being termed *nodes*.

196. Leaves are formed by an expansion of the fibres of the stem at particular parts. These fibres are bundles of vessels, chiefly spiral vessels, along with woody tissue, which by their ramification form a network, or skeleton, which is filled up by cellular tissue, continuous with the tissue of the bark. The whole is covered by the cuticle, except in leaves which grow under water, which appear to be destitute of cuticle. The spiral vessels are derived from the medullary sheath. Many of the vessels must be continuous with the alburnum.

197. When the bundle of fibres spread out immediately on leaving the stem, the leaf is called *sessile*, as in the White Poppy (*Papaver somniferum*). See Fig. 8, the leaf of Horned Poppy (*Glaucium luteum*).

Fig. 8.

Sessile Leaf.

Fig. 9.

Petiolated Leaf.

198. When the fibres are clustered together for a little way before they expand, they constitute what is called a *petiole* or footstalk, as in the Horse-chestnut (*Æsculus hippocastanum*), and trees. See Fig. 9, the leaf of Black Bryony (*Tamus communis*).

199. The leaf is therefore said to consist of two parts,—the leaf-stalk or *petiole*, and the leafy expansion, called blade, *lamina* or *disc*, the part usually termed the leaf.

200. The petiole is formed of spiral vessels, woody tissue, and cellular tissue, and resembles the stem and branches in structure.

201. In some cases, as in the simple leaves of the Mimosæ of New Holland, the lamina is not developed, and the petiole becomes expanded, or leafy, in which case it is called *phyllodium*. It is termed a pitcher or *ascidium*, when it is expanded into a cup or hollow vessel at its extremity, as in *Nepenthes distillatoria* or pitcher plant.

202. The projecting lines seen on the under surface of the leaf, and called veins or nerves, are the ramifications of the vascular and woody tissue which proceed from the stem.

203. Most leaves are divided into two lateral halves by a large vein extending from the base to the summit. This is a continuation of the petiole, and is called the *midrib*. From its base and sides the other veins proceed and spread in all directions. See Frontispiece, Fig. 4, the leaf of the Common Primrose. One side, however, is occasionally larger than the other, or of a slightly different form, as in the leaf of the lime tree (*Tilia Europæa*).

204. In the leaves of most exogenous or dicotyledonous plants, the veins form a kind of net-work, leaving the midrib abruptly, branching irregularly among the cellular tissue, and uniting frequently (anastomosing) with each other. See Fig. 4. The leaves also of the common oak, lime tree, &c. exhibit this structure.

205. In the leaves of most endogenous or monocotyledonous plants, the veins proceed directly from the base to

the apex, or diverge gradually from the midrib, are little ramified, placed parallel to each other, and connected by simple transverse veins. See Frontispiece, Fig. 3, the leaf of Lady's Slipper, one of the *Orchideæ*. The leaves of the grasses and rushes, illustrate this structure.

206. In Coniferæ and in Cycadeae, trees of an exogenous structure, the leaf resembles that of endogenous plants in the arrangement of its veins.

Leaves are either *simple* or *compound*.

207. In a simple leaf (Fig. 9, p. 59), the petiole is undivided, and the lamina or disc consists of a single piece. The simple leaf, when divided deeply, somewhat resembles the compound leaf: in the simple leaf, however, each division is continuous in its leafy part with the leafy parts of the divisions on each side, so that we cannot completely separate one division without tearing more or less those between which it is situated; as in the common hawthorn, which might at first be considered a compound leaf, from its numerous and deep divisions, but which is truly a simple leaf.

208. A compound leaf *(compositum)*, consists of several leaves or leaflets *(foliola)* attached to a common petiole *(rachis)*, and quite distinct from each other in every part, so that one may be detached without injuring any of the others. See Fig. 10. page 65.

209. Buds are not found in the axillæ of the leaflets of compound leaves. In them, they occur only at the base of the common petiole; and the whole is considered as only one leaf.

210. The branches of the petiole or petiolets of the leaflets are called *petiolets*, or secondary petioles. Sometimes the petiolet, or rather the leaflet, is compound, in which case the whole leaf is called *decompound*. And when the leaflets arise from the tertiary petioles, or branches of the secondary petioles, the leaf is called *supra decompound*.

According to their Duration on the stem, the leaves are,

211. *Caducous*, when they fall early, as in the Plane-tree.

212. *Deciduous*, when they fall before the new leaf appears, as in the Horse-chestnut and most other trees.

213. *Marcescent*, when they wither before falling, as in the Oak and many other trees.

214. *Persistent*, or *Evergreen* (*Sempervirens*), when they remain on the vegetable one winter or longer, as the Ivy, the Pine, the Myrtle, the Common Laurel, &c. Plants of this kind are called Evergreens. Sooner or later the leaves of Evergreens fall like those of other plants.

215. In the generality of plants the leaves annually decay, and are reproduced in the spring. It is supposed that before the leaf falls there is a kind of joint formed between it and the stem. It is chiefly in the dicotyledonous plants that this articulation is formed between the leaf and stem. In monocotyledonous plants and those acotyledonous plants which have leaves, the joint is frequently absent. The articulation is effected by the deposition of hard matter, and by the drying and shrinking of their tissue at the junction with the stem. In very warm climates their decay occurs at the conclusion of the summer, when, from the dryness of the soil, and the evaporation caused by the excessive heat, they are scantily supplied with sap. In temperate climes their fall takes place in autumn, when the weather is becoming colder. Their fall is, of course, always preceded by the cessation of the circulation in them. This may be partly the effect of their decay from exhaustion, but it is most probably the principal cause of that decay. Leaves with the petioles jointed on the stem fall first; next, those of which the petioles are not jointed; and lastly, those which are sessile. All leaves fall, sooner or later.

216. Plants which are destitute of leaves are called *aphyllæ:* Glass-wort (*Salicornia*), Dodder (*Cuscuta*), and many of the flowerless tribe of plants, as Lichens, Fungi.

217. There are two sets of veins or vessels in the leaf; one proceeding to the upper surface from the stem, and conveying from it the sap for the purpose of being exposed to the action of air and light. This surface is, in trees and

shrubs constantly turned to the light, and is said to be destitute of pores or stomata, or very scantily supplied with them. The other set of vessels proceeds from the lower surface of the leaf to the bark, and conveys to it the sap, now rendered fit for the nutrition of the plant. If the leaves of a branch be placed so that the upper surface be turned towards the earth, they will gradually resume their natural position: and if prevented from doing this, they will wither and die.

218. The under surface abounds with stomata, through which the watery part of the sap passes off in vapour. In aquatic plants the upper surfaces of those leaves which float on water are provided with most stomata, for the purpose of evaporation, as this process cannot take place in water.

219. The upper surface of the leaf is smoother and more shining than the lower, has seldom any down or hair, and few or no stomata. The lower surface is often downy or covered with hair, provided plentifully with stomata, of a lighter colour, and with the veins projecting and distinctly marked.

220. The leaves of succulent plants, such as the Cactus and the Aloe, are provided with few pores, and evaporate very slowly, and may be considered as reservoirs of nutritious matter for the use of the plant; in great heats, and in a dry soil, preserving its existence by their power of retaining the fluids which are absorbed. Plants which grow in dry and parched situations, where supplies of rain are very scarce, have leaves of this kind. The thin small leaves of the Fir are of an opposite nature, being provided with numerous pores, and evaporating freely.

221. The leaves, it has been supposed, are good radiators of caloric, and hence become lower in temperature during the night, by which they condense the watery vapour in the atmosphere; it is then absorbed in the form of dew. In grasses and other herbaceous plants, the leaves of which grow vertically, and have their opposite surfaces much

alike in appearance, the absorption of nutritive matter from water, or from the vapour diffused through the atmosphere, is carried on indifferently by either surface. In trees, the leaves of which have distinct upper and under surfaces, differing from each other also in appearance, this absorption is carried on only by the under surface.

222. This was ascertained by Bonnet, who laid on water alternately both surfaces of the leaves of many trees and herbs, and found that those of the trees lived longest when their inferior surfaces were laid on the water; while those of some of the herbs lived equally well with either surface applied to the water, and of other herbs, the leaves throve best with their upper surfaces next the water.

223. Some leaves have the power of producing from their margins buds capable of becoming new plants. The seeds or buds of the Ferns (*Filices*) are produced in this situation. The Bryophyllum and the Marsh Bog-orchis (*Malaxis paludosa*, *Ophrys p.* Linn.) also produce buds from the margins of their leaves. The buds on the Malaxis are in the form of papillæ, at the extremity of the leaf.

224. Thus, it will be seen that leaves are organs of great importance in the vegetable economy: they absorb nutritious matter from the vapour and other gases diffused through the atmosphere; discharge the watery part of the sap by evaporation; expose it to the action of air and light, and render it fit for the nutrition of the vegetable. Hence the virtues of plants frequently reside in their leaves.

CHAP. V.—APPENDAGES.

225. STIPULES. The stipules are small leafy appendages at the base of a petiole or sessile leaf, of the same structure as the leaf to which they are appended, but frequently of a different figure. (See Fig. 10, the leaf of White Dog-Rose.) The leafy appendages, winging the lower part of the petiole, are the stipules.

Fig. 10.

226. They are never found in Monocotyledonous plants, but occur frequently in the Leguminosæ and Rosaceæ, and almost always in the Betulineæ, Salicineæ, Magnoliaceæ, and in the exotic genera of the Rubiaceæ (Cinchonaceæ.)

Fig. 11.

227. When the margins of the stipules adhere so as to form a leafy sheath round the stem, they form what is called an *Ochrea*, as in the Polygoneæ. (See Fig. 11.)

228. They are generally two in number, one on each side of the petiole. Their form varies, sometimes similar to that of the leaf — frequently very different. They sometimes fall before the leaf, as in the Lime tree, frequently along with the leaf; some fall after the leaf, as the Gooseberry (*Ribes Grossularia.*)

229. Tendrills. (*Cirrhi*). Thread-like appendages generally found in plants which have feeble stems, unable to

support themselves, as the Pea, the Vine, the Vetch, &c. They wind spirally round neighbouring bodies, and thus support the plant.

230. They are supposed to be abortive petioles, peduncles, or branches;—petioles in the Pea and the Vetch, peduncles or racemes in the Vine. In some species of Smilax they are considered abortive stipules.

231. Spines or Thorns. Sharp-pointed organs, which arise from the woody or internal part of the vegetable. They are supposed to be abortive buds, as in the Sloe-tree, the thorns of which are converted into branches, if it be transplanted to a rich soil.

232. Prickles (*Aculei*) arise from the bark only, and can be easily detached, as in Rose, Bramble, &c.

233. Glands, minute globular bodies observed in many parts of the plant, as at the base of the sexual organs in the Cruciferæ, destined to secrete a particular juice from the general mass of fluids. This name is also applied to the receptacles filled with essential oil in many parts of the Aurantiaceæ, and particularly in the leaves of the Myrtaceæ and Labiatæ. These are called vesicular glands, and may be easily seen in the leaves of the Myrtle and of the Orange, giving them a dotted appearance. The Ice-plant (Mesembryanthemum crystallinum) takes its name from the number of glands on its surface, filled with a clear, colourless, transparent liquid.

234. Hairs are found chiefly on plants which grow in dry situations, and in these cases it is thought that they enlarge the absorbing surface: they are then termed *Lymphatic*. They are not found on very succulent or on aquatic plants, growing where there are abundant supplies of moisture. In many plants the hairs are the excretory ducts of glands, as in the Nettle (*Urtica)*, the hairs of which irritate the skin by pouring in an acrid fluid. These are termed *Secreting*. When very thickly set, they protect from the effects of too great heat or cold, as in the Great Mullein.

SECTION III.

PHYSIOLOGY OF THE NUTRITIVE ORGANS.

235. VEGETABLES consist principally of carbon (charcoal), oxygen, and hydrogen; they also contain small quantities of nitrogen, lime, magnesia, &c. They derive the principal part of their nourishment from the soil. The porous extremities of the rootlets absorb the fluids with which they come in contact. These fluids consist chiefly of water, holding in solution decayed animal and vegetable substances, and various earthy matters, as silica, alumina; and lime, magnesia, soda, potassa, in union with carbonic, sulphuric, hydrochloric, and acetic acids.

236. The animal and vegetable matters are essential, forming the main substance of the food of the plant. Hence lands which have been covered with wood afford excellent crops. The action of the earthy matters on the plant is not so well ascertained. It is most probable that they act as a stimulus to the absorbing fibres of the root; and within the plant, as a condiment, by their stimulating properties assisting to keep up the action of the solids in elaborating the food; and also forming an important part of the secretions. In the soil the different earths and salts assist in decomposing the animal and vegetable remains.

237. To certain plants, particular earthy substances or salts are essential, as chloride of sodium (common salt) to those which vegetate near the sea-coast, nitrates of lime or potassa to borage and nettles: sulphate of lime to leguminous plants, siliceous earth to those of the grasses having a firm rigid culm.

238. The food of vegetables must always be taken in a fluid form, as the spongioles are incapable of absorbing solid matter. Hence there is no need of teeth for the purpose of masticating the food. If a germinating plant be placed in a bottle of water containing a known quantity of very finely

pounded carbon, none of it will be taken up, for after several months, the whole of the carbon will still be found in the vessel. The spongioles cannot continue long to absorb a thick or viscid fluid, as they would be clogged up by it, and hence a plentiful supply of water is necessary. Water also affords two of the most necessary elements of vegetable matter, oxygen and hydrogen; and when there is a deficiency of decayed organic matter, the water derived from the atmosphere must be the principal source from which these elements are procured. It is probably chiefly in the form of carbonic acid that carbon enters the roots of plants. This compound is formed abundantly during the decomposition of organic bodies, and is absorbed in large proportion by water. Mucilage and sugar also contain large quantities of carbon, in a soluble state.

239. Four kinds of earth are generally found in soils: alumina, argil, or clay; sand or silex; lime or calcareous earth; and magnesia. These constitute two principal kinds of soils; stiff, from an excess of clay, or what is called argillaceous; or dry, loose, and sandy, from an excess of siliceous matter.

240. "The silica in soils is usually combined with alumina and oxide of iron, or with alumina, lime, magnesia, and oxide of iron, forming gravel and sand of different degrees of fineness. The carbonate of lime is usually in an impalpable form, but sometimes in the state of calcareous sand. The magnesia, if not combined with the gravel and sand of soil, is in a fine powder united to carbonic acid. The impalpable part of the soil, which is usually called clay or loam, consists of silica, alumina, lime and magnesia."—"The vegetable and animal matters are sometimes fibrous, sometimes entirely broken down and mixed with the soil."—*Davy's Agricultural Chemistry.*

241. A stiff argillaceous soil opposes the entrance of air to the seed, the free growth and penetration of the roots, and retains a great deal of moisture, which enfeebles the roots, and renders the crops which grow in it insipid, watery, or dropsical. It requires to be mixed with a light dry earth,

and to be frequently turned up by the plough that the clods may be broken down and pulverised.

242. A loose sandy soil does not retain the moisture afforded by the rain, which is so essential to the growth of the plant; and, owing to its want of cohesion, cannot fix the plant, so that when young it is liable to be rooted up by the winds. Besides these mechanical bad effects of a loose sandy soil, it is also inadequate to the growth of crops from the absence of lime and alumina, which, there is every reason to suppose, exert such a beneficial agency on the plant. From these causes, this kind of soil is also deficient in natural vegetable productions, the remains of which afford, in good soils, so large a proportion of the food of the plant. A soil such as this must be improved by the admixture of argillaceous and calcareous earth, and must be well manured, or have a crop of some light vegetable ploughed in with it, before it can be considered as fit for the production of a good crop.

243. Besides these, there are many other circumstances which affect the productiveness of soils; such as, the facility with which they are heated by the rays of the sun; the length of time they retain their heat; the power of absorbing moisture from the air; the degree of evaporation from their surface; their power in acting upon, combining with, and retaining the organized matter in the soil, which is greatest in rich soils, those which contain much alumina and carbonate of lime, and least in sandy soils, in which the organic matters, not being attracted by the soil, are decomposed by the air, or dissolved and removed by water; the nature of the subsoil; and many others, upon which it would be out of place to insist here.

244. Marl is a compound of clay and calcareous earth; and it is called argillaceous or calcareous, according as clay or lime predominates in its composition. It is of great value for the improvement of soil; argillaceous marl rendering a loose sandy soil more fit for the growth of vegetables, and calcareous marl performing the same office to a stiff argillaceous soil.

245. Lime is of great value in the improvement of soils. By its caustic nature, or its affinity for carbonic acid and water, it assists in decomposing the various organic matters in the soil; it acts as a stimulus to the absorbents of the root; and, by its firmness and cohesive properties, while at the same time it is not stiff and tenacious, forms an excellent addition to either a sandy or an argillaceous soil. It is particularly adapted to thin marshy soils, which are unable to retain the organic matters which are decomposed. Marl, by the quantity of calcareous earth which it contains, acts in the same way as lime, though less vigorously.

246. Ploughing breaks down the earth; exposes it and the various organic substances in the soil to the action of the atmosphere, the oxygen in which aids in the decomposition of any organized matter which may be present; and mixes thoroughly the different ingredients in the soil.

247. Manure enriches the soil by supplying the most essential matter for the nutrition of vegetables, decayed animal and vegetable matter. Soils which have become exhausted, that is, which have been deprived of their organic ingredients by a succession of crops, require to be invigorated by the admixture of more organic substances. This is done by means of manure, which is composed of the necessary material,—carbon, oxygen, and hydrogen, &c., and in which the putrefactive process has made such progress, that it is in an apt state for having its cohesion destroyed, and being reduced to its pristine elements. It is rendered soluble in water, in which state it is ready for being assimilated to the vegetable tissue.

248. This decomposition of the organic substances in the soil is effected partly by means of the water and other agents present there and by the air (assisted by the influence of heat), and partly by the reaction of the elements on each other, or putrefaction. The water also acts the part of a solvent. Owing to the presence of nitrogen, and their more complex nature, animal substances are soonest decomposed.

Vegetable substances, though more tardily, ultimately yield to the same agencies.

249. It has been observed that many plants excrete from their roots a peculiar matter which varies in the different kinds of plants. This matter, it is probable, consists of those parts of the sap which are not adapted for the nourishment of the vegetable, and which have been absorbed along with the nutritious particles, as the spongioles, it is supposed, have not the power of distinguishing between the different substances that are presented to them, but absorb promiscuously all fluids with which they come into contact.

250. This matter, being rejected by the vegetable, must therefore be injurious, or at least of no use, to a vegetable of the same kind; and hence a succession of crops of the same plant, or even of the same family of plants, become gradually degenerated and of an inferior quality; while, on the other hand, any crop or succession of crops is followed with advantage by a crop of another family, as it is found that it can make a good use of the exudation from the roots of the former.

251. This excretion from the roots may be considered a kind of manure, calculated, however, to be beneficial only to plants of a family different from that which produced it; and this is a principle capable of a most important and extensive application in agriculture, as, by a judicious succession of crops, we are enabled to provide from each crop a sort of manure for that which is to succeed it. It is in this manner supposed that a crop of leguminous plants prepares the ground for the succession of Corn, Barley, Oats, and the like. And it is also on the same principle that we find certain plants affect others in their vicinity, as the Lythrum salicaria, the Willow.

252. The fluids thus absorbed undergo some modification in their course from the fibrils of the root to the stem, being most probably acted upon by the secretions of the plant which they meet. They then become what is called *sap*, a watery sweetish fluid, containing various salts, the organic

matter which has been absorbed transformed into mucilage and sugar, and a large proportion of water.

253. The sap is found in the woody part of the stem, through which it begins to ascend towards the branches early in spring. At this period it may be easily collected by piercing the woody parts in the Vine, Birch, or Maple, when it will flow out in great abundance. About a pint of sap may be obtained in the course of twenty-four hours, from a divided branch of the vine. It rises or falls in the vessels according to the temperature of the atmosphere, heat distending the vessels, and promoting the free and vigorous circulation of the sap. By promoting the flow of the sap, heat is favourable to the growth of plants, and their vegetation is often accelerated by the application of artificial heat, which is called *forcing*. The greater size, and quicker and more vigorous growth of vegetables in tropical climates, is owing partly to this cause· and partly to the influence of light, to which they are more exposed in such countries. If a branch of a vine, or any tree be introduced into a hot-house, while the root and the remainder of the tree are outside, soon the branch within will shew signs of far more vigorous vegetation than the parts without.

254. When the buds are developed and have put forth their leaves, they cause the sap to flow more equally and steadily, by constantly consuming what is presented to them; and if the wood be now pierced, little or no effusion of sap takes place, the leaves drawing it towards them as it is required, and removing large quantities of the watery part by evaporation.

255. The cause of the ascent of the sap has not been well ascertained. It has been referred to the action of heat, to capillary attraction, to a vital contraction in the cells or in the vessels, to Endosmose, and to Electric influence.

256. Grew considered the ascent of the sap to depend on the play of the cells, which, when full, by their pressure on the vessel caused the sap to ascend, but he does not explain what is the cause of emptying and filling of these cells.

257. Capillary attraction has been supposed by many, and among others, by the late Sir Humphrey Davy, as the principal, if not the sole cause of this movement in the fluids of plants; but while it is probable, that to a certain extent, this peculiar force may promote the motion of the fluids, it is, on the other hand, impossible to account for either the height to which the sap ascends, and the pressure it overcomes in its progress upwards, or the rapidity with which this movement takes place, according to the theory of capillary attraction. From some experiments made by Monsieur Delon, it was ascertained that water in tubes full of sand, did not rise to the height of twenty-nine inches, till after the lapse of seven months. Some experiments of Hales established the fact, that the movement of the sap, in a vigorous branch of a pear tree, is fully one inch per minute.

258. Recently, a novel and ingenious explanation of the motion of the fluids has been proposed by M. Dutrochet. He has remarked, that when fluids of different densities are separated from each other by a membrane, a movement ensues, the direction of which invariably depends on the position of the two fluids. If a bladder be filled with a solution of sugar in water, or mucilage, and a tube be closely connected with its neck, on being immersed in a vessel of water, the fluid will be observed shortly to ascend in the tube, distinctly showing that some of the water must have passed into the bladder. On changing the fluids, that is, putting the less dense, or the water, into the bladder, and the solution of sugar, or gum in water, outside, the volume of fluid in the bladder gradually diminishes, the movement of fluids having taken place in the opposite direction, from within outwards. To these phenomena the terms Endosmose, and Exosmose were given: the former implying the movement of the fluids *inwards*, the latter, *outwards*. The words are of Greek derivation, ενδον *(endon*, within, and εξ, without).

On such facts he established the general law, that when two fluids of different densities are separated from each other by a membrane, the less dense is attracted by the denser.

259. This phenomenon he has been inclined to refer to galvanic action, which hypothesis he conceives to be mainly supported by the following fact:—An empty bladder is placed in a vessel of water, with the negative pole of a galvanic battery in it, while the positive pole is on the outside, or in the water; a current of fluid is then established inwards towards the bladder. As, then, the fluids of plants are of greater density than the external watery solutions, their electrical action will correspond to that of the negative pole, and, accordingly, the fluids from without will be attracted inwards.

260. It is probable that there may be some electro-galvanic attraction exerted by fluids of different densities; this field of inquiry has been only recently disclosed, and we can only, at present, allude to the probability of its leading to some explanation of the movement of fluids. We may observe, that some late physiologists have been inclined to ascribe an inherent power of movement to the animal fluids, especially the blood: and, if this hypothesis be admitted, it might be, perhaps, transferred to the explanation of the motion of the fluids in plants, without venturing too far into problematical theories. The singular movement in the cells described by Corti and Amici, would naturally seem to fall under this explanation.

261. The theory has been proposed by Saussure, that the vessels of plants possess a contractile power analogous to the peristaltic movement of the intestines; but there is no proof of this property of the vessels. Decandolle, who denies *in toto* the property of the vessels now stated, proposes the theory, that as the movement takes place principally if not solely by the cells, they are endowed with a contractile power, which resembles the systole and diastole of the animal heart, and, in this manner, by the alternate contraction and dilatation of the cells and intercellular passages, the sap moves upwards.

262. Decandolle is disposed to consider that this upward movement of the sap takes place chiefly through the intercellular passages of the plant; a proposition which he conceives in a great measure supported by the generally admitted fact of the lateral diffusion of the sap, which must necessarily be independent of the vascular tissue.

263. Experiments have been made by Bonnet and Hales to determine the velocity and force with which the sap moves upwards. The former etiolated some plants, by growing them in a dark cellar, in order that the movement of coloured fluids might be easily seen, and he noticed the coloured fluid to ascend in some of the experiments at the rate of two inches in the hour, and in others at the rate of three inches in the same time. When a fresh cut branch of a healthy pear tree was immersed in a tube full of water, Hales found that the sap rose in it eight inches in six minutes.

264. The force with which the sap ascends is considerable. This was determined by a very ingenious experiment of Hales: he cut off the upper portion of a vine branch, and enclosed the wounded surface of the lower portion in a tube. The force with which the sap ascended enabled it to rise to the height of forty-three feet, which is equivalent to a force capable of supporting the weight of an atmosphere and a half.

265. The greater part of the sap ascends through the alburnum to the full grown leaves, which afford it an outlet by evaporating part of it, and sending the rest through the proper vessels to the bark, thus consuming rapidly what they receive. The amount of the ascending fluid which is thrown off varies considerably under different conditions of the plant as well as of the atmosphere. The usual calculation is, that the average quantity of water exhaled is to that which is absorbed, in the ratio of two to three; that is to say, two-thirds are thrown off by the leaves, while the rest descends to nourish the plant, and of that a proportion is also rejected by the roots, forming the excretion from that part of the plant.

266. The sap, when it arrives at the leaves, is deprived of

its watery part by exhalation or evaporation, this passing off into the atmosphere when it comes into contact with it. This takes place principally under the influence of light and heat. Hot and dry weather greatly facilitates this operation, as Hales ascertained by experiments on the Sunflower *(Helianthus annuus)*, which was found in such weather to transpire thirty ounces daily, being one-half more than its average quantity. The Cornus mascula, or Cornelian Cherry, perhaps exceeds all other plants in the quantity of liquid which it evaporates daily, amounting to nearly twice the weight of the whole shrub. The watery part of the sap having performed its office of dissolving the solid matter necessary for the nutrition of the plant, thus rendering it fit to be absorbed by the spongioles, is discharged as of no further use.

VEGETABLE RESPIRATION.

267. An important operation, it is supposed, is carried on by the leaves when under the influence of light. They exhale oxygen gas, derived from the carbonic acid in the atmosphere, and from that conveyed to them in the sap. The carbon is retained, being an important element in the composition of vegetables. Light, then, it is generally believed, causes the accumulation of carbon, and the expulsion of oxygen.

268. During the absence of light, in the night-time, a very different process is carried on: the leaves absorb oxygen and give out carbonic acid.

269. The action of the leaves of plants on the atmosphere is a subject which is still involved in considerable obscurity. The experiments of Priestley, who discovered that leaves exert an action on the atmosphere, were supposed to shew that the general effect of vegetable respiration is the addition of oxygen to the atmosphere. From an extensive and interesting series of experiments instituted on this subject, Mr. Daniel Ellis was of opinion that plants consume more

oxygen than they give out, and add to the carbonic acid in the atmosphere; and that they do not derive carbon from the action of the leaf on the air. Subsequently, Sir Humphrey Davy was led from some experiments to adopt Priestley's opinion, that plants purify, or add to the oxygen of the atmosphere, gaining carbon from that source. There is still wanting a series of experiments sufficiently varied and accurate to enable us to pronounce upon this point.

270. Numerous experiments have been made to show the effect of the green parts of the plant in decomposing the carbonic acid. Decandolle arranged one experiment in the following manner: On the stand of a pneumatic trough, which was filled with distilled water, he placed two inverted jars, one of these was also filled with distilled water, and contained a plant of the Mentha aquatica—the other inverted jar only contained carbonic acid gas. The vessels were then exposed to the action of the sun's rays, to prevent any errors, the surface of the water in the trough being previously protected from the action of the air by a deep stratum of oil. In the glass where the plant was, the water gradually descended, its place being supplied by an equivalent bulk of oxygen, while in the other glass, the water ascended, an equivalent proportion of carbonic acid having been removed.

271. If distilled water only, or oxygen gas only be employed, there is no apparent result, and the plant speedily becomes sickly.

272. It is further to be noticed, that in the experiments performed by De Candolle and others, it was found that the brightest diffuse day-light, or the strongest lamp-light, was never able to effect the decomposition of the carbonic acid; in all the experiments the transmission of the direct solar beams was essential to effect this end; but in the natural conditions of plants, in the shade under hedges, and in various other positions, where there is no possibility of the sun's rays reaching them, these changes (if essential)

evidently must have taken place, as the deep green colour of their leaves, and the general healthy character of their functions sufficiently testify.

273. He also found that when plants were supplied with a greater quantity of carbonic acid than existed in the natural condition of the atmosphere, they displayed a more luxuriant vegetation than under ordinary circumstances. Among numerous other experiments, Senebier mentions that the branch of a tree which did not cause the disengagement of any gas in distilled water, in common water disengaged a volume of gas equal to that of 108 grains of water, and when the water was artificially saturated with carbonic acid, the volume of the gas then equalled 1664 grains of water.

274. It would appear, if we attempt to draw any conclusion from the experiments at present known, that, in clear sunshine, plants decompose carbonic acid derived from the sap or from that in the air, retain the carbon, and give out the oxygen; that in diffuse daylight or cloudy weather, they sometimes perform this process, and sometimes give out carbon, which unites with the oxygen of the air, and forms carbonic acid; and that during the complete absence of light, they mostly perform the latter process. This, however, is such an obscure and unsatisfactory view of vegetable respiration, that we must pause before we put implicit faith on the accuracy of the experiments on which it rests.*

* It must be observed, that all experiments on this subject place the plant more or less in an unnatural condition. The action of the wind is entirely excluded, and the plant is made to act on a limited quantity of air. The action of light, which is supposed to be the stimulus to the expulsion of oxygen, must be weakened. It is not improbable that the heat which accompanies the light may assist in bringing about the changes effected on the sap in the leaf, and in experimenting, we must necessarily diminish its agency. Indeed, heat seems to have been overlooked, in our inquiries into the causes of the action in the leaf. The colour of the leaf seems to be dependent on the action of light, but some of the other effects which have been hitherto attributed to the influence of this agent may, it is not impossible, be ascribed to heat, an agent more powerful in causing, and more frequently concerned in chemical action, than light; and which, in all the cases where light is made to

275. Carbon, it is known, is absolutely necessary for the support and growth of vegetables, and, when this element is not to be found in the soil, they *can* extract it from the atmosphere, and assimilate it to their substance. Saussure made plants vegetate in water and in an atmosphere, both of which were completely deprived of carbonic acid, and found that they did not thrive; but if carbonic acid were in the atmosphere, they flourished and arrived at muturity. Plants have been made to grow in dried earth, in flowers of sulphur, in a soil made of pounded glass and quartz, in all of which they could procure no carbon, which must consequently have been derived from the atmosphere. When a newly formed or barren soil is first beginning to be clothed with vegetation, the oxygen, hydrogen, and carbon must be derived solely from the atmosphere; and it is only by drawing largely from this source, through the medium of the vege-

act on a plant, must necessarily accompany it. The evaporation which takes place from the leaf must be modified while experimenting, and there will always be less carbon in the sap of a plant living in water, than when living in its natural soil; and even when a portion of earth is taken up along with the plant, it is not quite in its natural condition; the rootlets are apt to be torn, to be too much exposed, and are confined to a limited extent of ground. Then many of the experiments were made with leaves placed in water, and removed from the parent plant. All these circumstances must, more or less modify the condition of the plant, and render us cautious in coming to any conclusion from experiments. Of this Dr. Priestley himself seems to have been aware. After mentioning that many of his experiments did not at all accord with his theory, he says, "Upon the whole, I think it is still probable that the vegetation of healthy plants, growing in situations natural to them, has a salutary effect on the air in which they grow;" and then he alludes to the very delicate nature of such experiments, the great tendency to fallacy, the disadvantageous situation of the plant, and the numberless precautions that must be attended to. In another part, he says, "In those instances in which the plant grew the best, they were, however, but sickly, as appeared by the leaves soon turning yellow, and falling off when the least motion was given to them." This leads us to another objection, which may be urged against all those experiments in which the plants contaminated the air. It appears that whenever the leaves were unhealthy, or at all faded, they universally gave carbonic acid; and as we find that in Dr Priestley's experiments, as just quoted, the leaves soon became sickly, it is not at all improbable that this may have materially modified the result in almost all the experiments which were continued for any length of time.

tables growing upon them, that soils can at last become able to support the growth of more perfect vegetables.

276. Light, it is also known, is absolutely necessary for the healthy existence of the plant, and its operation, when it is in full power, seems to consist in causing carbon to be deposited, as plants grown in the dark are tender, feeble, and insipid, wanting many of those properties which, it is probable, must depend on the presence of carbon. If a plant be kept in the dark or etiolated, the green parts become of a sickly white colour, and indeed the whole plant becomes soft and feeble. There is a deficiency of carbon, which is necessary to the firmness and stability of the plant and the development of the green colour. This is well seen in the Garden or Heading Cabbage, the internal leaves of which are white and tender, while the external ones are strong and fibrous, and have the green colour properly developed. When vegetation proceeds in the dark, the plant loses its peculiar virtues, and all the fluids are nearly alike, possessing a mild sweetish taste. Too much light, or great intensity of light, by increasing the evaporation and the accumulation of carbon, renders all the parts of the plant more solid, stiff, and hard, and thus impedes its free growth.

277. These considerations, then, viewed by themselves, and in the absence of any decisive experiments, would seem to lead to the opinion, that plants do gain carbon by their action on the air. It may be observed, on the other hand, that vegetables can, in most cases, acquire a sufficient quantity of carbon in the soil, and that, when there is a sufficient provision for any end from one source, it is not likely that there should be another means constantly in operation conducing to the same end. This objection gains still more weight when we consider that leaves actually do, in certain circumstances, give out carbon (in the form of carbonic acid): rather an anomaly if they also take it in. Did we find that vegetables only take in carbon from the air when they cannot find it in the soil, in the same manner as they absorb moisture from the atmosphere when they cannot procure it

by their roots, we should be enabled to form a rational theory of vegetable respiration. It is possible that this may be the case, and that, in some of the experiments which have been made, there may have been a deficiency of carbon in the sap of the plant, which might lead to the absorption of carbon from the air, while this might not be the case in others.

278. The late Professor Burnett has proposed a new view of the subject. The very anomalous condition of the plant, evolving at one time pure oxygen, and at another carbonic acid, or, in other words, performing at certain, and often irregular periods, functions so diametrically opposed to each other, having led to more minute researches on this question, it was observed that a small portion of carbonic acid was disengaged by leaves both day and night. He therefore conceives that the commonly so-called function of respiration, includes another office, that of digestion. The respiratory process, analogous to the same in animals, is always going on, during the night as well as during the day, and accordingly will always be attended with the production of carbonic acid gas. So far then the theory of the evolution of the carbonic acid gas is sufficiently precise.

But how is the production of the oxygen to be explained? This he conceives, depends in part on the decomposition of the water, but also and principally on the decomposition of carbonic acid, whether taken up by the roots along with water, or simply applied to the leaf in the form of gas.

The same difficulties, however, present themselves to this theory, as we already adverted to in alluding to the commonly received theory of vegetable respiration; for the digestive process, depending on the direct action of the solar rays, must necessarily be a very precarious event in the plants of a country such as Great Britain. The theory, however, has the merit of getting rid of the very singular anomaly of oxygen being expired at one time, and carbonic acid gas at another, an anomaly which appears the more singular, if we were to conjecture such a condition in the animal species, the evolution, namely, from the human lungs, of carbonic acid during the night, and oxygen during the day.

279. It has been supposed that the expulsion of carbon may be for the purpose of relieving the plant from an excess of this substance ; and if it be allowed that the nature of the action which goes on in the leaf be determined, not by the demands or condition of the plant, but by the presence or absence of an external agent, light, it is by no means improbable that there may frequently be a necessity for expelling a superfluous quantity of carbon. And this leads us to observe, that, *a priori*, we should be inclined to doubt that so important a part of the functions of the plant should depend solely on the influence of an external agent, and be attended with such opposite results according to its presence or absence.

280. This would be a case to which we have nothing analogous in the animate works of nature. We would have plants of the same species, varying in a most important function, producing results diametrically opposite, according to the presence or absence of light, which, from their different situations, does not affect all alike. Plants in one situation would be adding carbon to the air, and in another adding oxygen. In cloudy climates, such as that of Great Britain, the plants must give out perhaps many times as much carbon as oxygen, while in tropical climes they must be almost constantly giving out oxygen.

281. It must be observed, also, that there are other differences between the nocturnal condition of plants and their condition in the day-time, besides the presence and absence of light. During the day the sap is flowing freely and rapidly through the plant ; large quantities pass through the leaves, and are modified by the great evaporation which takes place. During the night-time the sap flows much more slowly, evaporation goes on to a very limited extent, and consequently a much smaller quantity of the sap passes through the leaves. The pores are closed or contracted by

the absence of heat, and the whole plant must be in a condition differing considerably from its state during the day.

282. From what has been said, it will be seen that we are still very much in the dark regarding the nature and uses of the action which takes place in the leaf, and the influence of external agents upon it. It is not unreasonable to suppose that the leaf is not regulated in its action entirely by the degree of light present. It must be borne in mind that a plant is a being endowed with life, and capable, to a certain extent, of adapting the exercise of its functions to the circumstances in which it may be placed; and we may fairly presume, that the amount of carbon taken in by the leaf, or given out by this organ, will vary much according to the quantity in the sap derived from the soil, which, it is evident, must be very different in different situations.

283. Plants that are not green do not produce the same changes upon the atmosphere as those of this colour. Mushrooms, for example, produce carbonic acid, deteriorating the air, and they produce this effect during the day as well as during night.

284. The sap, having in the leaf been rendered fit for the nutrition of the plant, descends in the innermost layer of the bark, being here called *proper juice*, assists in preparing the cambium, which acts such an important part in the formation of the new layers of wood and bark, and spreading horizontally through the medullary rays, produces the different secretions which are found in the vegetable. Of these secretions, it is most probable that some are destined to renew the cambium along with the descending sap of the ensuing season, and some to qualify the ascending sap to promote the evolution and growth of the buds.

SECTION IV.

ANATOMY OF THE REPRODUCTIVE ORGANS.

285. The Reproductive Organs are those which serve for the continuation of the species. Every plant possesses some means of reproducing its kind; of these there is an infinite variety, from the simple homogeneous masses of cellular tissue which form the whole reproductive organs (sporules) of the lower tribes, up to the complex and elegant apparatus of FLOWER, FRUIT, and SEED, which we observe in the higher orders, as in the Apple or the Lily. They form the seed or rudiment of a new plant similar to that which produced it. At present we shall speak only of the reproductive organs of flowering plants.

CHAP. I.—THE FLOWER.

I. GENERAL VIEW OF THE FLORAL ORGANS.

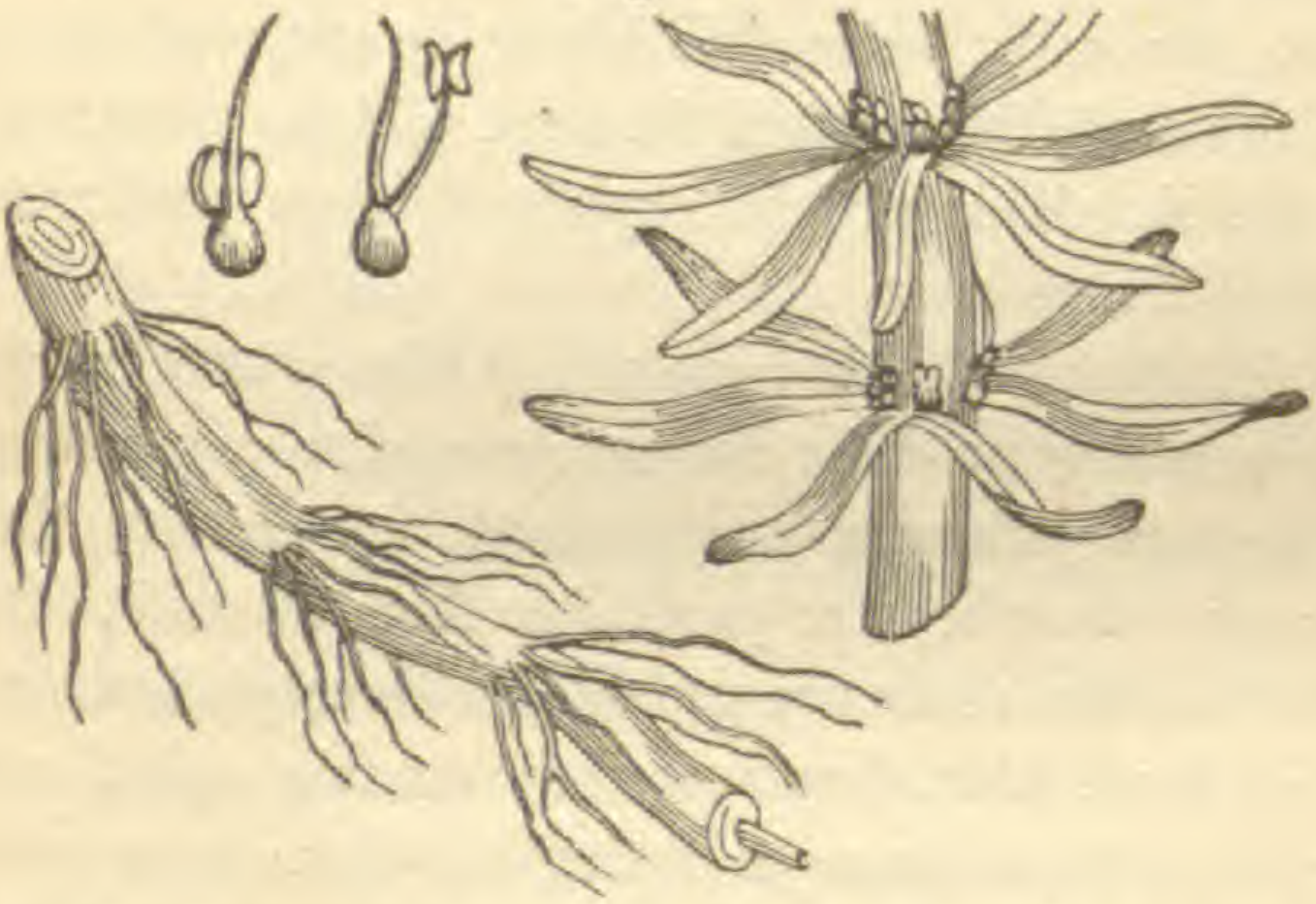
286. The floral organs, taken in the widest sense, consist of the Bractea, the Peduncle, the Calyx, the Corolla, the Stamen, and the Pistil. The bractea and peduncle may be considered appendages. In the accompanying figure, *a* is the peduncle, *b* the calyx, *c* corolla, *d* the stamens, and *e* the pistil, in the Deadly Night-shade (*Atropa belladonna.*)

Fig. 12.

287. Of these, the stamen and the pistil are the essential organs, as fructification in flowering plants can be carried

on without the assistance of the others, of which more than one are occasionally wanting, but never without the co-operation of both these organs. Hence they in particular receive the name of *sexual organs*, and, in strict botanical language, constitute the flower ; though, in popular language, this term is applied only to the coloured leaf which surrounds them. See Fig. 13, in which the stamen and pistil are seen at the left, without any accompaniment of flower stalk or floral envelope. A stamen and pistil is found in the axil of each leaf, constituting, botanically, *one flower*, seen magnified at the left, in the figure nearest the left hand of the two small figures.

Fig. 13.



288. They generally exist together in the same flower, which in this case is called *hermaphrodite* or *perfect*. When only one of them is present, the flower is termed *unisexual*, as in the Willow. The flower with the stamen is called the *male* or *barren* flower, because it fertilizes the pistil, and itself produces no seed ; the one with the pistil is called the *female* or *fertile* flower, because it bears the fruit and seed.

289. When male and female flowers grow on the same plant, it is called *monœcious* (from the Greek words μονος, one, and οικος, house,) as in the Oak (*Quercus*). When the male and female flowers are on different plants, they are called *diœcious*, (δις, twice, and οικος), as in the Willow *(Salix)*, the

Hop (*Humulus*). When hermaphrodite, male, and female flowers are found irregularly set on the same plant, or on different plants, they are called *polygamous*, as in a species of Bed-straw (*Galium cruciatum*).

290. The calyx and corolla are envelopes which cover and protect the sexual organs, and probably perform some important function connected with air and light: the peduncle gives support to the envelope and the sexual organs, and connects them with the stem; and the bractea is an appendage which protects the flower in the bud, and in some cases supplies the place of the calyx.

291. The flower is considered by modern physiologists as composed of several whorls of metamorphosed leaves or bracteæ; the calyx being the lower or external whorl, the corolla the next, the stamens the next, and the pistil the inner or last whorl. This will be explained more particularly at the end of this chapter.

292. Plants of this kind are called *phenogamic*, or flowering, because they produce flowers: *sexual*, because they have sexual organs, (stamens and pistils)), *embryonate*, because they possess an embryo or particular form of seed; *cotyledonous*, because the seeds are provided with cotyledons or seed-lobes; and *vascular*, because they contain spiral vessels. They receive these names to distinguish them from a class of plants which are destitute of spiral vessels, of cotyledons, of an embryo, of sexual organs, and of flowers.

II. THE PEDUNCLE.

293. When the flower is attached to the stem or branch by means of a stalk, this organ is called a *peduncle;* see *a*, fig. 12, par. 286. When there is no peduncle, the flower being attached by its base, it is said to be *sessile*, as in Common Star-thistle (*Centaurea calcitrapa*), and in Dodder (*Cuscuta*).

294. The peduncle is called a *scape* when it grows from

the root, as in Primrose and Cowslip (*Primula vulgaris* and *P. veris*), Lily of the Valley (*Convallaria majalis*).

295. When the peduncle is branched, each of the divisions is called a *pedicel ;* and the term *rachis* is applied to the main stalk from which the pedicels spring.

III. THE BRACTEA OR FLORAL LEAF AND ITS MODIFICATIONS.

296. Most flowers arise from the axilla of a leaf: this leaf, especially when different from the common leaves of the plant, is called a *bractea.* Where the floral leaf or bractea is not developed, it is still believed to be present in a rudimentary form. It sometimes resembles very much the other leaves of the plant, being smaller, however, and closer to the flower ; and at other times is very different from them both in colour and form, as in the Hydrangea, and in Purple Cow-wheat (*Melampyrum arvense*). In the Lime-tree (*Tilia Europæa*), the penduncle arises from a lanceolate bractea. The leaves of the tree are broad, cordate, and serrated.

297. All leaves between the bractea and the calyx are called *bracteolæ.*

298. An *involucre* consists of several bracteæ thickly set in a kind of whorl around the base of the flower, as in the Anemone, the Daisy (*Bellis*), and many others. The bracteæ are always called an involucre in the Umbel and in the Capitulum. The involucre is triphyllous, composed of three leaves, in the Anemone ; tetraphyllous, pentaphyllous, &c. See Fig. 19, par. 324.

299. The bracteæ sometimes are verticillate (whorled), and cohere at their margins like a calyx. They are then to be distinguished from the calyx chiefly by being placed beneath several flowers instead of only one.

300. When there is round the pedicel a whorl of floral leaves like a small involucre, they receive the name of *involucellum* or *partial involucre*, as in the Carrot (*Daucus carota*), which has an involucre of many leaves at the base of the peduncle, and a smaller one at the base of each pedicel. In

this case the proper involucre receives the epithet of *general*, or *universal*. See Fig. 19, par. 324.

301. The *spatha* is a sheath completely enclosing the flowers before their expansion, and bursting longitudinally to make way for them, as in Snowdrop (*Galanthus nivalis*), Daffodil (*Narcissus*), Onion (*Allium*), and Wake Robin (*Arum maculatum*). In the latter example it encloses a spadix, and some restrict the term to this case. It is a sort of bractea or floral leaf, and Sir J. Smith gives it this name in the bulbous genera mentioned above. Many of the Palms have a spatha of a woody consistence. See Fig. 20, page 94, the Wake Robin.

302. The cup (*cupula*) in the Cupuliferæ, in which the fruit rests, consists of a number of adhering bracteæ, as in the Oak, the Hazel.

303. The *glume* or husk is something between a bractea and a calyx, and is found in Gramineæ and Cyperaceæ, which are destitute of a proper calyx. This term is most generally applied to the outer and thicker set of scaly leaves next to the sexual organs (287) in Grasses, two in number, and embracing each other at the base, Fig. 14, in which are seen the outer scales (glume or calyx), and the inner scales (corolla), with the awn attached. The stamens and pistils are removed. The bristly spiral appendage, called *Arista* or *Awn*, is attached to the inner covering.

Fig. 14.

304. Dr. Hooker and Sir J. Smith consider the outer and inner coverings as calyx and corolla; and the former applies the term glume or valve to the individual pieces or leaves of each, (Hooker's Brit. Flora, p. 26.) Mr. Brown applies the term glume to the outer covering, or calyx of Hooker, and considers the thin inner covering as the true perianth. These small thin leaves or scales are called *paleæ* by some

(Lindley's Synopsis of the British Flora, p. 293). When these scaly leaves enclose several flowers, they are with propriety called bracteæ. The term *scales* is applied to the minute bodies at the base of the ovary in the grasses (nectary of Linnæus and Smith, see " Nectary.") Dr. Lindley " recommends the exterior empty bracts to be termed *glumes ;* those immediately round the fertilizing organs *paleæ ;* and the minute hypogynous ones, *scales* or *squamulæ*." According to the same botanist the glume is to be distinguished from the calyx by its leaves being alternate and not verticillate. He considers all these scaly leaves as bracteæ.

305. The form of bractea termed involucre, and some other varieties, perform the important purpose of protecting the young flower (or flowers) when in the bud, and also during the ripening of the seeds. This is well seen in the involucre of the Compositæ, as that of the Dandelion, in which the involucre, after closely enveloping the young flower bud, is turned down (reflexed) to spread out the expanded flowers, and again rises when the flowers have faded, to envelope and protect the ripening seeds. The same functions are often performed by the calyx, undergoing the same changes in position. Both calyx and involucre again fall back to allow the dispersion of the seeds.

IV. THE INFLORESCENCE.

306. This term is used to express the manner in which the flowers are arranged on the plant.

307. The flowers are called *solitary*, when they grow separately at distant points of the stem, as Round-leaved Toadflax (*Linaria spuria*).

308. *Opposite the leaves*, when the flower is at the same height on the stem, and opposite to a leaf, as Narrow-leaved Water Parsnip (*Sium angustifolium*.)

309. *Axillary*, when in the axilla of a leaf, as in the Ivy-leaved Speedwell (*Veronica hederifolia*).

310. *Extra axillary*, or lateral, when the flower grows from the side of the origin of a leaf, as in Common Garden Nightshade (*Solanum nigrum*).

311. *Epiphyllous*, when the flower grows on the surface of the leaf, as in Butchers Broom (*Ruscus aculeatus*).

312. *Terminal*, when the axis or stalk terminates in a flower or bunch of flowers, as Paeony.

The flowers are said to be in the form of a

313. SPIKE (*spica*), when they are sessile and placed simply along a common stalk or axis, as in Plantain (*Plantago*), the genus Orchis, Wheat (*Triticum hybernum*), Great Mullein (*Verbascum thapsus.*)

314. The term also has been applied to flowers in this form when the peduncle is very short, as Spiked Speedwell (*Veronica spicata)*, which Dr. Hooker calls a spicate raceme (318), Common Lavender(*Lavandula spicata)*, Foxglove (*Digitalis,)* &c.

315. The spike generally grows erect; and the expansion of its different flowers is progressive, the lower ones frequently having faded before the upper ones have opened.

316. The term *spikelet* (spicula) is applied to Grasses with many florets within one calyx (Smith), set on a little stalk, which is the spikelet, as in Meadow Grass (*Poa*) Ryegrass, (*Lolium Perenne.*)

317. The spike is sometimes *unilateral* (secunda), the flowers all leaning to one side, as in Matgrass(*Nardus stricta.*)

The Flowers are in the form of a

318. RACEME, *or cluster*, when they are numerous, distant, peduncled, and arranged along a common stalk, differing from the spiked form only in having peduncles, and in being more distant, as Common Red Currant (*Ribes rubrum ;* See Fig. 15.) Barberry (*Berberis vulgaris*).

Fig. 15.

Fig. 16.

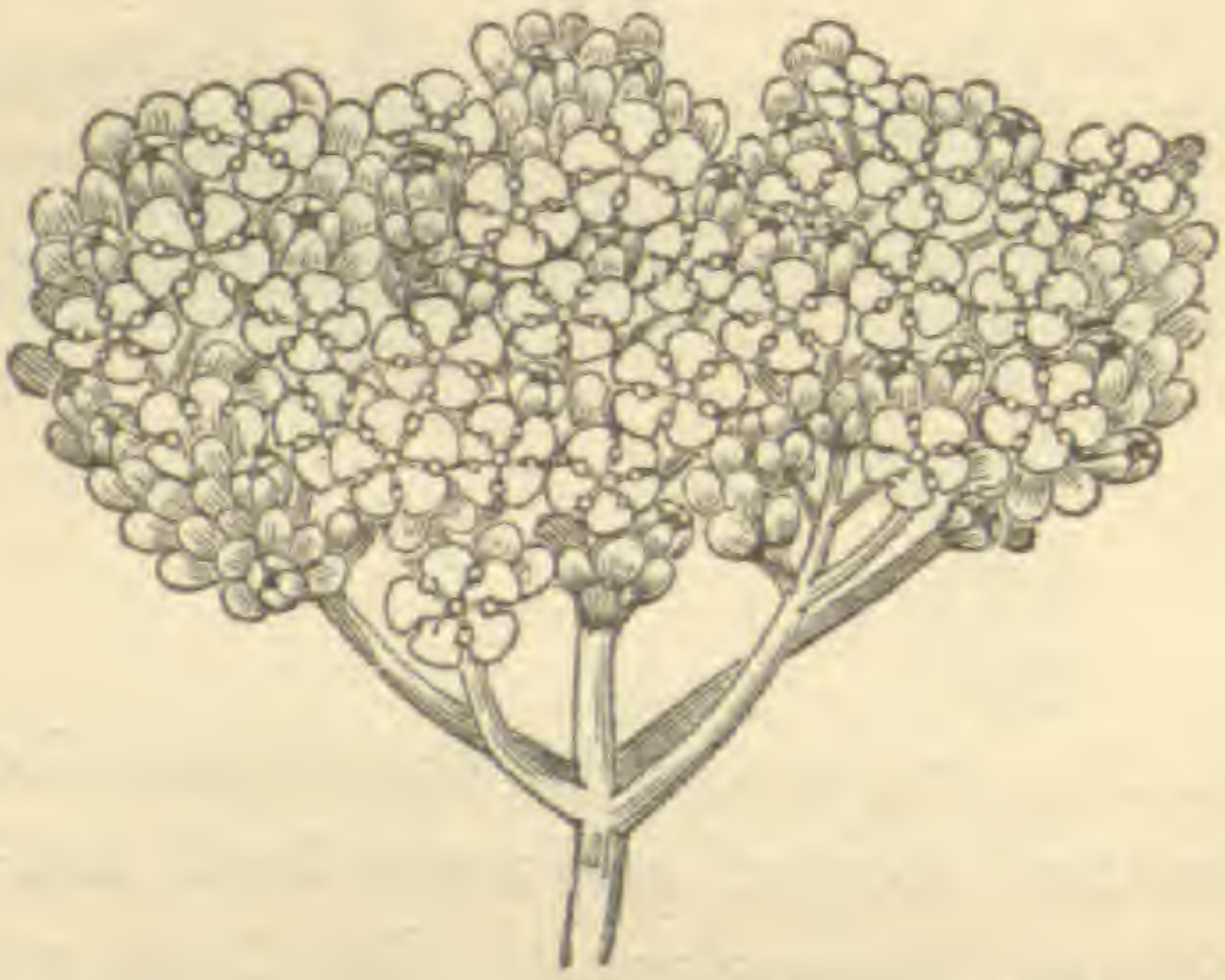
319. The PANICLE resembles the raceme, but the peduncles are branched, longer, and more loose and distant, as in London Pride or None-so-pretty (*Saxifraga umbrosa*), Oats (*Avena sativa*), Fig. 16, and many Grasses. It may be termed a branched raceme.

320. The CORYMB has the peduncles arising from different heights on the stem, but long in proportion to their distance from the summit, so that all the flowers are nearly at the same level, as in Common Yarrow (*Achillæa Millefolium*), Fig. 17, and many others of the order Compositæ. It may be regarded as a raceme, in which the lower pedicels are much elongated.

Fig. 17.

321. The CYME has the peduncles arising from the same point, but irregularly divided into pedicels, which do not proceed from one central point, the flowers being nearly at the same level, as in the Elder (*Sambucus nigra*), Fig. 18, the Guelder Rose (*Viburnum*), and the Wild Cornel or Dogwood (*Cornus sanguinea.*)

Fig. 18.



When the Cyme has very few flowers, it has been termed a *verticillaster*. Two opposite verticillasters are supposed to form the verticillus in Labiatæ. See par. 327.

322. The UMBEL has all the peduncles nearly equal to each other, springing from the same point, diverging like rays, the flowers in a globular or semi-spherical form, and the pedicels arising regularly from a central point: Fig. 19, next page, Mountain Stone Parsley.

323. The umbel is *simple*, when each peduncle is single flowered, as in Broad-leaved Garlic (*Allium ursinum*), Cowslip (*Primula veris*), or Eryngium. When the flowers of a simple umbel rise nearly to the same level, Richard calls it a *sertulum*.

324. The umbel is *compound*, when each peduncle at one point divides into many nearly equal pedicels, which bear the flowers. This is the case in the Carrot *(Daucus Carota)*, Parsnip *(Pastinaca sativa)*, Hemlock *(Conium maculatum)*, and the rest of the Umbelliferæ.

Fig. 19.

325. The peduncles, taken together, form the umbel, or universal umbel: the pedicels at the extremity of each peduncle form what is called a *partial umbel.*

326. The THYRSUS is a panicle in which the peduncles are irregularly divided, but sometimes have an umbellate form, and the middle branches of which are longer than those at the base or summit, as the Lilac (*Syringa vulgaris*), the Vine (*Vitis vinifera).* Some consider the vine as a raceme.

327. The WHORL (*verticillus*) is that form of inflorescence in which the flowers are arranged in a ring round the stem, as in Common Mare's tail (*Hippuris vulgaris).* See Fig. 13, page 85. White Dead-nettle (*Lamium album),* Penny-royal (*Mentha pulegium*), and many of the Labiatæ.

328. The SPADIX is a spike in which the flowers are set very close, and enclosed in a spatha, as Wake Robin (*Arum maculatum*), Fig. 20, next page. It is found only in monocotyledonous plants.

Fig. 20.

Fig. 21.

329. The CATKIN (*amentum*) consists of a cylindrical receptacle, with closely imbricated scales or bracteæ covering unisexual flowers, as in the Walnut (*Juglans regia*), the Fir (*Pinus*), the Birch (*Betula*), and the rest of the Amentaceæ (*Juss*). The fir-top is a catkin. The catkin of the Hop (*Humulus lupulus*) contains the bitter principle which renders this plant so valuable in brewing. See Fig. 21, the catkin of the Hazel (*Corylus Avellana*).

330. The CAPITULUM (*glomus*), head, or tuft, has the flowers sessile, or with very short peduncles, and ranged in a globular form, as in Common Thrift or Sea Gilly-flower (*Statice Armeria*), Trefoil (*Trifolium*), Scabious (*Scabiosa*). This is an umbel with nearly sessile flowers, and the term has been applied also to compound flowers, as the Thistles, in which the receptacle or top of the peduncle swells out into a spherical shaped body, called *phoranthus*, which supports the flowers. The capitulum is found in the Dipsaceæ, Compositæ, Calycereæ, &c. When flat and surrounded by an involucre, it is often termed *Anthodium*.

331. Dr. Lindley gives the following tabular view of the various forms of inflorescence :—

"Flowers not placed on stalks,
arranged upon a lengthened axis,
which is permanent, *Spike, Locusta, Spadix,*
which is deciduous, *Catkin,*
arranged upon a depressed axis, *Capitulum, Anthodium.*

Flowers placed upon distinct stalks,
arranged upon a lengthened axis;
Stalks simple.
and of equal length, *Raceme,*
the lowermost the longest,
Inflorescence centripetal, *Corymb,*
——— centrifugal, *Fascicle.*
Stalks branched,
Inflorescence lengthened and
centripetal, *Panicle,*
——— depressed, and
centrifugal, *Cyme, Verticillaster;*
arranged upon a depressed axis, *Umbel.*"

V. MODE OF EXPANSION.

332. The flower buds open in a certain order—sometimes the upper or central flowers expand first, and then gradually the lower or outer ones. This method of expansion is termed CENTRIFUGAL. In other cases the lower or outer buds expand first, and then the opening spreads towards the upper or central florets. This is termed CENTRIPETAL.

333. When the expansion is *centrifugal*, it is considered that the bunch of flowers have originated from the growth of several peduncles or branches; and the inflorescence is sometimes termed *compound*. Each bunch, however, of flowers, expands centripetally, though the whole opens centrifugally.

334. When the expansion is *centripetal*, it is considered that the flowers proceed from the growth of a single branch, and the inflorescence is termed *simple*.

335. In some cases the expansion is somewhat irregular incapable of being distinctly referred to either of the above kinds.

VI. THE FLORAL ENVELOPE.

336. This consists of one or two whorls of leaves of a peculiar form and appearance, immediately surrounding the sexual organs (287.) When there are two whorls, the inner, that nearest to the stamens and pistil, is called *corolla*, the outer is called *calyx*, and the plant is called *dichlamydeous*. When there is only one whorl, it receives the name of *calyx*, whatever be its form or appearance; and the plant is called *monochlamydeous*.

337. Considered as a whole, the floral envelope, whether there be one whorl or two present, receives the name of *perianth* (perianthium *or* perigonium.) The perianth is called *simple*, when it consists of the calyx alone; *double*, when both calyx and corolla are present.

338. When neither calyx nor corolla is present, the plant is called *achlamydeous*, and the sexual organs are said to be *naked*, as in Wake Robin (*Arum*), or in Mare's Tail. See Fig. 13, par. 287.

VII. THE CALYX.

339. This organ consists of a whorl of leaves placed at the top of the peduncle, immediately below the sexual organs, when there is no corolla; and when the latter is present, immediately below it. It is called *flower-cup*, from embracing the lower part of the corolla, which appears to rest in it. See *b*, Fig. 12, par. 286.

340. When the corolla is present, the calyx is generally shorter than it after the flower has expanded, but longer and embracing it before. It is usually of a green colour. When there is no corolla, the calyx (336) is generally thick, large, and richly coloured, having much of the appearance of the corolla, as in the Tulip and the Lily, the coloured flowers of which are considered as a calyx, or as a calyx and corolla

united. In many monocotyledonous plants, the calyx is the sole floral envelope.

341. The separate parts or divisions of which the calyx consists are called *sepals*. When these are united by their margins, so as to form one piece of a more or less tubular form, the calyx is called *monosepalous*, *gamosepalous*, or *monophyllous*, as in Henbane (*Hyoscyamus*) and the other Solaneæ, and in the Labiatæ. The lower part, where the sepals are united, form what is called the *tube*. They are generally spread out, and remain separate above, and there constitute the *limb*. See Fig. 22. The tube is generally formed by the union of sepals at the margin—sometimes, as in Eschscholtzia, it is an expansion and dilatation of the flower-stalk.

342. The Monosepalous calyx has different terms applied to it, according to the mode in which the limb is divided. It is,

343. *Toothed* (dentatus), when the divisions are very short, and have the appearance of sharp teeth.

344. *Cleft* (fissus), when the divisions extend about half way down: bifid, trifid, &c.; see Fig. 22, par. 358.

345. *Partite* (divided), when the divisions are very deep.

With respect to form, the monosepalous calyx is

346. *Tubular*; when it is cylindrical, long, and narrow, as in Cowslip *(Primula veris)*; see Fig. 22.

347. *Ventricose* (urceolate); the tube swelled, but becoming narrow near the limb, like a pitcher.

348. *Inflated*; thin, and dilated like a bladder, as in Bladder Campion *(Silene inflata.)*

349. *Campanulate*; shaped like a bell.

350. *Two-lipped* (bilabiate); having its limb so divided as to represent an under and upper lip, as in Sage *(Salvia)*, and many of the Labiatæ.

351. When the sepals are separate and distinct from each other from the base, the calyx is *polysepalous* or *polyphyllous*,

as in Wall-flower (*Cheiranthus Cheiri.*) See Fig. 26, par. 369.

352. The calyx in compound flowers (Compositæ), consists of a mere rim at the top of the ovary, or of hairs (called pappus) rising from the same part.

353. The calyx is called *superior* when it adheres to the ovary (447), in which case it is necessarily monosepalous, as every point in the circumference of the ovary is in contact with a part of the calyx; and the ovary is called *adherent* or *inferior*. When there is no adhesion, the calyx is *inferior*, or inserted below the ovary, which is called *free* or *superior*. The terms " superior" and " inferior," as applied to the various parts of the flower, are explained in par. 418, 419, 420, also 447, 448.

VIII. THE COROLLA.

354. This is the inner whorl of leaves when the perianth is double, placed immediately next the sexual organs, of a delicate texture, and generally highly coloured, forming the chief beauty of the flower. See *c*. Fig. 12, par. 286. The corolla seems to consist chiefly of cellular tissue, and spiral vessels, with no woody fibre. It exists only when the perianth is double, the single envelope always receiving the name of calyx. In some cases there is a little difficulty in finding if the perianth be double or single, as in some monocotyledons, where the floral envelope consists of six petaloid leaves, in which an outer and inner whorl can scarcely be distinguished. In such cases, however, some botanists speak of calyx and corolla, considering as calyx the three leaves which appear the more external.

355. The individual parts or divisions of which the corolla consists are called *petals*. When these are united by their margins, so as to form one leaf, or petal, of a more or less tubular form, the corolla is called *monopetalous*, as in Primrose (*Primula*), Foxglove (*Digitalis*), &c. See Figures 22–3.

356. The cylindrical part of a monopetalous corolla is called the *tube :* the upper spreading part is called the *limb.* These parts are well seen in the Cowslip. Fig. 22, par. 358.

The monopetalous corolla is regular or irregular.

357. It is *regular* when its figure is uniform, its incisions being equal, and the parts regularly disposed round an imaginary axis, as in the Cowslip, and in Nightshade: see Fig. 12, par. 286.

The monopetalous regular corolla is

358. *Bell-shaped* (campanulate), as in the Bell-flower (*Campanula)*, Bindweed *(Convolvulus)*, Jalap (*Convolvulus jalapa*), and many others. See Fig. 12, par. 286.

Fig. 22.

359. *Tubular*, when the tube is long and cylindrical, as in Lilach (*Syringa vulgaris*), or Cowslip, Fig. 22.

Fig. 23.

360. *Funnel-shaped* (infundibiliformis), when the tube, being narrow at the lower part, gradually widens towards the limb, as in Lungwort (*Pulmonaria*), Tobacco (*Nicotiana tabacum*), Fig 23.

361. *Salver-shaped* (hypocrateriformis), when the tube is long and narrow, and diverges abruptly into a horizontal spreading limb, as in Primrose, in Cowslip, Fig 22, Lilac, &c.

362. *Rotate*, or wheel-shaped, like the last, but with a very short tube, as Borage *(Borago)*, Nightshade *(Solanum)*.

363. *Ventricose*, or urceolate, pitcher-shaped, contracted at the orifice, as in Heath (*Erica*), sometimes called campanulate.

364. The monopetalous corolla is irregular, when the

incisions are not uniform, or the opposite sides are irregularly placed round an imaginary axis, as in Toadflax (*Linaria*), Snapdragon (*Antirrhinum*). See Fig. 24, the corolla of Ground-ivy (*Glechoma hederacea.*)

Fig. 24.

The monopetalous irregular corolla is

365. *Ringent*, *labiate*, or *bilabiate* ;—gaping, like the mouth of an animal, the tube widening at the upper part, and the limb being divided transversely into two unequal parts; one, called the upper, sometimes longer than the other, or lower one; as in Sage (*Salvia*), Dead-nettle (*Lamium*), Ground-ivy (*Glechoma*) Fig. 24, and all the Labiatæ. In some, the lips are nearly equal in length, as in Thyme, Bugle (*Ajuga*), Marjoram (*Origanum*), &c. See also Fig. 25, the corolla of Lavender (*Lavandula spica*), slit up longitudinally, and folded back.

Fig. 25.

366. *Personate*, when the tube is expanded, and the orifice narrowed by the approximation of the two lips, which are unequal, as Toadflax (*Linaria*), Snapdragon (*Antirrhinum*). The corolla of the Foxglove is sometimes called personate, sometimes, campanulate unequal.

367. When the petals are separate and distinct from each other from the base, the corolla is *polypetalous*, as in *Raphanus Raphanistrum* (Wild Radish or jointed Charlock), Fig. 26, par 369, the Pink (*Dianthus*). The lower part is called the *unguis* or *claw ;* the upper spreading part the *lamina* or *border*. When the claw is large and well marked, the petal is said to be *clawed* or *unguiculate*, as in the above examples. Ranunculaceæ, Rosaceæ, and Cruciferæ, afford examples of the polypetalous corolla.

368. The petals are sometimes *erect*, as in the Water Avens *(Geum rivale) ; inflexed*, the point curved inwards, or

towards the centre of the flower, as in Carrot, Angelica, and many of the Umbelliferæ; *reflexed*, the point turned outwards.

The polypetalous corolla is regular or irregular. The regular polypetalous corolla is

369. *Cruciform*, when there are four clawed petals, arranged in the form of a cross, as in Wall-flower *(Cheiranthus Cheiri)*, Turnip *(Brassica)*, and all the plants in the natural order Cruciferæ: See Fig. 26, the flower of Charlock.

Fig. 26.

Fig. 27.

370. *Rosaceous*, when there are five petals, with little or no claw, spreading out like a rose, as in the Rose, the Bramble *(Rubus)*, Cinquefoil (*Potentilla*), the natural order Rosaceæ. See Fig. 27, the flower of *Pyrus malus* (Crab-apple).

371. *Caryophyllaceous*, when there are five petals deeply clawed, as in Catchfly *(Silene)*, Pink *(Dianthus)*, Corn-cockle (*Agrostemna Githago*), and the Caryophylleæ.

The irregular polypetalous corolla is

372. *Papilionaceous*, when there are five petals, of which the uppermost and posterior is broad and dilated; the two middle and lateral ones are parallel to each other; and the two lower are also parallel and connected by their anterior or lower margins. The first is the *vexillum*, or

standard: the next two are the *alæ*, or *wings:* and the other two form the *carina*, or *keel*. This kind of corolla is found in the Pea and Bean, and the greater number of the Leguminosæ. It is called papilionaceous from having a resemblance to a butterfly with expanded wings. See Fig. 28, in which *a* is the vexillum, *b* the ala (of which there are two), and *c* the carina, or keel; Figs. 29, 30, *b*, one ala, *c*, the keel;—and Fig 31, the vexillum.

Fig. 28.

Figs. 29, 30.

Fig 31.

373. The other forms of irregular polypetalous corolla, as in the Monk's-hood *(Aconitum)*, Larkspur *(Delphinium)*, Violet, &c., are incapable of being reduced to any order.

374. The petals generally alternate with the sepals, that is, each petal is opposite to the space between the two sepals, not to a sepal. This is well seen in the Cruciferæ. See Fig. 26, par. 369.

Compound Flowers.

375. There is a class of flowers which in many points differ so much from the generality of flowers, that they require to be separately noticed. They are called *compound*, because what appears to be one flower consists of a great number of florets or little flowers, sessile on one receptacle called phoranthus, and occasionally very different from each other in form and other respects.

376. The most marked character of this class of flowers is the union of the stamens by the anthers, which has procured for them the epithet *syngenesious*.

377. The Daisy (*Bellis*), the Dandelion (*Leontodon Taraxacum*), the Thistle (*Carduus*), the Dahlia, the China Aster

(*Aster Chinensis*), the Artichoke (*Cynara Scolymus*), and the Sunflower (*Helianthus*), are examples of this class.

378. The florets are monopetalous, very small, and, in many, of two kinds; those of the *disc*, which are in the centre, and those of the *ray*, which are in the circumference,—the external ones which enclose the preceding.

379. Those of the disc are *tubular*, and five-cleft; and are yellow in the Daisy. Those of the ray are called *ligulate*, or strap-shaped, and are expanded into a long, narrow ribbon-shaped leaf. They are white in the Daisy.

380. The calyx is closely adherent to the ovary, and is not very distinct. It appears as a rim, or as pappus, at the top of the ovary. The stamens are five in number, and united by their anthers into a cylinder, through which the extremity of the style passes; and many of the florets are unisexual (288.)

381. When the flower or head is composed solely of tubular florets, it is called *flosculous*, as the Artichoke and Thistle.

382. When all the florets are ligulate, the flower is ligulate or *semiflosculous*, as Lettuce *(Lactuca)*, Dandelion.

383. When the central florets are tubular, and those of the circumference ligulate, the flower is *radiate*, as the Daisy, the China Aster.

384. The calyx in most compound flowers terminates in little hairs, which remain and are elongated after the corolla has fallen, forming the pappus or seed down which acts the part of wings, and assists the seed to fly away from the receptacle. The calyx surrounds the ovary, and becomes the most external covering of the seed.

385. The pappus is *sessile* when situated immediately on the top of the seed; *stipitate*, when supported on a little stalk called *stipes*, as in Lettuce; *simple*, when hairy and undivided, as in Lettuce; *feathery*, when small fine hairs project from the sides of the larger hairs like a feather, as in Goat's beard *(Tragopogon)*.

This singular tribe of plants will be more fully described in the description of the Natural Orders, under *Compositæ*, or in the account of the Linnæan System.

IX. THE ÆSTIVATION.

386. The various parts of the flower are folded in different ways in the bud, and in this state afford excellent characters for the distinction of natural orders. The arrangement of the parts has received the name of *æstivation* or *præfloration*.

The æstivation is

387. *Imbricate*, when each petal covers a small portion of the adjoining one, as in many of the Umbelliferæ.

388. *Valvate*, when the petals touch each other only by their margins, as in the Araliaceæ.

389. *Folded* (plicata), or plaited, when a monopetalous corolla is regularly folded, as in the Convolvulaceæ, and many of the Solaneæ.

390. *Corrugate*, when the petals are irregularly folded and wrinkled or crumpled, as in the Cisteæ, and Papaveraceæ.

391. *Contorted* or twisted, as in the Apocyneæ.

X. THE NECTARY.

392. This is often a part of the calyx or corolla, and the term was applied by Linnæus to any irregular part attached to either of these organs. It has been defined that part which secretes and retains honey. In the Columbine (*Aquilegia*), the five petals terminate inferiorly in a sort of spur, which is the nectary. In the violet, the lower petal is spurred at the base, or has a nectary: in the Crowfoot (*Ranunculus*), each petal has a small square body, or nectary, at the base. The term is applied to the elongation of the calyx in the Indian Cress (*Tropæolum majus*); to the glands

found at the base of the stamens in the Cruciferæ; and to the two petal-like bodies or long stalks concealed within the helmet-shaped leaflet of the Monk's-hood (*Aconitum*). The calyx or corolla is called *spurred* (calcarata), when there is a spur or nectary, or prolongation of the base.

Fig. 32.

393. There is a very singular nectary in the Grass of Parnassus (*Parnassia palustris*). See Fig. 32. There are five nectaries, one seen resting on each petal, consisting of a number of slender filaments united at the base, and swelling at the extremity.

XI. THE RECEPTACLE.

394. This is the extremity of the peduncle or pedicel, and to it the calyx, corolla, and stamens are generally fixed. It is also called *torus*. It is sometimes expanded into the form of a cup, surrounding the base of the pistil, as in *Pæony*. It is termed *Gynobase*, when it bears a single pistil. It is very prominent in the Compositæ, as the Thistle (*Carduus*), the Daisy (*Bellis*), and in them is called *phoranthus* by Richard. It is conical in the Daisy, hairy in the Thistle, chaffy in Burdock (*Arctium.*) In the *Ranunculus* or Crowfoot, and in the Poppy, the pistils rest upon this organ, and the stamens, calyx, and corolla are inserted into it. The part of the Strawberry which is eaten is the enlarged receptacle. In this plant the receptacle is convex; while in Rose, it is concave or hollow.

XII. THE STAMENS.

395. These are the male organs of the plant. They are

situated immediately within the corolla or perianth, being enclosed and protected by it when young. They vary in number in different flowers. In some there is only one—in others a hundred or more.

Fig 33.

396. The stamen consists of two parts, the filament and the anther; the former supporting the latter, which is the essential part. In Fig. 33, *a* is the filament, and *b* the anther of the Crocus; and a very great number of plants have stamens of a similar structure.

397. The *filament* is the long slender body forming the lower part of the stamen, and swelling out superiorly into the anther. It is called *prominent*, when it projects beyond the anther; *petaloid*, when it is broad and thin like a petal. The filament contains a considerable quantity of spiral vessels.

398. The filament and anther are connected in three different ways: 1. The anther adheres for a considerable part of its length by its back (dorsal surface) to the filament,—it is then termed *adnate*. 2. The anther is attached at its base to the extremity of the filament, appearing to be a prolongation of the filament,—it is then termed *innate*. 3. The anther is often attached by a single point in the connective (at its back) by a very tapering filament, so as to hang very loosely and lightly,—it is then termed *versatile*. This latter structure is seen in the grasses, in which the filament and anther are connected by a single point, from which the anther swings freely. These terms, adnate, innate, versatile, are applied to the anther.

399. The anther is the essential part of the stamen, as it contains the pollen or fecundating powder. It is of a cellular texture, and generally consists of two *cells* or membranous bags, often termed *lobes*, the sides being termed *valves*. See Figs. 33, 34, 35. The lobes are generally united by means of a transverse body called *connectivum*. This is

usually small, but sometimes attains a considerable magnitude, and separates the cells somewhat from each other. The lining of the anther is termed *Endothecium* by Purkinje, who has described it as composed of fibro-cellular tissue.

400. Sometimes there is only one cell, as in the New Holland Heaths, Epacrideæ, and Marantaceæ. In the Butomus umbellatus or Flowering-rush, and in Tetratheca and Laurineæ, there are four cells in the anther. See Fig. 34, the anther in the Laurineæ.

401. The cells of the anther open in due season to emit the pollen. This is called *dehiscence*, and the part is termed the line of dehiscence. In the generality of cases, the anther is so placed as to dehisce towards the pistil. The anthers are then termed *introrsae* (inwards), or *anticae* (forwards). In some plants, the line of dehiscence is turned towards the petals, when the anthers are termed *extrorsae* (outwards), or *posticae* (backwards.) This form of dehiscence is found in the Magnoliaceæ, and in the Crocus.

402. The anther dehisces or opens in four different ways. 1. It is *longitudinally dehiscent*, when it opens by a line or suture, running from the base to the apex of each cell, as in the Lily, the Crocus. (See Fig. 33, par. 396.) This is the most common mode of dehiscence. 2. Some anthers dehisce by a transverse slit across the cell, as in Lemna and Alchemilla. 3. The anthers may dehisce by pores, as in Solanum, where the upper part only of the longitudinal furrow opens—or in the Ericineæ, where the apex of each cell is prolonged into a tube opening at the top—or in Tetratheca, where the two cells become one at the apex, and dehisce by an aperture there common to them both. In some of the genus Pyrola, the pores

Fig. 34.

Fig. 35.

of the anthers are situated below. See Fig. 35, where the pores are seen at the apex of the anther. 4. The anther dehisces by valves, when the whole side of the cell, as in the Berberideæ, or parts of the side, as in Laurineæ. (See Fig. 34), separate and bend upwards, remaining attached only by a small point at the upper part of the piece that separates, like a hinge.

403. The POLLEN is a very fine powder, contained in the cells of the anther, from which it is emitted upon the stigma, whence it is conveyed, (or part of it), to the ovules, which it impregnates. It consists of small vesicles or globules, containing a mucous fluid mass. It is generally yellow in colour.

404. The form of the grains of pollen is usually spheroidal, the surface being occasionally marked by elevations and projections, as in the Mallow. They are very small, sometimes not more than 1-2000th part of an inch in diameter, while the largest never measure more than 1-360th part of an inch. These grains are generally loose, but in the Orchideæ, and Asclepiadeæ, they unite into a mass of a waxy consistence, and in the Onagrariæ they are held together by a loose web of cellular tissue. In the Orchideæ the pollen mass, as it is usually called, fills completely the cells of the anther, and has a stalk attached to it.

405. It does not appear, from numerous observations made at every stage of the growth of the pollen, that it has any connection with the walls of the cell of the anther. Decandolle, nevertheless, is inclined to believe that the grains of pollen are attached to the parts just mentioned, in the early stage of their formation;—a supposition, which he conceives, is strongly corroborated by their analogy to ovules. Turpin even goes so far as to maintain the existence of an elevated part to which these grains are connected.

406. When the pollen is smooth, it has been remarked by Malpighi, that a longitudinal line is seen when the grains are dry, disappearing when they are wet. The use of this is not known, but it has been conjectured, that it is to facilitate the

absorption of moisture, and thereby promote the disengagement of the matter within.

407. The pollen is said to be covered or protected by two membranes, but this point is still not satisfactorily determined.

408. Within each pollen grain, a peculiar slightly viscid fluid is contained, which constitutes the proper fecundating matter of the pollen, and has been called *fovilla.*

409. When mature, the pollen grains open commonly by an irregular laceration of the integuments: Sometimes, however, there is a regular dehiscence. On escaping into the stigmatic tissue, but not till then, and always after the lapse of several hours, a peculiar tube— *boyau*, or intestine, as it is called, is sent down, which constitutes a kind of channel or road for the transmission of the fovilla to the ovule.

410. The presence of water seems to exert an important action on the pollen, for it causes the rupture of the bags, and hence, if moisture be prematurely applied to the anther, the pollen mass will be discharged before it is ripe, and no fecundation of the ovary will ensue. Hence, a wet spring diminishes considerably the produce of the orchard.

411. In aquatic plants there are various means to prevent the access of the water. In *Zostera marina*, a plant which grows in this country, the flowers are protected by an envelope, including a little air, while in many others, the plants elevate themselves to the surface when the pollen is ripe. This phenomenon may be observed in the Ruppia maritima, and several species of Potamogetons, common in this country.

412. The number of stamens in different plants is very various. They are generally more numerous than the pistils. Flowers with one stamen are called *monandrous;* with two *diandrous*, and so on. See the account of the Linnæan System.

Fig. 36.

413. When there are four, of which two are longer than the other two, they are called *didynamous*, as in the most of the Scrophularineæ and Labiatæ. See Fig. 36. When there are six, of which four are longer than the other two, they are called *tetradynamous*, as in Wall-flower, and the rest of the Cruciferæ. See Fig. 26, page 101.

414. When the stamens are longer than the corolla, they are termed *exserted ; included*, when shorter.

415. When they are united by their filaments, they are called *monadelphous* (Fig. 37), if they form a tube, as in Mallow *(Malva) ; diadelphous* (Fig. 38), as in the Pea, and the rest of the Leguminosæ; *triadelphous*, *polyadelphous*,

Fig. 37.

Fig. 38.

according to the number of separate bundles or fasciculi into which they are formed. In Fig. 38, *a* is the pistil; the other bodies are stamens, nine united, and one free; or in two sets or divisions (diadelphous.)

416. When the stamens are united by their anthers, they are called *syngenesious*, as in the Daisy, the Thistle, &c. This is the distinguishing character of the extensive natural order Compositæ.

417. When they are incorporated with the pistil, they are called *gynandrous*, as in Orchis, and the rest of the Orchideæ.

418. The stamens are *hypogynous* or *inferior*, when they, or the monopetalous corolla on which they are placed, are inserted *under* the ovary, or pistil: as Poppy *(Papaver)*, Crowfoot *(Ranunculus)*, the Cruciferæ. See Frontispiece, Fig. 5, the Common Red Poppy, in which the stamens are seen to be inserted at the base of the central body—the pistil, or ovary.

Fig. 39.

419. The stamens are *perigynous*, or around the ovary, when they are inserted into the calyx, as in the Rose and other Rosaceæ. See Fig. 39, the flower of the Dog-rose, the petals being removed.

420. The stamens are *epigynous*, or *superior*, when they are inserted *above* the ovary, as in the Umbelliferæ. See also Frontispiece, Fig. 6. The terms "inferior" and " superior" are often applied to the perianth, indicating the same situation in that organ, as when applied to the stamens. The situation of the stamens is a point of great importance in a natural arrangement of plants.

421. In general the stamens correspond with, or are opposite to the sepals, being alternate with the petals, or opposite to the spaces between them; and they are frequently of the same number as the petals, or some multiple of that number.

422. Petals frequently develope in place of stamens, which are considered as modified petals,—the filament being analogous to the *claw*, the anther to the *lamina*. And as the petal is considered as a modified leaf, the stamen must necessarily be also a modified leaf, the filament representing the *petiole*, and the anther the *lamina* or *disk* of the leaf. This may be seen in the flower of the Nymphæa alba or White Water Lily, in which the petals may frequently be observed in every degree of metamorphosis, from the perfectly developed petal to the regular stamen with its two cells.

XIII. THE DISK.

423. This term is applied to the fleshy part that occasionally intervenes between the stamens and the pistil, and is often an expansion of the receptacle. It is

424. *Hypogynous*, when it is between the receptacle and the ovary, which is in this case superior; Cruciferæ, Labiatæ.

425. *Perigynous*, when it lines the tube of the calyx; Rosaceæ, Pomaceæ.

426. *Epigynous*, when it is placed above the ovary, which is inferior; Umbelliferæ.

427. The insertion of the stamens and position of the disk always correspond. The disk is always found in the Rosaceæ, Labiatæ, Umbelliferæ, Boragineæ. In Pæony, it is in the form of a shallow cup, surrounding the base of the ovary.

XIV. THE PISTIL.

428. This organ stands in the centre of the flower, and appears to be a continuation of the peduncle. It consists of three parts,—the *ovary* or *germen*, the *style*, and the *stigma*. In general, there is only one pistil, as in the Poppy. Sometimes, however, there are many, as in the Ranunculus. See Fig. 40 (*Atropa Belladonna*), in which *a* is the ovary or ger-

Fig. 40.

Fig. 41.

Fig. 42.

men, *b* the style, and *c* the stigma. See also Fig. 41, shewing the germen, style, and stigma of the Snapdragon (*Antirrhinum*); and Fig. 42, shewing the same parts of the Lily.

429. The *ovary* is the lower and thicker part, and contains the ovules. It consists of one cell or more, each of which may generally be considered a distinct ovary.

430. The *style* is the long cylindrical body placed upon the ovary, and terminates superiorly in the stigma, which it supports. In some plants, as Iris, it is flat, thin, and petaloid. It is sometimes articulated with the ovary and then soon falls off. In other plants it is continuous with the ovary, and is then persistent. The style is not essential, being frequently absent. It is generally continuous with the apex of the ovary. In some cases, it arises from the side of this organ, being then called *lateral;* as in Lady's-mantle (*Alchemilla vulgaris*).

431. The *stigma* is of a glandular nature, being generally covered with a viscid fluid; and is essential, as it receives and exerts a peculiar action on the fecundating pollen. It is called sessile, when the style is absent, being then placed immediately above the top of the ovary; Poppy (*Papaver*). See Frontispiece, Fig. 5. It is proper to distinguish between *stigma*, which is the extreme secreting surface, and divisions of the style. The ends of these only are to be considered stigma. The stigma is destitute of cuticle.

432. The pistil is frequently attached to the receptacle by a prolongation of the substance of the latter, called a *thecaphore* or *gynophore*. In the Strawberry (*Fragaria vesca*), the fleshy part which is eaten is the *gynophore*, the little whitish bodies being the pistils matured.

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433. The observations of modern physiologists, particularly of MM. De Candolle, Turpin, have led them to consider the pistil as the modification of a leaf, or of a whorl of

leaves, growing vertically. To a leaf, in this modified state, they have given the name of *carpel* (carpellum).

434. They describe a carpel as being formed of a folded leaf, of which the upper surface is turned inwards, the under surface outwards, and the margins are united, thus forming a hollow case or ovary.

435. The margins produce interiorly one or more buds, which are the ovules. The regular mode of production is a vertical row of buds on each margin.

436. The gynophore is deemed a modification of the stalk of the leaf or leaves which form the pistil; the style an elongation of the midrib; and the stigma the apex of the midrib endowed with a secreting property. See end of this Chapter.

437. In many flowers, the styles and stigmas remain separate, while the ovaries are closely united. Originally, however, each carpel has a separate style and stigma. When there are several carpels united in one mass, the pistil is termed *syncarpous*; when the carpels are more or less separate, they are called *apocarpous*.

438. The *ovary* is considered as formed of the lamina or disc of the leaf which became the carpel, and is a hollow body, containing the ovules or rudiments of the seeds. Its cavities are called cells. When there is only one cell in the ovary, it has been formed of a single carpel or modified leaf; or if by several carpels, by the obliteration of the dissepiments, as in Poppy.

439. In the many-celled ovary, each cell is formed of a single carpel, and the partitions between the cells are composed of the contiguous sides of the carpels. The partitions are called *dissepiments*. They are vertical, formed of two layers, and equal in number to the carpels of which the ovary is formed.

440. The ovary is *unilocular*, *bilocular*, &c. according to the number of the cells.

441. Where the margins of the folded leaf or carpel unite, there is interiorly a thickening of cellular tissue, form-

ing what is called the *placenta* or *trophosperm.* It is this body that bears the ovules.

442. The carpels, like leaves on a branch, are developed round a central axis, towards which all their margins are turned; and the placentæ, being formed at the margins of the leaves, are almost always next this imaginary centre line or axis, running down interiorly on the edges of the carpels. And hence the dissepiments appear to run backwards or outwards from the placentæ.

443. The margins of each carpel may be united—or the margins of adjoining carpels; and the placenta may be on the united margins of one carpel—or on the united margins of two adjoining carpels.

444. The placentæ are *central*, when in the situation described in paragraph 442, the dissepiments being entire.

445. A *free central* placenta is formed when the dissepiments in a many-celled ovary shrink backwards, or become obliterated, and the placentæ remain united in the centre of the ovary, as in Lychnis and many of the Caryophylleæ. This class of plants illustrates well the formation here alluded to: for in the early stage, the dissepiments may be seen running in a line from the centre to the circumference, but gradually disappear as the ovary advances to maturity.

446. The placentæ are *parietal*, when, owing to the contraction of the dissepiments, which do not divide the ovary into several distinct cells, but merely project from its inner surface, they are placed near its walls, on the free edges of the dissepiments, as in Poppy.

447. When the ovary is free in the flower, that is, forms no adhesion to the sides of the calyx, its base and that of the stamens being inserted into the top of the receptacle, it is called *superior;* and they are *inferior*, or *hypogynous;* as in Tulip, Poppy, Crowfoot (*Ranunculus.*) See Frontispiece, Fig. 5, the Poppy, in which the stamens and corolla are seen inserted into the receptacle, below the pistil.

448. When the ovary adheres to the sides of the calyx, and the stamens and corolla are inserted into the latter, or when

they are inserted into a disk above the ovary, this organ is called *inferior*, and the perianth and stamens are *epigynous* or *superior;* as in Umbelliferæ, Valerianæ, Dipsaceæ, &c. See Frontispiece, Fig. 6, the flower of Snowdrop (*Galanthus nivalis*), in which the stamens and perianth are seen inserted on the top of the ovary.

THE OVULE.

449. This is the seed in its unimpregnated state. It is found in the ovary, adhering to the placenta or trophosperm, and is considered as the bud of the carpel or modified leaf. It is generally attached to the placenta by a little stalk called *funiculus* or *podosperm.* See Fig. 47, page 128, in which is seen the funiculus of the matured ovule, (or seed) of the Pea. The base of the ovule is that part which is connected to the podosperm, and is called *umbilicus* or *hilum.* The opposite extremity is the apex.

450. When the placenta is developed only at the upper part of the margin of the carpel, the ovules necessarily hang down into the cell or cavity of the carpel, and are called *pendulous* or *reversed.* When the placenta is developed only at the lower part of the margin, the ovules are *erect*, projecting upwards into the cavity.

451. Some botanists use also the terms *suspended* and *ascending* to express these two positions of the ovule; while others limit these terms to those cases in which the placenta is developed along the whole margin of the carpel, the direction of the ovule still remaining the same.

452. The ovule consists of a *nucleus* or *kernel* (the essential part, and the basis of the future seed), inclosed within two sacs, which are called *primine* and *secundine.* These have open mouths, termed *exostome*, and *endostome;* or *foramen*, when both are spoken of. It is through this foramen that the impregnating particles of the pollen pass to vivify the nucleus. These apertures are always applied to the apex

of the nucleus, and of course to each other. The exostome, or aperture in the primine; and endostome, or aperture in the secundine, do not always correspond, as in the Euphorbiaceæ, according to Mirbel. The radicle of the seed is always next to the foramen. These parts are seen in Fig. 43,—*a* the base or hilum of the ovule, where it is attached to the podosperm, *b* the base of the nucleus, *c* the secundine, *d* the primine, *e* the apex of the nucleus, *f* the foramen, *n* the nucleus. See also Figs. 44, and 45.

453. In what appears the normal structure, the primine, secundine, and nucleus, are connected to each other at the base of the ovule, that is, next to the placenta. In this case, the axis or line of direction of the ovule is rectilinear, or *orthotropous*, and the foramen is at the extremity of the ovule opposite to, or farthest from the hilum. See Fig. 43, next page.

454. It sometimes happens that the base of the nucleus, or point of connection between it and the sacs, is at the apex of the ovule, the position being altered during the growth of the latter. In this case a bundle of vessels, called a *raphe*, (*g*, fig. 44), extends between the base of the ovule and the base of the nucleus, to supply the latter with nourishment. The raphe enlarges where it joins the base of the nucleus, forming the *chalaza*,(*h*, fig. 44.). In this case, the foramen and the apex of the nucleus are brought round, and are found near the base of the ovule. This results from the unequal growth of the different sides of the ovule, and is termed *anatropous*. See Fig. 44, next page.

445. In other instances, the ovule becomes curved like an U, the inner sides of the curve adhering. This brings the apex of the ovule round near its base. But the base of the ovule, and base of the nucleus are still at the same point, that is, next the hilum; the apex of the nucleus being bent round with the apex of the ovule. This structure is termed *campulitropous*. See Fig. 45, next page.

456. These three varieties will be easily understood from the following figures:—

Fig. 43.

Orthrotopous.

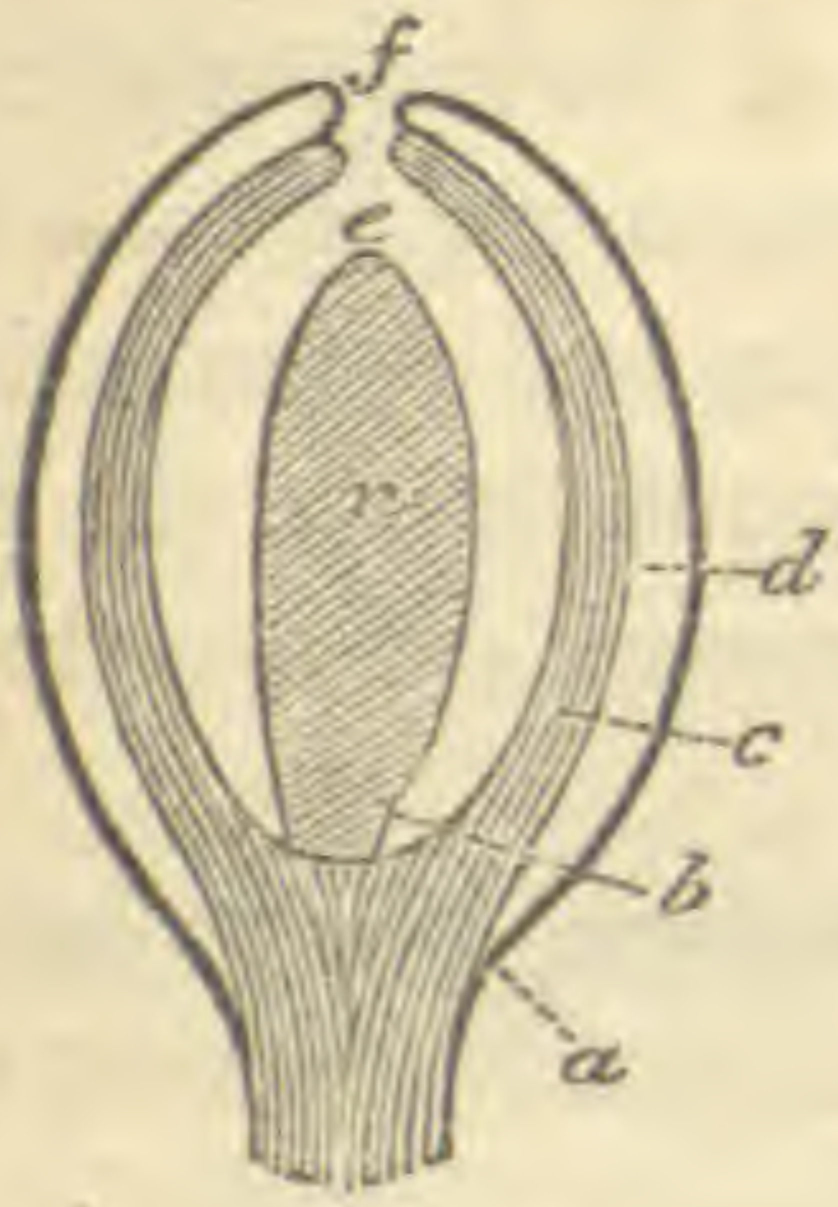


Fig. 44.

Anatropous.

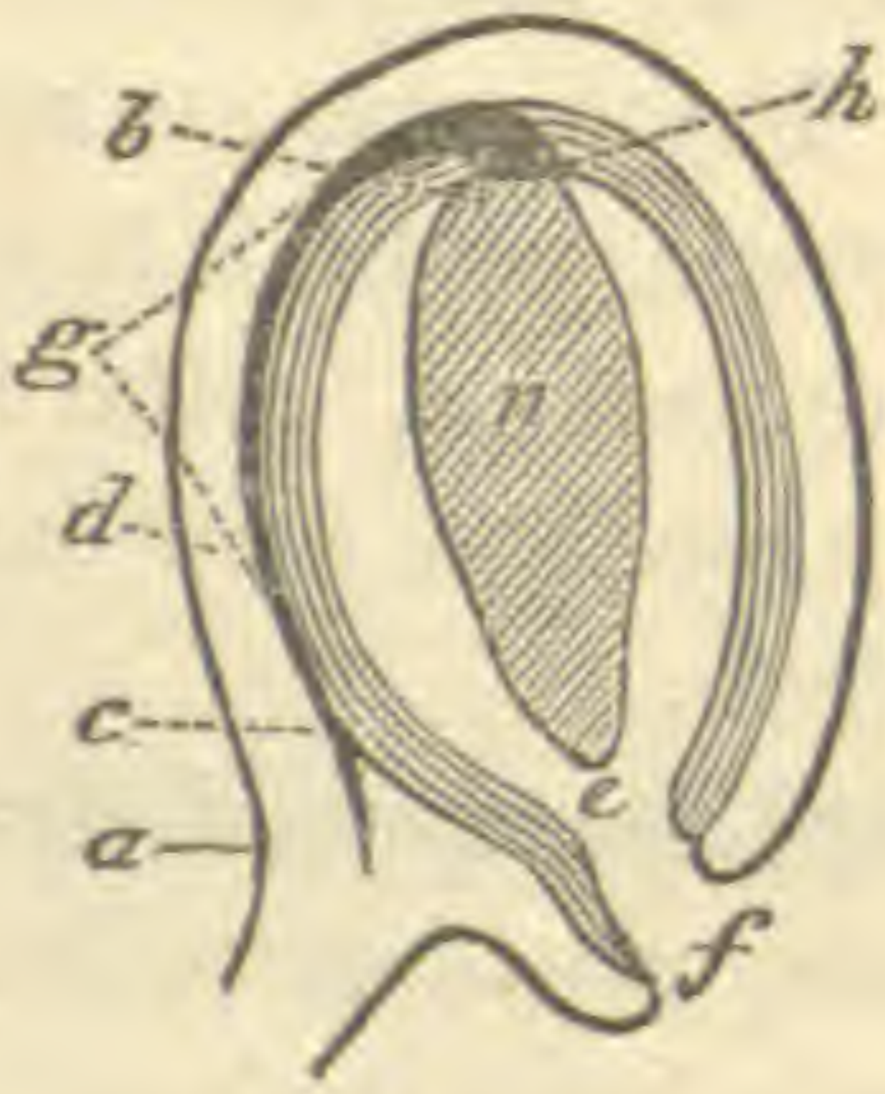


Fig. 45.

Campulitropous.

The different parts are expressed by the same letters in the above figures. See paragraphs 452, 453, and 454, for references.

457. The nucleus contains the *liquor amnios* which affords nourishment to the young embryo, and part of which assists to form the albumen; and some recent authors have described it as being covered by three coats, the *tercine*, *quartine*, and *quintine*; of which the first two become the albumen in the seed, and the last becomes the organ occasionally present, called *vitellus*. This is not often met with, but may be observed in the seed in the Nymphœaceæ and Piperaceæ. The nucleus with its coverings becomes the seed with its coats, to form which is the ultimate object of the whole apparatus of the reproductive organs.

458. The ovule is not always enclosed in an ovary, though generally so. In Coniferæ and Cycadeæ, the ovule is naked, uncovered by an ovary, and the pollen is immediately applied to the ovule.

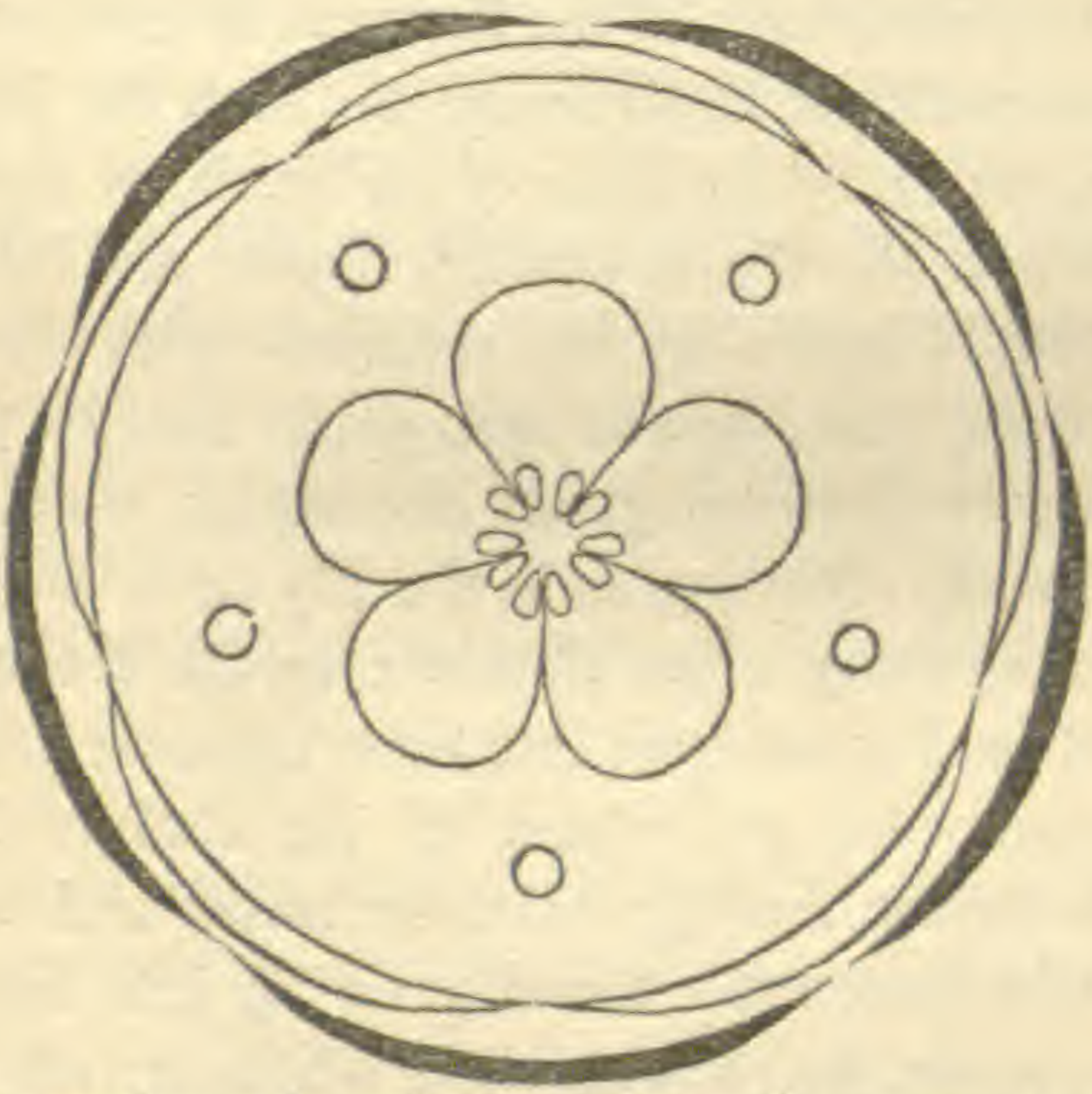
Of the formation, and relative situation of the different parts of the Flower.

459. It is an opinion now generally entertained by botanists, that all the parts of the flower are formed from leaves, modified by *folding*, *adhesion*, *abortion*, (deficient growth at some

parts), and *increased development* at other parts. The flower is considered to consist of a series of whorls of these modified leaves, the *calyx* being the outer or lower whorl; the *cells of the germen* the inner or upper whorl.

460. The parts of each whorl are alternate with the parts of the adjoining external and internal whorl; that is, the middle of each organ is opposite to the edges of the corresponding parts in the adjoining whorls, or opposite to the space between the two parts in the next whorls—or the organs in one whorl are opposite to the organs in the next whorl but one. See Fig. 46. This figure is a representation of a

Fig. 46.



horizontal section of a flower, giving a general view of the usual relative situation of the different parts. The external thick black lines represent the *calyx;* the open lines within, the *corolla;* next are seen the *stamens:* lastly, in the centre is seen the *germen*, consisting of several cells, with the *ovules* in the narrow and inner end of each cell, in the centre of the flower. There is generally a relation, in number, between the different parts of the flower, as seen in the figure. The *alternate* arrangement of the parts is also illustrated in Fig. 46.

461. Each cell resembles a leaf folded, so that its edges

meet and become united; the midrib forming the back or outer part of the cell; and the united edges being in, or turned towards, the centre of the flower. The ovules are developed at the inner part of these edges, one row along each margin or edge. This arrangement of the ovules is well seen in tulip, iris, lily, hyacinth, in which there are *three* cells in each germen; and in the pea and common celandine, in which there is only one cell in the germen. The cell being analagous to a folded leaf, the ovules resemble buds, which are found growing at the margins of some leaves, as in the Bryophyllum calycinum, and the Malaxis paludosa.

462. This view of the origin of the parts of the flower is supported by examination of the flower in its earliest stage; by a general resemblance in structure between the leaf and the calyx and corolla; by the form of the bracts or floral leaves, situated betwen the leaves and the flower, and intermediate between them in form; by the readiness with which, as in double flowers, the stamens and pistils become petals; by the resemblance between petals and sepals, which, in many cases, are hardly different, as in the lily tube, the tulip, the hyacinth, and many other flowers; by the frequency with which petals and sepals pass into each other in some plants, as the paeony rose, and others of the Ranunculus tribe; and by the strong analogy between leaves and sepals, the latter of which are often found growing into leaves, as in rose, water avens, &c., the sepals of which are often expanded and divided into leaflets, like the regular leaves of the plant. In Nymphœa, the different parts of the flower are seen gradually passing into each other in almost every stage of change.

463. This view of the structure and origin of the parts of the flower was hinted at by Linnæus, first distinctly suggested by the German poet GOETHE; and more satisfactorily illustrated and confirmed by the researches of BROWN, DE CANDOLLE, and DU PETIT THOUARS

CHAP. III.—FECUNDATION.

464. This operation consists in the action of the pollen on the ovule, which is thereby *impregnated*, that is, excited to a new and vigorous mode of action, by which it increases in size, all its parts are fully developed, and at last it becomes a *seed*, capable, when placed in a situation favourable to its growth or germination, of producing a full grown plant similar to that which gave it birth.

465. To effect this, it is necessary that the pollen contained in the anther of the stamen be allowed to escape, which takes place by the dehiscence of the anther; and that this pollen be brought into contact with the stigma, the moist surface of which causes the bags or vesicles to burst, and emit the tube with the vivifying mucous fluid, which is then conveyed along the style to the *foramen* (452), which admits it to the nucleus or kernel (452), there to produce its peculiar effects.

466. The pollen is conveyed to the stigma in various ways. In many hermaphrodite plants (288) the stamens are longer than the pistil; and the pollen, when it escapes from the anther, naturally falls on the stigma. In such cases, as Linnæus remarked, the flower is generally erect. When the stamens are shorter than the pistil, the flower frequently hangs downwards or droops, thus still enabling the pollen to fall on the stigma when it escapes. When the stamens are short, and the flower erect, there is frequently a nectary at the bottom of it, which attracts insects in search of honey; these become covered with pollen, which falls from them on the stigma as they fly out. The stamens of many plants are endowed with a certain degree of irritability, by which they are enabled to bend towards the stigma and deposit their pollen, returning afterwards to their usual position. In rue, barberry, rock rose, pellitory of the wall,

grass of Parnassus, the stamens are endowed with a motive power of this sort.

467. In monœcious (289) plants, the male flowers are frequently situated on the upper part, so that the pollen falls on the stigma. In these and in diœcious (289) plants, the wind is perhaps the chief agent in conveying the pollen, which is a light powder, from the male to the female flowers; and butterflies and other insects which fly from flower to flower also carry and deposit the pollen. In Persia, the female or fertile Palms chiefly are cultivated, and at the flowering seasons branches of Wild Palms with male flowers are gathered and shaken over the fertile flowers. This was practised long before the theory of the operation was known.

468. In a diœcious plant which grows under water (*Valisneria spiralis*), the antheriferous flowers become detached, rise to the surface, and float about, while the pistilliferous flower, which retains its connection with the plant, has a spiral stalk, which unfolds and lengthens out so as to elevate the flower above the surface of the water. There the two kinds of flowers meet, and insects or the wind apply the pollen to the stigma, an operation which does not go on effectively under water. Then the stalk of the pistilliferous flower resumes its spiral form, and draws the flower under water, there to perfect the seed. The Utricularia, a plant which grows under water, and has perfect flowers, has bladders attached to its roots, which become filled with gaseous matter, so as to cause the plant to ascend to the surface when the pollen is ripe, and effect the application of the pollen in the air. When this is done, the bladders lose their aerial fluid, and the plant again becoming specifically heavier, descends to ripen the seeds.

469. During fecundation, it has been observed in some instances that there is a considerable increase in temperature. In the spadices of the Arum cordifolium, a thermometer indicated 121°, while the temperature of the external air was 66°. The flowers of plants in the dark, act upon the air as

the leaves do—absorb a portion of oxygen, and replace it by carbonic acid. Fruits seem in all cases to exert a similar action on the air, the presence of oxygen, and evolution of carbonic acid being essential to their ripening.

470. When fecundation has been effected, the stamens and floral envelope, and also the style and stigma, are of no further use. They generally wither and fall off, though occasionally one or more are persistent. The calyx frequently forms a covering for the ovary, as in those cases where the ovary is inferior, as in the Apple; the stigma frequently remains, as in the Poppy. The ovary, of course, constantly remains, and forms the future pericarp or covering of the seed, while the ovule becomes the seed.

CHAP. IV.—THE FRUIT.

471. The fruit is composed of the ovary and its contents, arrived at maturity by the fecundating influence of the pollen; and consists of two parts, the *pericarp* or covering, which is the ovary matured, and the *seed*, which is the ovule matured. When the ovary is inferior, the external part of the pericarp is formed of the tube of the calyx.

I. THE PERICARP.

472. This organ is almost invariably present, but sometimes remarkably thin, as in the Umbelliferæ and Compositæ; and in the Coniferæ and Cycadeæ is altogether wanting, these being destitute of ovary.

473. The part by which it is attached to the peduncle is called the *base*. The other extremity is the *apex*, and frequently exhibits traces of the style or stigma. The *axis* is an imaginary line passing from the base to the apex. When there is a real axis it is called *columella*, as in the Euphorbiaceæ and the Umbelliferæ. There is a very distinct colu-

mella in the Orange. The columella may be formed from the extension of the peduncle, or by the cohering placentæ.

474. The pericarp consists of three parts; the *epicarp*, a thin membranous outer coating; the *endocarp* or *putamen*, the inner membrane which lines the cavity containing the seed; *sarcocarp* or *mesocarp*, a fleshy or pulpy substance, lying between these thin membranes. The fleshy or juicy part in Apples, Pears, Peaches, &c. is the sarcocarp. The rind or paring in these fruits is the epicarp. In the Apple, the endocarp is seen very distinctly lining the cells which contain the seeds.

475. In the nut these three parts are closely united. In the Pea, the pod of which is the pericarp, the sarcocarp is thin but evident, and the epicarp and endocarp are also distinct.

476. A pericarp consisting of one cell is called unilocular, as the Cherry (*Cerasus*), the Almond (*Amygdalus*), the Pink (*Dianthus.)* When there are two cells it is *bilocular*, as in Foxglove and the rest of the Scrophularineæ. It is trilocular, &c. according to the number of the cells.

477. The cells are separated by partitions called dissepiments, which, from their mode of formation, will always be alternate with the stigmas, the latter being the apices of the carpels, while the dissepiments are their sides. In the mature state, the dissepiments may be considered as formed of two layers of endocarp adhering closely to each other.

478. In consequence of various accidental occurrences, such as the abortion or obliteration of particular parts, or the irregular growth of others, particularly of the placenta, the pericarp does not always present the same structure as the unimpregnated ovary. A many-celled ovary may yield a one-celled pericarp, from abortion or contraction of the dissepiments; and from extension of the placenta or dissepiments, a one-celled ovary may be divided into several cavities. Examination of the ovary in the early stage, and of marks or scars in the pericarp, show the normal structure of the part. In the Oak (*Quercus*), and other Cupuliferæ, the

ovaries of which have several cells and ovules, the fruit has only one cell, and frequently only one seed.

479. The dissepiments of a many-celled pericarp often become contracted, so as merely to project into the general cavity, the placentæ being placed upon their edges and called *parietal*, as in Poppy. Or it may be supposed that the margins of each carpel have not united, and do not reach to the centre or axis of the pericarp, the placenta being then placed upon the united margins of the adjacent sides of two carpels. In the melon, the carpels are scarcely folded inwards, and the cells are not separate. In the Thorn Apple, (*Datura Stramonium*), two of the dissepiments are imperfect at the upper part, forming a communication between the cells, which are quite separate inferiorly. The dissepiments in these cases are called *incomplete*. Spurious or false dissepiments are those formed by enlargements of the placenta, or irregular projections from the back or sides of the pericarp (*Cassia fistula*): when horizontal they are sometimes called *phragmata*.

480. When the pericarp does not open spontaneously when ripe to let the seed escape, it is called *indehiscent*. When there are natural slits or openings by which the seed can escape, the pericarp is said to be *dehiscent*, and the pieces into which it divides are called *valves*. It is bivalved, trivalved, &c. according to the number of valves into which it splits.

481. Pericarps which are formed of a single carpel or modified leaf, have on their surface two well marked lines or sutures, by which they easily dehisce. One is called *dorsal*, and occupies the place of the midrib of the leaf which became the carpel. The other is called *ventral*, and corresponds to the united margins of the leaf, where the placenta is situated. The pod of the Pea has a dorsal and ventral-suture, both well marked. In shelling peas it is the dorsal-suture by which they are opened, and the peas or seeds will be observed placed on a thin placenta at the opposite or ventral suture. In the many-celled pericarp, each cell or carpel has a more or less distinct dorsal and ventral

suture, by which the dehiscence often takes place, as in Foxglove.

482. The dehiscence is *loculicidal* (splitting or breaking into the cells), when the pericarp bursts vertically at the back of the cells or by the dorsal suture, the layers forming the dissepiments being left in union, and the valves being opposite to the dissepiments, (each valve in this case consisting of the adjacent halves of two adjoining carpels): as in the Liliaceæ.

483. The dehiscence is *septicidal* (splitting the dissepiments,) when the pericarp bursts vertically in a line corresponding with the union of the sides of the carpels, the layers forming the dissepiments being separated from each other, the valves being alternate with the dissepiments, and having their margins turned inwards, and the cells remaining closed at the dorsal suture. Rhòdoraceæ Juss. In this case each cell generally dehisces at the ventral suture.

484. The dehiscence is *transverse*, when it takes place horizontally along the cells of the pericarp, as in the capsule of Pimpernel (*anagallis.*) The capsule is in this case called *circumscissa*.

485. The pericarp dehisces *by pores*, when there are several irregular holes or openings, as in the poppy, in the capsule of which the pores are placed beneath the permanent stigma.

486. There are other more irregular varieties of dehiscence. In some cases, the cells or carpels remain closed, falling away from the columella, as in Umbelliferæ. In other plants this takes place while the cells open, leaving an axis formed of cohering placentæ. In some plants, as Convolvulus, the dissepiments remain, cohering at the axis, and separating at the circumference from the back of the carpels, which dehisce at the dorsal suture, the adjoining halves of two carpels remaining united.

487. When the pericarp has lateral appendages like wings, it is *dipterous*, *tripterous*, &c. according to the number of these; it is *apterous* when there are none.

VARIETIES OF PERICARPS OR FRUITS.

488. There are many different kinds of pericarps or fruits. 1. Some are *simple*, being the result of a single carpel, of course in one flower, as the Pea: 2. Others are *compound*, being composed of several carpels united into one pistil, of course in one flower, as the Apple; 3. Some are *multiple*, consisting of several carpels in one flower, but remaining distinct in the matured state, as the Strawberry; 4. and others are *aggregate*, consisting of the fruits of several flowers united into one mass, as in the Pine-Apple (*Bromelia ananas.*)

489. By some, fruits are divided into two classes; 1. SIMPLE, embracing the first three classes above, simple, compound, and multiple; 2. MULTIPLE, embracing the 4th class above, aggregate, sometimes termed *Anthocarpous.*

490. Some fruits are *dehiscent* (480), as the Foxglove and Poppy; others are *indehiscent* (480), as the Peach.

491. Some are *dry*, as Wheat; others are *fleshy*, as the Apple. The two last characters, dry and fleshy, are of subordinate importance.

SIMPLE FRUITS.

Formed of a single carpel in each flower.

1. *Dehiscent.*

492. *The Legume* or Pod. This is a two-valved pericarp, having a dorsal and a ventral suture (481),

Fig. 47.

along the latter of which a placenta bearing the seeds is placed, as the Pea, the Bean, and the rest of the Leguminosæ. (See Fig. 47.) The Legume dehisces along the lines of the sutures—sometimes both open—sometimes only one suture.

493. In the Cassias there are spurious transverse dissepiments; and some of this genus, and a few more of the order are indehiscent. The Legume is *lomentaceous* when there are transverse articulations or joints, as in Ornithopus; and in this case the Legume is indehiscent in the line of the suture, but divides in the line of the joints.

2. *Indehiscent.*

Fig. 48.

494. *The Drupe.* This is a fleshy fruit, containing a stone or nut, as the Peach, the Plum, the Apricot, &c. In it the epicarp, sarcocarp, and endocarp are very distinct; the sarcocarp being considered an enlargement of the cellular substance of the carpel or leaf. (See Fig. 48, the Drupe of the Cherry.)

495. *The Nut.*—This resembles the preceding, except in not being fleshy. It includes the Almond, Walnut, &c. which have a very thin woody pericarp. Many botanists consider it a Drupe.

496. *The Achenium.*—A dry one-seeded pericarp, which does not adhere to the integument of the seed, as in the Thistle and other Compositæ. It is surmounted by the pappus or seed-down, as is seen in the seed of Dandelion, with which every one is so familiar.

497. *The Caryopsis.*—This is a dry one-seeded pericarp, adhering closely to the integument of the seed, as in Rice, Oats, Wheat, and all the Gramineæ. In general it is impossible to distinguish the pericarp from the seed in the Caryopsis.

COMPOUND FRUITS.

Formed of several carpels united into one pistil.

1. *Dehiscent.*

498. *The Capsule.*—This is a dry, many-celled pericarp, of a coriaceous or membranous nature, splitting into several valves (480), as the Thorn Apple (*Datura Stramonium*), or dehiscing by pores (485), as the Snap-Dragon (*Antirrhinum*), and the Poppy; the latter of which, by the contraction of the dissepiments, has only one cell. The Catchfly or Campion (*Lychnis*), and the rest of the Caryophylleæ, have capsules which open at the top by the separation of the teeth which closed them. (See Fig. 49, the Capsule of Lychnis).

Fig. 49.

499. Henbane (*Hyoscyamus*) and Pimpernel (*Anagallis*) have capsules which dehisce transversely. M. Richard applies the term *pyxidium* to this kind of capsule.

500. *The Siliqua* or Pod.—This is an oblong pericarp of two valves, somewhat resembling the Legume. It has two cells, separated by a longitudinal dissepiment, parallel to the valves. This dissepiment is considered a false or spurious one, being formed by an expansion of the placentæ. The seeds are ranged, alternately, along each edge of the dissepiment, and on each side of it, so that there are four rows of seeds. Wallflower, Turnip, Cabbage, and many of the Cruciferæ. (See Fig. 50.)

Fig. 50.

Fig. 51.

501. *The Silicula*, or pouch, differs from the preceding only in being very short, or even broader than it is long. Shepherd's Purse (*Capsella; Thlaspi*, Linn.) (See Fig. 51.)

2. *Indehiscent.*

(1.) Dry.

502. *The Gland.*—This is a one-celled, and frequently one-seeded pericarp, often contained in a scaly involucre called a *cupula*. The ovary had originally three cells, and several ovules which have become abortive. The Oak (*Quercus*), the Hazel (*Corylus*), and other Cupuliferæ. It is often called a Nut. (See Fig. 52. The Hazel.)

503. *The Samara.*—This has one or two cells, and is dilated at the apex or sides into a kind of wing or membranaceous appendage. It is considered a kind of capsule by some. The Ash (*Fraxinus*), the Maple (*Acer*), and the Elm (*Ulmus.*)

(2.) Fleshy.

504. *The Pome*, or Melonida of Richard.—This is formed of a semi-inferior ovary, consisting of from two to five carpels, the pericarp being fleshy, and formed of the calyx and ovary united. The Apple and the Pear, and the rest of the Pomaceæ are examples. (See Fig. 53.)

Fig. 52.

Fig. 53.

Fig. 54.

(3.) Pulpy.

505. *The Pepo*, or Peponida of Richard. In this fruit the cells are remote from the axis or centre; the margins of the carpels are not united; and their sides are not much turned inwards. The Placentæ are parietal, and the seeds

are scattered through a juicy pulp deposited in the cells. The pericarp is the thick external covering. The Cucumber, the Melon, the Gourd, and other Cucurbitaceæ.

506. *The Hesperidium*, or Orange.—In this fruit there is a thick integument, which is the pericarp; and a number of separate cavities into which the fruit can be easily divided; these cells or divisions are the carpels, the seeds being scattered through them; and the pulpy matter is not mesocarp, as might be imagined, but a peculiar deposition in the cells which contain the seed. The Orange and Lemon (*Citrus aurantium* and *C. Medica*,) are examples.

507. *The Berry.*—This is a pulpy fruit, with the seeds scattered loosely in the pulp. Gooseberry, Grape, Currant.

MULTIPLE FRUITS.

Several carpels in one flower, remaining distinct in the matured state.

1. *Dehiscent.*

508. *The Follicle.*—This is a membranous one-celled, one-valved pericarp, opening longitudinally by a ventral suture (481), to which is attached a placenta bearing the seeds, and having no dorsal suture; there are more than one in each flower. Peony, Periwinkle (*Vinca*), and many of the Apocyneæ.

2. *Indehiscent.*

509. *The Strawberry.*—This fruit consists of a number of minute pericarps, called sometimes Acheniums, at other times *Acini*, placed upon a pulpy or fleshy receptacle or gynophore, commonly called the fruit. Strawberry. In the Raspberry, the small spherical juicy bodies are the carpels. (See Fig. 54. page 130.)

510. The fruit of the Ranunculus resembles the Strawberry, except in the receptacle not being fleshy.

AGGREGATE FRUITS.

The fruits of several flowers united into one mass.

511. *The Cone* (Strobilus).—This is the catkin or amentum ripened and indurated. The seeds are found in the axillæ of the Bracteæ or scales. Fir-top. (See Fig. 21, page 94.) When small, and its parts closely compressed, it is termed a *Galbulus.*

512. *The Sorosis* of Mirbel.—This term is applied to the Pine-Apple (*Bromelia ananas*), which consists of several fruits growing together into a thick fleshy substance. The fruit of the Mulberry is of this kind. In this case the flowers were in the form of a dense spike, and the fruits, or pericarps, grow together from their vicinity to each other.

513. *The Syconium* of Mirbel.—This is the fruit of the Fig-tree (*Ficus carica.*) It consists of the receptacle or apex of the peduncle, or of an involucre dilated into a hollow body, fleshy interiorly, and containing a number of small hard pericarps or acheniums.

514. The dehiscence of the pericarp is well seen in willow-herb, violet, broom, and many other well known plants. Most plants produce a considerable number of seeds, and in a great many cases, there is some peculiar construction in the pericarp or seed, by which the seeds are prevented falling down and accumulating at the spot where they grew, being scattered and conveyed to a distance (disseminated) from the parent plant. In most plants which do not drop their seeds round themselves, the wind is the leading agent in dispersing the seeds, being often assisted by the great lightness of the seed, by some appendage, such as wings or feathers, (as in willow-herb ; in dandelion, thistle, and others of the syngenesious tribe), which aid the wind in wafting the seed to a distance ; or by the pericarp dehiscing at the upper

part and sides, so that the seeds do not fall out, but are shaken or blown out by the wind. In other cases, as the Broom, the Balsam, the Oxalis, there is a mechanical contrivance in the pericarp or seed, which has the effect of a spring, in projecting the seed, when ripe, to a distance from the parent plant. The use of these contrivances for dispersing seeds is obvious. They would choke each other in germinating close together, if they simply fell to the ground, and thus be lost or wasted. By being dispersed, the seeds are cast abroad, and get room to germinate; they grow up and fertilize other places, and thus perpetuate the species, and increase the useful products which the plant may yield.—Animals are the means of dispersing some sorts of seeds, which are rough, and adhere to their shaggy hair. Rivers, and even seas, also aid in the dissemination of seeds.

II. THE SEED.

515. This is the ovule, impregnated and arrived at maturity. In all cases, excepting Cycadeæ and Coniferæ, and one or two plants in which the ovule ruptures the ovary, or the carpel does not completely close, the seed is covered by a pericarp. It is found within the pericarp, and consists of the integuments or coverings, the albumen and the embryo. The terms used to express the different positions of the ovule apply also to the seed. See Fig. 55, the seed of the Bean (par. 518.) In Fig. 56. (par. 524.) the skin or episperm has been removed. In Fig. 57, the two lobes, which were united by means of the little conical body between them, are removed, and the most essential part of the seed is left—the gemmule and radicle, as they appear, after having grown a little.

516. The seed is attached to the placenta or trophosperm by the funiculus or podosperm, each of which grows along with the ovule. The hilum or umbilicus, where this attachment takes place, is considered the base of the seed, and at

this point the vessels which convey nourishment enter the seed. These vessels, clustered together, form the funiculus, and they derive their origin from the placenta. The funiculus is well seen in the pod of the Pea (Fig. 47. par 492.) In the seed the foramen is termed *micropyle*, and the radicle of the seed always points towards it.

517. When the placenta expands around the seed, it forms a covering called *arillus*, as the Nutmeg (*Myristica Moschata*), the mace of which is the arillus. The Spindle-tree (*Euonymus*), has an orange-coloured arillus enveloping the seed. M. Richard observes, that the arillus never occurs in plants with a monopetalous corolla.

518. The integuments, taken together, constitute what is called the *episperm*, and they are frequently incorporated together, so that there appears to be only one covering. The primine of the ovule becomes the *spermoderm*, or *testa* of Gaertner. The secundine receives the name of *mesosperm;* and the others are called *endopleura.* The episperm is very distinct in the Pea and Bean; and the hilum is always placed on it. (See Fig. 55, in which the dark part is the hilum.)

Fig. 55.

519. The *albumen* is the peculiar mucilaginous or amylaceous substance found in many seeds between the integuments and the embryo. It has also received the names of *perisperm* and *endosperm.*

520. The annexed table will better illustrate the structure and names of the corresponding parts in the ovule and seed.

Ovule.		Seed.		
Quintine	corresponds to	Vitellus		
Quartine, Tercine	......	Albumen	Endopleura	
Secundine	......	Mesosperm		Episperm.
Primine	......	Testa		

521. Any enlargements of the testa in the vicinity of the hilum, or at the other extremity, are called *carunculæ*, or *strophiolæ*.

522. Hairs on the testa, at any particular part, are termed *Coma*. In some cases, as the Cotton, the whole of its surface is covered with hairs.

523. The albumen forms a great part of the seed in monocotyledonous plants: these have only one cotyledon, which is generally small, as in the Wheat and other Gramineæ. The albumen affords nourishment to the young embryo during the first stage of its growth, becoming soluble and of a saccharine nature. It is a store of nutritious matter, laid up during the growth of the ovule, being formed of that part of the *liquor amnios*, which was not required to bring the seed to perfection. The white matter in the Cocoa Nut is the albumen, and the fluid is the residue of the liquor amnios, which is very plentiful in this plant.

524. The albumen may, in general, be eaten with perfect safety, even in families of a dangerous nature, as the Euphorbiaceæ. In Wheat, Oats, and Barley, it consists principally of starch and gluten, and is very wholesome.

Fig. 56.

Fig. 57.

525. The *embryo* is the organized body which lies innermost, and is the essential part of the seed, being the proper rudiment or germ of the new plant. (See Figs. 56, 57). It consists of the cotyledons (*c c*), the gemmule or plumule (*a*), and the radicle (*b*).

526. It is sometimes surrounded by a sack-like body, called *vitellus* or yoke, supposed to be formed of the quintine of the ovule (457).

527. The *cotyledons*, or seed-lobes, surround the gemmule

and radicle, and may be considered the rudiments of the first leaves which elaborate the sap and supply the young plant with nutritious matter, before it can put forth proper leaves to perform this function. In seeds which have little or no albumen, the cotyledons are filled with nutritious matter, which supply the young plant, as in the Pea. Plants are divided into two classes, according as they are provided with, or destitute of, cotyledons in their seeds—the Cotyledoneæ, and the Acotyledoneæ.

528. In some plants the cotyledons are abortive, or grow together and to the other parts, and there appear to be no cotyledons.

529. When there is only one cotyledon, (or if two, when they are alternate and not opposite), the plant is called *Monocotyledonous*, as in Wheat, Barley, Rice, &c. In monocotyledonous seeds the gemmule is enclosed within the cotyledon, which forms a sheath called *coleoptilon;* and the cotyledon is converted in germination into a thick leaf.

530. It has been found that *monocotyledonous* plants are *endogenous.*

531. When there are two opposite cotyledons, as in the Pea and Lupine; or several in a whorl, as in some of the Coniferæ; the plant is called *Dicotyledonous.* In this case the cotyledons are converted, during germination, into two leaves, affording nutriment to the young plant. (See Fig. 56.)

532. It has been found that *dicotyledonous* plants are *exogenous.*

533. The Cotyledons, when filled with nutritious matter, frequently remain under ground during germination, in which case they are called *Hypogean*, as in the Pea. When the cotyledons appear above ground, and assume the form of leaves, they are *epigean*, as in the Lupine.

534. The leaves into which the cotyledons are converted, are called *Seminal*, and differ in figure from the proper leaves of the plant.

535. The *Gemmule* (*a*, Fig. 57.) is the rudiment of the

stem, growing upwards, and becoming stem and branches, &c. It is often undistinguishable till germination has made some progress, being closely adherent to the cotyledon, as in monocotyledonous plants. It is very well seen between the cotyledons of the Pea or Bean, in which it is formed of several minute leaves closely folded together. These become the first or primordial leaves. The gemmule may be regarded as the first bud of the new plant, ready to be developed when situation and other circumstances are favourable. (See Figs. 56, 57.) In Fig. 57, the gemmule and radicle are represented as they appear after germination has made some progress.

536. The *Radicle* (*b*, Fig. 57.) is the rudiment of the root, and is continuous downwards with the gemmule. It is always simple and undivided, and in the dicotyledonous seed is of a conical shape with the apex inferior. It always points towards the micropyle (516), and invariably grows towards the centre of the earth, forming the root of the new plant.

537. Those plants in which the radicle is free and naked, not being enclosed in any sheath (excepting, of course, the episperm) were called *exorhizæ* by the late M. Richard, and correspond to the exogenous or dicotyledonous plants of other authors; as the Bean, in which the free pointed radicle is well seen.

538. Those in which the radicle is enclosed in a sheath were called *endorhizæ* by Richard, and correspond to the endogenous or monocotyledonous plants of other authors, as Wheat.

539. In the Coniferæ and Cycadeæ the radicle is incorporated in a peculiar manner with the albumen: These were called *synorhizæ* by Richard, but are included among the exogenous plants of other authors.

540. The part between the radicle and gemmule is called the *collet* or neck, and is the point where the ascending and descending parts meet; the root elongating downwards from it, and the stem elongating upwards from the same spot.

541. The embryo is *homotropous* or *orthotropous* when

the radicle is at the hilum or base of the seed, as in the Pomaceæ, the Solaneæ, &c. In this position it is sometimes called erect; and the nucleus is inverted.

542. The embryo is *antitropous* or *inverted* when the cotyledons are next the hilum, as in the Thymeleæ, Urticeæ. In this case the radicle is remote from the hilum.

543. The embryo is *heterotropous* when it lies across the hilum, as in Primulaceæ.

544. The embryo is *amphitropous* when carried round the albumen, so that the two extremities approach, as in the Caryophylleæ.

545. There is a peculiar class of plants which are constantly destitute of floral envelope, sexual organs, and seeds. They are reproduced by means of minute bodies, called *sporules*, which, indeed, may be considered as the seeds, but bear no analogy in mode of formation or in structure to the seeds which have just been examined.

546. The sporules of flowerless plants are of a homogeneous structure, not separable into gemmule, radicle, and cotyledons; and capable of germinating from any point. In monocotyledonous and dicotyledonous plants, the process of germination proceeds upwards (into stem) and downwards (into root) from one particular point—the neck. But in the flowerless plants, the root and stem seem to be capable of proceeding indifferently from any part of the sporule.

547. They are called *Acotyledonous*, from being destitute of cotyledons; *Inembryonate*, from being destitute of an embryo; *Asexual*, *Agamic*, and *Cryptogamic*, because they have no sexual organs, or because, if these do exist, they cannot be detected: and *Cellular*, because they are found to consist chiefly of cellular tissue, or are destitute of spiral vessels.

548. These differ in many other respects from phenogamic or flowering plants; and consist chiefly of the following tribes: Ferns, (*Filices*), Mosses (*Musci*), Mushrooms (*Fungi*). Sea-Weeds (*Algæ*). The General Anatomy of these will be fully described in their order along with the other natural families of plants.

CHAP. V.—PROPAGATION OF PLANTS.

549. This is effected in three ways: 1*st*, By means of the seed, which, when placed in a fit situation, becomes a new plant, of the same species as that which produced it, though frequently of a different variety.* The commencement of the growth of the seed is called *germination.* 2*dly*, By means of buds, which are also capable of producing new plants. In this case, it is always the same variety that is produced. 3*dly*, By means of slips or branches, which, when treated in a particular manner, are capable of becoming entire and independent plants, when separated from the parent. This is called propagation by slips or layers, and also includes *grafting*; and in this case, also, we always obtain the same variety. This latter mode of propagation might be included along with the second, thus making two principal modes of propagation—by seeds and by buds.

1. *Germination.*

550. A perfectly formed seed may be considered a young plant, the vital energies of which are in a dormant or latent state, but ready to be excited to action when the appropriate stimuli are applied; and containing a quantity of matter in a state to be easily formed into proper nutriment, and applied to its support before it is able to provide for itself.

551. Seeds possess a large quantity of carbon. This substance, by its antiputrescent qualities and hardness, prevents the seed from undergoing putrefaction, and thus preserves it for a great length of time. All that is necessary for preserving seeds, is, to prevent germination or putrefaction.

* Plants are divided into Genera, Species, and Varieties. Each genus includes many species, and each species many varieties. The varieties of any species differ in particulars which are not deemed of much importance, such as colour, size, &c.; and a seed always produces a plant of the same genus and species as that of the parent, but frequently of a different variety.

For this purpose, they must be carefully excluded from the action of heat and moisture, and other chemical agents.

552. Four conditions are necessary for the process of germination,—the presence of water, of heat, and of air, and the exclusion of light.

553. *Water* most probably acts in four ways; it softens the integuments and renders them capable of being burst by the swollen embryo: dissolves the nutritive matter contained in the seed, thus reducing it to a fit state for being absorbed for the nutrition of the embryo; conveys in solution nutritive particles from other sources: and by being decomposed, furnishes two important ingredients in the composition of vegetables.

554. The *air*, by means of the oxygen which it contains, effects a chemical change on the farina of the albumen, or that deposited in the cotyledons. The oxygen combines with the carbon, and forms carbonic acid, which escapes; thus, the proportion of oxygen and hydrogen being increased by the expulsion of the carbon, the farina is converted into a semi-fluid substance, of a saccharine or mucilaginous nature, consisting of starch, gum and sugar, well adapted for the nutrition of the plant in its infant state.

555. *Heat* always promotes chemical combination and decomposition, and thus assists the action of the water in dissolving the hard parts of the seed, and that of the air in its part of the process. Most probably heat also acts as a general stimulus to the absorbents in the seed. Seeds cannot be made to germinate in very cold weather, except by the application of artificial heat.

556. *Light* is unfavourable to germination, because it disposes to an accumulation of carbon in the seed, and a consequent hardening of the parts; or rather prevents the expulsion of carbon, and consequent softening of the parts, which is necessary, that they may be taken up and applied to the use of the plant.

557. From the operation of these causes, it will be seen why seeds planted too deeply in the earth do not germinate.

The air has not access to them, and therefore, from the want of this important stimulus, they remain torpid. Hence it is that earth newly dug up frequently becomes covered with weeds, the seeds of which soon germinate when exposed to the air.

558. Placing seeds at a certain depth in the earth, excludes them from the access of light, which is so injurious to germination; insures a supply of moisture, which would not remain with them were they placed at the surface; protects them from the wind, and from the attacks of animals; and enables the roots to take a firm footing in the soil.

559. When germination has commenced, the seed becomes soft, and swells; carbonic acid is disengaged, and oxygen absorbed; the particles of the episperm lose their cohesion, and it is burst to make way for the elongation of the embryo; the radicle elongates and descends, often attaining a considerable length before the gemmule has made any progress, and soon exercising its function of absorbing food; the albumen is gradually absorbed, and disappears: the cotyledons expand and become seminal leaves, which afford nourishment to the young plant, in the first stages of its existence, by elaborating the sap, and wither when the proper leaves of the plant have unfolded—or remain under the surface, are gradually absorbed, and disappear: the gemmule or first bud gradually unfolds, and enlarges; the primordial leaves and stem appear; and we now have a young plant—a living being, able to provide its own sustenance; to elaborate that sustenance, and to apply it to its increase, and to the formation of those wonderful organs by which it is enabled to perpetuate its species.

560. In the operation of malting, the object is to convert the farina or hordein of the albumen into sugar. For this purpose the seed is made to germinate: and this process is stopped at that point at which it has been found there is the greatest quantity of saccharine matter in the seed. Were germination allowed to proceed farther, the saccharine mat-

ter would be taken up for the nutrition of the young plant, and its nature completely altered.

561. Artificial means have been employed to expedite the process of germination, particularly by supplying the young seed with certain bodies or salts, which yield oxygen readily, or assist in procuring it from other bodies present, as the peroxide of manganese, chlorine, &c. Humboldt is very much in favour of the use of these substances, but there are others who doubt if any advantage is obtained by treating plants in that manner. Common cresses placed in a solution of chlorine, were observed to germinate in the course of six hours, whereas, when merely placed in pure water, thirty-six hours were required to produce the same result.

562. Electrical action is also believed to exert considerable power over the same process, and M. Becquerel seems to have established the fact, that when seeds are excited by a very weak positive electrical action, the germination is rapid, but does not take place if the electricity be negative.

563. In hydrogen, nitrogen, or carbonic acid gas, seeds will not germinate. In oxygen, this process goes on with too great rapidity. The presence of agents which contribute to the development of oxygen, in moderate proportions, as the solution of chlorine in water, is said to enable very old, hard, and dry seeds to germinate.

2. *Propagation by Buds.*

564. Plants are propagated by buds in four different ways: 1. By means of the bulbs which grow at the base of the scales in the bulbous root, as in the Snowdrop or Lily; these bulbs are soon detached from the parent bulb, and become independent plants: 2. By means of the bulbils which grow upon the stem in the axilla of the leaves, as in the Coral-root (*Dentaria bulbifera*), and in the Orange Lily (*Lilium bulbiferum*); or in the place of the flowers, as in the Mountain Garlic (*Allium carinatum*): 3. By means of the buds or small bulbs which grow at the margins of the leaves

in the *Bryophyllum* and the Bog Orchis (*Malaxis paludosa*): and, 4. By means of the minute buds or eyes found in the tubercles of various plants, as the Potato (*Solanum tuberosum*).

565. All these buds resemble seeds in this, that when detached from the parent, and placed in the earth, they produce new plants. They differ from seeds, in not being formed by sexual organs: in not being able to preserve their vitality for such a length of time; in not having distinct parts, such as radicle, gemmule, and cotyledons, being merely extensions of the substance of the parent; and in always producing the same variety. Hence the advantage of propagating the potato by buds; we have found a variety well adapted for use as an article of food, and we can ensure its reproduction. If grown from a seed, a very different variety might be produced, which would not have the same nutritious properties.

566. Alpine Meadow-grass *(Poa alpina)*, and Viviparous Alpine Bistort *(Polygonum viviparum)*, frequently bear little buds in their spikes. All plants which increase by buds or bulbs produce few seeds, and are called *viviparous.*

3. *Propagation by Layers and by Slips.*

567. *Propagation by layers* consists in surrounding a young branch with moist earth, in which case it throws out roots, and very soon becomes an independent plant. It is customary to make a small incision at the part placed in the earth, or to pass a ligature round it. This intercepts the descending sap, which, by being accumulated, excites the latent germs; and these, being developed in the earth, become roots.

568. Sometimes the branch is bent downwards and fastened in the earth, as in the Vine, which is always propagated in this way; and many plants propagate themselves naturally in this way, the stems or branches lying on the earth, and taking root where they come intimately into contact with it, as the Currant-bush and Laurel. At other

times the branch is surrounded with earth in its natural position, and detached when it has taken root. Propagation by runners, as in the Strawberry, may be considered somewhat analogous.

569. *Propagation by slips* much resembles the preceding mode. The only difference is, that the branch or slip is detached from the parent before being made to put out roots. The slips or cuttings of most trees that have a light white wood, as the Willow, the Ash, or the Poplar, easily take root when placed in the earth; and indeed the Willow is reproduced only in this way. It is difficult to propagate by slips woods which are very dense and contain much resin, as the Fir and Oak.

570. These processes for the propagation of plants, are, in many cases, preferred to multiplying by seed. Propagation by slips or layers always produces the same variety as that from which the slip is taken; so that, if we have a plant which produces good fruit, by propagation in either of these modes, several may be raised bearing fruit equally good. The tree is always more speedy in bearing fruit when formed in this way, than when grown from a seed.

571. It is a remarkable fact, and one which is turned to good account in the cultivation of fruit trees, that when the tree is raised in this way, the number of seeds in the fruit is almost always less than when produced from a seed, so that more of the juices and strength of the plant are expended in perfecting this fruit. The Vine, when raised by seed, has four seeds in each grape; but frequently only two, when propagated by layers. The Sugar-cane, which is propagated in a nearly similar manner, bears no seed at all, but the other parts of the plant are richly developed.

572. Thus, by a singular control over their mode of growth, which is also exhibited in the case of viviparous plants, vegetables are enabled to adapt the number of seeds to the demand for them—the demand depending on the number of other sources for propagation which they may possess.

GRAFTING.

573. This operation consists in uniting a part of one plant to another The branch or bud which is transferred is called the *graft* or *scion;* and the tree on which it is placed is called the *stock.*

574. The union of the graft and the stock is effected by the cambium, or proper juice in the bark; and hence it is necessary that the graft have a piece of fresh bark, and that this be placed in the bark of the stock, so that the vessels in each may unite. The cambium exudes from the edges of each, becomes organized, and thus brings about a complete union. Grafting succeeds only when the stock and graft belong to the same natural family.

575. By grafting we are enabled to accelerate considerably the fructification of various trees, improve much the quality of the fruit, and preserve and multiply particular varieties of trees which may be deemed valuable. An Apple-tree does not in general produce fruit till it is ten years of age; but if a scion of a seedling tree be grafted on one that has already borne fruit, it will bear fruit in the third or fourth year. " Suppose two acorns of a new species of oak received from a distant country; sow both, and after they have grown one or two years, cut one of them over, and graft the part cut off on a common oak of five or six years' growth: the consequence will be, that the whole nourishment of this young tree of five years' growth being directed towards nourishing the scion of one or two years, it will grow much faster, and consequently arrive at perfection much sooner than its fellow, or its own root left in the ground. A French author found the advantage of this practice, in the case of a new species of ash, to be as five to one in point of height."—*Loudon's Encyclopædia of Gardening.* The quality of the fruit is improved by the non-development of many of the seeds of grafted plants, which enables them to expend more of their energies in enriching the fruit. By grafting, we can supply a branch of an

old tree with a plentiful quantity of sap, more healthy and nourishing than it could get from the tree on which it grew, and thus for a time it is more vigorous, and produces richer fruit. " As the graft is merely an extension of the parent plant from which the scion came, and not properly speaking a new individual, so it is found to be the best method of propagating approved varieties of fruit-trees, without any danger of altering the quality of the fruit."—" Till lately, grafting was confined to the ligneous plants, but it is now successfully practised on the roots and shoots of herbaceous vegetables; and the Dahlia is grafted by the root; the Melon on the Gourd; the Love-apple on the Potato; the Cauliflower on the Cabbage, &c. by the shoot."—*Loudon.*

SECTION VI.

CHEMICAL COMPOSITION AND SECRETIONS OF VEGETABLES.

576. VEGETABLES consist chiefly of three elementary bodies, Carbon, Oxygen, and Hydrogen. Nitrogen is found in some, and minute portions of sulphur, phosphorus, potassa, soda, lime, magnesia, alumina (argillaceous earth), silica (sandy or flinty earth), and iron, may be found in most of them. These, however, bear a small proportion to the three first, which make up the greater part of all vegetables.

577. These simple materials, by their combination in different proportions, compose the different solid parts and fluid secretions which we find in plants.

578. From animals, in respect to their chemical composition, vegetables differ in being frequently destitute of nitrogen, an element which enters largely into the composition of animal compounds. Owing to the presence of nitrogen, and the greater variety and more complex nature of animal products, these are much more readily decomposed than those of the vegetable kingdom. The decomposition of the former is generally accompanied with the production of ammonia, from the union of their hydrogen and nitrogen, which does not so often occur in the decomposition of vegetables.

579. Between vegetable or animal and inorganic substances, there is a marked difference in chemical composition. The latter generally contain some leading element which characterises the compound, being different from those entering into the composition of other inorganic bodies. For example, sulphur is the base of sulphuric acid, and in point of composition distinguishes it from carbonic acid, which has for its base a totally different elementary substance. Organic substances, on the other hand, consist chiefly of the same

elementary bodies, differing in the proportion in which these are present.

580. Organic substances are remarkable for their tendency to spontaneous decomposition. When their elements are no longer held together by the principle of life, they are resolved into carbonic acid, water, carbonic oxide, and the different kinds of carbureted hydrogen. Ammonia is also formed when nitrogen is present. The carbon and hydrogen have a constant tendency to unite with oxygen to form carbonic acid and water ; but as there is never a sufficient quantity of oxygen to convert all the carbon into carbonic acid, and all the hydrogen into water, the carbureted hydrogen, which requires no oxygen, and the carbonic oxide, which requires less than the carbonic acid, are formed.

581. It has been ascertained by MM. Gay-Lussac and Thenard, that those vegetable products in which the oxygen and hydrogen exist in the proportions in which they unite to form water, are of a mild and inoffensive nature, being neither acid, resinous, nor oily ; that when there is more hydrogen than is necessary to form water with the oxygen, the product is resinous or oily ; and that when there is more oxygen than would be necessary to form water with the hydrogen, the product is in general of an acid nature. Besides these, there is a newly discovered class of vegetable principles called alkalis, many of which contain a considerable quantity of nitrogen ; and there are several vegetable compounds which cannot be included in any of the preceding classes. Under these heads, we shall now proceed to describe the leading products of the vegetable world.

CHAP. I.—VEGETABLE COMPOUNDS IN WHICH THE HYDROGEN AND OXYGEN ARE PRESENT IN THE PROPORTIONS IN WHICH THEY FORM WATER.

1. WOOD.

582. This forms the principal part of most vegetables. As we find it in trees, it contains many of the juices of the vegetable; by digesting any kind of wood in boiling water and then in alcohol these are removed, and the pure woody part remains, called *woody-fibre* or *lignin.* This is a fibrous substance destitute of taste and smell, and, if perfectly dry, not altered by exposure to the air. When moist it is decomposed, carbonic acid and water being produced. The same products result from its combustion. When exposed in close vessels to a strong heat it is resolved into acetic acid (pyroligneous acid) mixed with an empyreumatic oil, carbonic acid, carbureted hydrogen, water, and a fine charcoal which remains. The charcoal retains the figure and texture of the wood from which it is made. Lignin contains also a little carbonate of lime. It consists of carbon, oxygen, and hydrogen, in the following proportions, according to Dr. Prout:—

Carbon, ...	50
Oxygen;	44.45
Hydrogen, ...	5.55
	100 parts.

2. GUM.

583. This substance exudes in a fluid form from certain trees, and soon becomes hard when exposed to the air. It is white, pale straw-coloured, or even colourless, transparent, tasteless and very brittle. It is very soluble in water, form-

ing mucilage, but insoluble in alcohol, which decomposes mucilage, combining with the water and precipitating the gum. The elements which enter into its composition are nearly in the following proportions :—

	GAY LUSSAC.	BERZELIUS.
Carbon, ...	42.23	41.906
Oxygen, ...	50.84	51.306
Hydrogen, ...	6.93	6.788
	100 parts.	100 parts.

There is also present a small proportion of the carbonate and phosphate of lime, and it has been lately said, some nitrogen.

584. Gum is obtained principally from the *Acacia vera, &c.*; the Plum and Cherry trees also contain it; and the *Astragalus verus* affords a peculiar kind of gum.

585. Mucilage, or a substance resembling it much, is found in many vegetables,—as the Marsh-mallow, Quince-seed, Lichens, some Algæ, bulbous roots, Linseed, &c. Gum and mucilage are very nutritious. They are also useful for thickening colouring matters to prevent them spreading on cloth, and enable them to be applied to it; hence they are much used in calico printing. The mucilage from Lichens has been employed for this purpose.

3. STARCH (*Fecula*).

586. This substance does not exist quite free in the vegetable, but as it can be easily separated from the principles with which it is associated, it may be considered as mechanically mixed rather than chemically combined with them. To procure it from wheat, the grain must be steeped in cold water till it becomes soft, and gives a milky juice when squeezed; it is then to be put into linen bags and pressed in water. The milky juice which exudes contains the starch, which is soon deposited in the form of a white powder. It may also be obtained from potatoes, by rasping them in a large quantity of water: when the fibrous parts have been removed, the

starch will be found suspended in the water, and will soon be deposited.

587. Starch is insoluble in cold water, and with warm water forms a sort of transparent jelly. It is also insoluble in alcohol. When boiled in very dilute sulphuric acid, upon filtering and evaporating the solution after the acid has been neutralized by lime, the starch is found to be converted into a substance of a saccharine nature. This conversion of starch into sugar takes place spontaneously in germination and in malting. Starch consists of

Carbon, ...	43.55
Oxygen, ...	49.68
Hydrogen, ...	6.77
	100 parts

and a little saline and earthy matter. Proust found in Barley a peculiar principle which he called *Hordein;* this Dr. Thomson regards as a modification of starch.

588. Starch is contained in a great number of vegetable substances, and principally in seeds and tuberose roots. It is found in the roots of Bistort (*Polygonum bistorta*), White Bryony (*Bryonia alba*), Burdock (*Arctium Lappa*), Crowfoot (*Ranunculus bulbosus*), Broad-leaved, Sharp-pointed, and Water-Dock (*Rumex obtusifolius*, *R. acutus*, and *R. aquaticus*), Dropwort, (*Spiræa filipendula*), Earthnut (*Bunium bulbocastanum*), Dwarf and Common Elder (*Sambucus Ebulus* and *S. nigra*), Henbane (*Hyoscyamus niger*), *Iris pseudacorus*, and *I. fœtidissima*, Meadow Saffron (*Colchicum autumnale*), Masterwort (*Imperatoria ostruthium*), Deadly Nightshade (*Atropa belladonna*), *Orchis morio*, *O. mascula*, *O. bifolia*, *&c.* (these furnish *Salep*), Wake-Robin (*Arum maculatum*.) The roots of the *Iatropha manihot* furnish *Cassava* and *Tapioca*; the juice is highly poisonous, but the starch which they contain is perfectly innocuous when washed. Sago is a kind of starch procured from the pith of palm trees, the *Sagus laevis*, and the *Sagus farinifera*. The *Maranta arundinacea* furnishes a sort of starch, well known by the name of *Indian Arrow-root*.

589. Almost all seeds employed as food contain a large quantity of this substance. Wheat, Oats, Barley, Rice, &c. abound in it. Perhaps there are few plants which do not contain a quantity of starch in some part. Almost all perennial monocotyledonous roots contain a little.

4. SUGAR.

590. This substance exists in the sap of many vegetables; it is generally procured from the juice of the Sugar-cane *Arundo saccharifera* or *Saccharum officinarum.*) The juice of the cane is found to contain

Water,	Albumen,	Acetate of Lime,
Sugar,	Green Fecula,	Acetate of Potash,
Gum,	Lignin,	Super-Malate of Lime, and
Vegetable Mucilage,	Acetic Acid,	
Gluten,	Malic Acid,	Sulphate of Lime.

The juice is expressed from the cane by passing it between rollers, brought to a boiling heat, and mixed with a little lime, which neutralizes any acid that may be present. The liquid is then evaporated, and made to crystallize after the scum has been removed. The crystals are surrounded by a brownish liquid, *molasses or treacle*, which is separated by a mechanical process, and *muscovado* or *raw sugar* remains.

591. Sugar is soluble in cold water, in boiling water, and in alcohol; its other properties are too well known to require to be mentioned. It is very nutritious. The starch or farinaceous matter in the seed is converted during germination into sugar, which appears to be necessary for the growth of the young plant at that stage. Sugar is composed of carbon, oxygen, and hydrogen, in the following proportions, according to MM. Gay-Lussac and Thenard:—

Carbon, ...	42.47
Oxygen, ...	50.63
Hydrogen, ...	6.90
	100 parts.

Prout's analysis led to nearly the same results ; that of Berzelius is a little different. It will be observed how trifling a difference, in point of composition, there is between sugar and starch ; and this partly explains the facility with which starch is converted into sugar, both during malting and by the action of dilute sulphuric acid upon it. Indeed, it is not improbable that the difference in these two vegetable compounds may depend more on the presence of a minute quantity of some salt or other matter, or on a difference in the mode of arrangement in the particles, than on the almost imperceptible variety of the proportions of oxygen, hydrogen, and carbon.

592. Sugar may be obtained also from the American Maple (*Acer saccharinum*), the sap of which, when neutralized by lime, yields about one-fortieth (some say, one twentieth) part of sugar. The juice of the Grape (*Vitis vinifera*) affords sugar when treated with pot-ashes and evaporated. Manna, which exudes from the *Fraxinus Ornus*, a species of Ash, is a substance of a saccharine nature, resembling the sugar of Grapes. Sugar may be procured from the root of the Common Beet (*Beta vulgaris)* by boiling it, and evaporating the expressed juice. 100 lbs. of Beet root yield about 4 or 5 lbs. of purified or refined sugar, besides a quantity of syrup. In many fruits there is a kind of sugar which is not crystallizable. The sugar in molasses is of this nature. The stalk of Indian Corn furnishes a sugar of this sort. The following are the plants which furnish the greatest quantity of sugar :—

Sugar Cane (*Saccharum officinarum*).
Maple (*Acer saccharinum*).
Sycamore (*Acer pseudo-platanus*).
Birch (*Betula alba*).
Walnut (*Juglans regia*).
Flowering Ash (*Fraxinus ornus*).
Cocoa-tree (*Cocos nucifera*).
American Aloe (*Agave Americana*).

Fig-tree (*Ficus carica*).
Dulse (*Fucus palmatus ; Halymenia palmata*, Hook.)
St John's Bread (*Ceratonia siliqua*).
Cow Parsnip (*Heracleum sphondylium*).
Common Parsnip (*Pastinaca sativa*).
Carrot (*Daucus carota*).
Beet (*Beta vulgaris*).
Turnip (*Brassica rapa*).
Parsley (*Apium petroselinum*).
Onion (*Allium cepa*).
Bamboo (*Arundo bambos*) ; furnishes the *Sacar nambu* of the Indians.
Indian Corn (*Zea mays*).
Euxine Rhododendron (*R. ponticum*), from the flower.
Grape (*Vitis vinifera*).

The nectaries of flowers, and all sweet-tasted fruits, contain sugar. Many of the Palm trees furnish a highly saccharine juice : See *Palmæ*. Liquorice and some mushrooms contain a considerable quantity of sugar.

CHAP. II.--VEGETABLE COMPOUNDS IN WHICH THERE IS MORE HYDROGEN THAN WOULD BE NECESSARY TO FORM WATER WITH THEIR OXYGEN.

1. FIXED OILS.

593. These oils are obtained by expression from the seeds of many dicotyledonous plants. They generally retain part of the mucilaginous matter of the seed from which they are expressed, and hence acquire a peculiar flavour. They are found only in the seeds, except in the Olive (*Olea europea*), and the Bead-tree (*Melia azedarach*), in which cases the oil is situated in the pulpy matter surrounding the seed. When pure, which is seldom the case, they are transparent and colourless, and have little taste or smell.

They are mild and bland, require a temperature of about 600° to make them boil, and leave a stain upon paper which is not removed except by a high temperature. They are very inflammable, and produce water and carbonic acid by their combustion. When passed through a red-hot tube, they give out carbureted hydrogen, olefiant gas, &c. Olive oil, according to the experiments of Gay-Lussac and Thenard, consists of—

Carbon, .	77.213	or	10	equivalents	60	Olefiant Gas, 10 eq.	70
Oxygen, .	9.427	—	1	———	8	Water, . . 1 eq.	9
Hydrogen,	13.360	—	11	———	11		
	100 parts.				79		79

594. The following are the principal kinds of fixed oil:—

Croton oil,	from the	Croton tiglium.
Oil of Ben,	....	Guilandina moringa.
Linseed oil,	....	Linum usitatissimum et L. perenne.
Hemp oil,	....	Cannabis sativa.
Hazel-nut oil,	....	Corylus avellana.
Walnut oil,	....	Juglans regia.
Poppy oil,	....	Papaver somniferum.
Oil of Sesamum,	....	Sesamum orientale.
Olive oil,	....	Olea europea.
Almond oil,	....	Amygdalus communis.
Beech oil,	....	Fagus sylvatica.
Rape-seed oil,	....	Brassica napus.
Cole-seed oil,	....	Brassica campestris.
Oil of Mustard	....	Sinapis nigra et S. arvensis.
Cucumber oil,	....	Cucurbita pepo et C. melopepo.*
Castor oil,	....	Ricinus communis or Palma Christi.
Tobacco oil,	....	Nicotiana Tabacum et N. rustica.
Plum-kernel oil,	....	Prunus domestica.
Grape-seed oil,	....	Vitis vinifera.
Cocoa,	....	Theobroma Cacao.
Laurel oil,	....	Laurus nobilis.
Palm oil,	....	Elais guineensis, Cocos butyracea.

* The *Jolliffia Africana*, belonging to the same family, furnishes a great quantity of oil, resembling olive oil.

The fruit of the Bead-tree (*Melia*) also furnishes a considerable quantity of oil.

2. VOLATILE OILS.

595. These are not confined to any particular part of the plant, but are found in the root, the stem, the leaves, the flowers, or the rind of the fruit. They are characterized by possessing some strong and peculiar odour; and the odours of different plants seem to depend upon some volatile oil. They are obtained by placing the vegetable in water, and distilling; the oil rising in vapour along with the water, and being condensed in the receiver.

596. They have a strong and fragrant odour, and a hot and acrid taste, and are volatilized by a temperature of 320°; when distilled along with water, rising in vapour at 212°. Little attention has been paid to the composition of volatile oil. According to Dr. Ure, oil of turpentine consists of—

Carbon, ...	82.35
Oxygen, ...	9.80
Hydrogen, ...	7.85
	100 parts.

When purified by distillation, it has been found by some chemists to contain no oxygen.

597. The number of vegetables which afford volatile oil is very great. Almost every plant possessing any marked odour owes it to a volatile oil. The following are the principal volatile oils:

Oil of Cloves,	from the	Caryophyllus aromaticus.
...... Cajaput,	....	Melaleuca minor.
...... Cinnamon,	....	Laurus cinnamomum.
...... Lemons,	....	Citrus limonum.
...... Oranges,	....	Citrus aurantium, et vulgaris.
...... Anise,	....	Pimpinella anisum.
...... Juniper,	....	Juniperus communis.

Oil of Savine,	from the	Juniperus sabina.
...... Lavender,	....	Lavandula spica.
...... Sassafras,	....	Laurus sassafras.
...... Rosemary,	....	Rosmarinus officinalis.
...... Nutmeg,	....	Myristica moschata.
...... Caraway,	....	Carum carui.
...... Pennyroyal,	....	Mentha pulegium.
...... Spearmint,	....	.... viridis.
...... Peppermint,	....	.... piperita.
...... Turpentine,	....	Pinus sylvestris, et. P. larix.
...... Chamomile,	....	Anthemis nobilis.
...... Dill,	....	Anethum graveolens.
...... Fennel,	....	Fœniculum vulgare.
...... Pimento,	....	Eugenia pimenta.
...... Rue,	....	Ruta graveolens.
...... Origanum,	....	Origanum vulgare.

3. CAMPHOR.

598. This is obtained by distillation from the wood of the *Camphora officinarum* and the *Dryobalanops camphora*: the greater part of the camphor of commerce is obtained from the latter. It is obtained in cakes, of a white colour and crystalline structure. It is insoluble in water, but soluble in alcohol, acetic acid, and in the fixed and volatile oils. It consists of

Carbon, ...	78.02
Oxygen, ...	10.40
Hydrogen, ...	11.58
	100 parts.

It is found also in the volatile oils of Rosemary, Sage, (*Salvia*), Lavander (*Lavandula spicata)*, Marjoram *(Origanum majorana*), and several others.

4. WAX.

599. This substance resembles much the fixed oils, but is distinguished from them by its solidity and solubility in alcohol. It may be obtained in considerable quantity from the *Myrica cerifera* of America, by boiling the bruised berries in water. The wax collects on the top of the liquid, and becomes solid as it cools. This is the substance called *Myrtle wax.* The upper surface of many leaves is covered with a kind of wax; and, according to Proust, it covers the rinds of Raisins, Plums, Oranges, and such fruits. A species of Palm (*Ceroxylon andicola*) furnishes a considerable quantity of wax. According to MM. Gay-Lussac and Thenard, wax consists of

Carbon, ...	81.784
Oxygen, ...	5.544
Hydrogen, ...	12.672
	100 parts.

According to Dr. Ure, there is a little more oxygen and a little less carbon and hydrogen.

5. RESINS.

600. Resins exude spontaneously from many trees: they are in combination with a volatile oil, which is driven off by a gentle heat, and a solid substance, which is resin, remains. Resin is insoluble in water, but soluble in alcohol. It is very inflammable, burning with a black smoke, and is melted by a moderate heat. Common resin, according to MM. Gay-Lussac and Thenard, consists of

Carbon,	75.944	According to Dr. Ure	75.0
Oxygen,	13.337	....	12.5
Hydrogen,	10.719	....	12.5
	100 parts.		100 parts.

601. There are many varieties of resin. Common resin is obtained from the different species of Fir, the *Pinus sylvestris*, *P. Abies*, *P. Larix*, *P. balsamea*, &c. The first of these yields common turpentine, consisting of resin (in this case called *rosin*), and oil of turpentine; the *P. Larix* gives Venice turpentine; the *P. Balsamea*, Canada Balsam; the *P. Abies*, musk or frankincence. Strasburgh turpentine is obtained from the *Pinus Picea*: mastick is obtained from the *Pistachia lentiscus;* sandarach from the *Juniperus communis;* copal (much used for varnishing) from the *Rhus copallinum*; elemi from the *Amyris elemifera, &c.*

602. Balsams consist of resin, volatile oil, and benzoic acid. The principal are, opobalsam or balm of Gilead, the produce of the *Protium Gileadense;* copaiva, obtained from the *Copaifera Langsdorfii;* balsam of Tolu, from the *Toluifera balsamum;* balsam of Peru, from the *Myroxolon Peruiferum;* benzoin, from the *Styrax benzoina;* storax, from the *Styrax officinale;* dragon's-blood, from the *Calamus Draco*, *Pterocarpus Draco*, and *Dracæna Draco*.

603. Gum-resins are intermediate in their properties between gum and resin, of which they seem to be compounds. The most leading are, ammoniac, from the *Dorema Ammoniacum;* aloes, from the various species of *Aloe;* assafœtida, from the *Ferula assafœtida*; galbanum, from the *Galbanum officinale;* olibanum, from the *Juniperus lycia*, or from the *Boswellia serrata;* opoponax, from the *Opoponax chironium;* scammony, from the *Convolvulus scammonia;* gamboge, from the *Stalagmitis gambogioides;* gum-guaiac, from the *Guaicum officinale;* myrrh, from *Balsamodendion Myrrha;* euphorbium, from *Euphorbia officinalis.* Opium from the *Papaver somniferum;* is sometimes called a gum-resin.

6. CAOUTCHOUC.

604. This substance, commonly known by the name of Indian Rubber, is the juice of the *Haevea*, which grows in the Brazils. It may also be obtained from the *Urceola elastica*, the *Iatropha elastica*, and other Euphorbiaceæ, and the *Artocarpus integrifolia* and *Ficus elastica*. When newly exuded, caoutchouc has a whitish-yellow colour; but it turns black when exposed to the air for a while. It is distinguished by its great elasticity. When exposed to heat, it softens and swells, and emits an odour like that of burnt wool. When exposed in the air to a high temperature, it burns with a rich yellow flame. It is insoluble in water and in alcohol, but soluble in naphtha and in the volatile oils. According to Dr. Ure, it is composed of

Carbon, ...	90.
Hydrogen, ...	9.12
Oxygen, ...	0.88
	100 parts.

The oxygen, being in such small proportion, may be regarded as adventitious.

CHAP. III.—VEGETABLE ACIDS, MOST OF WHICH CONTAIN MORE OXYGEN THAN WOULD BE NECESSARY TO FORM WATER WITH THEIR HYDROGEN.

605. The acids which exist ready formed in vegetables are the acetic, tartaric, citric, oxalic, benzoic, malic, gallic, and prussic acids. In the state in which we procure them they are combined with a considerable quantity of water. In stating their chemical composition this is omitted.

1. ACETIC ACID.

606. This substance, the pure matter of vinegar, does not often occur free in vegetables, but is generally in combination with potassa or lime. In the sap of some trees it is present in very minute portions. It is formed during acetous fermentation, and by the destructive distillation of wood. Formed in the latter way, it is called Pyroligneous Acid. Acetic acid is transparent and colourless, has a fragrant odour, and a strong sharp taste. It consists, according to some chemists, of

Carbon,	4 equivalents	24
Oxygen,	3	24
Hydrogen,	3	3
		51 parts.

Dr. Prout, in his analysis of this acid, found that it contains three atoms of hydrogen, the oxygen and hydrogen being exactly in the proportion to form water. According to other views, there is an excess of one atom of oxygen.

2. TARTARIC ACID.

607. This acid exists in vegetables, mostly in union with potassa, forming a supertartrate. It may be procured from the pulp of the Tamarind (*Tamarindus indica,*) from the juice of the grape (*Vitis vinifera*), and of the Mulberry (*Morus nigra*). It is also said to exist in considerable quantity in Sorrel (*Rumex acetosa*), and in Dandelion (*Leontodon Taraxacum*). It consists of

Carbon,	4 equivalents	24	or	36.5
Oxygen,	5	40	...	60.5
Hydrogen,	2	2	...	3.0
		66 parts.		100 parts.

3. CITRIC ACID.

608. This acid exists in the juice of Oranges and Lemons (*Citrus aurantium* and *C. limonum*), of Cranberry and Whortleberry (*Vaccinium oxycoccos* and *V. vitis-idæa*), and Common Dog-rose (*Rosa canina)*, and in several other fruits. It gives the juice of the Lime and Lemon their acidity. It consists of

Carbon,	4 equivalents	24	or	41.369
Oxygen,	4	32	...	54.831
Hydrogen,	2	2	...	3.8
		58 parts.		100 parts.

4. OXALIC ACID.

609. This acid contains no hydrogen, consisting of oxygen and carbon alone. It is found uncombined in the juice of the Chick Pea (*Cicer arietinum*) ; but is generally in combination with lime or potassa. It is found in union with the latter of these in Common Sorrel (*Rumex acetosa)*, Wood Sorrel (*Oxalis acetosella*), and in the *Geranium acidum*. It has been found by M. Barconnot in several species of lichen, in combination with lime. It consists of

Carbon,	2 equivalents	12	or	33.34
Oxygen,	3	24	...	66.66
		36 parts.		100 parts.

5. BENZOIC ACID.

610. This acid is found in the balsams, as gum benzoin, storax, balsam of Tolu, &c. It has been found by M. Vogel in the flowers of the *Trifolium melilotus officinalis* (Common Yellow Melilot.) The fragrance of the Sweet-scented

vernal Grass (*Anthoxanthum odoratum*) is said to depend upon the presence of benzoic acid. It consists of

Carbon,	14 equivalents	84
Oxygen,	3	24
Hydrogen,	5	5
		113 parts.

6. MALIC ACID.

611. This acid is found in Apples, Oranges, Barberries, Elderberries, Currants, Strawberries, Raspberries, &c. It has been found also in the Houseleek (*Sempervivum tectorum*), combined with lime, and in the berries of the Service Tree (*Pyrus aucuparia.*)

Carbon,	4 equivalents	24	or	40.68
Oxygen,	4	32	...	54.24
Hydrogen,	3	3	...	5.08
		59 parts.		100 parts.

7. GALLIC ACID.

612. This is the acid which exists in the Gall-nuts, from which it takes its name. It is found in the bark of most trees of an astringent nature, as Oak (*Quercus pedunculata*), associated with tannin. It consists of

Carbon,	7 equivalents	42
Oxygen,	5	40
Hydrogen,	3	3
		85 parts.

8. PRUSSIC OR HYDROCYANIC ACID.

613. This acid contains no oxygen, but consists of carbon, hydrogen, and nitrogen, in the following proportions:

Carbon,	2 equivalents	12	Cyanogen 26
Nitrogen,	1	14	
Hydrogen,	1	1	
		27 parts.	

614. It exists in the seed of the Peach, Cherry, Almond: and may be obtained by distilling Laurel leaves. The leaves of the *Prunus Lauro-cerasus* give a considerable quantity when distilled.

615. Besides these, there are many vegetable acids of less interest, such as the Succinic, obtained from Amber; the Suberic, from Cork; the Pectic, from the Carrot, &c. They are of little importance, and do not exist in any considerable quantity in the vegetable kingdom.

CHAP. IV.—VEGETABLE ALKALIS, &c.

616. The vegetable alkalis are a newly discovered class of compounds, which generally contain nitrogen. In most plants which possess any marked property not depending on a volatile oil, as the Poppy, which has a narcotic effect, Peruvian Bark, which has a tonic effect, there has been found some peculiar principle, in combination with a vegetable acid, which principle is the cause of the virtues of the plant. This principle is called an Alkali, because it possesses the property of neutralizing acids. Morphia in opium, quinine in Peruvian bark, strychnia in the Nux-vomica, are the principles which give these plants their peculiar properties.

The following table shews the compositions of the three leading vegetable Alkalis:

	MORPHIA.	QUINA.	STRYCHNIA.
Oxygen,	48	16	24
Carbon,	204	120	180
Hydrogen,	18	12	16
Nitrogen,	14	14	14
	284	162	234

617. Besides these, the common alkalis, potassa and soda, are found in considerable quantities in vegetables. They are generally in combination with the acetic and carbonic acids; and in small quantities with the sulphuric and muriatic acids. Potassa may be obtained from some plants by burning them, washing the ashes, filtering them, and evaporating to dryness. It is the most common alkali in vegetables. Soda is found in all plants growing in or very near the sea. There are only four of the earths found in vegetables—lime, magnesia, alumina, and silica (239). They are procured by incinerating the plant. The lime is usually in combination with carbonic acid; and small portions of the sulphate and phosphate of lime are sometimes present. Lime and silica exist in much larger quantity in the vegetable kingdom than magnesia and alumina; and of these two the former is the more abundant. These alkalis and earths form the ashes which remain after the burning of vegetables; and the insoluble matter of the ashes consists principally of the earths. The only other metallic oxides found in plants are those of iron and manganese. They are in very minute quantities. When the ashes are brownish-red, they contain iron; when purple or blackish, manganese. Herbs give more ashes than shrubs and shrubs more than trees. The leaves of trees afford more than the branches, and the branches more than the trunk.

CHAP. V.—VEGETABLE COMPOUNDS WHICH DO NOT BELONG TO ANY OF THE PRECEDING CLASSES.

1. ALBUMEN.

618. This substance in the vegetable kingdom resembles, in composition and properties, that which exists in animal compounds. The purest albumen is the white of the egg. In the juice of the Papaw tree (*Carica papaya*) it exists in considerable quantity. When the juice is boiled, the albumen becomes coagulated, and is deposited. It has been found in large quantities in the fruit of the Ochra (*Hibiscus esculentus*). Care must be taken to distinguish between the chemical use of the term " Albumen," as applied to express a peculiar compound, and its botanical use as applied to a particular part of the seed. The part called the " Albumen" in Wheat contains little or no albumen.

2. GLUTEN.

619. This is a soft substance, much resembling dough. It is obtained from wheat-flour, by forming it into a paste, and washing it by exposing it to a small stream of water. The starch, mucilage, &c. are carried away by the water, and the gluten remains. It exists largely in the seeds of the Grasses. Wheat contains from one-fourth to one-fifth of gluten, and hence its superiority for the manufacture of bread. It is the gluten which produces the fermentation of the dough, by which the bread is raised, causing those interstices seen in every part. The yeast added is for the purpose of assisting and hastening the fermentation. It is found also in Acorns, Chestnuts, and many other seeds. It is very nutritious, and contains a considerable quantity of nitrogen.

3. TANNIN.

620. This is the substance which gives astringent vegetable substances their peculiar character. It is obtained in great quantities from the Gall-nut, in which it is mixed with water, gallic acid, and mucilage. It is obtained also from barks; the barks of the Oak and Horse Chestnut yield it abundantly. It may be obtained also from bruised grape-seeds. It is soluble in water and in alcohol, but insoluble in ether. Catechu, prepared from the wood of the *Acacia catechu*, and Kino, from the *Eucalyptus resinifera*, contain large quantities of tannin. It exists in the various kinds of tea, and in tormentil root, in considerable quantities. Tannin is characterised by precipitating solutions of animal jellies, and giving a bluish black or green precipitate with salts of the peroxide of iron. It has been analyzed by Berzelius, and found to consist of

Carbon, . . .	50.55
Oxygen, . . .	45
Hydrogen, . . .	4.45
	100 parts.

CHAP. VI.—GENERAL VIEW OF THE CHEMICAL COMPOSITION OF VEGETABLES.

621. There are altogether fifteen simple bodies entering into the composition of vegetables:—

Oxygen,
Hydrogen,
Carbon, } These three elements, with a small admixture of the following ingredients, make up the vegetable frame.

Nitrogen.

Sulphur (usually in combination with oxygen forming *Sulphuric Acid*).

Phosphorus (in combination with oxygen in the form of *Phosphoric Acid*).

Chlorine (forming, with hydrogen, *Muriatic Acid*), or with chlorine, forming chloride of sodium or common salt.

Iodine (forming, with hydrogen, *Hydriodic Acid*).

Potassium (in union with oxygen, in the state of *Potassa*).

Sodium (in union with oxygen, forming *Soda*).

Calcium (with oxygen, forming *Lime*).

Magnesium (with oxygen, forming *Magnesia*).

Silicum (with oxygen, forming *Silica*).

Aluminum (with oxygen, forming *Alumina*).

Iron (with oxygen, forming *Oxide of Iron*).

Manganese (with oxygen, forming *Oxide of Manganese*).

The last eight are metals, existing in vegetables in the state of oxides, mostly in union with some acid, and in very small quantities.

622. Many plants contain silica. Clover yields sulphate of lime in its ashes. Nitrate of potassa is found in the sap of the sun-flower; and nitrate of soda in barley. Oats and some seeds yield a little phosphate of lime. Sea weeds and plants growing near the shore contain a considerable quantity of chloride of sodium.

623. The sap is the watery fluid found in the alburnum; it varies much in different trees; it always contains a large quantity of water; and generally some sugar and mucilage, some acetate of potassa, carbonate of lime, acetate of lime, or acetate of alumina, and sometimes an uncombined acid. Sometimes tannin and gallic acid are present in the sap; but sugar and mucilage are the principal vegetable ingredients. Mr. Adams found twelve fluid ounces of the sap of the rose tree to contain

Oxalate of Lime, . . .	2.900 grains.
Acetate of Lime, . . .	1.097
Acetate of Potassa, . . .	0.7
Gum and Extractive, . .	2.1
Sugar, &c. (soluble in Alcohol), .	0.1
Loss, ...	0.353
	7.25

624. Sir Humphry Davy, in his Elements of Agricultural Chemistry, has given an excellent account of the general composition of the various parts of vegetables. From this part of his work I have made the following extracts:—

"The tubes and hexagonal cells in the vascular system of plants are composed of woody fibre; and when they are not filled with fluid matter they contain some of the solid materials which formed a constituent part of the fluids belonging to them."

"In the roots, trunk, and branches, the bark, alburnum, and heart-wood, the leaves and flowers; the great basis of the solid parts is woody fibre. It forms by far the greatest part of the heart-wood and bark; there is less in the alburnum, and still less in the leaves and flowers. The alburnum of the Birch contains so much sugar and mucilage, that it is sometimes used in the north of Europe as a substitute for bread. The leaves of the Cabbage, Broccoli, and Seacale, contain much mucilage, a little saccharine matter, and a little albumen. From 1000 parts of the leaves of common Cabbage, I obtained 41 parts of mucilage, 24 of sugar, and 8 of albuminous matter."

"In bulbous roots, and sometimes in common roots, a large quantity of starch, albumen, and mucilage, are often found deposited in the vessels; and they are most abundant after the sap has ceased to flow: and afford a nourishment for the early shoots made in spring. The potato is the bulb that contains the largest quantity of soluble matter in its vessels and cells; and it is of most importance in its application as food. Potatoes in general afford from one-fifth to one-seventh of their weight of dry starch."

"The Turnip, Carrot, and Parsnip, afford principally saccharine, mucilaginous, and extractive matter. I obtained from 1000 parts of common Turnip, 7 parts of mucilage, 34 of saccharine matter, and nearly one part of albumen. 1000 parts of Carrot furnished 95 parts of sugar, 3 parts of mucilage, and ½ part of extract. 1000 parts of Parsnip afforded 90 parts of saccharine matter and 9 parts of mucilage.

The *Walcheren*, or *White Carrot*, gave, in 1000 parts, 98 parts of sugar, 2 parts of mucilage, and 1 of extract."

" Fruits, in the organization of their soft parts, approach to the nature of bulbs. They contain a certain quantity of nourishment laid up in their cells for the use of the embryon plant: mucilage, sugar, starch, are found in many of them, often combined with vegetable acids. Most of the fruit trees common in Britain have been naturalized, on account of the saccharine matter they contain, which, united to the vegetable acids and mucilage, renders them at once agreeable to the taste and nutritive."

" Starch, or coagulated mucilage, forms the greatest part of the seeds and grains used for food; and they are generally combined with gluten, oil, or albuminous matter. In Corn, with gluten; in Peas and Beans, with albuminous matter; and in Rape-seed, Hemp-seed, Linseed, and the kernels of most nuts, with oils."

" I found 100 parts of good full-grained Wheat, sown in autumn to afford,

Of Starch, . .	77
Gluten, . .	19

100 parts of wheat sown in spring,

Of Starch, . .	70
Gluten, . .	24

" In some experiments made on Barley, I obtained from 100 parts of full and fair Norfolk Barley,

Of Starch, . .	79
Gluten, . .	6
Husk, . .	8

The remaining 7 parts saccharine matter."

" I obtained from 100 parts of Rye, grown in Suffolk, 61 parts of starch, and 5 parts of gluten."

" 100 parts of Oats from Sussex afforded me 59 parts of starch, 6 of gluten, and 2 of saccharine matter."

" 1000 parts of Peas, grown in Norfolk, afforded me 501 parts of starch, 22 parts of saccharine matter, 35 parts of albuminous matter, and 16 parts of extract, which became insoluble during evaporation of the saccharine fluid."

" The different parts of flowers contain different substances: the pollen, or impregnating dust of the date, has been found by Fourcroy and Vauquelin to contain a matter analagous to gluten, and a soluble extract abounding in malic acid. Link found in the pollen of the Hazel-tree much tannin and gluten."

" It has been stated that the fragrance of flowers depends upon the volatile oils they contain; and these oils, by their constant evaporation, surround the flower with a kind of odorous atmosphere; which, at the same time that it entices larger insects, may probably preserve the parts of fructification from the ravages of smaller ones. Volatile oils, or odorous substances, seem particularly destructive to those minute insects and animalcules which feed on the substance of vegetables; thousands of Aphides may be usually seen on the stalk and leaves of the Rose; but none of them are ever observed in the flower."—" The woods that contain aromatic oils are remarked for their indestructibility, and for their exemption from the attacks of insects: this is particularly the case with the Cedar, Rose-wood, and Cyprus."

" The petals of many flowers afford saccharine and mucilaginous matter. The White Lily yields mucilage abundantly; and the Orange Lily a mixture of mucilage and sugar; the petals of the Convolvulus afford sugar, mucilage, and albuminous matter."

PART II.

SYSTEMATIC BOTANY,

OR

BOTANICAL TAXONOMY.

625. After we have acquired a knowledge of the structure and functions of plants in general, we are able to proceed to the proper object of Botany—the study of individual plants.

626. The plants which we observe on the surface of the globe are, like the animal creation, divisible into groups, of which the individual plants are exactly similar to each other in appearance, in structure, &c. For instance, all the plants which are known by the name of "Common Red Poppy" are almost exactly alike; if we examine two specimens of Purple Fox-glove *(Digitalis purpurea)*, we shall find them almost exactly alike in every particular; one may be larger than the other, have more flower-buds developed, or have its petals of a richer hue, but in every essential point these two plants closely resemble each other; and they bear the same relation to one another as one animal does to another of the same kind or species. A group of plants, such as this, is called a *Species;* and any one particular plant is termed a *specimen* or *individual*. As, from their close resemblance, when we have made ourselves intimately acquainted with one specimen of a species of plants, we know all the rest, the ultimate object of a botanist is to render himself familiar with the characters of the different species which we find on the surface of the earth.

627. When we consider the infinite variety of species which compose the vegetable world, (there are about 80,000 known), it will be obvious that it will be advantageous to have some method for arranging them in divisions and subdivisions, each of which shall possess some well-marked character or characters, common to all the plants that are included under it. Fortunately, though the differences are numerous, there are always numerous resemblances between the species, which afford grounds for such arrangements. By this means we are better enabled to retain the names and characters of plants in the memory, *for it is easier to recollect that a number of plants possess certain characters by seeing them classified together under some name implying these characters, than by studying them separately.* When we know in what particular class or order a plant is placed, we already know so much of its structure, and, what is very important, by having plants classified, and the classes arranged, we learn what plants have resemblances, and what have little similarity.

628. Another object of a classification is, that a beginner, when he has a plant that is new to him, and no one at hand to tell him its name, may be able, by examining a few simple and easily found out characters of the plant, to find out its name in a work of reference (or Flora), and thus ascertain its history. This is the main object of what is called an *Artificial System* of Classification; so called because it does not necessarily depend on the distinctions marked out, nor correspond with the system followed, by Nature. It generally depends on only one or two organs, and sometimes upon an accidental or comparatively unimportant character of the organ; and frequently combines under one class or order plants dissimilar to each other in almost every point except that single one for which they may be brought together, and separates others which are in many respects nearly related. An artificial system, from its simplicity, is extremely convenient, and, indeed, necessary, for beginners: but it should be regarded only as an introduction, because it does

not communicate any information regarding the other characters, structure, or properties of the plant, and is of little or no use in the case of a new and unknown plant.

629. Now, it has been found that, in the vegetable as in the animal kingdom, the species are grouped together by Nature in Classes or Families, differing from each other in several particulars, but in each of which families, all the species agree in some important and easily discernible characters, and, more or less, in their internal structure and properties. These classes frequently run into each other, and their diagnostic characters and limits are not always so well marked as could be wished. Still, however, they are sufficiently distinct for the purpose of a good natural arrangement. Such a method, if at all perfect, should not only serve the purpose of an artificial system, but enable us, in the case of a new and unknown plant, from the examination of a few of its characters, to have an idea of many of its other characters, its internal structure, and habits, and to predict what properties it is most likely to possess.

630. Many of these natural families must have been observed by every one who has paid even the slightest attention to plants. No one ever mistook the Mosses for the Grasses, or the latter for the Ferns, or these for the Lily tribe. Accordingly, we find that there has always been some arrangement in use, however imperfect. The ancients spoke of Trees, Shrubs, and Herbs, and this division is in popular use at the present time. Then, plants were considered with respect to their uses as food or as medicines, and subdivided accordingly. Gradually, as our knowledge of plants increased, and the necessity for some arrangement became greater, they were classified as Grasses, Cruciferous Plants, Bulbous Plants, &c. This division, however, which is on excellent principles, the botanists of former times were unable to extend to all plants, from their very limited knowledge of vegetable anatomy. To this circumstance also we must attribute the number of artificial systems which were invented to supply the place of a natural method. Till the beginning of

the sixteenth century, the systems in use were very superficial, and of little practical utility. About this time there were two methods proposed, one by Gesner, and the other by Cæsalpinus. Many modifications of these, and several new modes, were proposed by various botanists between that period and the end of the seventeenth century, when Tournefort advanced his celebrated system. This, however, did not long enjoy the public favour: the system of Linnæus, promulgated in 1734, soon acquired a reputation far beyond that of any of its predecessors, and has continued ever since to occupy a high place in the estimation of botanists. But this system, so long the exclusive idol of the botanist, has, in its turn, been compelled to divide its claims with another, first developed by Jussieu in 1789, and subsequently improved by De Candolle, Brown, Richard, and other eminent botanists of the present day.

631. Gesner and Cæsalpinus were the first who pointed out the necessity of taking the leading characters in classification from the flower and the fruit. This was a great step gained. These are the most proper organs to be chosen for this purpose, as they are the most important parts of the plant, and the least subject to variation in structure and appearance; and upon these all the subsequent systems have been founded.

632. The method established by Tournefort was made to depend principally upon the presence or absence, form, and mode of division, of the corolla; and a few of his classes are very natural, and are still retained, as the Labiatæ, Cruciferæ, Papilionaceæ, Umbelliferæ, and one or two more. He first made a grand division of vegetables into Herbs and Trees. Herbs were divided into the Petalous (fourteen Classes), and the Apetalous (three Classes). The Petalous are divided into those with simple (eleven Classes), and those with compound flowers (three Classes). The Simple Petalous are divided according as they have monopetalous, polypetalous, regular, or irregular, corollas; and, finally, according to the form of the corolla. The trees are divided much in the same way.

633. A great many different systems for the classification of plants have been proposed, some natural, some artificial, some of a mixed nature. At present, the systems followed are the artificial or sexual system of LINNÆUS, and the natural method followed by JUSSIEU, improved and extended by subsequent botanists.

634. The system of Linnæus was founded on the number of the stamens. This was made to determine the primary divisions or classes: the subdivisions or orders, in most cases, depend on the number of pistils. These two systems (of Tournefort and Linnæus) are artificial methods. When we are informed that a plant belongs to a particular class in the Linnæan System, we know only the number of the stamens—we neither know any of its other characters, nor can we have any idea of its properties.

635. According to the method of Jussieu, plants are grouped together, not because they may agree in the structure or number of any single organ, but because, on taking all their different characters into consideration, they are found to bear a strong resemblance to each other; and we also find that, in general, the properties of plants are similar in those which are like in their external characters. For these reasons, it is generally called the Natural System. An acquaintance with it affords a broad, comprehensive, and scientific view of the vegetable creation; and it embodies much important information regarding the structure, physiology, and properties of plants, and their mutual relations. Though this is the system which it must always be the object of botanical science to perfect, and with which it is necessary for every student of botany to be intimately acquainted; as it has not been found possible to simplify it as much as could be desired, a knowledge of the Linnæan System must also be acquired. From its comparative simplicity, it is very convenient for those commencing the study; and indeed, till within these few years, it alone was followed in this country. Accordingly, these two methods will be explained in the present work.

636. Before proceeding to examine in detail the Natural and Artificial Systems, we must attend to the division of plants, into *genera*, *species*, and *varieties*. A genus includes many species, and a species many varieties. The Systems of Linnæus and Jussieu do not differ about the arrangement of varieties or species—with respect to these they are both the same, always placing the same variety under the same species, and the same species under the same genus. It is in the arrangement of the genera that these two methods are at variance.

637. A species (626) includes so many plants of the same structure, form, and general appearance, and the seeds of which always produce plants similar to themselves. Difference in species is the only precise and constant distinction established by nature. The arrangement of species into genera is an artificial classification; the occurrence of varieties is not constant nor regular; but a species is a group of plants formed by nature distinct from all other kinds of plants. The distinctive characters of species are taken generally from the root, stem, or leaves. A variety of a species differs from it in some trifling character, such as colour of the flowers, size, pubescence of the leaves, &c. A genus consists of several species differing from each other by what are called the specific characters, taken from the leaves, &c., but agreeing together in the more important characters taken from the fructification. The following generic and specific characters of the genus Pyrus, and the species which it includes, will illustrate the distinction between genera and species.

PYRUS (PEAR, APPLE, AND SERVICE.)

Generic Character.—Calyx superior, of five segments. Petals five. Styles two to five. Fruit fleshy (a pome, or apple), with five cartilaginous two-seeded cells.

Pyrus communis (Wild Pear-tree); leaves simple, ovate, serrated, peduncles corymbose, fruit turbinate.

Pyrus Malus (Crab-apple); leaves ovate, acute, serrated, flowers in a sessile umbel, styles combined below, fruit globose.

Pyrus torminalis (Wild Service-tree); leaves ovate or cordate, lobed, and serrated, lower lobes spreading, peduncles corymbose.

Pyrus domestica (True Service-tree); leaves pinnated, downy beneath, leaflets serrated upwards, flowers panicled, fruit obovate.

Pyrus aucuparia (Quicken-tree, Mountain-ash, or Rowan-tree); leaves pinnated glabrous, leaflets serrated, flowers corymbose, fruit (small) globose.

*Pyrus pinnatifida** (Bastard Mountain-ash); leaves entire, pinnatifid and pinnated, white and downy beneath, flowers corymbose, fruit globose.

Pyrus Aria (White Beam-tree); leaves ovate, cut and serrated, white and downy beneath, flowers corymbose, fruit globose.

The following description of the genus Rose, and the species Dog-Rose, will show more precisely the meaning of the term "variety" in Systematic Botany.

ROSA, (ROSE.)

Generic Character.—Calyx urn-shaped, fleshy, contracted at the orifice, terminating in five segments. Petals five. Pericarps (or carpels) numerous, bristly, fixed to the inside of the calyx.

Rosa canina (Common Dog-Rose); prickles uniform, hooked, leaves naked or slightly hairy, their disk eglandulose, calyx-segments fully pinnate deciduous, styles not united, shoots assurgent.

* Some of the *leaves* of this plant so nearly resemble the following *(Pyrus aria)*, "that I fear (and Professor Henslow is of the same opinion) it can only be considered a *variety*."—*Dr. Hooker;* from whose British *Flora* the above characters of Pyrus, and the following of Rosa, are taken.

α. Leaflets naked, carinate ; serratures simple.
 a. Green.
 b. Grey.

β. *Sarmentacea.* Leaflets naked, carinate ; serratures compound.
 a. Green.
 b. Grey.

γ. *Surculosa.* Leaflets naked, flat ; serratures simple.
 a. Green.
 b. Grey.

δ. *Dumetorum.* Leaflets more or less hairy, flat.
 a. Hairy on both sides.
 b. Hairy beneath only.

ε. *Forsteri.* Leaflets more or less hairy, not flat.
 a. Concave, green.
 b. Carinate, grey.
  1. Hairy beneath only.
  2. Hairy on both sides.

VIEW OF THE LINNÆAN METHOD OF ARRANGING PLANTS.

638. The object of the Linnæan Classification of Plants is to enable a beginner, from a few simple characters, to find out, in a work of reference, *the name* of any plant which may be new to him, and thus ascertain its history. It resembles an alphabetical index to a description of plants, which, when we know the name of the plant, informs us in what page we shall find it described. In like manner, when we know one or two characters of a plant, we can find its name and place in the Linnæan System, and thus, in any work containing a description of plants arranged according to this method, get access to an account of it.

639. For this purpose, plants are arranged in divisions,

all those in each division possessing some feature in common, which distinguishes them from those in the other divisions; so that, upon looking at a plant, we can easily see to which division it belongs. The plants in each division are arranged in subdivisions or sections, each also possessing some well-marked character, which distinguishes the plants which it includes from those in the other subdivisions, and so on. The first or great divisions are called CLASSES. The plants which each class contains are arranged in divisions called *orders*. These again, are divided into sections, each of which is called a *genus* or family, chiefly characterised by the form of calyx, corolla, and seed-vessel; and lastly, the genus is subdivided into *species*, each distinguished by the form and other appearances of the root, stem, leaves, &c. Every plant has two names, the name of the *genus* (its generic name) and that of the *species* (its specific name) to which it belongs: just as every man has two names—a sirname to tell his family, and a Christian name to distinguish him from the other members of the same family—the sirname being analogous to the generic name of a plant, and the Christian name to its specific name. In naming a plant, the generic name is placed first; thus, Veronica hederifolia (Ivy-leaved speedwell.) Veronica (speedwell), is the generic name, and the specific name hederifolia (ivy-leaved), is added to distinguish this plant from other kinds of Speedwell.

640. The mode by which a beginner finds out the name of a plant is very simple indeed. He has a book containing a description of all known plants. He is supposed to retain in his memory what is the distinguishing feature of each of the *classes*, and he examines the plant to ascertain which of these features it presents. This being found out, he knows that the plant is one of those included in the corresponding class. There are twenty-four classes—he has fixed it in one of them, and has thus already made some progress. The plants which the class contains are arranged in divisions (called *orders)*, each of which, like the classes, possesses some

easily discovered and well marked character. He again examines the plant to find to which of these divisions or orders it belongs. This being ascertained, he has now found in which of the twenty-four classes his plant is described and in which order of the class, the number of plants through which he has to search for it being now reduced very much. On looking at the descriptions of plants belonging to this order, it will be found that these are subdivided in various ways, and by comparing his plant with the characters of the subdivisions, he contracts the boundaries within which the plant is contained, gradually descending from class to order, genus, and species; fixing its genus by comparing the calyx, corolla, and other parts of the flower with those of the plants in the text book in the same class and order, and the species by examining the leaves, stem, root, &c. When he first began his inquiry, as far as he knew, the plant might be *any one* in his text book—the first step showed him that it was one out of a certain number: the next step reduced the number, and so on.

641. This is a general view, then, of the method for discovering the name of a plant, and such is the beauty and wonderful simplicity of the Linnæan Method, that, though developed about one hundred years ago, and at a time when our knowledge of plants was very imperfect, it is still decidedly the best (and indeed the only system) for the beginner. We shall now explain it in detail.

642. In this arrangement there are 24 classes. The first 23 include the FLOWERING OR PHÆNOGAMIC plants. They have, in general, a calyx and corolla, and produce their seeds by stamens and pistils. And these seeds consist of the gemmule, radicle, and cotyledons.

643. The 24th class consists of the FLOWERLESS or CRYPTOGAMIC plants (545, &c.), destitute of calyx, corolla, stamens and pistils.

644. The leading or diagnostic character of the first eleven classes is taken from the NUMBER OF THE STAMENS; and the

names applied to them, as well as to all the classes and orders in the Linnæan system, are compounded of two Greek words, so as to express precisely the peculiar character of each.

645. The first class, MONANDRIA, includes those plants which have but one stamen in each flower, and the term is made up from the Greek words *monos* (one) and *aner* (applied to the stamen); and all the other names are formed in a similar manner.

646. The termination *andria* is used where the word *stamen* or *stameus* is meant to be expressed.

647. And the following Greek names for numbers are used for the first eleven classes, and in one or two other cases. *Monos* (one), *di* (two), *treis* (three), *tetras* (four), *pente* (five), *hex* (six), *hepta* (seven), *okto* (eight), *ennea* (nine), *deka* (ten), *dodeka* (twelve.)

648. The following are the first eleven classes:

1. MONANDRIA,	with	1 stamen,...	Zingiber officinale, *Ginger.*
2. DIANDRIA,	...	2 stamens, ..	Olea europæa, *Olive.*
3. TRIANDRIA,	...	3	Valeriana officinalis, *Valerian.*
4. TETRANDRIA,	...	4	Dorstenia contrajerva.
5. PENTANDRIA,	...	5	Atropa Belladonna, *Nightshade.*
6. HEXANDRIA,	...	6	Aloe spicata.
7. HEPTANDRIA,	...	7	Æsculus Hippocastanum, *Chestnut.*
8. OCTANDRIA,	...	8	Daphne Mezereum *Spurge Laurel.*
9. ENNEANDRIA,	...	9	Rheum palmatum, *Rhubarb.*
10. DECANDRIA,	...	10	Cassia senna.
11. DODECANDRIA,	...	11 to 19...	Asarum europæum, *Asarabacca.*

649. The next 2 classes are characterised partly by the situation and partly by the number of the stamens, a new character, situation, being here taken into account:

12. ICOSANDRIA....20 or more stamens inserted into the calyx (perigynous),	Amygdalus communis, *Sweet Almond.*
13. POLYANDRIA,...20 or more stamens inserted under the ovary (hypogynous),*........................	Papaver somniferum, *Opium Poppy.*

650. In the next 2 classes the stamens are of the same number as in two of the preceding classes, (tetrandria and hexandria); but *they are of unequal length in each flower.* Hence the names *di* (two), *dynamia* (superior), *tetras* (four), *dynamia* (superior), from the Greek numerals already explained, and the Greek word *dunamis* (power.)

14. DIDYNAMIA,...4 stamens, 2 long and 2 short,..........	Digitalis purpurea, *Purple Foxglove.*
15. TETRADYNAMIA, ..6 stamens, 4 long and 2 short,......................	Cochlearia officinalis, *Scurvy-grass.*

651. The stamens are united by their filaments into fasciculi or bundles in the next 3 classes, which are characterized by the number of these fasciculi. This new character, the union of the stamens by the filaments, is expressed by the termination *adelphia*, from the Greek word *adelphos*, a brother:

16. MONADELPHIA,...stamens united in 1 fasciculus or tube,..........	Althæa officinalis, *Marsh Mallow.*
17. DIADELPHIA,...stamens united in 2 fasciculi,...............	Dolichos pruriens, *Cow-itch.*
18. POLYADELPHIA,..stamens united in 3 or more fasciculi,............	Citrus Aurantium, *Orange.*

652. The next class includes those plants described in par. 375, &c. and is named from two Greek words, *sun* (together), and *genesis* (growth), intended to indicate the union of the anthers. The term *Synantheræ* (anthers together) would be more expressive.

* The names of these two classes do not express their peculiar character so precisely as could be wished. They are from *eikosi* (twenty), *polus* (many). In both cases there are twenty or more stamens. The situation constitutes the distinction.

19. Syngenesia,...anthers united,	Anthemis nobilis, *Chamomile.*

653. The next class embraces a tribe of plants in which the anther is united with the style of the pistil, and named *gynandria*, from the Greek words *gune* (applied to the pistil), and *aner* (applied to the stamen.)

20. Gynandria,...stamen and pistil united,..	Aristolochia Serpentaria, *Snake-root*

654. In the next 3 classes the flowers are unisexual:

21. Monœcia,....male and female flowers on the same plant,.........	Ricinus communis, *Castor oil Plant.*
22. Diœcia,...the male and the female flowers growing on different plants,...............................	Humulus lupulus, *Hop.*
23. Polygamia,....hermaphrodite, male, and female flowers, growing on the same plant or on separate plants, ...	Ficus carica, *Fig.*

655. The last class embraces the plants destitute of stamens and pistils:

24. Crytogamia,.........flowerless plants, ...	Cetraria islandica, *Iceland Moss.*

656. The names of the two latter classes are from the Greek words *gamos* (applied in botany to express the manner in which the seeds are produced), *polus* (many), and *kruptos* (hid or concealed.)

657. In the first 13 classes the orders or subdivisions depend on the number of the styles or distinct sessile stigmas: The termination *gynia*, is from the Greek word *gune*, applied to the style. They are as follows:

Monogynia, ...	1 style.
Digynia, ...	2 styles.
Trigynia, ...	3 ......
Tetragynia, ...	4 ......
Pentagynia, ...	5 ......
Hexagynia, ...	6 ......
Heptagynia, ...	7 ......
Octagynia, ...	8 ......
Enneagynia, ...	9 ......
Decagynia, ...	10 ......
Dodecagynia, ...	12 ......
Polygynia, . . .	many . ...

The whole of these orders do not occur in each class; sometimes only 2 or 3.

658. In the 14th class, Didynamia, there are 2 orders: *Gymnospermia*, from the Greek words, *gumnos* (naked), and *sperma* (seed); *Angiosperma*, from *aggos* (a vessel), and sperma.

1. *Gymnospermia*, in which the seeds are naked (with thin ovaries); they are generally 4 in number.............	Lavandula vera, *Lavender*.
2. *Angiospermia*, in which the seeds are inclosed in a distinct seed-vessel or pericarp.	Scrophularia nodosa, *Knotted Figwort*.

659. In the 15th class, Tetradynamia, there are 2 orders:

1. *Siliculosa*, with the seed vessel a *silicula*, pouch, or short pod: see Fig. 51, page 129,.....	Crambe maritima, *Sea-Kale*.
2. *Siliquosa* with the seed vessel a *siliqua* or long pod: see Fig. 50, page 129...	Sisymbrium nasturtium, *WaterCress*.

660. In the 16th, 17th, and 18th classes, Monadelphia, Diadelphia, and Polyadelphia, the orders are determined by the number of the stamens, the same characters as the first 13 classes.

661. In the 19th class, Syngenesia, there are 5 orders*:

1. *Polygamia Æqualis.* Here all the florets are hermaphrodite or perfect, each having stamens, and an ovary bearing seed,........................	Leontodon Taraxacum, *Dandelion.*
2. *Polygamia Superflua.* Here the florets of the disk (378) are provided with stamens and pistil, while those of the ray (378) have only a pistil, both bearing seed,..............	Tanacetum vulgare, *Tansy.*
3. *Polygamia Frustranea.* Here the florets of the disk have both stamens and pistil, while those of the ray have neither stamens nor pistil, or an abortive pistil (neuter),...........	Centaurea benedicta, *Blessed Thistle.*
4. *Polygamia Necessaria.* Here the florets of the disk have only stamens, those of the ray only pistils,.....	Calendula officinalis, *Common Marigold.*
5. *Polygamia Segregata.* In this order the common calyx or involucre encloses several smaller calices or cups, which separate and surround the florets.	Echinops, *Globe Thistle.*

662. In the 20th, 21st, and 22d classes, Gynandria, Monœcia, and Diœcia, the orders are founded on the characters of several of the preceding classes, generally on the number of the stamens.

663. In the 23d class, Polygamia, there are 3 orders:

1. *Monœcia,* in which one plant may have perfect flowers and male flowers, perfect flowers and female flowers, or perfect, male, and female flowers,...	Veratrum album, *White Hellebore.*

2. *Diœcia,* in which the several kinds of flowers are found on 2 plants.

* Linnæus had a sixth order, Monogamia, including plants with united anthers, but simple flowers, now generally placed in Pentandria, having little affinity with the Syngenesia.

3. *Triœcia.* In this order the different kinds of flowers are placed on 3 different plants, as in the Fig-tree (*Ficus*),.....	Ficus carica, *Fig.*

664. In the 24th class, Cryptogamia, the orders have been somewhat modified since the time of Linnæus: see the table, page 191.

665. It will be seen, from the foregoing account of the Linnæan System, that the leading divisions, the classes, are themselves arranged in sets, determined by a variety of characters.

666. First, there are two great divisions, Flowering Plants (with stamens and pistils), and Flowerless Plants without stamens and pistils. The first 23 classes include the Flowering plants, the 24th the Flowerless.

667. The *twenty-three classes* of Flowering plants are divided into *two sets*,—*three classes* (21st, 22d, and 23d) which have the stamens and pistils separate from each other; and *twenty classes* (1st to 20th) in which the stamens and pistils are together.

668. These *twenty classes* are also in *two sets*,—*one class* (the 20th) having the anther and style *united*, while in the other *nineteen classes* these organs are separate.

669. These *nineteen classes* are in *two sets*,—*four classes*, (16th, 17th, 18th, 19th) in which the stamens are united to each other, and *fifteen classes* (1st to 15th) in which they are separate.

670. The *four classes* in which the stamens are united are in two divisions,—*one class* (19th) in which the stamens are joined by the anthers, the filaments being free, and *three classes* (16th, 17th, 18th) in which the stamens are joined by the filaments, the anthers being free.

671. The *fifteen classes* in which the stamens are separate from each other are in two sets, *two classes* (14th and 15th) in which the stamens are of unequal length in each flower; and *thirteen classes* in which the stamens in each flower are equal in length, or, at least, there is no very marked difference.

672. These *thirteen classes* are in two sets—*eleven classes* (1st to 11th) in which the number of the stamens in each flower is *less than twenty*, and *two classes* (12th and 13th) in which the number of stamens in each flower is *more than twenty*.

673. In these *two classes* the situation of the stamens is taken into account in determining the class; the stamens being placed upon the calyx in the 12th class, upon the *receptacle* (under the ovary) in the 13th class.

674. The first *eleven classes* are distinguished from each other solely by the number of the stamens.

675. Thus, in determining the Linnæan class of a plant, the student examines it to see, *first*, if it have or have not stamens and pistils; if it have these organs, he, *secondly*, looks if the stamens and pistils are in the same flower, or separate; if they are together, he, *thirdly*, looks if the stamens and pistil are free or united to each other; if free, he looks, in the *fourth* place, if the stamens are united to each other or separate; and so on, as will be understood from the arrangement of the classes in brackets in the following tabular view of the Linnæan system.

						CLASSES.
SEXUAL ORGANS PRESENT.	FLOWERS HERMAPHRODITE.	*Stamens distinct from the pistil.*	Stamens distinct from each other.	1 stamen		1. MONANDRIA.
				2 stamens		2. DIANDRIA.
				3 —		3. TRIANDRIA.
				4 —		4. TETRANDRIA.
				5 —		5. PENTANDRIA.
				6 —		6. HEXANDRIA.
				7 —		7. HEPTANDRIA.
				8 —		8. OCTANDRIA.
				9 —		9. ENNEANDRIA.
				10 —		10. DECANDRIA.
				11 to 19		11. DODECANDRIA.
				20 or more stamens on the calyx		12. ICOSANDRIA.
				. . . receptacle		13. POLYANDRIA.
				2 long and 2 short		14. DIDYNAMIA.
				4 long and 2 short		15. TETRADYNAMIA.
			Stamens united to each other.	By the filaments	In 1 fasciculus	16. MONADELPHIA.
					In 2 fasciculi	17. DIADELPHIA.
					In several fasciculi	18. POLYADELPHIA.
				By the anthers		19. SYNGENESIA.
		Stamens united with the pistil				20. GYNANDRIA.
	FLOWERS UNISEXUAL.	Male and female flowers on the same plant				21. MONŒCIA.
		. . . 2 different plants				22. DIŒCIA.
		Hermaphrodite, male, and female flowers, on the same or on different plants				23. POLYGAMIA.
SEXUAL ORGANS ABSENT OR NOT APPARENT						24. CRYPTOGAMIA.

ORDERS.

1. Monogynia, Digynia.
2. Monogynia, Digynia, Trigynia.
3. Monogynia, Digynia, Trigynia.
4. Monogynia, Digynia, Tetragynia.
5. Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Polygynia.
6. Monogynia, Digynia, Trigynia, Tetragynia, Hexagynia, Polygynia.
7. Monogynia, Digynia, Tetragynia, Heptagynia.
8. Monogynia, Digynia, Trigynia, Tetragynia.
9. Monogynia, Trigynia, Hexagynia.
10. Monogynia, Digynia, Trigynia, Pentagynia, Decagynia.
11. Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Dodecagynia.
12. Monogynia, Pentagynia, Polygynia.
13. Monogyn., Digyn., Trigyn. Tetragyn., Pentagyn., Hexagyn., Polygyn.
14. { 1. Gymnospermia, seeds naked.
    2. Angiospermia, seeds in a seed-vessel.
15. { 1. Siliculosa, pericarp a silicula.
    2. Siliquosa, pericarp a siliqua.
16. { Triandria, Pentandria, Heptandria, Octandria, Decandria, Endecandria, Dodecandria, Polyandria.
17. Pentandria, Hexandria, Octandria, Decandria.
18. Dodecandria, Icosandria, Polyandria.
19. { 1. Polygamia Æqualis, all the florets hermaphrodite.
    2. ——— Superflua, florets of the disk hermaphrodite, of the ray female.
    3. ——— Frustranea, florets of the disk hermaphrodite, of the ray neuter.
    4. ——— Necessaria, florets of the disk male, of the ray female.
    5. ——— Segregata, each floret with a separate flower-cup, or calyx.
20. Monandria, Diand., Triand., Tetrand., Pentand., Hexand., Octand.
21. { Monandria, Diand., Triand., Tetrand., Pentand., Hexand., Polyand., Monadelphia, Polyadelphia.
22. { Monandria, Diand., Triand., Tetrand., Pentand., Hexand, Polyand., Monadelphia.
23. Monœcia, Diœcia, Triœcia.
24. { Fungi, Lichenes, Algæ, Characeæ, Hepaticæ, Musci, Marsileaceæ, Lycopodiaceæ, Filices, Equisetaceæ.

NATURAL SYSTEM FOR THE CLASSIFICATION OF PLANTS.

676. The other mode of arranging plants is called the *Natural System*, or *Method of Natural Families*—It is the only system entitled to the name of a CLASSIFICATION. The principles of this system were first developed in 1789, in a work entitled *Genera Plantarum*, by a celebrated French Botanist, ANTOINE LAURENT DE JUSSIEU.

677. In this arrangement those plants are grouped together which have the greatest number of points of resemblance in structure—the greatest number of characters in common; thus differing from the Linnæan or Artificial System, which selects only one character, and groups together plants which are similar in that point, however dissimilar in other respects. An example will best explain the difference.

678. Sage *(Salvia)* evidently belongs to the Labiate tribe. It has all the characters which distinguish that tribe except one. It has the corolla of one piece and with a gaping mouth, the calyx two-lipped, the seeds four, the leaves opposite and corrugated, the stem quadrangular, and the plant presents the same aromatic properties which characterise the Labiate tribe. For these reasons, in a system where plants are arranged according to their natural affinities, Sage is included in the order *Labiatæ*. But it has only *two* stamens, while the generality of the Labiatæ have *four*; therefore, in the Linnæan system, where the situation of plants is determined by that one character, the number of the stamens—Sage is placed in DIANDRIA, far removed from its allies, the rest of the Labiatæ in DIDYNAMIA, and classed, and in the same order with Duckweed *(Lemna)*, and the Ash *(Fraxinus)*, which have just about as much resemblance to Sage and to each other, as a horse to a serpent, or a bird to a fish. In like manner,

Lady's Mantle (*Alchemilla*), a rosaceous plant in all its more important characters and properties, is removed from the rosaceous tribe in ICOSANDRIA, and placed far away in TETRANDRIA, because its stamens are only four.

679. Now, the Linnæan method is admirable for the purpose for which it was intended (638)—for assisting the *beginner* in learning the *names* of plants. But it is of no other use, and that use is only as an introduction to the *study of plants:* it conveys little knowledge of the structure, and none of the properties of plants.

680. The natural System, however, has higher pretensions. The plants in each Order (Family) are united there, because they have more points of resemblance with each other, than with any other plants. The order implies a *number* of characters, and hence, when the characters of an order are known, much valuable information is already acquired regarding all the plants whose names are under that order—with respect both to their structure, and their properties; for it is found that plants similar in many points of structure, have also many properties in common.

681. Cruciform, Rosaceous, Labiate, Papilionaceous, Umbellate plants (with the Flower-stalks radiating from a central point—as Hemlock) illustrate natural Families. Few are so clearly defined as these; but in all there are affinities, more or less marked and numerous, which serve to unite the plants in each Family. And, not only are the plants likest to each other joined in one family—the Families are arranged so that the adjoining ones are always the most similar, and are divided into classes: these are divided into sets, and arranged so that the most nearly related classes are adjacent. Thus, when we know the situation of a Family in a natural scheme—we already know some leading points in the structure of the plants of that Family.

682. The Natural System is the Grammar of Botany, and the natural arrangement of plants may be compared to the classification of words, as nouns, adjectives, verbs, &c., these into subdivisions, as verbs into moods—these into tenses, and

so on. And it is called "Natural," because it endeavours to follow the analogies and differences chalked out by nature, which has grouped vegetables, as well as animals, in Families, differing from each other in several particulars, but in each of which families, all the species agree in many important external characters, and, more or less, in their internal structure and properties.

683. Linnæus himself was sensible that the perfection of the natural method was the great end of Botanical science, and he published what he called *Fragments of a Natural Method.* There were not materials, however, in his time, for establishing the proper distinctive characters, and collecting the families into a system. He observes, however, that the natural system is no chimera, as all plants, of what order soever, show an affinity to others ; and hence, if this affinity, or the links of this natural chain could once be made out and connected, not only the virtues of a great number of species may be ascertained, but we may know with certainty how to find a proper succedaneum for plants which cannot easily be had. Jussieu brought to light this chain, the existence of which Linnæus had wished for and anticipated, while succeeding botanists, Brown, De Candolle, and others, have done much towards bringing the extremities of it into sight, rendering our view of some obscure parts more clear, and demonstrating the complete connection of the various links.

METHOD OF JUSSIEU.

684. The following sketch of the original arrangement of the Natu- Orders by Jussieu, may be useful, as his method is still used by some, a large proportion of his Orders have been retained.

685. In this arrangement there are 100 Orders, in 15 Classes, ich are included in three great divisions, Acotyledones, Monocotyle- es, and Dicotyledones. All these Orders are given in the subjoined t.

			Class
COTYLEDONES,			1
ONOCOTYLEDONES,		Stamens hypogynous.[1]	2
		——— perigynous,[2]	3
		——— epigynous,[3]	4
COTYLEDONES,	Apetalous,	Stamens epigynous,[4]	5
		——— perigynous,	6
		——— hypogynous,	7
	Monopetalous,	Corolla hypogynous,	8
		——— perigynous,	9
		——— epi-gynous, anthers combined,	10
		——— epi-gynous, ——— distinct,	11
	Polypetalous,	Stamens epigynous,	12
		——— hypogynous,	13
		——— perigynous,	14
	Diclines,[4] irregular,		15

SERIES OF THE ORDERS.

CLASS I.

Fungi.
Algæ.
Hepaticæ.
4. Musci.
5. Filices.
6. Naiades.

CLASS II.

Aroideæ.
Typhæ.
9. Cyperoideæ.
10. Gramineæ.

CLASS III.

11. Palmæ.
12. Asparagi.
13 Junci.
14. Lilia.
15. Bromeliæ.
16. Asphodeli.
17. Narcissi.
18. Irides.

CLASS IV.

19. Musæ.
20. Cannæ.
21. Orchideæ.
22. Hydrocharides.

[1] Inserted under the ovary, as in Butomus, Gramineæ, Ranunculaceæ,
[2] Inserted upon the calyx (or single perianth), as in Lilia, Daphne, Rosaceæ.
[3] Inserted above the ovary, as in Orchideæ, Umbelliferæ, Rubiaceæ.
[4] Unisexual plants.

CLASS V.

23. Aristolochiæ.

CLASS VI.

24. Eleagni.
25. Thymeleæ.
26. Proteæ.
27. Lauri.
28. Polygoneæ.
29. Atriplices.

CLASS VII.

30. Amaranthi.
31. Plantagines.
32. Nyctagines.
33. Plumbagines.

CLASS VIII.

34. Lysimachiæ.
35. Pediculares.
36. Acanthi.
37. Jasmineæ.
38. Vitices.
39. Labiatæ.
40. Scrophulariæ.
41. Solaneæ.
42. Boragineæ.
43. Convolvuli.
44. Polemonia.
45. Bignoniæ.
46. Gentianæ.
47. Apocyneæ.
48. Sapotæ.

CLASS IX.

49. Guaiacanæ.
50. Rhododendra.
51. Ericæ.
52. Campanulaceæ.

CLASS X.

53. Cichoraceæ.
54. Cinarocephalæ.
55. Corymbiferæ.

CLASS XI.

56. Dipsaceæ.
57. Rubiaceæ.
58. Caprifolia.

CLASS XII.

59. Araliæ.
60. Umbelliferæ.

CLASS XIII.

61. Ranunculaceæ
62. Papaveraceæ.
63. Cruciferæ.
64. Capparides.
65. Sapindi.
66. Acera.
67. Malpighiæ.
68. Hyperica.
69. Guttiferæ.
70. Aurantia.
71. Meliæ.
72. Vites.
73. Gerania.
74. Malvaceæ.
75. Magnoliæ.
76. Anonæ.
77. Menisperma.
78. Berberides.
79. Tiliaceæ.
80. Cisti.
81. Rutaceæ.
82. Caryophyll[illegible]

CLASS XIV.

83. Semperviva.
84. Saxifragæ.
85. Cacti.
86. Portulaceæ.
87. Ficoideæ.
88. Onagræ.
89. Myrti.
90. Melastomæ.
91. Salicariæ.
92. Rosaceæ.
93. Leguminosæ.
94. Terebinthaceæ.
95. Rhamni.

CLASS XV.

96. Euphorbiæ.
97. Cucurbitaceæ.
98. Urticæ.
99. Amentaceæ.
100. Coniferæ.

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686. The following tabular view will illustrate the mode of arra[illegible]ment recommended by De Candolle.

DE CANDOLLE'S METHOD.

CLASS

- **1.** *Exogenous or Dicotyledonous.*
  - A, DICHLAMYDEÆ, (*Perianth double, calyx and corolla distinct*),
    - *THALAMIFLORÆ, (*Petals distinct, inserted on the receptacle*).
      - 1. Carpels numerous. Stamens, if definite, opposite to the petals, . 1
      - 2. Carpels solitary or conjoined. Placentæ parietal, 2
      - 3. Ovary solitary. Placenta central, 3
      - 4. Gynobasic fruit, 4
    - **CALYCIFLORÆ, (*Petals free, or more or less combined, always perigynous, or inserted on the calyx.*)
      - 1. Polypetalous, . 5
      - 2. Monopetalous, . 6
    - ***COROLLIFLORÆ, (*Corolla monopetalous, hypogynous, not attached to the calyx.*) . . 7
  - B, MONOCHLAMYDEÆ, (*Perianth single; calyx and corolla forming only one floral envelope*),
    - I. Flowers perfect; each usually having stamens and pistils, . . 8
    - II. Flowers separated; generally monœcious or diœcious, ... 9
- **2.** *Endogenous or Monocotyledonous.*
  - A, PHANEROGAMOUS, (*The fructification visible and regular*),
    - I. PETALOIDEÆ,
      - A, Stamens hypogynous, 10
      - B, ——— perigynous, 11
      - C. ——— epigynous, 12
    - II. GLUMACEÆ, ... 13
  - B. CRYPTOGAMOUS,—(*Fructification concealed, unknown, or irregular*) 14
- **II.** CELLULAR OR ACOTYLEDONOUS PLANTS.
  - A, FOLIACEOUS,—(having apparently leafy expansions and distinct sexes), . . . 15
  - B, LEAFLESS,—(having no foliaceous expansion, and no evident sexes), ... 16

The following are examples of Orders in each of the divisions in th preceding Table, the numbers at the end of the Table referring to th Orders under the corresponding number in the following list:

1.	
Ranunculaceæ.	Berberideæ.
Nymphæaceæ.	

2.	
Papaveraceæ.	Polygaleæ.
Fumariaceæ.	Resedaceæ.
Cruciferæ.	Droseraceæ.
Violarieæ.	

3.	
Caryophylleæ.	Tiliaceæ.
Lineæ.	Acerineæ.
Balsamineæ.	Geraniaceæ.
Malvaceæ.	Oxalideæ.

5.	
Rhamneæ.	Onagrariæ.
Leguminosæ.	Grossulariæ.
Rosaceæ.	Crassulaceæ.
Tamariscineæ.	Saxifrageæ.
Cucurbitaceæ.	Umbelliferæ.

6.	
Caprifoliaceæ.	Campanulaceæ.
Rubiaceæ.	Lobeliaceæ.
Valerianeæ.	Vaccineæ.
Dipsaceæ.	Ericeæ.
Compositæ.	

7.	
Oleineæ.	Orobancheæ.
Apocyneæ.	Scrophularineæ.
Gentianeæ.	Labiatæ.
Convolvulaceæ.	Primulaceæ.
Boragineæ.	Plumbagineæ.
Solaneæ.	

8.	
Plantagineæ.	Thymeleæ.
Amaranthaceæ.	Santalaceæ.
Chenopodeæ.	Aristolochiæ.
Polygoneæ.	

9.	
Euphorbiaceæ.	Myriceæ.
Urticeæ.	Coniferæ.
Amentaceæ.	

10	
Alismaceæ.	Juncagineæ.
Butomeæ.	Aroideæ.

11.	
Smilaceæ.	Junceæ.
Liliaceæ.	

12.	
Hydrocharideæ.	Amaryllideæ.
Orchideæ.	Dioscoreæ.
Irideæ.	

13.	
Gramineæ.	Cyperaceæ.

14.*	
Equisetaceæ.	Lycopodineæ.
Marsileaceæ.	Filices.

15.	
Musci.	Hepaticæ.

16.	
Lichenes.	Fungi.
Hypoxyla.	Algæ.

* Part of the Naiades, *Juss.* are placed in this section by De Candolle.

LINDLEY'S METHOD.

687. Dr. Lindley, in his "*Artificial* Analysis of the Orders," prefixed to his Natural System of Botany, gives the following arrangement of them. The whole vegetable kingdom is divided into five classes:—

Class I. Exogens, or Dicotyledonous Flowering Plants.

Leaves reticulated. Stem with wood, pith, bark, and medullary rays. Flowers usually with a quinary division. Seeds in a pericarp. Cotyledons two or more, opposite.

Class II. Gymnosperms.

Leaves with parallel or forked veins. Stem with wood, pith, bark, and medullary rays. Floral envelopes absent. Seeds naked. Cotyledons two or more, opposite.

Class III. Endogens, or Monocotyledonous Flowering Plants.

Leaves with parallel veins. Stem without any distinction of wood, pith, bark, and medullary rays. Flowers usually with a ternary division. Seeds in a pericarp. Cotyledons solitary, or if two, unequal and alternate with each other.

Class IV. Rhizanths.

Leaves, if any, scale-like. Stem homogeneous, with scarcely any trace of a vascular system. Flowers with sexes. Seeds having no embryo, but consisting of a homogeneous sporuliferous mass.

Class V. Acrogens, or Acotyledonous, or Cryptogamic Plants.

Sexes absent. Sporules in lieu of leaves.

These Classes are sub-divided as follows in the artificial analysis :—

EXOGENS—Sub-class I. POLYPETALOUS.

* Polyandrous. *Stamens more than* 20.

** Oligandrous. *Stamens fewer than* 20.

Sub-class II. INCOMPLETÆ, or APETALOUS.

* Achlamydeous. *No calyx.*

** Monochlamydeous. *A calyx present.*

Sub-class III. MONOPETALÆ.

GYMNOSPERMS. { Taxaceæ, Coniferæ, Cycadaceæ, Gnetaceæ, Equisetaceæ. These are the orders in this class.

ENDOGENS.

* *Flowers complete (having distinct floral envelopes).*

** *Flowers incomplete (having no distinct floral envelopes except leaves.)*

RHIZANTHS, { Rafflesiaceæ, Cytinaceæ, Balanophoraceæ, Cynomoriaceæ. These are the orders in this class.

ACROGENS.

With a distinct axis of growth; leafy.
With a distinct axis of growth; leafless.
With no distinct axis of growth.

In the Exogens and Endogens, the inferior divisions are taken from the position of the ovary, *superior* or *inferior*—the leaves having or being without *stipules*—*carpels* combined or distinct.

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688. We shall now explain the arrangement of the natural orders to be adopted in the present work. It is that of JUSSIEU, with the orders as recognised by RICHARD in his *Elemens de Botanique.*

689. As has been already mentioned, the parts of the flower and fruit are those which are best adapted for the construction of a scientific arrangement. The natural system is composed of from one to two hundred orders; that is, there are upwards of a hundred families of plants which differ from each other in some well marked and important particulars. But botanists do not content themselves with observing the natural arrangements of plants in families. They go a step farther, and endeavour to arrange these families in divisions, sections, classes, &c., founded upon some parts of importance in the structure of plants. And accordingly, when it is found that a family of plants is placed in a particular situation in our method, we have acquired a knowledge of some leading points in the structure of the plants in that family. These families themselves must be classified, as well as the plants which they contain, that we may be enabled by one or two characters to find them easily.

690. The first grand division is into those which have flowers, sexual organs, and a seed with an embryo, and those which are destitute of these organs. The first are the Phenogamia, called also Vasculares, Embryonatæ, or Cotyledoneæ: The second are the Cryptogamia, called also Cellulares, Inembryonatæ or Acotyledoneæ.

CRYPTOGAMIA.

691. The orders in this division are few and easily remembered: they are often set down without any further arrangement, being only ten in number. See page 212.

PHENOGAMIA.

692. In this division there are a great number of different orders, which are arranged in sections or classes.

693. The Phenogamia or Cotyledoneæ are, in the first place, divided into two large sections: 1. The Monocotyledoneæ or Endogenæ; and, 2. Dicotyledoneæ or Exogenæ.

So far all botanists are agreed: after this, the further arrangements of the orders are different in the systems of different writers. I shall follow chiefly the scheme of Jussieu.

MONOCOTYLEDONEÆ.

694. The Monocotyledoneæ are, in Jussieu's method, divided into three classes, according to the mode of insertion of the stamens.

(1.) The *Monohypogyneæ*, in which the stamens are *hypogynous*, or inserted at the base of the ovary, which is here called *superior*.

(2.) The *Monoperigyneæ*, in which the stamens are *perigynous*, or inserted in the perianth or calyx around the ovary, which may be superior, inferior, or semi-inferior.

(3.) The *Monöepigyneæ*, in which the stamens are *epigynous*, or inserted above the ovary, which is here called *inferior*.

DICOTYLEDONEÆ.

695. The dicotyledonous orders are much more numerous, and require further subdvision. Accordingly, they are first arranged in three divisions.—The first embraces those which are destitute of petals, or *apetalous:* the next, those which have the petals united in one leaf, or are *monopetalous:* the next, those which have several distinct petals, or are *polypetalous.*

Apetalous Dicotyledons.

696. The dicotyledonous apetalous plants are subdivided, in Jussieu's arrangement, into three classes, according as the stamens are epigynous, perigynous, or hypogynous,—the Epistamineæ, Peristamineæ, and Hypostamineæ. Many of the apetalous plants have scaly organs resembling a floral envelope; these consist of bracteæ, or of a *single* floral envelope, called calyx: even where this organ is coloured, as in *Daphne Mezereum*, it is con idered as a calyx, if it be single, and the plant is called apetalous.

Monopetalous Dicotyledons.

697. The dicotyledonous monopetalous plants are divided into the *hypocorolleæ* with hypogynous stamens; *pericorolleæ*, with perigynous stamens; and the *epicorolleæ*, with epigynous stamens. The latter are divided into the Synanthereæ, with the anthers united; and the Chorisanthereæ, with the anthers distinct or free. It must be remembered that the insertion of the petals always corresponds to that of the stamens; we never have epigynous stamens and a hypogynous corolla; the terms "epigynous" and hypogynous" refer indifferently to the stamens and corolla.

Polypetalous Dicotyledons.

698. The dicotyledonous polypetalous plants are divided into the *epipetaleæ*, with epigynous stamens; the *hypopetaleæ*, with hypogynous stamens; and the *peripetaleæ*, with perigynous stamens.

699. The names of the classes are very characteristic. The three classes in the monocotyledonous divisions are marked by the prefixture *mono*. All the others (except the Cryptogamia) are in the dicotyledonous divisions. The first three classes in this division are apetalous; accordingly the terms *petal* or *corolla* are not mentioned in their names. In the next three classes the plants are monopetalous:—here, then, the term *petal*, which is generally used to express one of the parts of a polypetalous corolla, is not used. The term employed is *corolla*, which signifies the whole corolla, and may be properly applied to express an entire corolla. In the names of the last three classes, which are polypetalous, the term *petal* is used, signifying that the corolla here consists of several pieces or petals. These names were adapted to the classes by Richard.

JUSSIEU'S NATURAL METHOD.

					CLASS.
CRYPTOGAMIA (Acotyledoneæ)			Sexual organs absent or not apparent	Cryyptogamia.	I.
PHENOGAMIA (Cotyledoneæ.) Sexual organs always present.	MONOCOTYLEDONEÆ (Endogenæ.)		Stamens hypogynous	Monohypogyneæ.	II.
			perigynous	Monoperigyneæ.	III.
			epigynous	Monoepigyneæ.	IV.
	DICOTYLEDONEÆ (Exogenæ.)	Apetaleæ*	epigynous	Epistamineæ.	V.
			perigynous	Peristamineæ.	VI.
			hypogynous	Hypostamineæ.	VII.
		Monopetaleæ	hypogynous	Hypocorolleæ.	VIII.
			perigynous	Pericorolleæ.	IX.
			epigynous	Epicorolleæ.	X. XI.
		Polypetaleæ	epigynous	Epipetaleæ.	XII.
			hypogynous	Hypopetaleæ.	XIII.
			perigynous	Peripetaleæ.	XIV.
		Flowers constantly unisexual		Diclineæ.*	XV.

* In the following arrangement I have brought the orders in the last class (Diclineæ) to the subdivision Apetaleæ, and have dispensed with the arrangement into Epistamineæ, Peristamineæ, and Hypostamineæ, which cannot be applied with such propriety where the flowers are unisexual, and the perianth often altogether wanting.

TABLE

OF THE

NATURAL FAMILIES OF PLANTS.

In the following table the whole of the Natural Families are mentioned. The rare or unimportant families are given in Italics at the end of each division; the leading families are mentioned in small capitals, with an example of each; and those orders which contain Medicinal Plants have an M *annexed.*

DIVISION I.—CRYPTOGAMIA.

SECTION I.—APHYLLEÆ.

FUNGI, M..............Agaricus campestris, *Common Mushroom.*
LICHENES, M........ Cetraria Islandica, *Iceland Moss.*
ALGÆ, M...............Fucus vesiculosus, *Sea-ware.*

SECTION II.—PHYLLOIDEÆ.

I. MUSCOIDEÆ.

CHARACEÆ,...........Chara.
HEPATICÆ, ...Jungermannia.
MUSCI,.. ....Polytrichum commune.

II. FILICOIDEÆ.

MARSILEACEÆ, ...Pilularia globulifera, *Pillwort.*
LYCOPODIACEÆ, ...Lycopodium clavatum, *Club-moss.*
FILICES, M...........Aspidium Filix-mas, *Male Shield Fern.*
EQUISETACEÆ, ...Equisetum, *Horsetail.*

DIVISION II.—PHENOGAMIA.

SECTION I.—MONOCOTYLEDONEÆ.

I. MONOHYPOGYNEÆ.

NAYADEÆ, ...Zostera, *Grass-wrack.*
AROIDEÆ, M.........Acorus Calamus, *Sweet-flag.*
PIPERACEÆ, M.......Piper nigrum, *Black Pepper.*
GRAMINEÆ, M........Avena sativa, *Oat.*
CYPERACEÆ, ...Cyperus longus, *English Galangale.*

This section also contains *Typhineæ, Saurureæ, Cabombeæ,* families of less importance.

II. MONOPERIGYNEÆ.

PALMÆ, M.............Phœnix dactylifera, *Date Palm.*
JUNCEÆ, ...Juncus effusus, *Soft Rush.*
ALISMACEÆ,. ....Alisma Plantago, *Greater Water Plantain.*
COLCHICACEÆ, M...Colchicum autumnale, *Meadow Saffron.*
ASPARAGINEÆ, M...Smilax officinalis.
LILIACEÆ, M... . ...Scilla maritima, *Squill.*
BROMELIACEÆ,......Bromelia Ananas, *Pine Apple.*

Also *Restiaceæ, Commelineæ, Pontedereaceæ.*

III. MONOEPIGYNEÆ.

DIOSCOREÆ,....... ...Dioscorea alata, *White dry Yam.*
NARCISSEÆ,...........Galanthus nivalis, *Snow-drop.*
IRIDEÆ, M ....Crocus sativus, *Saffron Crocus.*
HÆMODORACEÆ......Dilatris tinctoria.
MUSACEÆ, ...Musa Paradisiaca, *Plantain.*
SCITAMINEÆ, M.....Zingiber officinalis, *Ginger.*
MARANTACEÆ,........Maranta arundinacea, *Arrow-root.*
ORCHIDEÆ,........... Orchis mascula, *Early Purple Orchis.*
HYDROCHARIDEÆ,..Stratiotes aloides, *Water Soldier.*

Also Balanophoreæ.

SECTION II.—DICOTYLEDONEÆ.

I. APETALEÆ.

ARISTOLOCHIÆ, M.. Asarum europæum, *Asarabacca.*
SANTALACEÆ, ... Santalum album, *Sanders-wood.*
CUPULIFERÆ, M..... Quercus Suber, *Cork-tree.*
JUGLANDEÆ, ... Juglans regia, *Walnut.*
CONIFERÆ, M. .... Pinus sylvestris, *Scotch Fir.*
CYCADEÆ, ... Cycas circinalis; yields *Sago.*
SALICINEÆ, M. .... Populus tremula, *Aspen.*
BETULINEÆ, ... Betula alba, *Common Birch.*
MYRICEÆ, ... Myrica Gale, *Dutch Myrtle.*
EUPHORBIACEÆ, M.. Ricinus communis, *Castor-oil Plant.*
URTICEÆ, M. .... Humulus lupulus, *Hop.*
MYRISTICEÆ, M. ..... Myristica moschata, *Nutmeg-tree.*
CHENOPODEÆ, ... Spinacia oleracea, *Spinach.*
POLYGONEÆ, M........ Rheum palmatum, *Rhubarb.*
LAURINEÆ, M. .... Cinnamomum aromaticum, *Cinnamon-tree.*
THYMELEÆ, M. ...... Daphne Mezereum, *Spurge Laurel.*
AMARANTHACEÆ, ... Amaranthus.
NYCTAGINEÆ,......... Mirabilis Jalapa, *Marvel of Peru.*
Also, *Cytineæ, Monimeæ, Proteaceæ, Eleagneæ.*

II. MONOPETALEÆ.

1. *HYPOCOROLLEÆ.*

PLANTAGINEÆ, ... Plantago major, *Greater Plantain.*
PLUMBAGINEÆ, ... Statice Armeria, *Sea Gilliflower.*
PRIMULACEÆ, ... Primula veris, *Cowslip.*
GLOBULARIEÆ,.. ..... Globularia, *Blue Daisy.*
OROBANCHEÆ, ... Orobanche major, *Greater Broom-rape.*
SCROPHULARINEÆ,M. Digitalis purpurea, *Foxglove.*
SOLANEÆ, M. .... Hyoscyamus niger, *Common Henbane.*
ACANTHACEÆ, ... Acanthus mollis.
JASMINEÆ, M...... ... Syringa vulgaris, *Lilac.*
VERBENACEÆ,...... ... Verbena officinalis, *Common Vervain.*
LABIATÆ, M. .... Mentha piperita, *Peppermint.*
BORAGINEÆ, M.. ... Symphytum officinale, *Common Comfrey.*
CONVOLVULACEÆ, M. Ipomaea Jalapa, *Jalap.*

BIGNONIACEÆ, ...Bignonia chica, *Trumpet Flower.*
GENTIANÆ, M. ......Gentiana lutea, *Yellow Gentian.*
APOCYNEÆ, M.........Strychnos nux-vomica.
SAPOTEÆ, ...Achras Sapota.
Also, *Lentibulareæ*, *Myoporineæ*, *Polemoniaceæ*, *Myrsineæ*, *Ebenaceæ.*

2. *PERICOROLLEÆ.*

STYRACEÆ, M, ...Styrax Benzoin.
ERICINEÆ, M..........Vaccinium Oxycoccos, *Cranberry.*
CAMPANULACEÆ, M.Campanula, *Bell-flower.*
Also, *Gesneriaceæ.*

3. *EPICOROLLEÆ.*

COMPOSITÆ, M. ......Leontodon Taraxacum, *Dandelion.*
DIPSACEÆ, ...Scabiosa succisa, *Devil's-bit Scabious.*
VALERIANÆ, M.......Valeriana officinalis, *Valerian.*
RUBIACEÆ, M. ....Asperula odorata, *Sweet Woodruff.*
CINCHONACEÆ, M....Cinchona.
CAPRIFOLIACEÆ, M..Lonicera Periclymenum, *Woodbine.*
LORANTHEÆ, ...Viscum album, *Misseltoe.*
Also, *Calycereæ.*

III. POLYPETALEÆ.

1. *EPIPETALEÆ.*

RHIZOPHOREÆ, ...Rhizophora, *Mangrove.*
UMBELLIFERÆ, M...Daucus Carota, *Carrot.*
ARALIACEÆ, ...Panax quinquefolium, *Ginseng.*

2. *HYPOPETALEÆ.*

RANUNCULACEÆ, M..Aconitum Napellus, *Monkshood.*
MAGNOLIACEÆ, M...Wintera Aromatica, *Winter's-Bark tree.*
ANONACEÆ, ...Anona squamosa, *Custard Apple.*
BERBERIDEÆ, ...Berberis vulgaris, *Barberry.*
MENISPERMEÆ, ...Menispermum Cocculus.
RUTACEÆ, M...........Guaiacum officinale.
GERANIACEÆ, M. ....Oxalis acetosella, *Wood Sorrel.*
MALVACEÆ, M.........Althæa officinalis, *Marsh Mallow.*
BOMBACEÆ, ...Bombax pentandrum, *Cotton-tree.*

BYTTNERIACEÆ, ...Theobroma Cacao, *Chocolate Nut tree.*
TILIACEÆ, ...Tilia europæa, *Lime tree.*
THEACEÆ, ...Thea sinensis, *Tea-tree.*
OLACINEÆ,.............Heisteria coccinea, *Partridge Wood tree.*
GUTTIFERÆ, M. .....Stalagmitis Gambogioides, *Gamboge tree.*
HYPERICINEÆ........Hypericum perforatum, *St. John's Wort.*
AURANTIACEÆ, M...Citrus Aurantium, *Orange-tree.*
VINIFERÆ, M.........Vitis vinifera, *Vine.*
ACERINEÆ, ...Acer saccharinum, *Maple-tree.*
MELIACEÆ, M.........Canella alba, *False Winter's Bark.*
SAPINDACEÆ,..........Sapindus saponaria, *Soap Apple.*
POLYGALEÆ, M... ..Krameria triandria, *Ratanhy.*
FUMARIACEÆ,.........Fumaria officinalis, *Common Fumitory.*
PAPAVERACEÆ, ...Papaver somniferum, *Opium Poppy.*
NYMPHÆACEÆ,.......Nymphæa alba, *White Water Lily.*
CRUCIFERÆ, M. .. ..Brassica oleracea, *Cabbage.*
CAPPARIDEÆ,...... ...Capparis spinosa, *Caper-bush.*
RESEDACEÆ, ...Reseda odorata, *Mignonette.*
CISTEÆ,.................Cistus Helianthemum, *Rock Rose.*
DROSERACEÆ,.........Dionæa muscipula, *Venus' Fly-trap*
VIOLARIÆ, M.........Viola tricolor, *Heart's Ease.*
CARYOPHYLLEÆ, M..Dianthus deltoides, *Maiden Pink.*
LINEÆ, M...............Linum usitatissimum, *Flax.*

Also *Dilleniaceæ, Ocknaceæ, Pittosporeæ, Chlenaceæ, Margraaviaceæ, Hippocraticeæ, Malpighiaceæ, Erythroxyleæ, Tremanareæ, Flacourtiaceæ, Frankenaceæ.*

3. PERIPETALEAE.

PORTULACEÆ..........Portulaca, *Purslane.*
SAXIFRAGEÆ, ...Saxifraga granulata, *White Saxifrage.*
CRASSULACEÆ, ...Sempervivum tectorum, *House Leek.*
NOPALEÆ, ...Cactus opuntia, *Indian Fig.*
RIBESIEÆ,.............Ribes Grossularia, *Gooseberry.*
CUCURBITACEÆ, M..Momordica Elaterium.
ONAGRARIEÆ.........Epilobium. *Willow Herb.*
MYRTACEÆ, M.........Myrtus Pimenta, *Allspice Tree.*
SALICARIÆ, M.........Lythrum Salicaria, *Loosestrife.*
TAMARISCINEÆ, M..Tamarix.
ROSACEÆ, M... ....Pyrus Malus, *Crab Apple.*
LEGUMINOSÆ, M . .Pisum sativum, *Garden Pea.*

TEREBINTHACEÆ, M. Amyris gileadensis, *Balsam of Gilead tree.*
RHAMNEÆ, M........Rhamnus catharticus, *Purging Buckthorn.*
CELASTRINEÆ, ...Euonymus, *Spindle Tree.*
AQUIFOLIACEÆ ......Ilex Aquifolium, *Holly.*

Also *Paronychieæ*, *Ficoideæ*, *Hamamelideæ*, *Bruniaceæ*, *Loaseæ*, *Passifloreæ*, *Hygrobeæ*, *Combretaceæ*, *Melastomaceæ*, *Homalineæ*, *Samydeæ*.

CHARACTERS, &c.

OF THE

NATURAL ORDERS OF PLANTS.

FIRST DIVISION.

CRYPTOGAMIA.*

Cryptogamic or Flowerless Plants.

Cryptogamia, Linn.—*Acotyledones*, Juss.—*Inembryonatæ*, *Exembryonatæ*, or *Ahrizæ*, Richard—*Cellulares*, De Candolle.—*Agamæ*, Lamarck.

Characters.—Floral envelope and sexual organs absent or not discernible. Reproduced by means of little bodies

* The term "Cryptogamia" (κρυπτω, to be hid, and γαμος, marriage), is here preferred, because it agrees better than any other with the present state of our knowledge in this department of Botany, and is more comprehensive. The term "Cellular" is objectionable, because the Ferns are provided with a distinct vascular system; and the appellation "Actoyledonous" implies the constant absence of cotyledons, organs analogous to which have been supposed to exist in Ferns: from which Agardh divided the Cryptogamic plants into the true Acotyledonæ, as Algæ: and the Pseudo-Cotyledonæ, as Ferns, &c. The term "Cryptogamia" signifies that the sexual organs of this class, if they have any, are not apparent; which is an undoubted and obvious fact. Some botanists have endeavoured to make out something resembling sexual organs in the Ferns and Mosses. These attempts, however, have not been successful; and we might almost be justified in using the word *ogamæ*, signifying the total absence of sexual organs. It would seem that, in this instance, there has been an idea that Cryptogamic plants must have their sporules or seeds formed by means of a sexual apparatus, because this is the case with flowering plants. But since these two great divisions are so very different in structure, functions, form, and appearance, why may they not also differ in the mode of forming their seed? If an analogy will be allow-

called *sporules*, mostly inclosed in cases called *thecæ*, and frequently irregularly dispersed about the plant. Seeds or sporules (*sporæ*, *gongylæ*) simple bodies, without radicle, gemmule, or cotyledon; germinating indifferently in any direction, and striking root from any part of their surface. Destitute of spiral vessels, consisting chiefly of cellular tissue, except the higher orders.

EXAMPLES.—Sea-weeds,—Mosses,—Mushrooms,—Ferns.

The Orders in this Division are ten, and may be arranged in the following manner:*—

I. APHYLLÆ, or leafless; consisting of cellular tissue alone, and having naked sporules, ...		Fungi. Lichenes. Algæ.
II. PHYLLOIDEÆ,—having leafy expansions, and sporules enclosed in a proper integument or case.	1. MUSCOIDEÆ, or Moss-tribe, consisting of cellular tissue alone.	Characeæ. Hepaticæ. Musci.
	2. FILICOIDEÆ, or Fern-tribe, having vascular tissue.	Marsileaceæ. Lycopodiaceæ. Filices. Equisetaceæ.

ed, it may be observed, as M. Richard and Dr. Hooker have pointed out, that there are in many of the higher orders of vegetables organs formed without sexual apparatus, capable of reproducing the plant, as the bulbils of the Orange Lily, and Mountain Garlic, &c. And, indeed, it may be further observed, that flowering and flowerless plants (supposing the latter to be destitute of sexual organs) do not differ more in mode of reproduction than the Mammalia, and the Polypi and Infusoria, which appear to be utterly dessitute of sexual organs, and are conceived in many cases to propagate their species by means of organs analogous to the bulbils of some vegetables.

* In this arrangement the methods of MM. Agardh and Brongniart are combined.

SECTION I.

APHYLLÆ.

ACOTYLEDONEÆ, *Agardh.*

CHARACTERS.—Cryptogamic plants destitute of leaves and of vessels, and having naked sporules. No marked distinction or point of separation between root and stem; being irregular homogeneous masses of vegetable tissue.

Orders.—FUNGI, LICHENES, ALGÆ.

ORDER I.

FUNGI—MUSHROOMS.

Fungi, Linn. and Juss.—*Epiphytæ, Byssoideæ, Gastromyci, Fungi*, and part of *Hypoxyla* of Dr. Greville.

CHARACTERS.—Growing on the ground, or parasitic on the trunks of trees, decayed wood, dead leaves, &c.; seldom aquatic, and rarely or never green. Substance fleshy, corky, coriaceous, gelatinous, or minutely filamentous (floccose). Frequently resembling a parasol in form; sometimes consisting of globular masses, or of irregular stem-like bodies (like branches of Coral): in their simplest state small filaments, but extremely variable in form. Sporules frequently lying loose in the cellular tissue, or enclosed in membranes or coriaceous coverings. They are of quick growth and very short duration, and, when dried, do not revive by the application of moisture.

The *volva* or *wrapper* is the bag enveloping the young plant in many Fungi, and having a cup-like appearance when the stem or stype has emerged from it. The conical part supported by the stipe in many of this order is the *cap* or *pileus*, from which, in some, project downwards the *gills*, thin perpendicular lamellæ, supporting the sporules. This, the part of fructification, is the *hymenium*, which at other times consists of tubes, pores, subulate processes, or a cellular head, &c. In many Fungi there is a circular membrane surrounding the top of the stipe; this is the *annulus* or *veil*. The sporules are sometimes contained in a seed-vessel, called *peridium*; the sporules and peridium, which is often like a hollow ball, forming the whole plant.

EXAMPLES.—Common Mushroom (*Agaricus campestris*); Agaric of the Oak (*Boletus fomentarius*); mould of cheese, &c. (*Mucor*); *Uredo segetum*, which attacks Wheat crops and destroys the grain, converting it into a black powder, called brand, dust brand, smut, or burnt corn. Another Fungus, *Uredo caries*, also injures Corn, by filling the kernel with a fetid greasy powder, which, when the Corn is thrashed, affects the whole mass. The *Puccinia graminis* also attacks Corn, causing the disease called blight, mildew, or rust. The dry-rot in wood is caused by the *Merulius lacrymans* (*Boletus l.*), a species of Fungus. The Puff-ball or Devil's Snuff-box (*Lycoperdon*) is a Fungus, the bag containing the dust being the peridium, while the dust consists of innumerable small sporules.

They may be divided into two great sections: the ANGIOCARPI, which bears seeds internally, the Fungus being closed on all sides; and the GYMNOCARPI, which bears seed externally, that is, not enclosed by the Fungus. The Angiocarpi are either hard externally, like Sphæria; fleshy and solid, like Tuber (Truffle); or membranaceous and coriaceous, filled with a fine dust (the sporules), like Puff-ball, Blue Mould (*Monilia glauca* or *Mucor. g.*). This division contains no eatable Fungi except Truffle.

The Gymnocarpi bear their sporules imbedded in an appropriate membrane (the hymenium), are fleshy, and have generally a distinct stipes and pileus. The hymenium, in some, as Phallus, dissolves into a gelatinous mass; while in others it is more permanent, sometimes forming plates or gills, as in the Common Mushroom; in other cases forming tubes, as in Boletus. Almost all the eatable Fungi are among the Gymnocarpi.

M. Braconnot found in Fungi a peculiar principle, which he has termed *fungin*, resembling vegetable fibre in the inertness of its properties, but affording by distillation products which resemble those obtained from animal matters. He also obtained an acid (*fungic acid*), *adipocire*, *sugar*, an *oily matter*, and a substance resembling osmazome.

Economical Properties.*—In Great Britain and in many parts of the Continent, Mushrooms are regarded as a delicate article of food, and in some places are much used by the poorer inhabitants. Some kinds are much used for making ketchup, and various kinds of sauces. Many Fungi are of a very dangerous nature. The taste is perhaps the best mode of distinguishing injurious from wholesome Fungi. If they are at all bitter, astringent, or styptic, or otherwise disagreeable, of course they must be rejected; and also when the flesh is soft, or watery, gelatinous, or leathery, and if they become blue or green when cut. They should be used when young, as, when matured, they are often insipid and tough. The hymenium is in general to be rejected when the pileus has expanded. In very young Fungi, however, it is not so dangerous. It is said that spices, more particularly salt and vinegar, render even poisonous Fungi wholesome. All Fungi employed as articles of diet in Russia, where perhaps they are more employed than in any other country, are salted before being eaten. M. Richard recommends that all Mushrooms, about the wholesomeness of which there may be any doubt, should be steeped in vinegar before being used. Owing to the very volatile nature of their acrid principle, cook-

* For an account of the characters, properties, &c. of the eatable Fungi, see a paper in the Fourth volume of the Transactions of the Wernerian Society by Dr. Greville.

ing, as stewing, is advisable with most Fungi, and seems to render them all more easily digested. The following are the kinds of Fungi most in use:—

Agaricus campestris (Common Mushroom.)*
——— procerus.
——— edulis (White Caps).
——— orcades (Scotch Bonnets).†
——— violaceus (Bluets).
——— odorus.
——— eburneus.
——— ulmarius.
——— deliciosus.
Tuber ciberium (Truffle).
Morchella esculenta (Morel).
Helvella esculenta.
Clavaria coralloides.
——— cinerea.
Merulius cantharellus.
Boletus edulis.
Amanita cæsarea or aurantiacea.

Medicinal Properties.—These are of little interest. *Boletus igniarius* (or *fomentarius*), called Female Agaric, Agaric of the Oak, Spunk, Touchwood, has been employed as a styptic, for the suppression of hemorrhage. It probably acts in the same manner as lint or sponge. It grows parasitic on the Oak. To render it fit for use, the epidermis and porous parts are removed, and the rest is beaten into a soft spongy state. Dipped in a solution of nitre, it forms *amadou* or *German tinder*. The *Boletus laricis* (B. purgans) is a powerful cathartic, but little used. M. Dufresnoy has recommended an electuary of *Agaricus acris* or of *A. deliciosus* in consumption. The Ergot of Rye (*Spermoedia Clavus*) be-

* Vauquelin analyzed this Mushroom, and found in it adipocire, a thick or oily matter, albumen, sugar of Mushrooms, a matter of an animal nature resembling osmazome, soluble in alcohol and in water, a matter insoluble in alcohol, fungin, and acetate of potassa.

† This is the species most frequently forming the *fairy rings*.

longs to this family. It is also termed *Secale cornutum*, Grains of Rye, Spurred Rye, Sclerotium clavus of De Candolle, *Acinula clavus*, &c. See Gramineæ.

Officinal Plants.—Boletus igniarius.
Acinula clavus.

Poisonous Properties.—Many of the Fungi are poisonous, and some that are used as articles of diet occasionally acquire poisonous properties. M. Braconnot analyzed many of this family, and found in some a saccharine matter, an acrid resinous matter, a volatile principle of a similar character, and fungin. M. Letellier found in some a narcotic principle of a very poisonous nature, which he called *amanitine*. They may be placed among the *narcotico-acrid* poisons. In some parts of Russia, the *Amanita muscaria* is used as an intoxicating agent, being dried, made into a kind of bolus, and swallowed without being chewed. The following are the most dangerous of the Fungi:

Amanita muscaria (Agaricus muscarius).*
.... venenosa (Agaricus bulbosus).
Agaricus annularius.
.... olearius.
.... urens.
.... necator.
.... pyrogalus.
.... stypticus.

ORDER II.

LICHENES.—LICHENS.

Part of the *Algæ*, of Juss. and Linn.—*Lichenes,* and part of the *Hypoxyla*, De Cand. and Grev.

Characters.—Membranaceous or gelatinous masses of cellular tissue, often dry and horny: some are spread over

* Vauquelin found a portion of the hydrocyanate of potassa in this Fungus; and in it *amanitine* was found by M. Letellier

the trees, rocks, or earth on which they grow, in an expansion, thin like a crust, granulated, lobed, having imbricated scales, or sometimes consisting of a powdery layer; some resemble shrubs or corallines in miniature, growing erect on the ground, or hanging from trees. This expansion is called a *frond*, *thallus*, or *universal receptacle*, and is of various colours in different Lichens. The sporules are imbedded in the substance of the thallus, or scattered on its surface, and are often included in organs called *apothecia*, *shields* (scutella), or *tubercles*.

Examples.—*Lepraria botryoides*, a thin powdery green crust, frequent in shady situations on trees, posts, rails, &c. *Cenomyce coccifera* (Lichen cocciferus), which resembles a wine-glass; *Graphis scripta*, which resembles written characters; *Parmelia parietina* (Lichen p.), of a bright yellow colour, with Saucer-shaped apothecia, frequent on trees and walls; *Lecanora murorum* (Lichen m.), of an orange-colour, frequent on rocks and stones.

Lichens are much used in dyeing, furnishing a red, purple, or crimson dye. *Lecanora tartarea* furnishes the *Cudbear* of dyers. *Archil* (Orchall), a valuable dye, is obtained from the *Rocella tinctoria*. *Litmus* is prepared from this lichen. *Lecanora perella* affords a purple or crimson dye, the *orseille de terre* of the French. These are the principal kinds, but there are many others which abound in colouring matter.

Economical Properties.—The Lichens contain a considerable quantity of starch and mucilage, which renders them very nutritious. The *Tripe de Roche*, on which the Canadian hunters frequently subsist, is a Lichen, called Gynophora. The rein-deer, which are so useful to the Laplanders, feed on the *Cenomyce rangiferina*, or Rein-deer Moss. *Cetraria islandica* (Lichen islandicus or Iceland Moss) is consumed as food by the Icelanders, being reduced to powder and made into cakes, after being steeped in water to extract the bitter and purgative principles which it contains. *Cetraria nivalis* and *Sticta pulmonacea* may be used for the same purpose.

MEDICINAL PROPERTIES.—*Cetraria islandica* is a useful demulcent, and has been recommended in cases of emaciation, on account of its nutritious virtues; and also in catarrh, hæmoptysis, diarrhœa, and dysentery. *Peltidea aphthosa* (Lichen aphthosus), according to Linnæus, is used in Sweden to cure the aphthæ or thrush in children; it is purgative. *Cladonia sanguinea* is used for similar purposes in Brazil. Mr. Lindley mentions *Parmelia parietina*, *Borrera furfuracea*, *Everina prunastri*, and *Cenomyce pyxidata* and *C. coccifera*, as possessed of astringent and febrifuge qualities. "The medicinal properties of the Lichens," says De Candolle, in his essay on the Medicinal Properties of Plants, "reside chiefly in those of a soft consistence, perhaps because they contain most mucilage. They all have more or less of a bitter taste; appear to be composed of mucilage, of a small quantity of resin, but chiefly of a substance of an animal nature analogous to gelatine: the most of them are demulcent, usefully employed in decoction in diseases of the lungs, and capable of supplying food for man, as by steeping or repeated boiling their bitterness may be removed."—*Essai*, p. 318-9.

Officinal Plants.

Cetraria islandica (*Lichen islandicus.*)
Rocella tinctoria.

ORDER III.

ALGÆ.—SEA WEEDS, &c.

Algæ, Juss.; he included in Algæ the Lichenes, now made a separate Order.—*Hydrophyta*, Rich.—*Algæ* and *Chætophoroideæ*, Grev.

Characters.—Mostly aquatic vegetables, growing in the sea or in fresh water, destitute of a root for absorbing nourishment, but often firmly fixed by a fibrous or callous base, called a *scutate root*. Substance gelatinous; thin, membranous, or pellucid; tough and horny; or even woody. *Fronds* sometimes arising directly from the root, and constituting the whole plant; at other times placed on a stem (stipes) more or less thick; composed of delicate capillary filaments often finer than hair, of thin membranous bands varying in length and in breadth, or of a more solid cylindrical or strap-like substance; sometimes solid, at other times tubular; frequently divided by joints or articulations; and often inflated at particular parts, forming vesicles filled with air. *Sporules* imbedded in tubercles in the substance of the vegetable; in simple dilatations or projections arising from the frond; scattered on its surface; placed in the tube when the frond is tubular; surrounded by an open involucre; or in clusters on a common receptacle. Semitransparent, and of a brown, green, purple, or reddish colour. "After having been kept dry for a considerable length of time they will revive by immersion in water; but that portion of the plant only imbibes the fluid which is immersed in it.—*Hooker*.

Examples.—Bladder Fucus, Sea Ware, or Sea Wrack (*Fucus vesiculosus*); Dulse (*Fucus palmatus; Rhodomenia palmata*, Grev.; *Halymenia p.*, Hooker); Tangle (*Fucus digitatus; Laminaria digitata*, Hook. and Grev.); and all other Sea Weeds. The green slimy matter observed very distinctly on those parts of newly formed piers exposed to the action of the water,—on rocks in the sea,—on gravel-walks after rain,—attached to sticks and stones in ditches and lakes,—belong to the genera Linckia (*Rivularia*), Nostoc, Palmella, &c. in this Order. Algæ vary in size, from the fine delicate capillary tufts of the Confervæ, found waving in rivulets and ditches, to the thick stout stalks of Sea-tangle (*Laminaria digitata*), found in great abundance on our shores. In many parts of the ocean the Algæ form immense submarine forests.

The Algæ may be arranged in four divisions: I. Tremellineæ; II. Confervoideæ; III. Ulvoideæ; IV. Fucoideæ.

Many of the Algæ abound in a gelatinous matter, which affords a kind of glue or varnish. The *Chondrus crispus* furnishes size for the use of house-painters. *Gracilaria tenax* is used by the Chinese in place of gum or glue.

"In the manufacture of kelp, however, for the use of the glass-maker and the soap-boiler, it is that the Algæ take their place among the most useful vegetables. The species most used for this purpose are *Fucus vesiculosus* (Kelp-ware or Sea-ware); *F. nodosus* (Sea-whistles); *F. serratus* (Black Wrack or Prickly Tang; *Laminaria digitata* (*Fucus digitatus*, Sea-girdles, Tangle, Red Ware); *L. bulbosa* (*F. bulbosus*, Sea Fur-belows); *Himanthalia lorea* (*F. loreus*, Sea-thongs, Drew); and *Chorda filum* (*F. f.*, Sea Catgut, Sea Lace.")—"Where the plants did not grow naturally, attempts have been made, and not without success, to cultivate them, by covering the sandy bays with large stones. By this method a crop of Fuci has been obtained, as we are informed by Mr. Neill, in about three years, the sea appearing to abound every where with the necessary seeds."—*Grev. Algæ Brit.*

Iodine is also procured from Kelp, this element existing in many sea-weeds.

Kelp contains a great quantity of an impure carbonate of soda. The sea-weeds are dried, and put into a pit or kelp-kiln made in the earth. They are then burned to ashes; the vegetable matter flies off; and the ashes unite into a hard bluish mass, which is the kelp. Barilla is a substance of the same nature, and formed in the same way, but richer and purer. It is imported from the Mediterranean.

Economical Properties.—The Algæ contain a large quantity of a nutritious gelatinous substance (mucilage and albumen, according to Richard), and, were it not for their saltness, would probably be much more employed as articles of food. Sir Humphrey Davy (*Agricul. Chem.* p. 245) mentions, that from the Common Fucus, by boiling it in water, he obtained one-eighth of a gelatinous matter, which had characters similar to mucilage. "*Rhodomenia palmata* (*Fucus palmatus*), the Dulse of the Scots, Dillesk of the Irish, and Saccharine Fucus of the Icelanders, is consumed in considerable quantities throughout the maritime countries of the north of Europe, and in the Grecian Archipelago: *Iridea edulis* (*Fucus e.*, *Halymenia e.*, and 'Dulse' in the south-west of England), is still occasionally used." "*Porphyra laciniata* (*Ulva laciniata* or *umbilicalis*, Sloke in Scotland), and *P. vulgaris* (*P. purpurea*, *Ulva umbilicalis* or *purpurea*), is stewed and brought to our tables as a luxury, under the name of 'laver;' and even the *Ulva latissima*, or Green laver, is not slighted in the absence of the *Porphyræ*." "*Laurentia pinnatifida* (*Fucus pinnatifidus*), distinguished for its pungency, and the young stalks and fronds of *Laminaria digitata*—the former called Pepper Dulse, the latter Tangle —were often eaten in Scotland." "When stripped of the thin part, the beautiful *Alaria esculenta* (*Laminaria e.*, *Fucus esculentus*, Bladder-locks, Honey-ware), forms a part of the simple fare of the poorer classes in Ireland, Scotland, Iceland, Denmark, and the Faroe Islands."—*Greville.*

"To go farther from home, we find the large *Laminaria potatorum* of Australia furnishing the aborigines with a proportion of their 'instruments, vessels and food.' On the authority of Bory de Saint Vincent, the *Durvillæa utilis*, and other Laminariæ, constitute an equally important resource to the poor on the west coast of South America. In Asia, several species of Gelidium are made use of to render more palatable the hot and biting condiments of the East.—*Greville.*

Gracilaria lichenoides is used for food in the islands of the East Indies.

Medicinal Properties.—The *Gigartina Helminthocorton* (*Fucus H.*), or Corsican Moss, is a native of the Mediterranean, and frequently employed on the Continent as a vermifuge. A decoction of Chondrus crispus is sometimes used as an emollient and demulcent. Sea-weeds are valuable in medicine as furnishing iodine, which is employed with so much advantage in cases of bronchocele (goitre, or enlargement of the thyroid gland), and for the removal of other indolent tumours. The Algæ contain iodine in the state of a hydriodate of potash or soda. The *Fucus vesiculosus* and *saccharinus* contain considerable quantities of this substance; and M. Ecklond ascertained that *Laminaria buccinalis*, found at the Cape of Good Hope, contains more than any of the European Algæ; and, according to Sir Humphry Davy, the Algæ of France furnish more than those of this country.

Officinal Plant.—Fucus vesiculosus.

"Among these plants," says De Candolle, "I do not perceive one which is *poisonous*, or at all *suspected*." Richard makes the same observation.

SECTION II.

PHYLLOIDEÆ.

PSEUDO-COTYLEDONEÆ, *Agardh.*

CHARACTERS.—Cryptogamic plants, having leaves or a leafy expansion, sporules regularly placed on some particular part of the surface of the plant and enclosed in a proper integument, and a distinct root and stem.

1. MUSCOIDEÆ. 2. FILICOIDEÆ.

MUSCOIDEÆ.

Destitute of Vascular Tissue.

Orders.—4. CHARACEÆ. 5. HEPATICÆ. 6. MUSCI.

ORDER IV.

CHARACEÆ.

Part of *Naiades*, Juss.—Placed in *Monandria Monogynia* by Sir J. Smith.—Part of *Hydrocharideæ*, R. Brown.—*Characeæ*, Richard, Hooker, &c.

CHARACTERS.—Aquatic, submersed plants, with fibrous roots fixed in the mud. Stems slender, green, and tubular, sometimes pellucid, and sometimes brittle, having a layer of carbonate of lime beneath the epidermis; sometimes articulated. Branches tubular, in whorls at regular distances round the stem, and bearing the fructification, which is of two kinds: 1. Minute round *globules*, of a reddish or orange colour, containing fluid, and a mass of minute filaments, and composed externally of a number of triangular scales which separate and produce its dehiscence. 2. *Nucules*, or capsules, which are axillary, sessile, oval, solitary, spirally twisted or striated, invested by a pellucid membrane, divided obscurely at the summit into five segments or lobes, one-celled, and containing many minute bodies, supposed to be seeds or sporules. The short branches which accompany the nucule, surrounding it at its base, have been called *bracteas*.

Examples.—This order consists of one genus, Chara, and little is known regarding the nature of its reproductive organs. Some have considered the nucule as a pistil, and the globule as an anther. It is chiefly remarkable for the quantity of calcareous matter under its epidermis. The nucules are often found fossil in chalk, and here called *Gyrogonites*.

ORDER V.

HEPATICÆ.

Characters.—This family resembles the Mosses (*Musci*), but is distinguished from them by having spiral filaments (*elateres*) mixed with the sporules, and by the absence of any operculum or lid closing the theca, and of the peristome or fringe which is found in the Mosses. The reproductive organs generally consist of capsules and anthers, the former of which dehisce by two or more longitudinal valves. When dried they readily revive by the application of moisture. They are minute plants, having a sort of rachis or stem from which sessile leaves arise (*foliose*), or spread out into a broad leafy expansion (*frondose*), and provided with roots.

Examples.—Jungermannia, Marchantia, Targionia, Sphærocarpus, Riccia, Anthoceros.

Medicinal Properties.—*Marchantia polymorpha* was considered by the ancients as a specific in liver complaints, from which circumstance the order takes its name.

ORDER VI.

MUSCI.—MOSSES.

Characters.—Minute plants, aquatic or terrestrial, having fibrous or tufted roots; erect or creeping stems, varying in length from a line to several feet, simple or branched, with minute leaves, always sessile and alternate, and often imbricated, *cauline* (belonging to the stem), or *perichætial* (surrounding the fructification, and constituting the *calyx* or *perichætium* of Linnæus). Reproductive organs consisting, 1. of a seed-vessel (*theca*, *capsule*, or *urn*), sessile or on a stalk (*seta*) enveloped, when young, in a membranous covering, divided transversely into two portions, of which the upper (*veil* or *calyptra*, like an extinguisher) remains for a while and the lower forms a permanent sheath (*vaginula*). The seed-vessel is generally closed at the top (under the calyptra) by a deciduous circular lid (*operculum*). The mouth (*stoma*) of the theca is naked, surrounded externally by an elastic ring, or furnished with one or more circular fringes or rows of teeth (*peristomia*), four in number, or some power of four. Theca filled with sporules, surrounding a central axis (*columella*). 2. Of axillary oblong bodies (*anthers?*) concealed among the leaves, with short footstalks, "containing a number of spherical or oval particles, which are emitted on the application of water."—Lindley. After being dried they readily revive by the application of moisture.

The calyptra is *dimidiate* when there is a slit passing up one side; when entire at the base, or with several very short clefts, it is *mitriform*. A little swelling on one side of the base of the theca is called a *struma;* when the theca is prolonged downwards, the appearance is termed an *apophysis*, which is evident in the genus Splachnum.

In Andræa, Phascum, and Voitia, the operculum is persistent. In Andræa the theca dehisces by four valves.

Examples.—Polytrichum; Hypnum; Sphagnum, found in bogs, and called Bog-moss; Phascum (earth-moss); *P. cuspidatum* is common on moist and shady banks; *P. piliferum* is abundant on dry banks and sandy fields; *Tortula muralis* (*Bryum murale*) on walls and stones; *T. ruralis* (*Bryum rurale*) on roofs of houses, trees, and wall tops. *Funaria hygrometrica* is abundant on old walls and buildings, and on dry and barren soils. Mosses are abundant every where; on trees, house-tops, walls, rocks, in bogs, in rivers, on cow-dung which has been long exposed to the weather, and on the ground.

The thecæ are considered the seed-vessels; but the nature of the axillary bodies is not well known. Hedwig supposed that they were anthers; while Sprengel considered them as buds, and Palisot de Beauvois held the same opinion. The latter physiologist considers the theca as an hermaphrodite flower, the central columella being the pistil enclosing the seeds or sporules, while the surrounding granules are the pollen; while Hill regarded the granules as true ovules, and the teeth of the peristomium as stamens. The axillary bodies cannot be anthers, because they can strike root and become new plants; and because the theca often arrives at maturity before the supposed stamens or anthers are developed, and even when they do not exist. The columella cannot be viewed as a pistil, for it is often a hard solid body; nor the teeth of the fringe as anthers, as they are absent in many mosses. It is most probable that these axillary bodies are buds, capable of reproducing the plant, somewhat resembling the bulbils of some Phenogamic plants.

Mosses are found in almost every part of the world, being plentiful even on rocks in Spitzbergen; but they are less numerous where the atmosphere is dry and the climate warm. They are frequent on the roots and trunks of trees, and are supposed to defend them against the cold of winter, the burning heat of the sun, and the effects of too much rain.

Medicinal Properties.—*Polytrichum commune* was at one time used as a sudorific, and some of the mosses have been supposed astringent. At present none are used in medicine.

FILICOIDEÆ.

Possess a Vascular System.

ORDERS.

vii. Marsileaceæ, viii. Lycopodiaceæ, ix. Filices. x. Equisetaceæ.

ORDER VII.

MARSILEACEÆ.

Included in the *Filices*, Linn. and Juss.—*Rhizospermeæ*, De Candolle.

Characters.—Small plants, more or less aquatic, sometimes floating, frequently having a creeping stem; fructification situated at the bases of the leaves, near the root, and consisting of coriaceous or membranous involucres not opening, containing globular membranous sacs, some of which (anthers ?) enclose loose grains, and others (capsules) seeds or sporules, sometimes intermixed with minute granules.

Examples. — Marsilea; Isöetes (*Quillwort*); *Pilularia globulifera* (Pill-wort or Pepper-grass). In Isöetes the fructification is quite concealed, and contained within the very base of the leaf or frond, which only betrays its contents by being somewhat swollen at that part.

This singular family may be distinguished by the sporules being enclosed in thecæ contained in close involucres, and by the situation of the involucre at or near the root, from which De Candolle gave them the name Rhizospermeæ.

ORDER VIII.

LYCOPODIACEÆ—CLUB MOSSES.

Included in the *Musci*, Linn.; and in the *Filices*, Juss.

Characters. — Moss-like plants, with fibrous roots, simple or branched stems often creeping, numerous undivided small leaves, and the fructification axillary (at the inner base of a leaf) or in spikes, consisting of small capsules or thecæ (*conceptacles* and *coques*), opening by two or three valves, some containing a mass of minute pulverulent granules, others containing larger corpuscles or sporules, both kinds being sometimes found on the same plant.

Examples.—Lycopodium; *L. clavatum* (Common Club-moss) is plentiful on alpine moors and heaths. It is generally believed that plants of this family attained a great size in former times, and that the remains of many of them occur along with Ferns in the Coal formations.

The capsules of the Lycopodiums contain a yellow powder, called Vegetable Sulphur; it is very inflammable, and is used for fire-works. M. Pelletier found it to contain wax, sugar, and alum. Some of this family have been used for fixing fugitive colours in dyeing.

Medicinal Properties.—" The decoction of the herb of the *Lycopodium clavatum*, and especially of *L. Selago*, excites vomiting."—*De Candolle*, Essai, p. 312. The former is said to be a specific for Plica Polonica—and the latter is much used in the Highlands of Scotland as a counter irritant and detergent.

ORDER IX.

FILICES—FERNS.

Characters.—Herbaceous plants, perennial, having generally a subterraneous caudex (*rhizoma*), sometimes a creeping one; and, in tropical climes, a trunk above ground, resembling that of the Palms, having a hard fibrous coating formed of the persistent bases of the leaves. Leaves, or fronds, coming off from the main stem in the manner of leaves, simple, or variously divided, frequently pinnatifid, and rolled inwards at the point when beginning to grow. Reproductive organs, sometimes in spikes, generally on the back of the leaf (in which case the Fern is called *dorsiferous*). In the latter situation the groups of capsules or thecæ are called *sori*. The sori are often covered by a membranaceous integument, formed of the raised cuticle, and called *indusium* or involucre. The thecæ are sessile, or raised on a sort of pedicel (*pediçellate*), which is generally continued round them, constituting an elastic ring, by the action of which the dehiscence of the thecæ is produced.

Examples.—Polypodium; *P. dryopteris* (tender three-branched Polypody); *Aspidium Filix-mas* (Male Shield Fern) is a very beautiful specimen, and very common. They have been divided into five sections, the Polypodiaceæ, Gleicheniceæ, Osmundaceæ, Marattiaceæ, and Ophioglosseæ. They are frequently found fossil in coal formations, and exist in most parts of the world. In tropical climes, as in

South America, they frequently assume the form and size of trees.

The Ferns, when burnt, afford a considerable quantity of potash, and have been used for the manufacture of glass.

Economical Properties.—Many of the Ferns possess a considerable quantity of starch or of mucilage in their roots, and are used as articles of food in some countries. *Pteris aquilina* (Common Brake). P. *esculenta*, *Nephrodium esculentum*, *Diplazium esculentum*, *Cyathea medullaris* and *Angiopteris evecta* are said to be nutritious. Pteris aquilina has been employed as a substitute for hops.

Medicinal Properties.—The leaves of *Adianthum pedatum*, A. *capillus veneris* (Maiden-hair), and several other species, are employed indiscriminately under the name of Capillaires, being astringent, expectorant and demulcent. They contain a thick mucilage, somewhat astringent, with a weak aroma. *Polypodium Calaguala* and other Polypodiums are used in Peru as astringent and diaphoretic. *Aspidium* (or *Nephrodium*) *Filix-mas* (Male-shield Fern) has a place in our Pharmacopœias as an anthelmintic, particularly for Tænia. The internal part of the root is the officinal part. *Pteris aquilina* possesses anthelmintic properties. The root of Osmunda regalis is tonic and somewhat styptic.

Officinal Plant.

Aspidium Filix-mas.
(Nephrodium Filix-mas.)

ORDER X.

EQUISETACEÆ.—HORSE-TAILS.

Included in the *Filices* of Linnæus and Jussieu.

Characters.—Herbaceous perennial plants, with hollow striated stems lined with silex under the cuticle, and articulated, each articulation being surrounded by a sheath, toothed, or cleft longitudinally into a number of pieces. Often branched, the branches arising in whorls from the articulation. Fructification forming an oblong spike at the extremity of the stem. Spike covered with peltate scales, from the under surface of which 4-7 wedge-shaped, one-valved thecæ, bursting longitudinally, project inwards. The thecæ contain sporules, surrounded by minute granules, and having at their base four elastic filaments, swelled at the apex or extremity, twisted spirally round the sporule when moist, but unrolled and expanded when dry.

They may easily be distinguished by the tubular toothed sheath at each articulation of the stem, the terminal spike or cone of fructification, the four elastic filaments surrounding each sporule, and, if branched, by the branches being in whorls at the articulations, and sheathed like the stem.

Examples.—This family consists of only one genus, Equisetum, or Horse-tail. *E. arvense* (Corn Horse-tail) is very common. *E. fluviatile* (Great Water Horse-tail) is frequent in muddy lakes, sides of rivers, and pools, and is the largest of the British species, being three or four feet high. *E. sylvaticum* (Branched Wood Horse-tail) is an elegant species.

Hedwig considers the sporule as a hermaphrodite flower, the central globular body being the pistil, while the surrounding filaments, he imagines, are stamens. M. Brongniart considers the swollen filaments as grains of pollen.

The Equisetaceæ are remarkable chiefly for containing under the cuticle a considerable quantity of siliceous earth. "The *Equisetum hyemale* contains more silex beneath its delicate epidermis than any other, and is, consequently, most employed in polishing hard wood, ivory, and even brass. The silex is so abundant, that the vegetable matter may be destroyed, and the form retained, as was done by Mr. Sivright." —*Greville.*

The *Equisetum hyemale* is largely imported from Holland, for the purpose of polishing ivory, brass, &c. under the name of Dutch Rushes.

SECOND DIVISION.

PHENOGAGMIA.

Phenogamic or Flowering Plants.

Cotyledones, Juss.—*Vasculares*, De Cand.—*Embryonatæ*, Rich. —First twenty-three Classes of Linnæus.—*Phanerogamia* or *Phenogamia*, &c.

CHARACTERS.—Sexual organs always present; in most cases surrounded by a floral envelope. Reproduced by means of seeds, having distinct coverings, cotyledons, and a radicle and gemmule. Growth in germination taking place only from the radicle and gemmule. All provided with vessels, and almost all having spirals.

EXAMPLES.—Rose, Lily, Palm, Grass, Poppy, Elm, Oak, Horse-chestnut, Lilac, Azalea, &c.

This very large assemblage of Plants has been divided into two sections, according to the structure of the embryo: 1. *The Monocotyledonous*; 2. *The Dicotyledonous*;—or *Monocotyledoneae*, and *Dicotyledoneae*.

SECTION I.

MONOCOTYLEDONEÆ.

Endogenæ, De Cand.—*Endorhizæ*, Rich.—*Monocotyledones*, Juss. and most authors.

CHARACTERS.—*Embryo* with one cotyledon; or, if there are two, the additional one is smaller and less perfect than, and alternate with the other. *Gemmule* usually enclosed in the substance of the embryo, which it bursts laterally at germination. *Radicle* also enclosed by the embryo, the inferior extremity of which is pierced by, and forms a sheath for, the radicle. *Perianth* sometimes absent; often single or simple; and its parts generally three in number, or a multiple of three. *Leaves* frequently alternate and sheathing at the base; sessile or not distinctly articulated with the stem: and having parallel veins or nerves little branched. (See Frontispiece, Fig. 3.) *Stem* consisting of cellular tissue, through which bundles of vessels are irregularly scattered; without any division into pith, wood, and bark; and growing by the descent of new matter into the central part. (See Frontispiece, Fig. 1.)

EXAMPLES.—Palms, Lilies, Grasses, Orchis, Tulip, Onion.

The Monocotyledoneæ are called *Endogenae* from their mode of growth, and *Endorhizae* from the radicle being enclosed in a sheath.

Monocotyledoneæ, according to Humboldt, are 1-6th of the flowering plants in tropical regions; 1-4th in the temperate latitudes, between 36° and 52°; and 1-3d in the northern and arctic regions.

The monocotyledoneæ are generally wholesome. They often contain a large quantity of starch in the roots, as the yams—the stem, as the Sago Palm—or the fruit, as in the grasses: and sugar is also plentiful in them. There are few of a bitter, acrid, or poisonous nature.

The monocotyledoneæ are divided into three classes, according as the stamens are hypogynous, perigynous, or epigynous.

MONOHYPOGYNEÆ.

Monocotyledonous plants, with hypogynous stamens, and the ovary of course superior.

ORDERS.

11. Nayadeæ.	13. Piperaceæ.	15. Cyperaceæ.
12. Aroideæ.	14. Gramineæ.	

ORDER XI.

NAYADEÆ.

This is a family of little interest. It contains Ruppia, Potamogeton (*Pondweed*), Zannichellia (*Horned Pondweed*), Zostera (*Grass-wrack*), and Nayas.

ORDER XII.

AROIDEÆ.

Characters.—Perennial herbs, or under-shrubs; often stemless. Root often tuberose or fleshy. Leaves sheathing. Inflorescence a spadix, generally enclosed in a large highly developed spatha. Hermaphrodite, or unisexual and monœcious. Perianth absent, or a scaly calyx of four or six divisions. Stamens short, hypogynous, anthers turned outwards. Ovary 1- (occasionally 3-) celled; many-seeded, superior. Stigma sessile, or with a short style, Pericarp indehiscent; a berry, or, more rarely, a capsule; sometimes one-seeded by abortion.

Examples.—Wake-Robin or Cuckoo-pint (*Arum maculatum*), Duckweed (*Lemna*).

The Aroideæ are found chiefly between the tropics. They are comparatively rare in temperate latitudes.

This family has been divided into three sections:

I. The true Aroideæ, which have unisexual naked flowers, and the fruit a berry. Arum, Dumb-cane (*Caladium*), African-arum (*Calla*).

II. The Orontiaceæ, with hermaphrodite flowers, and a scaly calyx. Sweet Flag (*Acorus*), Dracontium, Pothos, Orontium, &c.

III. The Pistiaceæ, Floating plants, with a two-flowered spadix, naked flowers, and a capsular pericarp. Pistia, Lemna. This has been made a separate order by some botanists.

Economical Properties.—The fleshy roots of many of this family contain a considerable quantity of an amylaceous substance, or starch, which, by maceration or roasting, is obtained free from the acrid principle which characterises the order, and is very nutritious. The *Arum maculatum*, treated in this way, furnishes a sort of substitute for bread-flour, known by the name of *Portland Sago*, and much used in Weymouth and in Portland Island. *A. esculentum*, *A. mucronatum*, *A. violaceum*, *A. Colocasia*, *Calla palustris*, and some others, may be used in the same way.

Medicinal Properties.—There is an acrid stimulating principle found in this family, which renders many of them aromatic, stomachic, or purgative; but it is very volatile and fugacious. The root of *Acorus Calamus*, or *Calamus aromaticus* (Sweet Flag), is an agreeable aromatic. The aromatic principle is a volatile oil. The tuberous root of Wake-Robin, (*Arum maculatum*) is purgative: this property resides in the acrid milky juice of the fresh root. The fresh leaves of *Dracontium pertusum*, laid upon the skin, excite rubefaction or vesicles.—*De Cand.* Essai, p. 279. The roots and seeds of the Skunk Cabbage *(Symplocarpus fœtidus)* are used as expectorants in North America.

Officinal Plants.
Arum maculatum.
Acorus Calamus.

Poisonous Properties.—The acrid principle is so powerful in some of this family as to render them dangerous. The Dumb-cane *(Caladium seguinum* or *Dieffenbachia seguina)*, when chewed for a short time, or even bit, swells the tongue to an enormous degree, and often deprives the individual of speech for a while. Arum esculentum has somewhat similar properties.

ORDER XIII.

PIPERACEÆ.

Included in the *Urticeæ* of *Jussieu.*

Characters.—Shrubs or herbs; leaves alternate, sometimes opposite; flowers in cylindrical spikes, hermaphrodite, naked, generally sessile; stamens 3 (Peperomia has only 2), slightly adhering to the ovary, hypogynous, and accompanied by some irregular scales; ovary superior, one-celled, one-seeded, with a sessile stigma; pericarp fleshy (a berry), indehiscent, one-celled, one-seeded, the seed erect; embryo in a fleshy sac opposite the hilum.

Examples.—This family consists of two genera, Piper, which is shrubby, and has three stamens; and Peperomia, which is herbaceous, and has only two stamens.*

* In these characters, I have followed Richard's account in his *Histoire Naturelle Medicale.* Many botanists describe Piper as having only two stamens, placing it in Diandria Trigynia. Mr. Lindley places Piperaceæ among Dicotyledons, the stem presenting the medullary rays, the leaves being somewhat articulated; and the embryo being two-lobed.

They are found only in tropical climes, as South America, the East Indies, and the islands of Java, Borneo, and Sumatra, where they are extensively cultivated.

Economical Properties.—The use of Common Pepper as a condiment is well known: this is the berry of the *Piper nigrum.* The entire berry, when dry, forms what is called Black Pepper: White Pepper is the internal part or seed of the same berry, the outer coat having been removed. The stimulant aromatic property is not confined to the berry; it is found in the other parts of the plant. M. Pelletier has found in *P. nigrum* a crystalline substance of a peculiar nature, which he has called *Piperin.*

The leaf of *Piper Betle* is chewed in India as a luxury, along with the nut of the *Areca Catechu*, a Palm, called Betel Nut, and a little lime: the composition is called *Betle*, and is much esteemed. The South Sea islanders prepare an intoxicating liquid from *Piper inebrians.* It possesses narcotic properties.

Medicinal Properties.—*Piper nigrum* is stimulant and carminative. *Piper longum* is used in several aromatic preparations. The berry of *Piper Cubeba* furnishes the cubebs of the shops, a well known purgative and diurectic, and used chiefly in cases of inflamed urethra. According to Vauquelin, cubebs contain a volatile oil, and a resin resembling copaiba balsam. They are used in the form of powder and tincture.

Officinal Plants.

Piper nigrum.
Piper longum.
Piper Cubeba.

There are no poisonous plants among the Piperaceæ.

ORDER XIV.

GRAMINEÆ.

(THE GRASS-TRIBE.)

CHARACTERS.—Herbaceous annual or perennial plants; roots fibrous, sometimes bulbous; stem a cylindrical culm, generally fistulous, and with knots from which alternate sheathing leaves arise; a transverse partition at the knots; leaves arising as sheaths, long and narrow, and having a small collar (ligula) at their union with the sheath, which is slit in the whole length; inflorescence a spike, spikelet, or panicle; flowers mostly hermaphrodite, occasionally monœcious or polygamous. At the base of the sexual organs are floral coverings or imbricated bracteæ, called Glumes and Paleæ. The most external are *glumes*,* two in number, alternate, and often unequal; sometimes one is absent. The next are *paleæ*,† also two in number, and alternate: see Fig. 14, page 88. Stamens hypogynous, generally 3, occasionally fewer, but seldom more; filaments capillary; anthers versatile; ovary superior, surmounted by two styles, terminated by glandular feathery stigmas, 1-celled, 1-seeded. At its base there are frequently two little *scales*, called also the *glumella* or *nectary;* pericarp a caryopsis closely adhering to the seed; embryo at one side of the base of a farinaceous albumen.

EXAMPLES.—This very natural family is one of the most extensive and important in the vegetable kingdom. It consists of all those vegetables called *Grasses*, as Wheat, (*Triticum hybernum*), Oat *(Avena sativa)* Barley (*Hordeum distichum)*, Reed *(Arundo)* Meadow-Grass (*Poa*), Fox-tail Grass (*Alopecurus*) Rice *(Oryza)*, Indian Corn (*Zea mais*), Sugar Cane (*Saccharum officinarum)*.

This family much resembles the Cyperaceæ. The follow-

* The *calyx* of Linnæus and Smith (the separate pieces being called Valves); called Glumes, and considered bracteæ, by Brown and Lindley.

† The corolla of Linnæus and Smit perianth of Brown, glume of Richard.

ing are the marks of distinction. The Cyperaceæ have a solid and frequently angular stem, no transverse partition (diaphragm) at the joints, an entire sheath, a single bractea or scale bearing the flower in its axilla, and generally three stigmas. The Gramineæ have a hollow or fistulous and round stem, a diaphragm at the joints, the sheath cleft, two pairs of scales to each flower, and two styles. In the Gramineæ the embryo is without the albumen: in Cyperaceæ, it is enclosed in one end of the albumen.

The Gramineæ contain a considerable quantity of silex in their culms, and hence are sometimes used for polishing brass, marble, &c.

The Grasses form about 1-16th or 1-20th of the phenogamic plants, reckoning the number of *species*. They form a much larger portion of the individuals. They occur in every part of the world, from the Line to very high latitudes; and also at almost every elevation. Barley and Oats are the grasses used as food which reach furthest north. Rye and Buck wheat are the next. Wheat prevails about the middle latitudes. Maize, or Indian Corn, is the next, passing towards the Line. And, lastly, Rice, which is only found in tropical or nearly tropical regions.

Economical Properties.—The uses and importance of this family of plants as food both to man and the lower animals are well known. The leaves of the Meadow Fox-tail Grass (*Alopecurus pratensis*); Roughish, Smooth-stalked, and Annual Meadow-Grass (*Poa trivialis, P. pratensis*, and *P. annua*), are excellent pasture for cattle. Perennial Darnel or Rye-grass (*Lolium perenne*), is often employed for pasture and hay along with clover. Crested Dog's-tail-Grass (*Cynosurus cristatus*), Sheeps' and Hard Fescue-Grass (*Festuca ovina* and *F. duriuscula*), and some species of Cat's-tail Grass (*Phleum*), also make excellent pasture. Sweet-scented Vernal-Grass (*Anthoxanthum odoratum*) gives new made hay its fragrance (610) In India Linear-bent-Grass (*Agrostis linearis, Cynodon dactylon*, or Dog's-tooth Grass) is considered as the sweetest and most nutritive food for cattle.—*Ainslie's Materia Indica*, vol. ii. p. 28. At page 59 of the same volume, Dr. Ainslie mentions that the fresh leaves of the sweet Rush or Lemon-Grass (*Andropogon schænanthus*) are sometimes used by the English in India as a substitute for tea; and that the white succulent centre of the leaf-bearing culms is often put into curries to give them an agreeable flavour. The most important part of the Grasses to man is the seed. This part contains a large quantity of starch (586) and gluten (619), and is very nutritious. Hence the extensive cultivation of Wheat, Oats, Barley, Indian Corn or Maize, Rice, &c. These kinds are preferred, as M. De Candolle observes, not so much because they are better than the seeds of other Grasses, but because they are larger. The seed of the Rye (*Secale cereale*) furnishes an agreeable kind of flour, much used for bread in some countries. The seeds of the Floating Fescue (*Festuca fluitans*) are sweetish, and are sometimes eaten in Poland. In Iceland and in Greenland the seeds of the Sea-lyme-Grass (*Elymus arenarius*) are made into bread. The small round seeds of Italian Millet, *Panicum Italicum*) are much valued by the native Indians, who make cakes of it, and also a kind of porridge. They use *Cynosurus coracanus* in the same way; it is called *Natchenny* by the Europeans.—*Ainslie.* Rice (*Oryza sativa*) and Indian Corn, (*Zea Mays*) contain little or no gluten: it is to the large proportion of gluten which it contains that Wheat owes its superiority to other kinds of grain. The seeds of the Grasses are also important from the facility with which they can be made to ferment and furnish alcohol, the basis of all our malt liquors. Arrack, the whisky of the Indians, is obtained from Rice; and another kind of spirit which bears the same name, is prepared from the fermented juice of the Sugar Cane. The culms of many of the Grasses contain a considerable quantity of sugar, particularly the *Saccharum officinarum*, from which the sugar of commerce is obtained. De Candolle mentions that the *Holcus saccharatus* has been cultivated with success in Italy for the sugar it contains. The *Saccharum sinense* is the species from which the Chinese procure their sugar: it yields sugar of a much richer quality than the Indian Cane, and continues to produce even to the third year, while the other must be renewed yearly.—*Ainslie*, vol. i. p. 409. The young shoots of some tall reeds in Brazil, called Taraquassa, contain a cool agreeable liquid, used as a drink by hunters.

Thus man derives his main support from the Grasses, living chiefly on their seeds, and on animals which derive their substance from them.

Medicinal Properties.—The Grasses present little of interest in a medicinal point of view. The roots and stems are more or less sweet, and of a demulcent nature, and also the seeds in decoction. The Ergot of Rye is of great use to the medical practitioner on account of its stimulant action on the uterus. This property, however, does not belong to the seed in its natural state, but in a state of disease from the presence of a fungus (*Sclerotium clavus*, De Candolle), or as some suppose, from the ravages of an insect. The disease has been called Ergot, and consists in the pickle being changed to a long blackish body, somewhat like a spur; hence the name "Spurred Rye." The disease attacks Rye chiefly in damp situations, and is very frequent in some parts of France. Couch Grass (*Triticum repens*) is said to have a diuretic virtue in its roots; and the same property is found in the roots of *Arundo Donax* and *A. phragmites*. Several species of *Andropogon* are said to be aromatic and tonic, as *A. schœnanthus*, *A. citratum*, and *A. nardus*. Rice (*Oryza sativa*) has been reckoned a good demulcent. Triticum vulgare (T. hybernum) furnishes starch.

Officinal Plants.

Avena sativa.
Triticum hybernum.
Hordeum distichum.
Saccharum officinarum.

Poisonous Properties.—There is only one plant of a poisonous quality in this family, the Bearded Darnel *Lolium temulentum*) the seeds of which are of a deleterious nature. It seems to be one of the narcotico-acrid poisons, causing intoxication and convulsions. The Spurred Rye is also of a poisonous nature. It brings on giddiness, convulsions, and gangrene of the extremities. It is sometimes accidentally mixed with the grain in rye-bread, and has been known to cause a sort of epidemic in particular districts on the Continent where this kind of bread is much in use. Indian Corn is subject to the same disease as Rye, the ergot, and in this diseased state is called *Mays peladero*.

ORDER XV.

CYPERACEÆ.

Characters.—Herbaceous plants, generally growing in moist places; roots fibrous; stem a cylindrical or triangular culm, often without joints, solid, and with no diaphragm at the joints; leaves sheathing; sheaths not slit; inflorescence a spike or spikelet: flowers unisexual or hermaphrodite; sexual organs generally in the axilla of a single bractea (glume); bracteas imbricated; stamens various, generally 3, hypogynous; anthers fixed by the base; ovary 1-celled, 1-seeded, superior, surmounted by a single generally trifid style (sometimes bifid), surrounded at the base by minute scales or bristles (setæ); ovule erect; pericarp an achenium; embryo enclosed within the base of the albumen.

Examples.—Sedge or Sea Carex (*Carex arenaria*), which has long and creeping roots, and is useful in binding a loose soil; Sweet Cyperus or English Galingale (*Cyperus longus*): Cyperus papyrus, from which the Papyrus of the ancients was made; Club-rush or Bull-rush (*Scirpus lacustris*), much used for mats, chair-bottoms, &c.; Twig-rush (*Cladium*), which has two stamens and two stigmas.

The Cyperaceæ are found in every region of the globe, in moist, dry, in sandy situations, in streams, marshes, and at very various elevations.

Economical Properties.—Many of this family contain a considerable quantity of mucilage in their roots. They are generally insipid and inodorous. The tubers of the *Cyperus esculentus* contain a great deal of starch, and a saccharine mucilaginous substance, and are eaten in Egypt, Spain, and Italy. Scaly-stalked Spikerush, or Deer's Hair, (*Eleocharis cæspitosa* or *Scirpus cæspitosus*) yields an abundant food to sheep on the Highland mountains in spring.—*Hooker.*

Medicinal Properties.—These are of little interest in this family. M. De Candolle mentions the roots of *Carex arenaria*, *C. disticha*, and *C. hirta* as being diaphoretic and demulcent; they are called "Salsepareille d'Allemagne," or German Sarsaparilla. The roots of *Cyperus longus* and *C. rotundus* are bitter and slightly astringent and aromatic, and may be used as tonics and stomachics.—*Richard.*

The Cyperaceæ and Gramineæ are sometimes made a separate division of monocotyledons, as by Dr. Lindley, under the name *Glumaceæ.* All the others he includes in another division called *Petaloideæ.*

MONOPERIGYNEÆ.

Monocotyledonous plants, with perigynous stamens.

Orders.

16. Palmæ.
17. Junceæ.
18. Alismaceæ.
19. Colchicaceæ.
20. Asparagineæ.
22. Liliaceæ.
23. Bromeliaceæ.

ORDER XVI.

PALMÆ.—PALMS.

CHARACTERS.—In general *large trees*, with a cylindrical stem, generally unbranched, sometimes shrubby. Stem has circular scales, formed by the persistent bases of the leaves. *Leaves* in a cluster at the top of the stem or stype, large, persistent at the base, and often pinnate; sheathing, and plaited in the bud. *Inflorescence* a terminal spadix, covered before expansion by a coriaceous or even woody spatha. Spadices sometimes in clusters. *Flowers* occasionally hermaphrodite, oftener diœcious or polygamous. *Perianth* of 6 divisions, 3 internal and 3 external, like calyx and corolla, persistent. *Stamens* 6, seldom 3: opposite to, and at the base of, the segments of the perianth. *Ovary* superior, 1 or 3-celled, or 3-lobed, each cell 1-seeded, ovule erect. *Pericarp* a berry or fibrous drupe, containing a bony nut; albumen at first tender, afterwards horny; embryo small, cylindrical, and situated horizontally in a lateral depression of the albumen.

EXAMPLES.—This is a well-known family, of a most elegant and majestic appearance. The Date Palm (*Phœnix dactylifera*), and the Cocoa-nut tree (*Cocos nucifera*), are the best known examples. The latter is about 60 feet in height, and has at the top upwards of 50 leaves, from 8 to 12 feet long, and nuts as large as a man's head. The Palms are found almost solely within the tropics, and most frequently in South America, India, and Africa. According to Von Martins, they hardly range beyond 35° south latitude or 40° north latitude.

They are of the greatest importance to the natives in some tropical countries, furnishing them with food, drink, clothing, and materials for huts, for thatching cottages, for bows, cloth, mats, baskets, brooms, oars, ropes, &c. The woody midribs and tough fibres of the leaves are of great use. Wax is obtained from the stem of the Wax Palm (*Ceroxylon andicola*). The kernels of the *Cocos butyracea* and *Elais guineensis* furnish palm oil. The oil of the *Cocos nucifera* is used for lamps. Dragon's-blood is obtained from the *Calamus draco*, and *C. Zalacca*.

Economical Properties.—The terminal bud or cabbage of many of the Palms, when young, serves as food in various parts of India and Africa: that of the Cocoa-nut tree is much esteemed, and particularly that of the *Areca oleracea* or Cabbage Palm. The fruit of the Cocoa and Date Palms is valued both in their native countries and in Europe. The milk of the Cocoa-nut (a mild and refreshing drink) is contained within the kernel while growing. The milk diminishes in quantity, and becomes sharp and aperient, as the kernel ripens. The kernel is a common ingredient in curries. The substance called *Sago*, a nutritious article like starch, is obtained from the soft central part of the stems of many of this family, particularly *Sagus lævis*, *S. Rumphii*, *Caryota urens*, which are said to yield the finest sago. It is prepared from the soft central parts, taken before the fructification appears. It is also procured from *Sagus farinifera*. *Phœnix f.*, *Corypha umbraculifera*, and the *Borassus gomutus* of Mr. Crawford (*gomuti*), the latter of which also furnishes Toddy, from which the Malays make sugar. The spatha of the Cocoa tree and several others, when wounded, furnish a pleasant drink called *Toddy*. A spirituous liquor, a kind of *arrack*, is obtained by fermentation and distillation from the juice of the flowers and stem of the Date, Cocoa-nut, and other Palms, which contain a large quantity of saccharine matter. This is an inferior kind of arrack. It is the best, however, of several which receive promiscuously the name of *pariah arrack*, and which are much inferior to that obtained from rice. Sugar is also obtained from the toddy of the Cocoa tree, of the *Caryota urens*, and of the Palmyra tree (*Borassus flagelliformis*). All these sugars are common in the bazaars of India: they are altogether unrefined, and known by the English under the general name of *Jaggeries.—Ainslie*, i. 409. These three palms furnish the best kind of toddy. Palm wine is the fermented juice of several Palms, not subjected to the process of distillation. The best kind is that obtained from the *Elais guineensis*. The wine is obtained by scooping a cavity in the top of the stem, after cutting off the crown of foliage. The juice flows into the cavity at the rate of one gallon daily for a fortnight, gradually diminishing after that time. It is very sweet at first, but soon ferments and turns vinous. The *Areca Catechu* furnishes the Betel-nut; see p. 239.

Medicinal Properties.—The Palms are of little interest in a medicinal point of view. Toddy is said to have a gently aperient effect. The Betel-nut, when young and tender, is occasionally made into decoction, and given in costiveness from dyspepsia. A soft, downy, light brown substance, found on the outside of the lower part of the branches of the Cocoa-nut tree, where they spring from the stem, called Cocoa-nut cotton, is used by the Indians for suppressing hæmorrhage in cases of wounds, leech-bites, &c.—*Ainslie*, ii. 419. Palm-oil and Sago being articles in some of the Pharmacopœias, there are two

Officinal Plants.

Cocos butyracea.
Sagus Rumphii.

ORDER XVII.

JUNCEÆ.

This family resembles the Gramineæ and Cyperaceæ. Herbs, with fistular or flat and channelled leaves, and inflorescence a capitulum. They have a *perianth* formed of

6 glumaceous pieces, more or less in two rows; 6 *stamens* at the base of the perianth, or 3 opposite to the outer segments; *ovary* superior, 1-celled or 3 celled, and 1-, 3-, or many seeded, with 1 style and 3 stigmas; *pericarp* usually a 1-celled capsule, or with 3 incomplete cells and 3 valves, each having the dissepiment in the middle of its inner surface.

Examples.—This family consists of the extensive genus *Juncus* (Rush), and one or two more. Common Rush (*Juncus conglomeratus*), and Soft Rush (*Juncus effusus*), are much used for mats, chair-bottoms, the wicks of candles, &c.

ORDER XVIII.

ALISMACEÆ.

Included in the *Junci*, Juss.—*Alismaceæ*, *Butomeæ*, and *Juncagineæ*, of Lindley.

The inflorescence is a spike, umbel, or raceme; and the perianth consists of six herbaceous segments, of which the three inner are sometimes coloured. Stamens generally six, and ovaries many.

Water Plantain (*Alisma*) and Arrow-head (*Sagittaria*) exemplify Alismaceæ; Flowering-rush (*Butomus*) is an example of the Butomeæ; and Arrow-grass (*Triglochin*) of the Juncagineæ.

ORDER XIX.

COLCHICACEÆ.

Included in the *Junci* of Jussieu; *Melanthaceæ* of Brown and Lindley.

Characters.—*Herbaceous plants*, with fibrous or bulbous roots, and alternate sheathing leaves. *Flowers* mostly hermaphrodite, occasionally unisexual, terminal, in panicles, or in racemes on a naked scape. *Perianth* coloured, in 6 deep divisions, often tubular at the base. *Stamens* 6, opposite to the divisions of the perianth; anthers turned outwards: *Ovary* superior, 3-celled, or 3 1-celled ovaries in each flower; ovules many, attached to the inner angle of each cell; style trifid, or one to each cell or ovary; stigmas undivided and glandular. *Pericarp* a capsule, dividing into three pieces, dehiscing internally at the suture (loculicidal); carpels sometimes separate when ripe. Seed with a membranous or reticulated testa, and a fleshy albumen.

Examples.—Meadow Saffron (*Colchicum*), Hellebore (*Veratrum*), Bog-Asphodel (*Narthecium*), Scottish Asphodel (*Tofieldia*), Melanthium, Bulbocodium.

This important family is distinguished from the Junceæ by having a coloured perianth, carpels distinct or separating when ripe, and anthers turned outwards. The latter characters, together with the three styles and membranous testa, separate this family from the Liliaceæ.

Medicinal Properties.—The alkaline principle called *Veratrin* is found in several of this family,—in the bulb of Meadow Saffron (*Colchicum autumnale*), the tuberous root of White Hellebore (*Veratrum album*), and the seeds of Sabadilla or Cevadilla (*Veratrum Sabadilla*); Cevadilla seeds are also procured from the Helonias Officinalis (Veratrum officinale). These are drastic purgatives, violent emetics, narcotics, and also produce a powerful diuretic effect. They are very active medicines, have an acrid taste, and in too large doses produce great irritation of the intestinal canal. The *Eau medicinale* (a favourite remedy in gout) is supposed to owe its virtues to the presence of veratrum or of colchicum; and preparations of the latter are now much used in gout and rheumatism, and in dropsies. It allays the pain, and seems to act as a sedative. The tincture of the seeds, M. Richard mentions, is more energetic than that of the bulb. The fleshy tubers of the *Colchicum illyricum* are also purgative, and the *Gloriosa superba* (*Methonica superba*) is said to possess the properties of the order in a high degree. The powder of the *Veratrum album* has been used as an errhine. The flowers and leaves in this family possess more or less the same properties as the roots and seeds. *Veratrum viride* is similar to *V. album* in its properties.

Officinal Plants.

Colchicum autumnale.
Veratrum album.
Veratrum Sabadilla.
Helonias officinalis.

Poisonous Properties.—The same principle which renders this family so useful in medicine, produces very dangerous effects on the animal economy, when taken in too large a dose. Veratrin, when injected into a vein, causes death by tetanus, without any other apparent irritation. Plants of this family may be ranked among the narcotico-acrid poisons.

Helonias frigida, *H. erythrosperma*, *H. dioica*, in this family, are remarkable for their poisonous, or active medicinal properties.

ORDER XX.

ASPARAGINEÆ.

Included in the *Asparagi*, Juss.—*Smilaceæ, and part of Liliaceæ and Melanthaceæ* of Dr. Lindley.

Characters.—*Herbs* or *under-shrubs*, with alternate leaves, sometimes sheathing and reticulated; *flowers* hermaphrodite, sometimes diœcious; *perianth* often coloured and petaloid, 6 (occasionally 8) parted, sometimes appearing in a regular calyx and corolla (Paris); stamens of the same number as, and inserted into the base of, the divisions of the perianth; the three opposite the sepals occasionally absent or of a different form; ovary 3-celled (Paris 4-celled), cells 1, 2, or many seeded; style simple, with a 3-lobed stigma, or 3-parted; pericarp a capsule or roundish berry, sometimes 1-celled and 1-seeded from abortion; seed with a membranous testa, and a fleshy or cartilaginous albumen.

Paris, and one or two others of this family, are placed in Colchicaceæ (Melanthaceæ) by some botanists. Ruscus, Asparagus, and Convallaria are in the Liliaceæ of Dr. Lindley.

Examples.—Lily of the Valey (*Convallaria majalis*), Herb Paris (*Paris quadrifolia*), Butcher's Broom (*Ruscus aculeatus*), *Asparagus officinalis.*

Economical Properties.—The young shoots or buds of the *Asparagus officinalis* form the Asparagus of our tables. M. De Candolle mentions that the root of *Smilax China*, (*Too-fuh* of the Chinese, *Squine* of the French), which is very thick and fleshy, is used as food in America. This plant is also used in some parts of China instead of Rice. The roots of most of this family are of a mucilaginous nature, being composed principally of mucilage and starch, mixed, however, with a little bitter matter.

Medicinal Properties.—The leading character of this family, in a medicinal point of view, is the demulcent, diaphoretic, and diuretic properties of their roots. Various species of Smilax possess these properties, particularly the *Smilax officinalis*, *S. aspera*, and *S. China*, *S. Purhampuy*, *S. medica*, *S. siphilitica*. *Smilax Sarsaparilla* is not now considered as the plant which yields Sarsaparilla. These are much used after a course of mercury. The roots of *Asparagus officinalis* and *Ruscus aculeatus* possess similar properties. M. Broussais has proposed Asparagus as a substitute for Digitalis or prussic acid, when it is wished to diminish the force of the circulation, and lessen the heart's action, as it does not injure the stomach. The roots of Trillium are emetic, and the berries are to be avoided. Gumdragon, a styptic, now little used, is obtained from the *Dracæna Draco*; it is the juice of the plant.

Officinal Plant.

Smilax officinalis.

There are no poisonous plants in this family, except perhaps Trillium.

ORDER XXI.

LILIACEÆ.

Lilia and *Asphodeli*, Juss.—Includes the *Hæmerocallideæ* of Mr. Brown.

Characters.—*Herbaceous plants*, with bulbous, creeping, or tuberous roots. Leaves frequently all radical, alternate, and often very thick and fleshy. *Flowers* often solitary and terminal, upon a scape; sometimes in spikes, racemes, or umbels; often in a spatha, enclosing them before they expand. *Perianth* coloured and petaloid; single, and in 6 pieces, or occasionally disposed in two rows, (three inner pieces and three outer); segments often united at the base, and somewhat tubular, often distinctly monosepalous. *Stamens* 6, inserted into the segments of the perianth. *Ovary* free and superior; 3-celled, with a variable number of seeds in two rows at the ventral suture; style simple or absent; stigma 3-lobed. *Pericarp* a 3-celled capsule, with a loculicidal dehiscence, and separating into three valves. Seed sometimes with a black, brittle, and crustaceous testa, sometimes membranous, and winged. Albumen fleshy, with a cylindrical embryo.

Examples.—Hyacinth, Tulip, Harebell (*Scilla nutans*, or *Hyacinthus non-scriptus*), Alöe, Squill, Onion. This family may be distinguished from the Asparagineæ by the capsular pericarp and bulbous root. In the Asparagineæ the root is mostly a creeping stem-like body, and the pericarp a berry.

Economical Properties.—The properties of the Onion (*Allium cepa*), the Leek (*Allium porrum*), and Garlic (*Allium sativum*), are well known. The strong but agreeable flavour of these plants renders them useful as condiments. Their stimulating properties seem to be owing to an acrid volatile oil. Their acridity is much diminished by cultivation. M. Richard observes that all the bulbs in this family contain a mucilage much resembling gum arabic; this, he says, is very abundant in the *Scilla nutans*.

Medicinal Properties.—The bulbs in this family contain two different principles, a mucilaginous or starchy matter, and a bitter and highly stimulating juice. It is most probably an acrid volatile matter which confers on them their flavour. M. Vogel found that Squill (*Scilla maritima*) contains two distinct active principles, one an acrid volatile matter, which is decomposed at the temperature of boiling water, the other a bitter principle, soluble in alcohol and in vinegar, which he has called *Scillitin*, and which appears to be the principal cause of the action of Squill on the animal economy. The *Scilla maritima* is in great reputation as a diuretic and expectorant; it is also, in large doses, emetic and purgative. The bulbous root of the *Erythronium indicum* has got the name of Squill in India, from its resemblance to the root of the *Scilla maritima* in appearance and natural qualities. The bulbs of *Scilla Lilio-Hyacinthus*, and *Anthericum bicolor*, are purgative. *Scilla indica* is possessed of properties similar to *S. maritima.* Onion and Garlic are also diuretic, and generally stimulant: the properties of the latter are said to be owing to a volatile oil; Garlic has been recommended as anthelmintic. The Alöe is in this order: it is also a general stimulant, mostly used for its cathartic properties. The *Alöe vulgaris* (*perfoliata*) furnishes the Barbadoes or hepatic Alöes, also obtained from the East Indies and from Arabia: it is an extract from the whole plant. The best kind of Alöes is that obtained from the leaves of the *Alöe socotrina*, or Socotrine Alöe. The *Alöe spicata* is found " in many parts of the South of Africa, such as in the kingdom of *Melinda*, where the greater part of the extract is prepared that is now sold under the name of Socotrine Alöes."—*Ainslie*, vol. i. p. 9. The drug is obtained in the form of an inspissated juice from the leaves; but a viscid amber-coloured juice, having much resemblance to the extract, also exudes from the plant, when it is cut. *Horse Aloes* are supposed to be the produce of *Aloe spicata.*

Officinal Plants.

Allium porrum.	Alöe spicata.
Allium sativum.	Alöe vulgaris (perfoliata).
Allium cepa.	Scilla maritima.

ORDER XXII.

BROMELIACEÆ.

Characters.—Leaves radical, narrow, rigid, channelled, and with spinous margins; inflorescence a spike, raceme, or capitulum; calyx and corolla 3 parted each; stamens 6.

This family is chiefly remarkable for containing the Pine Apple (*Bromelia Ananas*), so much valued for its fruit. A species of Wild Agave in Mexico contains a considerable quantity of saccharine juice, used for making, by fermentation, a kind of wine called *Pulque*. The leaves of the *Agave Americana* furnish an extract similar in properties to that of the Aloe. The plants in this family are mostly inhabitants of South America.

MONOEPIGYNEÆ.

Monocotyledonous Plants with epigynous stamens, and inferior ovaries.

Orders.

23. Dioscoreæ.
24. Narcisseæ.
25. Irideæ.
26. Musaceæ.
27. Scitamineæ.
28. Marantaceæ.
29. Orchideæ.
30. Hydrocharideæ.

ORDER XXIII.

DIOSCOREÆ.

Characters.—Twining plants, with alternate reticulated leaves and small diœcious flowers generally on a spike, a perianth of 6 pieces or 6 lobed, 6 stamens, a 3-celled ovary, and a capsular pericarp, often 1-celled by abortion. The leaves are reticulated like those of dicotyledonous plants.

Examples.—Black Bryony (*Tamus communis*), the Yam *Dioscorea*).

Economical Properties.—The roots of the Yams are fleshy and mucilaginous, and much used as food in tropical countries. They also contain a little saccharine matter. The White Dry Yam (*Dioscorea alata*) is by far the best, and is indigenous in the Indian islands; the Purple Yam (*D. purpurea*) is much esteemed; in taste the Yams much resemble potatoes.—*Ainslie*, vol. i. 329. *Tamus communis* contains a considerable quantity of fecula, which may be turned to good account by washing and roasting the root, to remove the acrid matter which it contains.

ORDER XXIV.

NARCISSEÆ.

Part of the *Narcissi*, Juss.—*Amaryllideæ* of Mr. Brown.

Characters.—*Herbaceous plants* with bulbous roots, radical leaves, sheathing and ensiform; *flowers* solitary or umbellate on a scape, and enclosed in a spatha; *perianth* 6-partite, the divisions overlapping; orifice of the perianth sometimes having a petaloid nectary of a cylindrical form; *stamens* 6, anthers bursting inwardly; *ovary* inferior, 3-celled, many seeded; style simple; stigma 3-lobed; *pericarp* a 3-celled, 3-valved capsule, with a loculicidal dehiscence, sometimes a berry with a few seeds:

Examples.—Daffodill (*Narcissus*), Amaryllis, Snowdrop (*Galanthus*), Snowflake (*Leucojum*), *Hæmanthus*.

This family may be distinguished from the Liliaceæ by the inferior ovary; and from the Irideæ by being hexandrous.

Medicinal Properties.—The bulbs of all the plants of this family contain a small quantity of fecula, and a considerable quantity of an acrid, stimulating, gum-resinous matter, which appears to be analogous to that in Squill. The bulb of the *Narcissus pöeticus* is emetic, and the *N. odorus* and flowers of *N. pseudo-narcissus* also have this property. They are also deemed antispasmodic.

Poisonous Properties.—In the form of extract, the last mentioned plants, particularly the *Narcissus pseudo-narcissus*, are said to be poisonous in the dose of two or three drachms. The bulb of the *Brunsvigia toxicaria* (*Amaryllis disticha*), and several other species, contain a peculiar matter, in which the Hottentots dip their arrows to render them poisonous.

ORDER XXV.

IRIDEÆ.

Characters.—*Herbaceous plants*, with fibrous, tuberous, or solid bulbous roots; alternate ensiform equiant leaves: *flowers* enclosed in a membranous spatha. *Perianth* coloured, 6 partite, tubular at the base, divisions often entirely separate. *Stamens* three, sometimes monadelphous. *Ovary* inferior, 3-celled, style simple, stigmas three, petaloid. *Pericarp* a 3-celled capsule, 3-valved, and with a loculicidal dehiscence. Seeds with a fleshy or horny albumen, numerous, and disposed longitudinally in two rows.

Examples.—Iris, Crocus, Gladiolus. The *Crocus odorus* and *C. sativus* furnish saffron (the dried stigmata of the plant), a material used in dyeing. The seeds of *Iris Pseudacorus* roasted, are recommended as a substitute for coffee. —*Hooker*.

Medicinal Properties.—The roots of some species of Iris, as Orris Root (*Iris florentina*), and *I. germanica*, are slightly stimulant, and may be used for keeping open an issue, for exciting salivation or the secretion from the nose, or as purgatives. *Iris Pseudacorus*, *I. germanica*, *I. tuberosa*, *I. versicolor* and *I. verna*, are cathartic, and the two first are also brisk emetics. The roots of the Iris appear to contain gum, an astringent extract, abundant in the *I. Pseudacorus*, some fecula, an acrid and bitter oil, and a volatile oil, which exists mostly in the roots of those which are odorous. The stigmata of the *Crocus sativus* were formerly used in hysteria: they are aromatic, pungent, stimulant, and exhilarating, and have been said to resemble spirituous liquors in their action. They are now used only as secondary in pills and tinctures.

Officinal Plants.

Crocus sativus.
Iris florentina.

ORDER XXVI.

MUSACEÆ.

Characters.—Herbaceous stemless plants. Leaves with long sheathing petioles, with a kind of swelling between the petiole and the leaf. Flowers on a common stalk in the centre of the leaves, and contained in spathas. Perianth irregular, in two rows, 6-parted, and petaloid. Stamens 6, filaments membranous at the extremity. Ovary 3-celled, many seeded. Pericarp sometimes a capsule, sometimes fleshy.

Examples.—Plantain (*Musa*), Urania, Heliconia.

Economical Properties.—The Plantain (*Musa paradi-*

siaca) and the Banana (*M. sapientum*) belong to this family. Their fruit is very agreeable, and is much used as an article of food in tropical countries. They produce a very great quantity of fruit, and are plants of the greatest importance to the natives all over the torrid zone. "The Plantain is certainly one of the most delicious of all the Indian fruits and one of the safest for such as have delicate stomachs, being entirely free from acidity; it is moreover very nourishing, and is always prescribed as food, by the Hindoo practitioners, for such as suffer from bile and heat of habit."—"The Plantain and Banana are the principal fruits of the Eastern islands; unripe, they are sliced and made into curry, when they taste like potatoes."—*Ainslie*, i. 316-7. Humboldt calculates that the produce of the Banana is to that of Wheat, on the same extent of ground, as 133 to 1, and to that of Potatoes as 44 to 1. With respect to its nutritive power the Banana is inferior to Wheat, but when the immense quantity of produce is considered, its nutritious matter is to that of Wheat as 25 to 1.

ORDER XXVII.

CITAMINEÆ.

Forming along with Marantaceæ the *Cannæ*, Juss.; *Amomeæ*, Rich; or *Drymyrrhizæ*, De Cand.

CHARACTERS.—*Herbaceous plants* with a creeping root; simple, sheathing, and alternate leaves. *Inflorescence* a dense panicle or spike, accompanied by large membranous spathas. *Calyx* tubular, unequally 3-lobed. *Corolla* tubular, irregular, with six segments in two rows, 3 outer segments nearly equal, and 3 inner, of which two are equal and occasionally abortive, and a third (*labellum*) is longer than the rest, and often lobed. *Stamen* 1, inserted into the tube of the corolla opposite the labellum. *Anther* 2-celled, the lobes occasionally embracing the upper part of the style. *Ovary* 3-celled, each cell many seeded: stigma dilated, hollow; at the base of the filiform style are two scales, considered abortive stamens. *Pericarp* a 3-celled 3-valved capsule, occasionally a berry. Seeds with a farinaceous albumen, and radicle next the hilum.

Examples.—Amomum, Curcuma, Zingiber, Kæmpferia.

This has been considered an anomalous family among the Monocotyledons, which have generally 3 or 6 stamens, and only 1 or 2 whorls in the perianth. They are considered as having 6 stamens, however, of which some are modified. Of these stamens one is fertile, the other five abortive or barren. In place of two of the barren stamens we have the two scales or tubercles, at the base of the style, and the other three are metamorphosed into the three inner petaloid segments, so that in reality there are only two rows in the perianth. In this manner, as M. Lestiboudois has pointed out, we can explain these apparent anomalies.

Economical Properties.—The roots of the plants in this family contain an aromatic stimulating principle which renders them agreeable as condiments, seasonings, &c. Ginger (*Zingiber officinale* of Mr. Roscoe, *Amomum Zingiber*, Linn.) is the most notable of these, but there are several others, which may be used in the same way. *Curcuma angustifolia* is said, by Dr. Ainslie, to furnish an excellent kind of arrow-root, and is much grown on the Malabar coast. They all contain a considerable quantity of fecula, but, in general, not in a state to be used as food, being mixed and impregnated with their hot aromatic principle. Turmeric (*Curcuma longa*) is a constant ingredient in curries. This plant also furnishes a yellow dye. *Kæmpferia Galanga*, yields Galangale, some of which is also procured from *Alpinia Galanga*, the roots of which are the *Galanga major* of the shops.

Medicinal Properties.—A pungent volatile oil is found in almost all parts of the plants in this family. The roots and seeds are valued in medicine as aromatics, stomachics, &c. Ginger, Galangale (*Alpinia galanga*), Turmeric, Zedoary, and Cardamom, are chiefly used. Lesser Cardamom seeds, so much employed in extracts, confections, and tinctures, are the produce of the Alpinia Cardamomum (Elettaria cardamomum medium). Similar properties are found in the seeds of Amomum Cardamomum, and A. aromaticum.) The Greater Cardamom seeds are procured from the *Amomum grana paradisi.* The latter are more pungent and less aromatic than the Lesser Cardamom seeds, which are most esteemed. Dr. Ainslie mentions three kinds of Zedoary, 1. The *Kæmpferia rotunda* or *Zedoaria rotunda;* 2. The *Curcuma zerumbet*, or *Amomum zerumbet*, found in the East Indies, Cochin China, and Otaheite, and said to be that which yields the Zedoary of the London druggists; and, 3, the *Curcuma zedoaria*, or *Amomum zedoaria*, (Turmeric coloured). According to others *Curcuma Zerumbet* yields the Zedoaria longa, *Curcuma Zedoaria*, the Zedoaria rotunda. *Curcuma longa* gives Turmeric. Turmeric is used in chemistry as a test for alkalis, which change the yellow colour to a brown.

Officinal Plants.

Zingiber officinalis.
Alpinia Cardamomum.
Curcuma longa.

ORDER XXVIII.

MARANTACEÆ.

Cannæ of Mr. Brown.—Included in the *Cannæ* of Jussieu, and *Drymyrrhizæ* of De Candolle.

Characters.—Nearly the same as in the Scitamineæ. They differ from the preceding family in having the two lateral segments of the inner whorl of the perianth different from each other, the stamen adjacent, and not opposite to the labellum, the filament petaloid, the anther 1-celled, and in being destitute of that pungent aroma which characterises the Scitamineæ.

Examples.—Indian arrow-root (*Maranta arundinacea*), Indian cane (*Canna*).

The existence of only one stamen in this family is explained in the same way as in the Scitamineæ.

Economical Properties.—The roots of the Marantaceæ contain a considerable quantity of fecula, which forms an article of food in the East and West Indies. The fecula is not combined, as in Scitamineæ, with a hot aromatic principle, and is very nutritious. The *Maranta arundinacea* affords the greatest quantity: the well known powder called "Indian Arrow Root," is obtained from this plant. It receives the name of Arrow Root from its supposed virtues in extracting the poison communicated by poisoned arrows. Other species furnish a nutritious matter abundantly, as *Maranta nobilis* and *M. ramosissima*. *Canna edulis* and *C. coccinea* also have much fecula in their roots.

Officinal Plant.

Maranta arundinacea.

ORDER XXIX.

ORCHIDEÆ.

Characters.—*Herbaceous plants* with a fibrous root, *or* a tuberous root variously divided, destitute of stem, or having a short one formed of the persistent bases of the leaves: leaves simple, alternate, sheathing; *inflorescence* a terminal spike, panicle, or raceme; flowers rarely solitary; calyx in 3 segments, usually coloured; one of the segments higher than the others, which may be called the lateral ones, *corolla* in 3 segments, usually coloured: two of the segments are lateral, on each side of the higher segment of the calyx, and themselves higher than the other segment of the corolla, which is called the *lip* or *labellum;* it projects between the lateral pieces of the calyx, is of a different figure from the others, frequently lobed, and often with a hollow prolongation or spur at the base: *stamen* 1 (2 abortive), forming, along with the style to which it is united, a column (*gynosteme*), arising from the top of the ovary: and having at "its anterior and upper surface a glandular depression, which is the stigma, and at its summit, an anther with 2 cells, opening either by a longitudinal suture, or by a lid which forms the whole of its upper part. The pollen contained in each cell of the anther is united into a mass, which has the same form as the cavity which contains it. At the top of the gynosteme, at each side of the anther, there are found two small tubercles, which are two abortive stamens, and which are called *staminodes.* These two stamens are, on the contrary, developed in the genus *Cypripedium*, while the middle one is abortive."—*Richard.** Thus the anthers and stigma are united at the top of the column, and are opposite to the labellum; *ovary* inferior, 1-celled, and with three parietal placentæ, with many small seeds. Style incorporated with the filament; stigma facing the labellum, viscid; *pericarp* a capsule dehiscing by 3-valves; seed with a reticulated testa.

Examples. — Orchis; Cypripedium (Lady's Slipper); Malaxis (Bog Orchis); Ophrys; Epidendrum. They are found in all parts of the world, and chiefly in moist situations, and are remarkable for the beauty and stately elegance of their flowers. They are frequently parasitic.

The peculiar union of the sexual organs into one column, is sufficiently characteristic of this very natural family. The union of the granules of pollen into a mass, is another strik-

* Nouveau Elemens de Botanique.

ing peculiarity which they present. Like the Scitamineæ and Marantaceæ they are considered to possess several stamens, of which all are abortive but one. In the Orchideæ the number abortive is two, thus still preserving the ternary division found in the Monocotyledons ; the three filaments being united in the column, and the anthers only being deficient. This family also resembles the two preceding, in having its corolla with a labellum, but has only two rows of perianth, while they have three.

Economical Properties. — The fleshy tuberous roots contain a sweetish mucilaginous fecula, which is extracted in considerable quantities from the *Orchis mascula* and other species of Orchis, and sold under the name of *Salop* or *Salep*. Salep, Dr. Ainslie mentions, is used by the Arabians in consumption : and is said to have the power of correcting the saltness of sea-water. The fleshy fruit of the Epidendrum Vanilla furnishes the aromatic substance called *vanilla*. It is considered stomachic in South America, and in this country is employed to give a pleasant flavour to chocolate.

ORDER XXX.

HYDROCHARIDEÆ.

This is a family of little interest. It contains Frogbit (*Hydrocharis*), Water-soldier (*Stratiotes*), and one or two others.

SECTION II.

DICOTYLEDONEÆ.

Exogenæ of De Candolle,—*Exorhizæ* and *Synorhizæ* of Richard.

Characters.—*Embryo* with two opposite cotyledons, or several in a whorl. *Radicle* not enclosed in a sheath. Generally with a distinct calyx and corolla, or *double perianth;* which, and also the sexual organs, very frequently consist of 5 parts, or some multiple of 5: or occasionally of 2, or some of its multiples. *Leaves* often opposite, jointed at their union with the stem, and having their veins or nerves much and irregularly ramified. (See Frontispiece, Fig. 4.) *Stem* consisting of concentric cylinders surrounding a central column of pith, and composed of two parts, wood and bark, between which the newly formed matter is added. (See Frontispiece, Fig. 2.)

Examples.—Oak, Elm, Rose, Pea, Poppy.

The Dicotyledoneæ are called *Exogenæ* from their mode of growth; and *Exorhizæ* from the radicle being free. The *Synorhizæ* are also included in the Dicotyledons.

Dicotyledonous plants are arranged in three subsections; the Apetalous, the Monopetalous, and the Polypetalous.

I. APETALEÆ.

Dicotyledonous plants, with a single perianth, or none.

The following is a list of the leading orders in this subdivision:—

31. Aristolochiæ.
32. Santalaceæ.
33. Cupuliferæ.
34. Juglandeæ.
35. Coniferæ.
36. Cycadeæ.
37. Salicineæ.
38. Betulineæ.
39. Myriceæ.
40. Euphorbiaceæ.
41. Urticeæ.
42. Myristiceæ.
43. Laurineæ.
44. Chenopodeæ.
45. Polygoneæ.
46. Thymeleæ.
47. Amaranthaceæ.
48. Nyctagineæ.

ORDER XXXI.

ARISTOLOCHIÆ.

Characters.—Herbs or shrubs with alternate simple leaves, with petioles and sometimes stipules, and hermaphrodite axillary flowers; calyx with a valvate æstivation, monosepalous, with 3 lobes; stamens epigynous, 6 to 12, distinct and free, or united to the style and stigma; ovary 3- or 6-celled, many seeded; style simple when free; stigma 3- or 6-lobed; pericarp a capsule, 3- or 6-celled and many seeded; seeds attached to the internal angle of each cell.

Examples.—Snake-root or Birthwort, (*Aristolochia Serpentaria)*; Asarabacca (*Asarum europæum*):

Cytinus and *Rafflesia* are made a separate order by some, *Cytineæ*.

Medicinal Properties.—The roots of most of this family are acrid, stimulating, bitter, and aromatic. Snakeroot is a tonic and stimulating diaphoretic; other species of Aristolochia possess similar properties, as *A. rotunda*, *A. longa*, and *A. clematitis*. The leaves of Asarabacca are emetic and purgative. They are used chiefly as errhine in the form of powder. *Asarum canadense* has similar properties. The fruit of the Hypocyst (*Cytinus hypocistis*) is astringent, owing to the presence of gallic acid, and Rafflesia is used as an astringent in Java.

Officinal Plants.

Aristolochia Serpentaria.
Asarum europæum.

There are no poisonous plants among the Aristolochiæ.

ORDER XXXII.

SANTALACEÆ.

Characters.—Flowers in spikes; calyx 4- or 5-cleft; stamens 4 or 5; ovary 1-celled, inferior, with 1 to 4 ovules; style 1; pericarp a drupe, 1-seeded.

Examples.—Sanderswood (*Santalum album*) Thesium, Osyris.

ORDER XXXIII.

CUPULIFERÆ.

Included in the *Amentaceæ*, Juss.—*Corylaceæ*, Lindley.

Characters.—*Trees* or *shrubs*, with simple alternate leaves, having two caducous stipules at the base; inflorescence an amentum; *flowers* unisexual (mostly monœcious); *stamens* 5 to 20, inserted at the base of a scale or calyx somewhat divided; *female flowers* sometimes in a kind of capitulum; *ovary* surmounted by an imperfect superior calyx, and placed within a scaly involucre or cupule, 2-, 3-, or many-celled, each cell containing 1 or 2 pendulous ovules; stigmas 2 or 3, almost sessile; *pericarp* 1-celled, 1- or 2-seeded by abortion, dry, indehiscent, more or less enveloped in the bony cupule or involucre, and called nut or gland.

Examples.—Oak (*Quercus robur,* now *Q. pedunculata*), Hazel (*Corylus Avellana*), Beech (*Fagus sylvatica*), Spanish Chestnut (*Castanea vulgaris* or *Fagus castanea*), Hornbeam (*Carpinus Betulus*). Cork is the bark of *Quercus suber.* Quercitron is furnished by the *Quercus tinctoria,* and Kermes dye by the *Q. coccifera.*

This family is distinguished by the superior scaly calyx, the cupule, and the gland having only 1 or 2 seeds.

Economical Properties.—The nuts of *Castanea vulgaris* are used as an article of daily food in the south of Europe.—*Hooker.* The pericarp, deprived of its scaly cupule, contains starch, gluten, and some saccharine matter. The Hazel-nut is well known as an article of food; and Acorns, the nuts of the Oak, are given to swine.

Medicinal Properties.—The bark of the Oak, *Quercus pedunculata,* is well known for its astringent properties, depending on the tannin and gallic acid which it contains. Quercus sessiliflora has similar properties. The Gall-nut (a peculiar morbid growth on the young shoots, caused by an insect) is the produce of the *Quercus infectoria.* It is very astringent. The leaves of *Q. falcata* are astringent.

Officinal Plants.

Quercus robur (Q. pedunculata.)
Quercus infectoria.

There are no poisonous species among the Cupuliferæ.

ORDER XXXIV.

JUGLANDEÆ.

Included in the *Terebinthaceæ*, Juss.

Characters. — *Trees*, with impari-pinnate, alternate leaves destitute of stipules; *flowers* monœcious, males on an amentum; calyx in the female flowers superior, and of four divisions; *stamens* 3 to 36, inferior; *ovary* inferior; 1-celled, 1-seeded, surmounted by the limb of the calyx and two stigmas; ovule ascending; *pericarp* a drupe, almost dry, or nut.

Examples.—Walnut, (*Juglans regia*), Hiccory (*Carya*).

Economical Properties.—The Walnut is well known. The seed contains a considerable quantity of a thick oil; in some places used instead of olive oil. The outer parts of the fruit are said to contain tannin and gallic acid.

ORDER XXXV.

CONIFERÆ.

Pinaceæ, Lindley.

Characters.—*Trees* or *shrubs*, with a resinous wood, narrow and linear leaves, sometimes solitary, sometimes fascicled, with a scarious sheath at the base; *flowers* monœcious or diœcious, on an amentum; *stamens* variable in number, sometimes one, occasionally at the base of a scale, at other times naked, sometimes united by the filaments, at other times with sessile anthers; *female flowers* solitary, or on an oval amentum or cone, with the ovaries in the axillæ of imbricated membranous bracteæ; *ovary* thin, flat, and scaly, 1-celled, 1-seeded; *pericarps* acheniums, generally forming a strobilus or cone; the female flowers are occasionally united in a kind of involucre, which becomes fleshy, as in the Juniper berry, containing about three minute acheniums, which are the true fruit, and in the Yew (*Taxus*); embryo in an oleaginous fleshy albumen, and included in two or more cotyledons; radicle in union with the albumen.

Examples.—Scotch Fir (*Pinus sylvestris*), Larch (*P. Larix* or *Abies Larix*), Juniper (*Juniperus communis*), Yew (*Taxus baccata*), Cedar of Lebanon (*Larix Cedrus*).

Medicinal Properties.—The Coniferæ are valuable in a medicinal point of view, chiefly as furnishing the various kinds of resin so much used for cerates and plasters, and turpentines, with their volatile oils, which are active cathartics, diuretics, and anthelmintics. The resinous juice which exudes from the trees is called Turpentine; by distillation a volatile oil is driven off (Oil of Turpentine), and a solid matter remains, which is resin. The Wild Pine or Scotch Fir (*Pinus sylvestris*) furnishes common turpentine (*Terebinthina vulgaris*), from which oil of turpentine and common or yellow resin (*Resina flava*), are obtained. Common tar is also obtained from this tree by burning. Black pitch is a preparation of tar. The Larch (*Pinus Larix* or *Abies Larix*) furnishes Venice Turpentine and a volatile oil. The Bordeaux Turpentine is procured from *Pinus Pinaster:* Hungarian balsam from the *Pinus Pumilio.* Balsam Spruce (*Pinus balsamea* or *Abies balsamea*) yields Canada Balsam (*Terebinthina canadensis*). The Spruce Fir (*Pinus Abies*) furnishes common Frankincense (*Thus*) and Burgundy Pitch (*Pix abietina*). Silver Fir (*Pinus Picea*, *Abies Picea*, or *A. pectinata*) affords Strasburg Turpentine. The bark of the Hemlock Spruce (*Abies canadensis* or *Pinus c.* is said to contain much of the tanning principle, and is used in Canada for the manufacture of leather. Much information regarding the various kinds of Fir will be found in the second volume of the transactions of the Literary and Historical Society of Quebec.

The leaves of *Juniperus Sabina*, or Savine, are diaphoretic and emmenagogue; and the berries of *Juniperus communis* are stimulant and stomachic, and also diuretic. Olibanum was formerly said to be the resin of *Juniperus lycia*; it is now referred to *Boswellia serrata*, but *Juniperus lycia* still retains its place in the pharmacopœias. Sandarach is obtained from *Thuja articulata (Callitris quadrivalvis)*; some refer it to *Juniperus communis*.

Officinal Plants

Pinus sylvestris.	Juniperus Sabina.
Pinus Larix, (Abies Larix.)	Juniperus communis.
Pinus balsamea, (Abies balsamea.)	Juniperus lycia.
Pinus Abies.	

Poisonous Properties.—The berries, or juicy involucres of the Yew (*Taxus baccata*) are deemed poisonous: they are sometimes eaten, but the seeds which they contain must be rejected. M. Richard mentions, that he was affected with a slight pain in the head from reposing under the Yew: the leaves are considered narcotic. The leaves of *Juniperus Sabina* are dangerous, being narcotic and very acrid.

ORDER XXXVI.

CYCADEÆ.

Characters.—Trees with an unbranched stem and pinnated leaves with parallel veins, resembling Palms, increasing by a single terminal bud; wood in concentric cylinders; diœcious; female flowers in cones, or consisting of naked ovules (destitute of ovary) on the margins of imperfect leaves.

EXAMPLES.—Cycas, Zamia. Sago Palm (*Cycas circinalis*) furnishes a kind of sago, obtained from the soft central part of the tree.

ORDER XXXVII.

SALICINEÆ.

Included in the *Amentaceæ*, Juss.

CHARACTERS.—*Trees* or *shrubs*, with simple alternate stipulate leaves, and monœcious or diœcious flowers on an amentum; stamens 2 to 20, at the base of a scale; *ovary* superior, at the base of a scale, 1- or 2-celled, with many erect ovules, attached to two parietal placentæ about the base of the cell; *style* absent, or very short; *stigmas* 2; *pericarp* an elongated dehiscent capsule, 1- or 2-celled, and 2-valved, many-seeded; seeds comose (hairy.)

EXAMPLES.—This family consists of Willow (*Salix*) and Poplar (*Populus.*)

MEDICINAL PROPERTIES.—The bark in the Salicineæ is generally astringent and bitter. The bark of common White Willow (*Salix alba*) has been recommended as a substitute for Cinchona Bark. It contains a peculiar principle, *Salicine*, resembling Quina. Some species have barks with nearly as much tannin as the Oak. *S. Russelliana*, *S. pentandra*, *S. caprea*, and *Populus tremuloides* have been recommended for the febrifuge qualities of the bark. *Populus nigra*, and *P. balsamifera* are said to possess valuable medicinal qualities in the young buds—aromatic and antiscorbutic.

Officinal Plants.

Salix alba.
Salix fragilis.
Salix caprea.

ORDER XXXVIII.

BETULINEÆ.

Included in the *Amentaceæ*, Juss.

CHARACTERS.—This family resembles the last, but has monœcious flowers, sometimes in the male flower a calyx of several divisions, a 2-celled ovary, with one pendulous ovule in each cell; and the pericarp a membranous indehiscent 1-celled, 1-seeded nut.

EXAMPLES.—Birch (*Betula*), Alder (*Alnus.*)

The Betulineæ contain tannin in their barks, which are also somewhat tonic.

ORDER XXXIX.

MYRICEÆ.

CHARACTERS.—Trees or shrubs, with alternate simple leaves, often dotted; unisexual flowers, on an amentum; a 1-celled, 1-seeded ovary, with an erect ovule, surrounded by several hypogynous scales, which in some become fleshy; in others, the pericarp is dry and dehiscent.

EXAMPLES.—Sweet Gale, or Dutch Myrtle (*Myrica Gale.*) The berries of *Myrica cerifera* furnish a kind of wax.

ORDER XL.

EUPHORBIACEÆ.

CHARACTERS.—*Herbs, shrubs*, or *trees*, with leaves opposite or alternate, usually simple, and with stipules, and a milky acrid juice in many, especially the herbaceous kind: *flowers* monœcious or diœcious, with bracteas, solitary, in clusters, or within a common involucre; calyx inferior, with glands or scales, of several (often 5 or 10) divisions, of which the more interior are sometimes petaloid; *stamens* free or united; *female flowers* with a calyx resembling that of the male flowers; *ovary* superior, sessile, or with a stalk, generally 3-celled, and with 3 sides (rarely 2, or more than 3 cells), each cell with 1 or 2 suspended ovules; *styles* generally 3: *pericarp* sometimes fleshy exteriorly, 3-celled (2 or more than 3 cells occasionally), the cells dehiscent, 1- or 2-seeded, 2-valved, and separating from each other with elastic force; *seed* with an arillus; embryo in the interior of a fleshy albumen.

EXAMPLES.—Sun-spurge or Little-good (*Euphorbia helioscopa*), Castor-oil plant (*Ricinis communis*), Box-wood (*Buxus sempervirens*).

ECONOMICAL PROPERTIES.—*Iatropha manihot* (Janipha manihot) or Mandiocca, furnishes Cassava and Tapioca, two varieties of starch, well known for their nutritious properties. The root contains a very large quantity of starch, mixed, however, with an extremely acrid poisonous milky juice: the poisonous principle is very volatile and is removed by washing and by heat. The root is reduced to a pulp or paste, by being bruised or grated; the paste is pressed in bags, to squeeze out the juice which contains the poisonous principle, and repeatedly washed with water, when *cassava* remains. The water with which the cassava has been washed, according to Richard, deposits a white farinaceous powder, which is *tapioca*. Dr. A. T. Thomson applies the term Tapioca to the matter which is here called Cassava. Caoutchouc is furnished by *Hevea guianensis*.

Medicinal Properties.—The Euphorbiaceæ are important in a medicinal point of view. They are, in general, very acrid and irritating; these properties reside in the milky juice in which they abound. The acrid principle, however, is very volatile, and easily expelled by heat. Gum euphorbium is the produce of *Euphorbia officinarum*, and also of *E. antiquorum* and *E. canariensis*; it is an active, indeed violent emetic, cathartic, hydragogue, and errhine. The thick oil in the seeds of Caper Spurge (*Euphorbia lathyris*), and in those of *E. Cyparissias*, has similar properties. The roots of *Euphorbia Ipecacuanha*, *E. sylvatica*, *E. Gerardiana*, *E. Cyparissias*, and *E. pithyusa*, are said to be excellent substitutes for Ipecacuanha. The bark of *Croton Cascarilla* is tonic and stimulant, and an agreeable carminative: some refer the bark commonly called cascarilla to *Croton Eleuteria*. *Croton pseudo-china* is said to yield some of the Cascarilla bark. *Croton Draco* gives a Dragon's Blood. *Mercurialis annua* is emollient and laxative. The expressed oil of the seeds of *Croton Tiglium* (Croton oil) is a drastic purgative; the seeds were formerly called "grana molucca." Crozophora tinctoria *(Croton tinctorium)* furnishes the purple dye, turnsol. Lac is the produce of *Croton lacciferum*. The leaves of Box (*Buxus sempervirens*) are sudorific and laxative. The expressed oil (which may be obtained also by decoction) of the seeds of the *Ricinus communis* or *Palma Christi* is a mild purgative, well known by the name of Castor oil. The acrid principle which this oil contains is expelled by being subjected to a moderate heat. The seeds of the *Anda Gomesii* are also purgative; those of the *Iatropha curcas* are violently cathartic. Numbers of this family are employed medicinally by the natives in India and South America.

Officinal Plants.

Euphorbia officinarum.	Croton Tiglium.
Croton Cascarilla.	Ricinus communis.

Poisonous Properties.—Many plants in this family are very active poisons: the milky juice in which they abound is very deleterious, and almost all are more or less dangerous; many of the valuable medicines which we find in this family would be poisonous in large doses. The Manchin Eel tree (*Hippomane mancinella*), which has a very poisonous juice, and is said to be capable of poisoning persons who may happen to sleep beneath it, is in this family. Dr. Hooker mentions that Irish Spurge (*Euphorbia hiberna*) "is extensively used by the peasantry of Kerry for poisoning or rather stupifying fish, in the same manner as the exotic *E. piscatoria*. So powerful are its qualities, that a small creel or basket filled with the bruised plant, suffices to poison the fish for several miles down a river." The juice of *Excæcaria Agallocha*, and of *Hura crepitans*, is very deleterious. The fruit of *Hyænanche globosa*, according to Dr. Ainslie, is used at the Cape of Good Hope to poison hyenas. The various species of Iatropha, and indeed most of the plants in this family, are highly poisonous when taken in considerable doses.

ORDER XLI.

URTICEÆ.

Characters.—*Trees*, *shrubs*, or *herbs* with alternate stipulate leaves; *flowers* monœcious or diœcious, in clusters or in heads; *calyx* sometimes monosepalous, deeply divided, sometimes polysepalous, generally persistent, accompanying the fruit; *stamens* about 4 or 5 at the base of the calyx; anthers bending back when dehiscing; *ovary* superior, 1- or 2-celled, each cell 1-seeded, 1 or 2 stigmas; pericarp an indehiscent drupe or achenium, often with the calyx surrounding it; female flowers often in the internal part of the hollow receptacle or involucre, which becomes fleshy, or placed upon the receptacle forming a fleshy head; seed destitute of albumen.

EXAMPLES.—Hop (*Humulus Lupulus*); the Banyan tree (*Ficus indica*); Fig (*Ficus Carica*); Nettle (*Urtica dioica*); the well known plant which furnishes Hemp (*Cannabis sativa*); Mulberry (*Morus nigra*). The bark of *Morus papyrifera* (*Broussonetia p.*) furnishes the paper of the Chinese.

There are three divisions in this family; 1. the true Urticeæ, with 1-celled ovaries, erect ovules, fruit dry, and flowers in a raceme or panicle, exemplified in Urtica and Humulus; 2. the Ulmaceæ (*Ulmus*), with 2-celled ovaries and pendulous seeds; and, 3. the Artocarpeæ (*Artocarpus*), with the flowers in fleshy heads, ovules suspended, and fruit a fleshy receptacle with nuts in fleshy calyces, or a fleshy receptacle or involucre enclosing the pericarps or acheniums (*Ficus.*)

ECONOMICAL PROPERTIES.—The true URTICEÆ contain no plants useful in domestic economy except the Hop (*Humulus Lupulus*), which is valued in brewing for the bitter quality of its strobili or cones. The ARTOCARPEÆ contain the Bread-fruit tree (*Artocarpus incisa*), the fruit of which is a valuable article of food in some tropical countries; the Fig-tree (*Ficus Carica*); the Mulberry-tree (*Morus nigra*), *Morus tinctoria*, the wood of which yields fustic, a yellow die; the Cow-tree (*Palo de Vacca* or *Galoctodendron utile*), which furnishes abundantly a nutritious juice resembling milk. *Cecropia peltata*, it is said, is one of the plants which afford caoutchouc; this is also obtained from *Ficus elastica* in this order, and from some Apocyneæ and Euphorbiaceæ. Gum lac is procured from the *Ficus Indica*.

Medicinal Ppoperties.—The Mulberry is cooling and laxative, and contains a considerable quantity of mucilage. The Hop is narcotic, sedative, and diuretic. The virtues depend on a peculiar principle called *lupulin*. The bark of the Elm (*Ulmus campestris*) is deemed diuretic. The Fig is a demulcent and gentle laxative. Contrajerva root is obtained from *Dorstenia contrajerva*: *D. brasiliensis*, *D. Houstoni*, and *D. opifera*; it is sudorific and tonic. *Cannabis sativa*, is a powerful narcotic. It is smoked like tobacco.

Officinal Plants.

Humulus Lupulus.	Ficus Carica.
Ulmus campestris.	Dorstenia Contrajerva.
Morus nigra.	

Poisonous Properties.—The leaves of Nettles (*Urtica urens*, *U. dioica*, and *U. pilulifera*) are covered with hairs, which are the excretory ducts of glands situated at the bases of the hairs; the pain and irritation caused by their sting arise from the fluid of the gland being poured into the skin. *Urtica stimulans* and *U. crenulata* produce similar effects, but are much more violent. The Upas of Java (*Antiaris toxicaria*) is one of the most deadly poisons known. It is said that a single seed introduced into the cellular tissue of a dog is sufficient to kill the animal. Its poisonous properties seem to depend on *Strychnine*, the same alkaline principle which characterizes *Nux Vomica*. The Upas belongs to the Artocarpeæ, many of which contain an acrid milky juice. The juice of *Ficus Toxicaria* and of *F. Dæmona* is very poisonous. The emanation from a Hemp or a Hop plantation is said to be injurious: the leaves of the former are narcotic in a high degree.

ORDER XLII.

MYRISTICEÆ.

Characters.—*Trees*, with entire alternate stipulate leaves, diœcious, with a 3-lobed calyx; *stamens* generally monadelphous; anthers 4 to 12, sometimes united, turned outwards; *ovary* superior, 1-celled, 1-seeded: ovule erect; style short, with 2 stigmas, or 1 lobed stigma; *pericarp* a kind of drupe or berry, 2-valved, with a seed enclosed in an arillus in many narrow slips, and having an oily or fleshy albumem.

Examples.—Nutmeg-tree (*Myristica moschata*) a native of the Molucca Islands, and now cultivated in Sumatra.

Medicinal Properties.—Nutmeg and Mace are the produce of the *Myristica moschata*. Nutmeg is the kernel or seed with the albumen, and Mace is the fleshy arillus which envelopes the seed. They are aromatic (forming an agreeable spice), stimulant, carminative, and narcotic in large doses; and furnish an expressed and volatile oil.

Officinal Plant.

Myristica moschata.

ORDER XLIII.

LAURINEÆ.

Characters.—*Trees* or *shrubs*, with firm, coriaceous, and persistent, alternate leaves, seldom lobed, and generally smooth and shining; inflorescence an umbel or panicle; *calyx* monosepalous, with 6 (rarely 4) divisions; *stamens* perigynous, from 6 to 9, of which the 3 inner are abortive; inner filaments having generally glands at the base; anthers adnate, 2 or 4-celled, dehiscing by a longitudinal lid or valve which opens from the base to the apex; *ovary* superior, 1-celled, 1 or 2 seeded; ovule pendulous; *style* and stigma simple; *pericarp*, a berry, or drupe, of which the base is enveloped by the persistent calyx; *seed* without albumen; cotyledons thick; embryo inverted.

Examples.—Common Sweet Bay (*Laurus nobilis*) Cinnamon-tree, *Laurus* (*Cinnamomum*, or *Cinnamomum zeylanicum*). Found chiefly within the tropics.

Economical Properties.—The use of the bark of *Laurus cinnamomum* as a spice is well known.

Medicinal Properties.—All the parts of these plants contain an aromatic volatile oil, which renders them warm and carminative. The *Laurus Cinnamomum* is astringent, tonic, and cordial; its volatile oil is powerfully stimulant. *Laurus Malabathrum*, (*Cinnamomum javanicum*), *Cinnamomum Loureirii*, *Cinnamomum aromaticum*, *Nectandra Cinnamomoides* (Laurus C.), *Oreodaphne Cupularis*, (Laurus C.) and several other species yield a kind of Cinnamon. The bark and flower-buds of *Laurus cassia*, (*Cinnamomum zeylanicum*, var. Cassia), have similar properties. *Cinnamomum Culilawan*, (*Laurus C.*), and several other species, as *C. rubrum*, *C. Sintoc*, yield Culilawan bark, which is highly esteemed as carminative and stomachic. Camphor is obtained from the wood of *Laurus Camphora**, (*Camphora officinarum*), it is narcotic and diuretic. Laurel leaves, from the *Laurus nobilis*, are narcotic and carminative; they contain hydrocyanic acid. The berries with their fixed oil are of a similar character. The wood and bark of Sassafras (*Laurus Sassafras*, or *Sassafras officinale*), are diaphoretic and diuretic. *Benzoin odoriferum*, (*Laurus Benzoin*), is highly aromatic and

* It is mostly obtained from the *Dryobalanops camphora*. See Guttiferæ.

tonic in the bark, twigs, and oil of the berries. The berries have been used as a substitute for Allspice.

Officinal Plants.

Laurus Cinnamomum.
Laurus Cassia.
Laurus Camphora.
Laurus nobilis.
Laurus Sassafras.

ORDER XLIV.

CHENOPODEÆ.

Atriplices, Juss.

CHARACTERS.—*Shrubs* or *herbs*, with alternate leaves (rarely opposite), without stipules; *flowers* small, occasionally unisexual; *calyx* monosepalous, persistent, with 2, 4, or 5 deep divisions; *stamens* perigynous, of the same number as, or fewer than, the segments of the calyx, to which they are opposite; *ovary* superior, 1-celled, 1-seeded; ovule erect; *style* of 2 or 4 divisions: *pericarp* thin and membranous, rarely fleshy; embryo curved round mealy albumen; radicle next the hilum.

EXAMPLES. — Spinach (*Spinacia oleracea*) Beet (*Beta vulgaris*), Glasswort, (*Salicornia*), Strawberry Spinach (*Blitum.*)

ECONOMICAL PROPERTIES.—Many of this family are favourite pot-herbs, as Garden Orach (*Atriplex hortensis*) once used instead of spinach; Spinach (*Spinacia oleracea*). The roots of the Beet and Mangel Wurzel are much esteemed: the former is used in France for the preparation of sugar. *Chenopodium album*, and *C. bonus Henricus* are sometimes used for the table. The Salsolas (Saltworts) and Salicornias (Glassworts) abound in soda, so much used for making glass and soap, and for medicinal preparations. The soda procured from the ashes of vegetables, is obtained principally from *Salsola sativa*, *S. kali*, *S. soda*, *S. tragus*, *Salicornia herbacea*, *S. arabica*, *Chenopodium setigerum*, *C. fruticosum*, belonging to this family; *Mesembryanthemum nudiflorum*, *Fucus vesiculosus*, and one or two others. M. Richard mentions that the best soda is obtained from *Chenopodium setigerum*, and some species of Salsola. It is from these that *Barilla*, which contains a purer soda than Kelp, is obtained.

Medicinal Properties. — *Chenopodium ambrosiodes*, (Mexican tea), is mentioned by Richard as stimulating and aromatic, and said to be antispasmodic. *C. Botrys* (Jerusasalem oak) is said to be a valuable expectorant. *C. olidum* is a popular antispasmodic. *C. anthelminticum* furnishes Worm-seed Oil, considered a good anthelmintic in North America. *Petiveria alliacea* is considered in Brazil a powerful sudorific.

There are no poisonous plants in this family. *Chenopodium olidum* is said to exhale ammonia during its growth.

ORDER XLV.

POLYGONEÆ.

Characters.—*Herbaceous* (seldom woody) *plants*, with alternate leaves, revolute in the early stage, and having stipules which form a thin membranous sheath (*ochrea*) round the stem; flowers small, greenish (sometimes coloured), often in clusters, sometimes unisexual; *calyx* inferior, monosepalous, in 3, 5, or 6 divisions, persistent; *stamens* in the bottom of the calyx, which is there lined with a perigynous disk, anthers dehiscing longitudinally; *ovary* superior, 1-celled, 1-seeded; ovule erect; stigmas 2 or 3, occasionally sessile, sometimes with styles; *pericarp* small, a triangular achenium, enveloped by the calyx, which is sometimes fleshy: albumen farinaceous, radicle remote from the hilum.

EXAMPLES.—Bistort or Snakeweed (*Polygonum Bistorta*), Rhubarb (*Rheum palmatum*), Sorrel (*Rumex acetosa*).

ECONOMICAL PROPERTIES.—The seeds of Buckwheat (*Polygonum Fagopyrum*) contain a considerable quantity of starch and gluten, and are used for being made into bread in Brittany and Normandy. In Iceland, the recent root of Bistort (*Polygonum Bistorta*) is eaten raw, or made into bread. In France the leaves of Sorrel are used for the table. The leaf-stalks of Rhubarb have a pleasant acid taste, and are much used for tarts.

MEDICINAL PROPERTIES.—The roots of many of this family are purgative, emetic, and astrigent. This latter property also resides in the young leaves; these have a sharp acidulous taste. *Polygonum Bistorta* has a place in the pharmacopœias as astringent and tonic; the root contains tannin, gallic acid, and oxalic acid. The fruit of *P. aviculare* is said to be emetic and cathartic. *P. amphibium* is said to have properties resembling sarsaparilla. The root of Water Dock (*Rumex aquaticus*) is powerfully astringent, and was formerly used in cases of scurvy, under the name of *Herba britannica*. The leaves of Common Sorrel (*R. acetosa*) are refrigerant and diuretic; they have an acid taste, and contain bin-oxalate of potassa and tartaric acid. M. Richard states, that they are an antidote to acrid substances, as a *ranunculus*, the effects of which they almost instantly neutralize. *R. acutus*, *R. scutatus*, *R. acetosella*, and several others, are used in the same way as Sorrel in different countries. Common Dock (*R. patientia*) is astringent, stomachic, and purgative, and is recommended by Dr. A. T. Thomson in ichthyosis. *R. crispus* and *R. obtusifolius* have similar properties. The most useful plant in the Polygoneæ is *Rheum palmatum*, the root of which furnishes rhubarb, a favourite and useful stomachic and purgative, and also astringent. Wave-leaved Rhubarb (*Rheum undulatum*) is also believed to furnish some of the rhubarb of commerce. There are three kinds of rhubarb, Russian, Turkey, and Chinese rhubarb. Its virtues are said to be dependent on a peculiar principle called *rheumine;* it also contains a yellow colouring matter called *rhabarbarine*, oxalate of lime, and gallic acid. Other species, as *R. Emodi*, *R. Webbianum*, *R. spiciforme*, *R. Rhaponticum*, *R. compactum*, *R. crassinervium*, possess similar properties. *Coccoloba uvifera* (sea-side grape), is powerfully astringent. It yields, on evaporating the decoction, a sort of Kino, (Jamaica Kino.) The fruit is edible. *Polygonum Hydropiper* has an acrid and caustic juice, and is also a rubefacient.

Officinal Plants.

Rheum palmatum.	Rumex acetosa.
Rheum undulatum.	Rumex aquatica.
Polygonum Bistorta.	

ORDER XLVI.

THYMELEÆ.

CHARACTERS.—Shrubs with alternate entire leaves, a monosepalous, tubular, petaloid, superior, 4- or 5-cleft calyx, sometimes persistent; corolla absent or scaly; stamens inserted in the tube, generally 8 or 4; ovary superior, 1-celled, 1-seeded; ovule pendulous; style and stigma simple; pericarp a drupe or achenium.

EXAMPLES.—Spurge Laurel (*Daphne Mezereum*), Passerina. *D. gnidium* and *P. tinctoria* furnish a yellow dye. The Lace-bark tree is a species of Daphne, *D. lagetto*, or now *Lagetta lintearia.*

MEDICINAL PROPERTIES.—The inner bark of several species of Daphne, especially *D. Mezereum*, and also the leaves and fruit, are extremely acrid and caustic, producing great heat in the mouth when chewed, and being even capable of exciting vesication when applied to the skin. *D. Mezereum* is a stimulating diaphoretic, but apt to excite vomiting and purging. *Daphne Laureola* (Spurge laurel), and *D. Gnidium* are of a similar character.

Officinal Plant.

Daphne Mezereum.

Poisonous Properties.—M. Richard states that, taken internally, the bark of *Daphne Gnidium* produces effects similar to those of the acrid and corrosive poisons: he considers it a very energetic poison. The berries of *D. Laureola* and of *D. Mezereum* are deemed poisonous.

ORDER XLVII

AMARANTHACEÆ.

This order contains the Amaranth, Gomphrena, &c. It is one of little interest. The leaves of some are mucilaginous.

ORDER XLVIII.

NYCTAGINEÆ.

This order contains the Marvel of Peru (*Mirabilis Jalapa*, or *Nyctago hortensis*), which was formerly supposed to be the Jalap plant. The roots of many are purgative.

II. MONOPETALEÆ.

Dicotyledonous plants with a monopetalous corolla.

I. HYPOCOROLLEÆ.

Monopetalous dicotyledonous plants with hypogynous stamens, mostly inserted in the corolla, and inferior ovaries.

49. Plantagineæ.
50. Plumbagineæ.
51. Primulaceæ.
52. Globularineæ.
53. Orobancheæ.
54. Scrophularineæ.
55. Solaneæ.
56. Acanthaceæ.
57. Jasmineæ.
58. Verbenaceæ.
59. Labiatæ.
60. Boragineæ.
61. Convolvulaceæ.
62. Bignoniaceæ.
63. Gentianeæ.
64. Apocyneæ.

ORDER XLIX.

PLANTAGINEÆ.

Characters.—*Herbs*, with ribbed leaves, mostly radical; *flowers* in spikes on a scape, hermaphrodite (rarely unisexual); *calyx* persistent, of 4 divisions; *corolla* tubular, 4-lobed; *stamens* 4, inserted into the corolla, and alternate with its segments, anthers versatile; *ovary* 2 (seldom 4) celled, with a filiform style: *pericarp* a 2-celled 2-valved capsule, with a transverse dehiscence.

Examples.—Greater Plantain (*Plantago major*), Plantain Shore-weed (*Littorella lacustris.*) The latter of these genera is monœcious, and its flowers are solitary.

Medicinal Properties.—The leaves and root of *Plantago major* are slightly astringent. The seeds of *P. arena-*

ria and *P. Psyllium* are emollient, and contain a large quantity of mucilage; they were at one time used for collyria. They are also used to prepare and stiffen muslins. *P. Ispaghula* is much used in India, from the emollient quality of the seeds.

There are no poisonous plants among the Plantagineæ.

ORDER L.

PLUMBAGINEÆ.

CHARACTERS.—*Herbs* or *shrubs*, with alternate or radical leaves sheathing at the base; *inflorescence* a spike, capitulum, or sort of panicle; *calyx* tubular and persistent, plaited; *corolla* of 5 divisions, (sometimes very deep, almost polypetalous); stamens 5; *ovary* superior, 1-celled, 1-seeded, ovule pendulous, attached to the apex of a filiform podosperm, which rises from the bottom to the top of the cell; styles about 5, with the same number of stigmas; *pericarp* a capsule, covered by the calyx, sometimes indehiscent, or dehiscing by 5 valves.

EXAMPLES.—Thrift (*Statice Armeria*, or *Armeria vulgaris*); *Armeria maritima* (Sea Gillyflower), Leadwort (*Plumbago europæ a*, Taxanthema.

MEDICINAL PROPERTIES.—Many of the plants in this family are acrid and astringent; *Statice caroliniana* (Marsh Rosemary) is said to possess the latter property in a high degree. *Armeria vulgaris* is an active diuretic. The fresh leaves and root of *Plumbago europæa* are extremely acrid and caustic; the leaves are employed in some cutaneous diseases. *P. scandens* is also very acrid, and is called *Herbe du Diable* in St. Domingo.—*Lindley*. *P. rosea* has similar properties.

ORDER LI.

PRIMULACEÆ.

CHARACTERS.—Herbaceous plants with the limbs of the calyx and corolla usually 5-cleft, stamens opposite the segments of the corolla, and 5 in number; a 1-celled ovary, with numerous ovules on a free central placenta, 1 style, a capitate stigma, and a dehiscent capsule.

EXAMPLES.—Primrose (*Primula vulgaris*), Water Violet (*Hottonia palustris*), Sow-bread (*Cyclamen europæum*), which is eaten in Sicily by the wild boars: this plant is generally deemed an acrid poison. This family is interesting chiefly for the beauty of its flowers, which has rendered the Cowslip (*Primula veris*) and Primrose such universal favourites.

ORDER LII.

GLOBULARINEÆ.

CHARACTERS.—Tetrandrous plants, with a bilabiate corolla, a 1-celled, 1-seeded ovary, and an indehiscent pericarp; inflorescence a capitulum.

EXAMPLE.—Blue Daisy (*Globularia*). The leaves of *Globularia alypum* are bitter and acrid, and deemed purgative.

ORDER LIII.

OROBANCHEÆ.

CHARACTERS.—Leafless, parasitic herbs, with brownish scales on the stem; a persistent corolla; 4 didynamous stamens; a 1-celled ovary, with 2 or 4 many-seeded parietal placentæ; and 1 style, with a 2-lobed stigma.

Examples.–Toothwort (*Lathræa squamaria*), Broom-rape (*Orobanche major*), which is parasitic on the roots of Broom and Furze.

ORDER LIV.

SCROPHULARINEÆ.

Personatæ, Linn.—*Pediculares* and *Scrophulariæ*, Juss.—*Antirrhinæ* and *Rhinanthaceæ*, De Cand.

Characters.—*Herbs* (rarely shrubs), with leaves mostly opposite, sometimes alternate or whorled; *flowers* in spikes or racemes, or axillary; *calyx* monosepalous, persistent, 4, but generally 5-cleft, often unequal; *corolla* deciduous, more or less irregular, imbricated in æstivation; *stamens* 2, or 4 didynamous, attached to the corolla; anthers 2, or by growth together, 1-celled; *ovary* superior, many seeded; style 1; stigma simple or two-lobed; *pericarp* a 2-celled capsule, dehiscing by 2 valves,—each sometimes bearing on the middle of its internal surface one part of the dissepiment, which is formed of the incurved margins of the valves,—by 4 valves,—or by pores at the upper part of each cell (*Antirrhinum*); seeds many, fixed to a central placenta, and having a fleshy albumen.

Examples.—Speedwell (*Veronica*), Snap-dragon (*Antirrhinum*), Foxglove (*Digitalis*), Yellow Rattle (*Rhinanthus*), Cow-wheat (*Melampyrum*). Many of the Scrophularineæ turn black in drying.

This family bears a considerable resemblance to the Solaneæ. The latter have alternate leaves, a regular corolla plaited in æstivation, and stamens equal in number to the lobes of the corolla. The Scrophularineæ have opposite leaves, an irregular corolla, imbricated in æstivation, and 2 or 4 didynamous stamens.

Medicinal Properties.—These are various, but most of the plants in this family are somewhat acrid. The leaves of Brooklime (*Veronica Beccabunga*) are bitter, acrid, and somewhat stimulant and diuretic; they are also deemed antiscorbutic. The leaves of *Veronica officinalis* are bitter and aromatic. *V. Chamædrys*, *V. teucrium*, and *V. spicata* have similar properties. The herbaceous part of Hedge Hyssop (*Gratiola officinalis*) is an active emetic, diuretic, and cathartic, "producing, in very large doses, all the effects of an irritative poison."—*Dr. A. T. Thomson.* Its properties reside in a bitter matter of a resinous character. Knotty-rooted Figwort (*Scrophularia nodosa*) has a place in the Pharmacopœias, as diuretic and sedative, and *S. aquatica* is purgative: they are seldom, if ever, used. The most notable plant in this family is Purple Foxglove (*Digitalis purpurea*); the leaves and seeds of this plant are powerfully sedative and diuretic, and the various preparations are deemed of great value when it is wished to diminish the force of the circulation, and lessen the heart's action. Its properties are said to depend on an alkaline principle, which has received the name of Digitaline. Eye-bright (*Euphrasia officinalis*) is bitter and slightly aromatic, and was formerly used in diseases of the eye. Linaria vulgaris (*Antirrhinum Linaria*) and *L. cymbalaria*, have been used as diuretic; the former as purgative also, the latter as antiscorbutic.

Officinal Plants.

Veronica Beccabunga.	Scrophularia nodosa.
Gratiola officinalis.	Digitalis purpurea.

Poisonous Properties.—*Gratiola officinalis* is characterised by M. Richard as a dangerous plant, and *Digitalis* is poisonous: it may be considered an acro-narcotic or sedative poison.

ORDER LV.

SOLANEÆ.

CHARACTERS.—*Herbs* or *shrubs*, with alternate undivided (sometimes lobed) leaves, and flowers variously arranged; *calyx* monosepalous, in 5 (rarely 4) divisions, more or less deep, persistent; *corolla* with a plaited æstivation, rotate, funnel-shaped, or campanulate, with the limb 5-cleft, (rarely 4), regular (except in Verbascum); *stamens* 5, (occasionally 1 somewhat abortive), inserted in the corolla, and alternate with its segments; anthers dehiscing longitudinally, occasionally by pores at the apex; *ovary* 2-celled, with 2 many-seeded placentæ; style and stigma simple; *pericarp* a 2-celled 2-valved capsule (Datura is 4-celled and 4-valved), or a berry 2-celled; or with many cells from enlargements of the placenta; embryo curved, in the interior of a fleshy albumen; radicle next the hilum.

Nolana has a 5-lobed ovary, each lobe having 1 or 2 1-seeded cells. *Nicotiana multivalvis* has several cells external to the 2 central ones of the ovary.

EXAMPLES.—Henbane (*Hyoscyamus niger*), Deadly nightshade or Dwale (*Atropa Belladonna*), Potato (*Solanum tuberosum*), Tobacco (*Nicotiana Tabacum*).

ECONOMICAL PROPERTIES.—The Potato is the fleshy tuber which grows on the roots or subterraneous branches of *Solanum tuberosum*. It consists almost entirely of a nutritious fecula, but is said to contain an acrid or narcotic principle; this, however, is in a very small proportion, and is dissipated by heat, as in boiling or roasting. The tubercles of *S. montanum* and *S. Venezuelæ* are of a similar nature.—*Richard*. The same author informs us, that in some countries the leaves of *S. nigrum* are boiled and eaten in the same manner as Spinach, and that the fruit is also much used in some places. The fruit of the Egg-plant (*Solanum melongena* or *S. esculentum*) is much used as an article of food in the West Indies, and in some provinces in France. The fruit of *S. lycopersicum* (Tomato or Love-apple) is frequently used for sauces; and the fruits of other species of Solanum, belonging to the Tomato section, are eatable. All these, however, are exposed to heat before being eaten, to expel a volatile poisonous matter. "It is stated that the poisonous species derive their properties from the presence of a pulpy matter which surrounds the seeds; and that the wholesome kinds are destitute of this pulp, their fruit consisting only of what botanists call the Sarcocarp; that is to say, the centre of the rind in a more or less succulent state." —*Lindley*. The dried berries and seeds of *Capsicum annuum* are known by the name of Cayenne Pepper; they are hot, pungent, and aromatic, and are used as a condiment. *C. frutescens* and *C. baccatum* have similar properties. The fruit of the Winter Cherry (*Physalis Alkenkengi*) is also used as a condiment. Tobacco is procured from several species of Nicotiana.—American from *N. Tabacum*—Persian, from the *N. persica*—that grown in Turkey and Syria from *N. rustica*.

Medicinal Properties.—The general character of this family, in a medicinal point of view, is narcotic. The root and leaves of *Atropa Belladonna* are powerfully narcotic. Mr. Brandes discovered in this plant an alkali (*Atropia*), on which its narcotic properties depend, so extremely powerful, that the utmost caution is required in experimenting with it. The chief use of Belladonna is to dilate the pupil before the operation for cataract: abroad, it is used in hooping-cough. The herb and seeds of Henbane (*Hyoscyamus niger*) are also narcotic, and used in the same way as opium, where the use of the latter is inadmissible; the plant contains a peculiar alkali (*Hyoscyama*.) *H. albus* and *H. aureus* have similar properties. The extreme twigs of Woody Nightshade or Bitter-Sweet (*Solanum Dulcamara*) and *S. nigrum*, are narcotic, diaphoretic, and diuretic, but little used: an excellent bitter and tonic, said to be nearly equal to that of Cinchona, is obtained from the *Solanum pseudo-quina*. Solanum also contains a vegetable alkali (*Solanine*). The herb and seeds of Thorn Apple (*Datura Stramonium*) are of a somewhat similar nature; smoking the plant has been recommended during the paroxysm of asthma. Mr. Brandes has found in *D. Stramonium* a vegetable alkali (*Daturine*), on which its properties seem to depend. *Datura Tatula* and *Datura ferox* have similar properties. *Physalis somnifera* is narcotic. The fruit of the Winter Cherry (*Physalis Alkenkengi*), is diuretic. The leaves of the Tobacco plant, (*Nicotiana Tabacum*) are narcotic, catharic, emetic, diuretic, or errhine, according to the mode in which they are employed. Their use in the form of snuff or for smoking, is well known. The fruit of *Capsicum annuum* is an active stimulant and carminative, and is said to be destitute of any narcotic property. The leaves of the Mullein (*Verbascum Thapsus*) are gently anodyne and emollient.

Officinal Plants.

Atropa Belladonna.	Nicotiana Tabacum.
Solanum Dulcamara.	Verbascum Thapsus.
Hyoscyamus niger.	Capiscum annuum.
Daturus Stramonium.	

Poisonous Properties.—All the plants of the above list, except the two last and perhaps *Solanum Dulcamara*, are violent narcotic poisons. The Mandragore, a powerful poison, is a species of Atropa (*A. mandragora*:) the root is the most dangerous part of the plant, but the fruit is also poisonous. The berries of the *A. Belladonna* have sometimes proved fatal to children. The volatile oil obtained from the leaves of Tobacco is a most virulent poison, and used by the Hottentots to poison snakes: its effects, when applied to the tongue, are almost instantaneous.

ORDER LVI.

ACANTHACEÆ.

Characters.—This family resembles the Scrophularineæ. They are distinguished by having bracteæ (3) to each flower, an imbricated calyx, a bilabiate corolla, a capsule dehiscing with elasticity into 2 valves, and an embryo with large cotyledons, and no albumen. The cells of the ovary are 2, and 2 or many-seeded; ovary in a circular disk; stamens 2, or 4 didynamous.

Acanthus mollis is considered emollient; and several species of *Justicia* are reckoned stomachic and antispasmodic.

ORDER LVII.

JASMINEÆ.

Jasmineæ and *Oleaceæ*, Lindley.—*Oleineæ.*

Characters. — *Trees* or *shrubs*, with opposite leaves, simple or pinnate, and having their inferior surfaces often dotted; *inflorescence* a raceme, panicle, or corymb; *flowers* occasionally diœcious; *calyx* monosepalous, of 4 or 5 teeth or divisions, persistent; corolla regular, with a limb of about 4 or 5 (or 8) divisions; *stamens* 2, inserted in the corolla; *ovary* 2-celled, each cell 2-seeded (or 1 seeded); style 1; stigma 2-lobed or bifid; *pericarp* a capsule of 2 cells, each containing 1 or 2 seeds, or a berry or drupe, with from 1 to 4 minute nuts.

Examples.—Lilac (*Syringa vulgaris*), Privet (*Ligustrum vulgare*), Ash (*Fraxinus excelsior*), Olive (*Olea europæa*), Jessamine (*Jasminum officinale*). The *Jasmineæ* are mostly twining, have erect ovules, corolla imbricate in æstivation, of 5 or more divisions, and have little albumen in the seed. The *Oleaceæ* have pendulous ovules, corolla valvate in æstivation, and of 4 divisions, and a large fleshy albumen.

Economical Properties.—Olive Oil is the expressed oil of the pericarp of *Olea europæa*, and is the only instance (except Melia, and the orange tribe,) of a fixed oil being procured from the pericarp; fixed oils are almost always contained in the seed. In some parts of Italy the manna which exudes from the Ornus europæa (*Fraxinus Ornus*) is used instead of sugar. The Chinese give Tea an aromatic flavour by the leaves of the *Olea fragrans*. Oil of Jessamine is the produce of *Jasminum officinale* and *J. grandiflorum*.

Medicinal Properties.—Olive oil is demulcent and laxative; it is mostly employed as a vehicle for more active medicines, or for ointments. The leaves are bitter and astringent, and have been recommended as a substitute for bark by M. Didot. The young capsules of *Syringa vulgaris* are said to be tonic and febrifuge.—*Richard.* The leaves of Common Ash (*Fraxinus excelsior*) have similar properties. Manna is an agreeable laxative, but principally used along with other medicines: it is obtained from the *Fraxinus rotundifolia* as well as from *F. Ornus* (Ornus r. and Ornus europæa.) The flowers of White Jessamine (*Jasminum officinale)* were formerly used as antispasmodic; they have an agreeable aromatic perfume.

Officinal Plants.

Olea europæa.
Ornus europæa (Fraxinus Ornus.)

ORDER LVIII.

VERBENACEÆ.

Characters.—Trees, shrubs, or herbs, with opposite or whorled leaves, corolla irregular, often bilabiate, stamens 2, or 4 didynamous; ovary 2- or 4-celled, each cell 1-seeded; pericarp a minute capsule, or a drupe or berry, indehiscent, with 2 or 4 cells, each 1-seeded.

Examples. — Vervain (*Verbena officinalis*), Teak-tree (*Tectona grandis.*) Vervain is emollient, but scarcely ever used: it was highly prized by the ancients as a remedy for a variety of diseases.

ORDER LIX.

LABIATÆ.

Characters.—*Herbs*, or *shrubs*, with a quadrangular stem, opposite leaves containing much aromatic volatile oil, and *flowers* in axillary whorls: *calyx* monosepalous, tubular, with 5 or 10 teeth or divisions, somewhat bilabiate, persistent; *corolla* tubular, bilabiate, the upper lip entire or bifid, the lower one 3-lobed, and larger than the other; *stamens* inserted in the tube of the corolla, 2, or more often 4 didynamous; anthers 2 celled, or 1-celled from confluence, or 1 being abortive; *ovary* deeply 4-lobed, each lobe 1 seeded; style simple, and stigma bifid; a fleshy disk at the base of the ovary; ovule erect; *pericarp*, consisting of 4 indehiscent acheniums, each 1-seeded, enveloped by the calyx.

Examples.—Spearmint (*Mentha viridis*), Lavender

(*Lavandula vera*), Meadow Clary or Sage (*Salvia officinalis.*)

These plants resemble the BORAGINEÆ. The LABIATÆ are distinguished by the square stem, the oil in the leaves, the stamens 2 or 4, the irregular corolla, and the leaves opposite. The BORAGINEÆ have round stems, leaves rough with hairs or bristles, and alternate, the corolla usually regular, and stamens generally 5.

ECONOMICAL PROPERTIES.—All the plants in this family contain an aromatic volatile oil, and many of them are used as condiments or seasonings, as Spearmint (*Mentha viridis*), Thyme (*Thymus vulgaris*), Savory (*Satureia hortensis*), Basil (*Ocymum basilicum*), Sweet Marjoram (*Origanum Majorana*). Others also might be used, but these are preferred. Lavender Water, according to M. Richard, is prepared from *Lavandula vera*. Dr Hooker states that Wood Germander (*Teucrium scorodonia*) has been sometimes substituted for Hops: it is very bitter.

MEDICINAL PROPERTIES.—The Labiatæ are characterised by their strong penetrating odour, owing to the volatile oil which exists in almost every part of the plant, and renders them stimulant and carminative, and by a bitter quality dependent on a gum-resinous matter, and which gives them tonic virtues. The latter quality is predominant in Wood Germander (*Teucrium scorodonia)*, and in Yellow Bugle (*Ajuga chamæpitys)*. Their general character is stimulant and carminative, and a few are deemed antispasmodic, as Peppermint (*Mentha piperita.*) *Oil of Spearmint*, and *Spearmint water*, are prepared from *M. viridis*. *Oil of Thyme* is prepared from *Origanum vulgare* (Wild Marjoram). Ground Ivy (*Glechoma hederacea*, or *Nepeta h.*), has a popular reputation as a pectoral. Rosemary is said to be used in preparing *Hungary water* and *Eau de Cologne*. The oil of Rosemary is frequently used for liniments; the oil of *Origanum majorana* is very acrid; *Hyssopus officinalis* and *Satureia montana* also are acrid. The following are the plants of this family mentioned by the pharmacopœias; they are not much used.

Officinal Plants.

Mentha viridis.
——— piperita.
——— Pulegium (Penny-royal)
Origanum vulgare (Common Marjoram.)
———— Majorana.
Salvia officinalis (Garden Sage.)
Hyssopus officinalis (Common Hyssop.)
Lavandula Spica (L. vera.)
Marrubium vulgare (White Horehound.)
Melissa officinalis (Common Balm.)
Rosmarinus officinalis (Rosemary.)

There are no poisonous plants among the Labiatæ.

ORDER LX.

BORAGINEÆ.

Asperifoliæ, Linn.

Characters.—*Herbs* (rarely shrubs) with round stems and alternate leaves, which are covered with stiff hairs, arising from a hard and persistent base. *Flowers* often in unilateral spikes or racemes, sometimes axillary and solitary: *calyx* monosepalous, of 5 (seldom 4) divisions more or less deep, persistent; *corolla* mostly regular, 5- (rarely 4-) cleft, with imbricated æstivation, often with 5 appendages at the orifice of the tube; *stamens* inserted in the corolla, of the same number as, and alternate with, its segments; *ovary* superior, 4 lobed, each lobe or cell 1-seeded, ovules pendulous, style 1, stigma simple or 2-lobed; *pericarp* sometimes a 4-celled 4-seeded berry or capsule, mostly of 4 acheniums, separate, or united at the base; seed destitute of albumen.

See Labiatæ for the distinctions between Boragineæ and Labiatæ.

Examples.—Viper's Bugloss (*Echium vulgare*), Borage (*Borago officinalis*), Common Comfrey (*Symphytum officinale.*) *Anchusa tinctoria*, *Onosma echioides*, *Lithospermum tinctorium*, and *Echium rubrum*, are used by dyers; their roots are known by the name of *Orcanette.—Richard.*

Medicinal Properties.—These are not of much interest. The roots and leaves of the Boragineæ contain a considerable quantity of mucilage; and this seems to be the leading character of the order. Hound's Tongue (*Cynoglossum officinale*) is emollient, and anodyne from a narcotic principle. *Borago officinalis* is emollient and slightly diaphoretic and diuretic; it contains nitrate of potassa. Comfrey (*Symphytum officinale* and *S. tuberosum*) contains mucilage very abundantly. Lungwort (*Pulmonaria angustifolia*) resembles Borage in its properties. Dyers' alcanet (*Anchusa tinctoria)* has a place in the pharmacopœias, but is only used as a colouring matter for oils and ointments.

Officinal Plant.

Anchusa tinctoria.

ORDER LXI.

CONVOLVULACEÆ.

Characters.—*Herbs* or *shrubs*, often milky, with slender twining stems, and alternate leaves without stipules; *flowers axillary* or terminal; calyx of 5 deep divisions, persistent, imbricated, sometimes unequal; *corolla* regular, generally plaited, with the limb entire or 5-lobed; *stamens* 5, inserted in the lower part of the corolla, and alternate with its lobes; *ovary* simple, 1- to 4-celled, each cell having a few erect ovules; style simple, or of several divisions; *a disk* present; *pericarp* a capsule, 1- to 4-celled, enveloped by the calyx; embryo curved, in a mucilaginous albumen, and with the cotyledons plaited or shrivelled.

This family is distinguished from the Boragineæ by the plaited corolla, capsular pericarp, structure of the embryo, and twining habit.

Examples.—Bindweed (*Convolvulus sepium*), Dodder (*Cuscuta Epithymum.*)

Economical Properties.—The Sweet Potato is the root of *Convolvulus Batatas;* it contains an abundant quantity of starch, being used as an article of food, and is destitute of that resinous principle and violent purgative quality which reside in the roots of most of the Convolvulaceæ; the root of *C. edulis* is also edible.

Medicinal Properties.—The valuable properties found in this family reside in the genus Convolvulus. The roots contain an acrid juice, which, when dried in the sun, furnishes a resinous matter, as in the Scammony (*C. Scammonia),* which is a well known and powerful cathartic. The powdered root of Jalap, formerly referred to *Convolvulus Jalapa* (Ipomæa macrorhiza), now to *Ipomæa Jalapa* (I. purga), is another valuable cathartic obtained from this family. Turbith root, obtained from *Ipomæa Turpethum*, or *C. Turpethum*, is also a drastic purgative; and M. Richard states that *C. mechoacan*, *C. sepium*, *C. Soldanella*, *C. althæoides*, and *C. arvensis*, have similar properties.

Convolvulus sepium and ***C. Soldanella*** are now placed in the genus ***Calystigia.*** ***Convolvulus Turpethum, C. Jalapa*** are now ***Ipomæa T.*** and ***Ipomæa macrorhiza.*** The latter is said not to possess any purgative properties. *Ipomæa orizabensis*, *I. tuberosa* and *I. cathartica* possess properties similar to Jalap. The *Mechoacan root*, used as a gentle purgative in Mexico, is considered to belong to some species of *Ipomæa*. *Pharbitis nil* (Convolvulus nil), has a cathartic power in the seeds, from which it is used in India.

Officinal Plants.

Convolvulus Jalapa (or Ipomæa Jalapa.)
Convolvulus Scammonia.

ORDER LXII.

BIGNONIACEÆ.

An order of little interest, except for the beauty of their flowers; the Trumpet flower (*Bignonia chica*) is an example. The corolla is irregular, the capsule 2-celled with a central many-seeded placenta, and seeds winged.

ORDER LXIII.

GENTIANÆ.

Characters.—*Herbs* (rarely shrubs) with opposite entire ribbed, often sessile leaves; *flowers* axillary or terminal; *calyx* monosepalous, usually of 5 divisions, persistent; *corolla* regular, tubular, usually of 5 lobes, or the same number as those of the calyx, æstivation twisted and imbricated, persistent; *stamens* generally 5, inserted upon the corolla, and alternate with its segments; *ovary* simple, 1- or 2-celled, many-seeded; style simple or bifid; stigma 2-lobed, or 2 stigmas; *pericarp* a 1- or 2-celled, many-seeded berry, or capsule, generally 2-valved, with a central placenta when there are 2 cells, and 2 parietal placentæ where there is only 1 cell.

The Gentianæ resemble the Apocyneæ considerably. The former are distinguished by being generally herbs, having a persistent corolla, with an imbricated æstivation, pericarp a capsule, and no milky juice.

EXAMPLES.—Centaury (*Erythræa Centaurium*), Buckbean or Marsh Trefoil (*Menyanthes trifoliata*) Field Gentian (*Gentiana campestris*).

MEDICINAL PROPERTIES.—Bitterness is the prevailing property of this order; the plants it contains are generally tonic and stomachic. Yellow Gentian (*Gentiana lutea*) is much employed in medicine on account of these valuable qualities; the root is the part used. *G. purpurea*, *G. punctata*, and *G. pannonica* possess similar properties, and are used in Germany; and *G. Amarella*, *G. cruciata*, *G. campestris*, and *Menyanthes trifoliata* are also bitter, and sometimes used. *G. Catesbæi* is used in North America as a substitute for *G. lutea*. *Erythræa Centaurium* is the *centaury* of the pharmacopœias; the flowering tops are the parts used, and are deemed antiseptic as well as bitter. *Menyanthes trifoliata* is also reckoned diuretic and purgative; the leaves are the officinal parts. Worm-grass (*Spigelia marilandica*) is purgative and anthelmintic. *Frazera carolinensis* has the properties of *calumba* root.

Officinal Plants.

Gentiana lutea.
Erythræa Centaurium.
Menyanthes trifoliata.
Spigelia marilandica.

ORDER LXIV.

APOCYNEÆ.

Apocyneæ and *Asclepiadeæ,* Lindley; *Strychneæ,* De Cand.; *Vinceæ,* De Cand.

Characters.—Milky *herbs*, *shrubs*, or *trees*, with entire opposite or whorled leaves without stipules, but with glands or ciliæ on the petioles; *flowers* in a sort of corymb, umbel, or raceme: *calyx* monosepalous, of 5 divisions, persistent; *corolla* monopetalous, 5-lobed, sometimes with appendages at the orifice of the tube, deciduous; *stamens* 5, inserted upon the corolla, alternate with its segments, sometimes monadelphous and surrounding the ovary, the anthers close to the stigma; pollen sometimes pulverulent, sometimes united in masses, occasionally adhering to some projections of the stigma; *ovaries* 2 (rarely 1 from the union of the two), many-seeded, with the seeds attached to a longitudinal placenta at the ventral suture of each cell; styles sometimes united at the apex into 1 stigma, often short; *pericarp* a follicle, of which there are 2, a drupe or capsule, (rarely a berry), dehiscing by a longitudinal suture; seeds with an embryo in a small fleshy albumen, some having an appendage of downy hairs.

This family has been divided into two sections; the *Asclepiadeæ*, which have the stamens united, the orifice of the corolla with five appendages, the æstivation imbricate, and the pollen in masses; and the true *Apocyneæ*, with the stamens distinct, the orifice of the corolla generally naked, the æstivation twisted, and the pollen pulverulent.

Examples.—1. *Asclepiadeæ;* Swallow-wort (*Asclepias*), *Cynanchum*, Mudar plant (*Calotropis Mudarii*, or *C. gigantea*): 2. *Apocyneæ;* Periwinkle (*Vinca major*) Dog's-bane (*Apocynum*), *Strychnos Nux-vomica*, *Urceola elastica.*

Economical Properties. — "We find some nutritious plants in this family; but these are always among the herbaceous species, at an early period of their growth, when the ascending sap, formed of an abundant aqueous juice, has not yet been formed into proper juice by the operation of vegetation. Thus, in some countries, they eat the young shoots of *Periploca esculenta*, (*Apocynum indicum*) *Asclepias aphylla*, &c. It is the same with the pulpy fruits of some plants of this family. The greater part of them are acrid and poisonous, but notwithstanding some are very agreeable eating, as the *Couma* and the *Carina edulis* in Nubia, the *Strychnos pseudo-quina* in Brazil."—*Richard*." The pulp of the fruit of *Strychnos Nux-vomica* is said to be eaten without any injurious consequences. The Hyahya or Milk-tree of Demerara is the *Tabernæmontana utilis* of this order. Caoutchouc is obtained from it, and abundantly from *Urceola elastica*. *Asclepias lactifera* yields abundantly a milky juice, used as food by some Indians. The Kiriaghuna plant (*Gymnema lactiferum*, or Cow-plant of Ceylon), also furnishes a nutritious milk.

Medicinal Properties.—These are various. Most of the plants in this family contain an acrid milky juice, and furnish valuable medicines in India, Africa, and America. Some are emetic, others purgative, others bitter and tonic, and some are narcotic. The leaves of *Cynanchum Argel*, or *C. oleæfolium* are often mixed with senna, and they possess similar properties. The concrete juice of *C. monspeliacum* is violently purgative, and is sometimes called Scammony of Montpellier. Dog's-bane (*Apocynum androsæmifolium*), is tonic and emetic. *Periploca Secamone* (*Secamone Alpini*) furnishes Smyrna Scammony. The roots of *C. Ipecacuanha* and *Asclepias curassavica* are sometimes used instead of the true Ipecacuanha root. The leaves of Periwincle (*Vinca major* and *V. minor*) are gently purgative and diuretic. The *Strychnos Nux-vomica*, or Rat's-bane, is the only officinal plant in this family. The seeds are the part used, and are powerfully stimulant, exerting their action chiefly on the nervous system. The vegetable alkali Strychnia is procured from them, and this is considered the best form for the exhibition of the medicine. In the plant it is in combination with Igasuric acid. St. Ignatius' Bean (*S. Ignatia*) is much less active, and has been used in cholera in India. The bark of *S. pseudo-quina* is astringent and bitter, and resembles quassia and gentian : it is much employed as tonic and febrifuge in Brazil. The wood of the root of *Strychnos colubrina* is the *Lignum colubrinum* esteemed in India as a cure for the bite of snakes and intermittent fevers. The *Lignum colubrinum*, formerly esteemed as a cure for paralysis, was procured from the *Strychnos ligustrini*. The root of the Yercum or Mudhar plant (*Calotropis gigantea*, or *Asclepias g.*) is much used in India as an alterative, stimulant, and sudorific. Dr Duncan has discovered in it a peculiar principle, which he has called *mudarine*. For a full account of the uses of the various plants in this useful and interesting family, I must refer to Dr. Ainslie's Materia Indica.

Officinal Plant.

Strychnos Nux-vomica.

Poisonous Properties.—The acrid juice in which the plants of this family abound is, in many cases, extremely poisonous. The leaves, bark, and wood of the Oleander or Rose-bay (*Nerium oleander*) possess an extremely subtile and powerful poisonous principle, which, it is said, has proved fatal to persons who have merely been exposed to the emanations of the tree for some time. The root of *Nerium odorum* is also poisonous The seeds of *Strychnos Nux-vomica* are poisonous in a high degree: the poison seems to exert its action chiefly on the spinal marrow and muscles connected with it, producing locked jaw and tetanus, and spasmodic contractions of the heart and arteries. The active principle is the vegetable alkali Strychnia, which exerts a powerful action on the animal economy even in very small doses. St. Ignatius' bean (the fruit of *Strychnos Ignatia*), *S. colubrina*, and the *Upas tieute*, (with which the Javanese poison their arrows), owe their poisonous properties to the presence of Strychnia. The *Upas tieute* is said to be a species of Strychnos. The seeds of the Tanghin tree (*Cerbera Tanghin*) and *C. Manghas*, which grow, the first in Madagascar, the second in the East Indies, are powerful poisons. *Camerarea latifolia* (Bastard Manchineel) yields a juice which is said to be highly poisonous.

2. PERICOROLLEÆ.

Monopetalous dicotyledonous plants, with perigynous stamens.

65. Styraceæ. 66. Ericineæ.
67. Campanulaceæ.

ORDER LXV.

STYRACEÆ.

Diospyreæ, Rich.

Characters. — *Trees* or *shrubs* with simple alternate leaves without stipules, and axillary flowers and scaly bracteas; *calyx* monosepalous, sometimes entirely free (hypogynous), sometimes united by its base or altogether with the ovary, of 4 or 5 unequal divisions, persistent; *corolla* imbricate in æstivation, divided; *stamens* inserted on the corolla, with the filaments sometimes irregularly united by the base; anthers innate; *ovary* sometimes superior, sometimes inferior or semi-inferior, generally 4-celled (3 or 5), each cell having 2 or 4 ovules, of which half are erect, the others pendulous: style simple, generally with a 4-lobed stigma: *pericarp* dry or fleshy, enclosed in the calyx, sometimes with 3 or 4 1-seeded cells, or with 1 cell, 1-seeded by abortion; embryo long, contained in a hard or horny albumen.

Examples.—Benjamin-tree (*Styrax Benzoin*), *Symplocos*, *Alstonia*, Indian Date Plum (*Diospyros*).

Medicinal Properties. — The balsam called Storax exudes from incisions in the bark of *Styrax officinale:* it consists of resin and benzoic acid, and is expectorant, but little used except for its fragrance. Gum benzoin, which contains a large quantity of benzoic acid, is obtained in a similar manner from *Styrax Benzoin*, and is of a similar medicinal character.

Officinal Plants.

Styrax officinale.
Styrax Benzoin.

ORDER LXVI.

ERICINEÆ.

Ericineæ and *Vaccineæ*, Richard's Histoire Naturelle Medicale; *Ericæ* and *Rhododendra*, Juss.

Characters.—*Arbuscles* or *shrubs*, with alternate opposite, or whorled leaves, without stipules; *flowers* mostly in spikes or racemes; *calyx* monosepalous, of 4 or 5 teeth or lobes, sometimes adhering to the ovary (superior), and persistent; *corolla* regular, of 4 or 5 divisions, (sometimes deep, the corolla appearing polypetalous), imbricated in æstivation; *stamens* 8 or 10. inserted at the base of the perigynous corolla, and having 2 awl-shaped appendages or horns at the base or apex of the 2-celled anthers; anthers dehiscing by pores; *ovary* sometimes free, sometimes adhering to the calyx, generally of 4 or 5 many-seeded cells, with one style and 1 stigma; *pericarp* a 4- or 5-celled 4- or 5-valved capsule, often accompanied by the calyx, many-seeded, with central placentæ, or a 4- or 5-celled berry, crowned by the teeth of the persistent calyx; seeds minute, with a fleshy albumen.

The true Ericineæ have a superior ovary, and a capsular pericarp. The Vaccineæ have an inferior ovary (adhering to the calyx), and the pericarp a succulent berry: perhaps the Vaccineæ might be placed under Epicorolleæ.

Examples. — Ericineæ; the Rhododendrons, Azalea, Winter-green, Bearberry (*Arbutus*), Heath (*Erica*): Vaccineæ; Bilberry (*Vaccinium myrtillus).*

Economical Properties.—The use of Cranberries for tarts, &c. is well known; they are the berries of *Vaccinium Oxycoccos* (*Oxycoccos palustris)*, and *V. macrocarpum*. The Bilberry or Whortleberry (*V. myrtillus*) is much eaten in the Scottish Highlands. The berries of the Strawberry-tree (*Arbutus Unedo*) are eaten in some places, and wine is made from them. In Canada the leaves of *Ledum palustre* are used by the hunters in lieu of tea.—*Dr. Hooker.*

Medicinal Properties.—A sharp, sour, or bitter taste, is the characteristic of almost all the organs of the plants which compose the Ericineæ, and they are generally diuretic and astringent. The leaves of Bearberry, *Arctostaphylos Uva-ursi* (*Arbutus uva-ursi*), are tonic, diuretic, and astringent, and contain tannin and gallic acid. The herb of Winter-green (*Pyrola umbellata* or *Chimaphila u.*) is diuretic and tonic, and much used in North America. The leaves of Golden-flowered Rhododendron (*R. chrysanthum*) are astringent, bitter, and narcotic. This, and another species, *R. ferrugineum*, are much used in Russia. *Rhododendron maximum* (American Rose-bay) is astringent, and said to be a narcotic poison.

Officinal Plants.

Arctostaphylos uva-ursi (Arbutus uva-ursi.)
Chimaphila corymbosa (*Pyrola umbellata*).
Rhododendron Chrysanthum.

Poisonous Properties.—The acridity of *Kalmia latifolia* is so great as to render it poisonous. The honey which bees prepare from the materials they find in the flowers of *Azalea pontica*, is reported, both by ancient and modern authors, to be poisonous. M. Richard also mentions *Ledum palustre* and *Andromeda mariana* as dangerous; *A. ponticum* and *A. maximum* are to be suspected. Ledum is said to be very narcotic.

ORDER LXVII.

CAMPANULACEÆ.

Lobeliaceæ and *Campanulaceæ*, Lindley.

Characters.—*Herbs* or *shrubs*, with a milky juice; leaves alternate, without stipules, simple; *calyx* 5-lobed, persistent; *corolla* monopetalous, inserted in the calyx, 5-lobed or 5-cleft, persistent, *stamens* on the calyx, alternate with the lobes of the corolla (anthers cohering in Lobeliaceæ); *pericarp* a capsule, 1 or more celled, many-seeded, dehiscing at the sides or apex.

This Order is exemplified in Bell-flower (*Campanula*), Rampion (*Phyteuma*), and Lobelia. It possesses little interest, except for the beauty of some of the species, as Bell-flower. *Lobelia tupa*, *L. longiflora*, and several other species, are said to be poisonous. *Lobelia siphilitica* and *L. inflata* (Indian Tobacco) are now used medicinally. They are acrid, narcotic, and emetic. The latter has acquired a reputation in Asthma.

Officinal Plant.

Lobelia inflata.

3. EPICOROLLEÆ.

Monopetalous dicotyledonous plants, with epigynous stamens.

Orders.

68. Compositæ.
69. Dipsaceæ.
70. Valerianeæ.
71. Rubiaceæ.
72. Cinchonaceæ.
73. Caprifoliaceæ.
74. Loranthеæ.

ORDER LXVIII.

COMPOSITÆ.

Synanthereæ, Rich.—*Syngenesia*, in the artificial system of Linnæus.

Characters.—*Herbs* or *shrubs*, with alternate (rarely opposite) leaves, without stipules; *flowers* very minute, united in a head or capitulum on a common receptacle, surrounded by an involucre, unisexual or hermaphrodite, sometimes neuter; *calyx* closely united to the ovary, incorporated with it, and generally terminating in several epigynous hairs or feathers, called *pappus; corolla* ligulate or tubular, with 4 or 5 teeth, generally deciduous; *stamens* 5, with the filaments distinct, but the anthers united, and forming a hollow cylinder surrounding the style; *ovary* inferior, 1-celled, with 1 erect ovule, and 1 style with a bifid stigma; *pericarp* an achenium, dry and indehiscent, often crowned by the limb of the calyx expanded into a feathery plume, or consisting of a scaly border.

This very natural and extensive family has been divided into three tribes; the Cynarocephalæ (Carduaceæ, Rich.), Cichoraceæ, and Corymbiferæ.

1. CYNAROCEPHALÆ.—In this tribe the florets of the capitulum are all tubular *(flosculous):* Thistle (*Carduus*), Artichoke (*Cynara*) are examples.

2. CICHORACEÆ.—In this tribe all the florets are ligulate (*semi-flosculous*), as in Lettuce (*Lactuca*), Dandelion *(Leontodon)*.

3. CORYMBIFERÆ.—In this tribe the florets are tubular in the centre, and ligulate in the circumference of the head or capitulum, which is then called radiate; as in Daisy (*Bellis*), Sun-flower (*Helianthus*).

Another division is now added, *bilabiate*, in which the corolla is 2-lipped—called MUTISIACEÆ.

ECONOMICAL PROPERTIES.—These are of little interest in this family. Among the Corymbiferæ we have Jerusalem Artichoke (*Helianthus tuberosus*) the tubers of which form a wholesome article of diet; and Tansy *(Tanacetum vulgare)*, the leaves of which have an agreeable aroma, and are used for seasoning. Among the Cynarocephalæ, we have the Artichoke (*Cynara Scolymus*), the fleshy receptacle of the young flower of which is deemed a luxury. Among the Cichoraceæ, we have Lettuce, a cooling and agreeable salad, the leaves of *Lactuca sativa;* Endive (*Cichorium endivia*) also a favourite salad; and Succory or Chiccory (*Cichorium Intybus*), the leaves of which are used as a salad, and the dried root has been recommended as a substitute for Coffee.

MEDICINAL PROPERTIES.—Bitterness is the leading character of the plants of this family. They are generally tonic and stimulant, and contain a bitter milky principle, (the nature of which is little known) and an aromatic volatile oil, sometimes solid and concrete, resembling camphor; this volatile oil is found in greatest abundance in the *Corymbiferæ*.

The tribe *Corymbiferæ* contains Common Chamomile (*Anthemis nobilis*), the flowers of which are tonic, stomachic, and even emetic; Pellitory of Spain (*Anthemis Pyrethrum*, or *Anacyclus P.*) the root of which is stimulant and sialagogue; Leopard's-bane (*Arnica montana*) a very active medicine, its leaves and flowers being stimulant, diaphoretic, and narcotic, and emetic and cathartic in large doses, while the root is tonic and aromatic; Tartarian Southernwood or Wormseed (*Artemisia Abrotanum*), the tops and seeds of which are tonic and anthelmintic; Common Wormwood (*Artemisia Absinthium*), the leaves and tops of which have similar medicinal virtues, and are said also to have a narcotic property: *Artemisia Moxa*, the downy parts of the leaves of which form the Chinese Moxa; Elecampane (*Inula Helenium*), the root of which is tonic, diuretic, and expectorant; Tansy (*Tanacetum vulgare*), the leaves of which are reckoned tonic and anthelmintic; and Colt's-foot (*Tussilago Farfara*), the leaves and flowers of which are demulcent and expectorant.

There are only two medicinal plants among the *Cynarocephalæ*, Burdock (*Arctium Lappa* or *Lappa Minor*), the seeds and root of which are said to be diuretic and diaphoretic, and Blessed Thistle (*Centaurea benedicta* or *Cnicus benedictus*) the leaves of which are tonic, diaphoretic, or even emetic, according to the dose: Common Star Thistle (*Centaurea Calcitrapa*) is extremely bitter.

The *Cichoraceæ* abound in a milky juice, which is very bitter, and often narcotic. The milky juice of the Garden Lettuce (*Lactuca sativa*) is the *Lactucarium* of the Edinburgh Pharmacopœia, the medicinal properties of which are similar to those of opium. The expressed juice of Strong-scented Lettuce (*Lactuca virosa*) is also powerfully narcotic and diuretic. Dandelion (*Leontodon Taraxacum*, or *Taraxacum Dens leonis*), is diuretic and aperient.

Besides those already mentioned, there are several others used medicinally in some places; they have generally the same properties as the preceding. The leading ones are Bastard Saffron (*Carthamus tinctorius*) which is purgative, and the flowers of which furnish a yellow dye, and also a red dye which is the basis of *rouge;* Milk Thistle (*Carduus Marianus* or *Silybum Marianum*); Common Blue-bottle (*Centaurea cyanus*); Grand Centaury (*C. centaurium*); *Carlina acanthifolia;* Mountain Cud-weed (*Gnaphalium dioicum*); Stinking Chamomile (*Anthemis cotula*); Yarrow (*Achillæa millefolium*); Sneeze-wort (*A. Ptarmica*, or Ptarmica vulgaris); Mugwort (*Artemisia vulgaris*); Wild Chamomile (*Matricaria chamomilla*); Butter-bur *Petasites vulgaris* or *Tussilago P.*); Wild Succory (*Cichorium Intybus*); Goat's Beard (*Tragopogon pratensis*); Sow-thistle (*Sonchus oleraceus*). *Liatris squarrosa* (Serratula s.) is used as a remedy for the bite of the Rattle-snake in South America. *Eupatorium perfoliatum* is esteemed in America as a substitute for Peruvian bark. *Solidago odora* is fragrant, and yields an aromatic and carminative volatile oil. *Pyrethrum Parthenium* was once a favourite remedy for ague.

Officinal Plants.

1. *Corymbiferæ.*
Anthemis nobilis.
Anthemis Pyrethrum.
Arnica montana.
Artemisia Absinthium.
Artemisia santonica.
Artemisia chinensis (or *A. Moxa*).
Inula Helenium.
Tanacetum vulgare.
Tussilago Farfara.

2. *Cynarocephalæ.*
Arctium Lappa.
Centaurea benedicta.

3. *Cichoraceæ.*
Lactuca sativa.
Lactuca virosa.
Leontodon Taraxacum (*Taraxacum Dens leonis*)

ORDER LXIX.

DIPSACEÆ.

Characters.—This family consists of *herbs* or *shrubs*, with opposite or whorled leaves; *inflorescence* a capitulum, with a common involucre, each flower having an involucellum; *calyx* adhering to the ovary, similar to a pappus or seed down; *corolla* monopetalous, tubular, unequal, 4-5 lobed, imbricated in aestivation; *stamens* usually 4, alternate with the lobes of the corolla, with the anthers distinct; a 1-celled *ovary*, with 1 pendulous ovule, 1 style, and a simple stigma; *pericarp*, 1-celled, surmounted by the feathery calyx, dry and indehiscent.

Examples.—Fuller's Teasel (*Dipsacus fullonum*), and Devil's-bit scabious (*Scabiosa succisa*) are examples of this family. The root of the former is said to be tonic and aperient, and its heads or tufts are used for dressing cloth. The root and leaves of the latter are bitter and astringent.

ORDER LXX.

VALERIANEÆ.

Characters.—*Herbs* with opposite leaves, without stipules; *flowers* in corymbs, panicles, or heads; calyx adherent, often toothed; *corolla* tubular, inserted into the top of the ovary, with about 5 unequal lobes, and sometimes spurred at the base; *stamens* 1 to 5, inserted in the corolla; *ovary* 1-celled, with a solitary pendulous ovule (occasionally 2 other cells, abortive), 1 style, and sometimes a trifid stigma; *pericarp* dry, indehiscent, 1-celled, crowned by the teeth of the calyx, or by a feathery tuft, and sometimes having 2 empty cells; embryo destitute of albumen.

This family is distinguished from the Dipsaceæ by the want of the involucre, of the albumen in the seed, and by the flowers seldom being disposed in a capitulum.

Examples.—Valerian (*Valeriana officinalis*), Corn Sallad (*Fedia olitoria*). The Spikenard of the ancients, which has an agreeable flavour, is said to be *Valeriana Jatamansi* (Nardostachys J.)

Economical Properties.—*Fedia olitoria* is sometimes cultivated as a sallad, and known by the name of Lamb's Lettuce.

Medicinal Properties.—The root of the Wild Valerian (*Valeriana officinalis*) is stimulant, antispasmodic, and emmenagogue, and much used in nervous diseases. It is also anthelmintic. *V. Phu*, *V. dioica*, *V. celtica*, and *V. Supina*, have similar properties. *Valeriana Dioscoridis* is said to be the most active in its medicinal properties. *V. Officinalis* has received the name of Allheal, from its leaves being frequently employed by the poor as an application to fresh wounds. Cats are very fond of the odour of this plant: it produces a kind of intoxication in them.

Officinal Plant.
Valeriana officinalis.

ORDER LXXI.

RUBIACEÆ.

Stellatæ, Lindley; *Asperulæ*.

Characters.—*Herbs*, with quadrangular stems, simple and entire whorled leaves, without stipules, and minute flowers; *calyx* superior, with 4 or 5 lobes; *corolla* regular, tubular, or rotate, of 4 or 5 lobes, and inserted in the calyx; stamens 4 or 5, inserted on the corolla, and alternate with its lobes; *ovary* 2-celled, each cell having 1 erect ovule, with 1 style and 2 stigmas; *pericarp* dry and indehiscent (occasionally a berry), 2-lobed, 2-celled, and 2-seeded; embryo in a fleshy or horny albumen.

EXAMPLES. — Woodruff (*Asperula odorata*), Bedstraw (*Galium cruciatum*), Madder (*Rubia tinctorum*), which furnishes the *Madder* or *Turkey Red* of dyers. Madder is procured in India from *Rubia cordifolia*, and *R. angustissima*. The roots of *Galium verum* and *Asperula tinctoria* also contain a red dye.

MEDICINAL PROPERTIES.—These are of little interest. *Rubia tinctorum* is emmenagogue, but little used in medicine. *Galium verum* has been used to curdle milk for cheese. Squinancy-wort (*Asperula cynanchica*) is somewhat astringent, and has been used for gargles. *A. odorata* is diuretic.

Officinal Plant.

Rubia tinctorum.

ORDER LXXII.

CINCHONACEÆ.

Included in the *Rubiaceæ*, Juss.

CHARACTERS.—*Trees*, *shrubs*, or *herbs*, with simple and entire leaves, opposite, (rarely whorled), and having intermediate stipules; *calyx* superior, adhering to the ovary, with the limb entire, or with 4 or 5 divisions; *corolla* regular, tubular, and with 4 or 5 divisions, and a valvate or imbricated æstivation; *stamens* 4 or 5, inserted on the corolla; *ovary* with 2 many-seeded cells; ovules, when numerous, attached to a central placenta; style simple, or somewhat divided, with the stigma also simple or divided; *pericarp* generally a dehiscent 2-valved capsule, with 2 cells, sometimes a berry, and occasionally many-celled; seed with a hard or horny albumen.

Examples—The coffee-tree (*Coffea arabica*), Ipecacuanha (*Cephælis Ipecacuanha*), Peruvian Bark (various species of *Cinchona*).

Economical Properties.—Coffee is the roasted seed of the *Coffea arabica*, which belongs to this family. Coffee contains an acid, supposed by some to be *gallic* acid, a peculiar crystallizable principle called *caffein*, and an empyreumatic oil. It is somewhat bitter, but contains an agreeable aroma, and is tonic and exciting. "The fruit of some species of Gardenia, Genipa, and of Vangueria, the Voa Vanga of Madagascar, are succulent and eatable."—*Lindley*.

Medicinal Properties.—This is one of the most important natural families in a medicinal aspect; it contains Cinchona and Ipecacuanha. Coffee also has been used medicinally in intermittent fever and in chronic diarrhœa. Cinchona has long been reckoned a specific in intermittent fever. In general, the plants of this family are bitter and tonic, and some are emetic. There are three species of Cinchona or Quinquina mentioned by the pharmacopœias as furnishing Peruvian Bark, Lance-leaved Cinchona (*C. lancifolia*), which yields the Pale Bark, or Crown Bark; Oblong-leaved Cinchona (*C. oblongifolia*), from which the Red Bark is procured, and Heart-leaved Cinchona (*C. cordifolia*), which furnishes the Yellow Bark. Cinchona Bark contains two vegetable alkalis, Cinchonia and Quina, on which its febrifuge properties depend. In the bark these alkalis are in combination with kinic acid. *C. lancifolia* contains Cinchonia alone; *C. oblongifolia* contains both Cinchonia and Quina; and *C. cordifolia* Quina alone. Great uncertainty prevails with regard to the exact species from which the various kinds of Peruvian bark are procured; and other genera besides Cinchona are bitter and febrifuge. *C. Condaminea*, *C. ovalifolia*, *C. micrantha*, *C. nitida*, *C. lucumæfolia*, *C. lanceolata*, *C. rotundifolia*, *C. glandulifera*, *C. hirsuta*, *C. magnifolia*, *C. purpurea*, furnish good bark, and much of what is brought to this country, besides the species mentioned above. *Exostema caribeum* and *E. floribundum* are febrifuge, and called false Cinchonas, but do not contain either Quina or Cinchonia. Several others furnish a kind of false bark. A bitter and very astringent matter, called Gambeer, is obtained from the leaves of the *Nauclea Gambir* (Uncaria G.); this is said to be the Kino of druggists, while others say that Catechu is got from it.

Ipecacuan root is obtained from *Cephælis Ipecacuanha* (*Calicocca I*). It contains an active principle, of a peculiar nature, called Emetine. *Psychotria emetica* furnishes the root called Black or Striated Ipecacuan. The roots of *Richardsonia scabra*, *R. emetica*, *Spermacoce poaia*, *S. Ferruginea*, and *Manettia cordifolia*, are also emetic. *Chiococca anguifuga* and *C. densifolia* are drastic purgatives, and much used in Brazil.

Officinal Plants.

Cephælis Ipecacuanha.	Cinchona lancifolia.
Cinchona cordifolia.	Cinchona oblongifolia.

ORDER LXXIII.

CAPRIFOLIACEÆ.

Characters.—*Trees*, *shrubs*, or *herbs*, with opposite leaves, without stipules, and the flowers in a cyme or corymb; *calyx* 4- or 5-cleft, generally with 2 or several bracteæ:

corolla 4- or 5-lobed, regular or irregular; *stamens* 4 or 5; *ovary* surmounted by an epigynous disk, of 1 or several cells, many-seeded, or 1 of the cells having 1 pendulous ovule; style 1, with 1 or 3 stigmas; pericarp generally fleshy, crowned by the persistent calyx.

The Hederaceæ, containing Hedera and Cornus, are polypetalous, and are made a separate order by some.

Examples.—Elder *(Sambucus nigra)*, Woodbine (*Lonicera Periclymenum)*, Ivy (*Hedera Helix*.)

Medicinal Properties.—The flowers and berries of the *Sambucus nigra* are diaphoretic and aperient, and the bark and leaves are active purgatives. Dwarf-Elder (*S. Ebulus*) is violently purgative. The latter character, and astringency, are the leading features of the Caprifoliaceæ. The flowers of Honeysuckle (*Lonicera Caprifolium*) are mucilaginous, and its leaves are astringent. The berries of Ivy (*Hedera Helix*) are purgative. In North America *Cornus florida* and *C. sericea* are used as tonic and febrifuge, and as a substitute for Cinchona bark.

Officinal Plant.

Sambucus nigra.

ORDER LXXIV.

LORANTHEÆ.

Characters.—Parasitical plants, with a corolla of 4 or 8 divisions, and stamens opposite and equal in number to the divisions, a 1-celled ovary, containing 1 pendulous ovule, with 1 style, and a fleshy pericarp.

Loranthus, and Misseltoe *(Viscum)* are examples.

III. POLYPETALEÆ.

Dicotyledonous plants, with a polypetalous corolla.

I. EPIPETALEÆ.

Polypetalous plants, with epigynous stamens, and inferior ovaries.

75. Umbelliferæ. 76. Araliaceæ.

ORDER LXXV.

UMBELLIFERÆ.

Apiaceæ.—Lindley.

Characters.—*Herbs*, with fistulous stems often furrowed, and alternate sheathing leaves, generally divided or compound; *flowers* small, white, or yellow, disposed in simple or compound umbels, and generally surrounded by involucres; *calyx* superior, with the limb absent, entire, or of 5 teeth; *petals* 5, inserted on a fleshy epigynous disk; stamens 5, alternate with the petals, æstivation incurved; *ovary* 2-celled, each cell having 1 pendulous ovule, styles 2, with a simple stigma; *pericarp* 2 acheniums (carpels), united by a central axis or columella; carpels with ridges, separated by furrows, in which are often found *vittæ*, small cavities containing oil; seed with a horny or fleshy albumen, generally adhering closely to the pericarp.

This family is distinguished from the Araliaceæ by having only 2 cells in the ovary, and the pericarp dry. The Araliaceæ have several cells, the pericarp succulent, and are often trees or shrubs.

EXAMPLES.—Hemlock (*Conium maculatum*), Carrot (*Daucus Carota)*, Parsley (*Apium Petroselinum*) Parsnip (*Pastinaca sativa.*)

The Umbelliferæ are divided into three tribes or sub-orders:—

I. ORTHOSPERMÆ.—With the seed plane in front, neither involute nor convolute.
Hydrocotyle. Sanicula. Eryngium. Apium.

II. CAMPYLOSPERMÆ.—Seed rolled inwards (inflexed) at the margin, or deeply furrowed in front.
Scandix. Myrrhis. Conium. Smyrnium.

III. CÆLOSPERMÆ—Seed with the base and apex curved inwards.
Coriandrum.

ECONOMICAL PROPERTIES.—There are several favourite and useful culinary vegetables in this family, as Parsley (*Apium Petroselinum*, *Petroselinum sativum*, Hooker), Celery (*A. graveolens*), Carrot (*Daucus Carota)*, Samphire (*Crithmum maritimum*), Parsnip (*Pastinaca sativa)*, Earth Nut (*Bunium flexuosum*, and *B. Bulbocastanum*). The blanched leaf-stalks of Celery, the leaves of Parsley and Samphire, and the roots of Carrot, Parsnip, and Earth-nut, are the parts used. The leaves and stems in this family are in general dangerous, but the seeds are, for the most part, safe, being warm and aromatic, as in Caraway (*Carum Carui*), Coriander (*Coriandrum sativum*). The root of Sweet Fennel (*Anethum Fœniculum*) is eaten in some parts of Italy. Garden Beaked-Parsley (*Anthriscus Cerefolium* or *Scandix C.*) is a salad and pot herb, known by the name of Garden Chervil. " Candied Angelica, a well known article in confectionary, consists of the prepared stalks of the *Angelica Archangelica*." (Archangelica officinalis).—Hooker. Cow-parsnip or Hog-weed (*Heracleum Sphondylium*) is said to be relished by hogs, and to be wholesome and nourishing for cattle in general.

Medicinal Properties. — There are two principles found in the Umbelliferæ: 1. An aromatic resinous principle, containing a volatile oil, and found chiefly in the seeds; this renders them tonic, stimulant, and carminative, and useful as articles of diet when mixed with much saccharine or mucilaginous matter, as in the Carrot, Parsnip, Parsley, &c.; those which furnish the gum-resins are of the aromatic species; 2. A bitter extractive principle, which gives them the character and properties of narcotic poisons, as we find in Hemlock. The seeds of Dill *(Anethum graveolens)*, Sweet Fennel *(Fæniculum vulgare*, or *A. fæniculum*), Caraway *(Carum Carui)*, Coriander *(Coriandrum sativum)*, Cumin *(Cuminum Cyminum)*, and Anise (*Pimpinella Anisum*), are warm, aromatic, and carminative; they all contain a volatile oil, on which their properties depend. The fruits of Sweet Cicely *(Myrrhis odorata)* "are remarkable for their large size and powerful fragrance; and, as Sir J. E. Smith well observes, make a part of the humble luxuries and simple medicines of the mountain cottager."—*Hooker*. The root of *Angelica Archangelica* is deemed an excellent aromatic. The root of *Burnet saxifrage (Pimpinella saxifraga*) is diuretic. The seeds of *Œnanthe Phellandrium* are aromatic, and regarded as febrifuge, and equal to Peruvian Bark by some. The root of Parsley is diuretic and diaphoretic; and the root of Celery is also diuretic and antiscorbutic. Gum galbanum was formerly considered the juice which exudes from the stem of Lovage-leaved Bubon *(B. galbanum, Selinum g.* Spreng.); it is now supposed to be procured from *Galbanum officinale*. It contains much volatile oil, and is reckoned antispasmodic and expectorant. Asafœtida is the juice which exudes from the cut root of *Ferula Asafœtida*, and is deemed an excellent antispasmodic, expectorant, emmenagogue, and anthelmintic. Gum Ammoniac, an expectorant, antispasmodic, and purgative, is the juice of the *Dorema Ammoniacum* belonging to this family. Opoponax is the juice of the roots of *Opoponax chironium (Pastinaca Opoponax)*: it is antispasmodic and emmenagogue. The leaves and seeds of *Conium maculatum* are powerfully narcotic, and used both externally and internally, to allay pain, &c. The root of the Carrot has been deemed aperient, and the roots of Celery and Parsley also possess this property in a slight degree. The root of *Pimpinella Saxifraga* is astringent. *Fœniculum dulce* yields *oil of Sweet Fennel.* The juice of the root of Hog's Fennel (Peucedanum officinale) is antispasmodic. The root of *Imperatoria Ostruthium* is acrid and bitter, and said to be febrifuge.

Officinal Plants.

Anethum graveolens.	Conium maculatum.
Carum Carui.	Galbanum officinale.
Coriandrum sativum.	Dorema Ammoniacum.
Cuminum Cyminum.	Fœniculum vulgare.
Pimpinella Anisum.	Ferula Asafœtida.
Angelica Archangelica	Opoponax chironium.
(Archangelica officinalis.)	Daucus Carota.

Poisonous Properties. — Many of the species in this family are extremely poisonous, being narcotic, and very acrid. Hemlock-water Dropwort (*Œnanthe crocata*) is full of a poisonous yellow juice in every part, and serious accidents have resulted from its roots being taken for those of *Bunium Bulbocastanum.* Fine-leaved Water-Dropwort (*Œ. Phellandrium* or *Phellandrium aquaticum*) is also dangerous. *Conium maculatum* is a very active poison, and Fool's Parsley or Lesser Hemlock (*Æthusa Cynapium)* is also poisonous, and dangerous, because it is apt to be mistaken for Parsley. Water-Hemlock or Cowbane (*Cicuta virosa*) is a deadly poison; and *C. maculata* (Snakeweed) is also a very active poison. Rough Chervil, *Anthriscus vulgaris* (Scandix Anthriscus) is poisonous.

ORDER LXXVI.

ARALIACEÆ.

This Family differs from the preceding chiefly in having more than 2 cells in the ovary, styles also more than 2, and the pericarp fleshy, and in being shrubby.

Examples.—Aralia; Ginseng *(Panax quinquefolium).* The root of Panax is valued by the Chinese and Javanese as a tonic and excitant, and is a favourite restorative with them.

2. HYPOPETALEÆ.

Polypetalous dicotyledonous plants with hypogynous stamens and superior ovaries.

77. Ranunculaceæ.
78. Magnoliaceæ.
79. Memispermeæ.
80. Rutaceæ.
81. Geraniaceæ.
82. Malvaceæ.
83. Bombaceæ.
84. Byttneriaceæ.
85. Theaceæ.
86. Guttiferæ.
87. Aurantiaceæ.
88. Viniferæ.
89. Acerineæ.
90. Meliaceæ.
91. Polygaleæ.
92. Fumariaceæ.
93. Papaveraceæ.
94. Nymphæaceæ.
95. Cruciferæ.
96. Cappárideæ.
97. Violarieæ.
98. Caryophylleæ.
99. Lineæ.

ORDER LXXVII.

RANUNCULACEÆ.

Characters.—*Herbs* (seldom shrubs) with alternate, rarely opposite leaves, sometimes with stipules, generally much divided, and having the petiole dilated and almost sheathing; *calyx* of from 3 to 6 sepals, rarely persistent; *corolla* of 5 or many hypogynous petals, occasionally irregular; stamens many, inserted under the pistils, anthers adnate; *ovaries* many, and quite distinct, placed on an enlarged receptacle, each with a short lateral style and 1-seeded; occasionally the ovaries are united into 1 many-lobed and many-celled ovary; *pericarps* dry nuts or acheniums, or capsules aggregated together, distinct, or more or less united, or a berry; seed with a fleshy or horny albumen.

Examples.—Anemone, Buttercup or Crowfoot (*Ranunculus bulbosus*), Monk's-hood (*Aconitum Napellus*), Traveller's-joy (*Clematis Vitalba.*) The leaves of *Ranunculus Ficaria* (Pilewort or Lesser Celandine) are used as a pot-herb in some parts of France, and the seeds of Fennel-flower (*Nigella sativa*) were formerly used as a spice; but the plants in this family are in general dangerous, and always to be suspected.

Medicinal Properties.—The plants in this family are in general acrid and caustic, and some are even poisonous. These properties depend on a very volatile principle, residing in every part of the plant, and easily expelled by boiling, or even by desiccation. The leaves of Upright Meadow Crowfoot (*Ranunculus acris*), Lesser Spearwort (*R. Fammula*), and several other species, are rubefacient, and in some places are used as a vesicatory: the distilled water of the latter is also deemed emetic. *R. bulbosus*, *R. sceleratus*, and *R. repens*, are also very acrid. The roots, and particularly the unripe fruits, are very acrid in the genus Ranunculus. Pasque-flower Anemone (*A. Pulsatilla*) is extremely acrid, and has been recommended by Storck in amaurosis and paralysis. The root of Black Hellebore (*Helleborus niger*) is a powerful purgative and emmenagogue; and the leaves of Bear's-foot or Stinking Hellebore (*H. fœtidus*) are both emetic and cathartic, and were formerly much used as anthelmintic. *Delphinium Consolida* has been recommended in Asthma. The seeds of Staves-acre (*Delphinium Staphisagria*) are violently emetic and cathartic, and, when chewed, stimulate the salivary glands. The leaves of Monks-hood or Wolfsbane (*Aconitum Napellus*), and of *Aconitum paniculatum*, are narcotic and diuretic, and also diaphoretic, and have been used in rheumatism, gout, amaurosis, paralysis, &c. It is a very active medicine, and must be administered with great caution. The seeds of Peony (*Peonia officinalis*) are emetic and cathartic—the root antispasmodic.

Officinal Plants.

Ranunculus acris.	Helleborus fœtidus.
Ranunculus Flammula.	Delphinium Staphisagria.
Helleborus niger.	Aconitum Napellus.
Helleborus officinalis, Lond. Pharm.	——— paniculatum.

Poisonous Properties.—This family is, perhaps, more uniform in its properties than any other in the vegetable kingdom. *Ranunculus acris* is a powerful acrid poison, and causes great irritation and inflammation of the intestinal canal, and even death. *Ranunculus bulbosus, R. Thora, R. sceleratus* and *R. Flammula* are acrid and irritating, and even poisonous. *Anemone hortensis, A. coronaria, A. Pulsatilla, A. nemorosa,* Traveller's-joy (*Clematis Vitalba*), *C. recta, Helleborus niger, H. fœtidus, Delphinium Staphisagria, Actaea spicata;* and *Aconitum Napellus*, are acrid and extremely virulent poisons. The Biku, Bish, or Vish, of India, one of the most powerful poisons known, is believed to belong to this family, and is referred by some to the genus *Caltha*, by others to *Aconitum ferox*. *A. Anthora*, and *A. cammarum* are also poisonous. The narcotic principle of *A. Napellus* is said by Mr. Brandes to be a vegetable alkali, which he has called *aconita*. The seeds of *Delphinium Staphisagria* also contain an alkaline principle called *delphinia*, in combination with malic acid.

ORDER LXXVIII.

MAGNOLIACEÆ.

Characters.—*Trees* or *shrubs*, with alternate not dotted leaves, at first enveloped in 2 large deciduous leafy stipules; *flowers* large, and with a sweet odour; *calyx* caducous, of 3 to 6 sepals; *corolla* of 3 to a great many petals in several rows; *stamens* numerous, with long adnate anthers inserted below the ovaries; *ovaries* numerous and distinct, superior, each 1-celled, with 1 ovule or more; a short style, and a simple stigma; *pericarps* various, dehiscent capsules opening by 2 valves or by a single slit, minute and indehiscent, or sometimes fleshy, distinct or partially united, and set on an elongated receptacle; seeds with a fleshy albumen, containing a small embryo at its base.

Example.—Tulip-tree *(Lyriodendron tulipifera.)*

Medicinal Properties.—The Magnoliaceæ are in general aromatic and more or less stimulant, and also bitter and tonic, and the flowers have a strong fragrant odour, which is said in some cases to produce injurious effects. The bark of *Lyriodendron tulipifera* is very bitter, and is much used in North America instead of Peruvian-bark, in intermittent fever. *Magnolia glauca* (Swamp Sassafras, or Beaver-tree), is of a similar nature, and used in North America in intermittent fever and chronic rheumatism, and was at one time supposed to yield Angustura bark. The bark of the Winter's-bark tree (***Wintera aromatica*** or ***Drymis a.***) is antiscorbutic, and also stomachic and carminative, and is very pungent and aromatic. The seeds of ***Illicium anisatum*** are highly aromatic and stimulant; these, and the flowers of some other plants in this family, are employed to give an aroma to various liquors, both in Europe and in the West Indies.

Officinal Plant.

Wintera aromatica.

ORDER LXXIX.

MENISPERMEÆ.

Characters.—Twining ***shrubs***, with simple, petiolated, alternate, mucronate leaves, without stipules; ***flowers***, minute and generally diœcious; ***calyx*** and ***corolla*** formed of several sepals and petals, in 1 row or more, with 3 or 4 in each row, inserted under the pistils, and early deciduous; ***stamens*** often monadelphous, sometimes free, in number equal to the petals, or 2, 3, or 4 times as numerous, but variable, anthers adnate; ***ovaries*** many, 1-celled, and with 1 style, distinct, or occasionally united into a 1 or many-celled ovary; ***pericarp*** generally a 1-seeded drupe, somewhat crooked or kidney-shaped; seed of the same form as the pericarp, with no or very little albumen, and a curved embryo.

Example.—*Menispermum Cocculus.* (*Anamirta C.*)

Medicinal Properties.—Many of the roots of the plants in this small family contain a bitter principle, and a considerable quantity of starch. Calumba-root, a valuable tonic bitter, is the root of *Menispermum palmatum* or *Cocculus palmatus*; and *M. cordifolium*, (Cocculus cordifolius) is similar in its properties. The berries of ***M. cocculus***, or Jagged Moonseed (***Cocculus suberosus*** or ***C. Indicus***, or Anamirta Cocculus) have been used in some cutaneous diseases. They are narcotic and poisonous. *Pareira brava*, or velvet leaf, (*Cissampelos Pareira*), is tonic and diuretic in the root, and has been adopted into the London Pharmacopœia. *Cocculus crispus*, and *C. acuminatus*, and *C. cordifolius* are much used medicinally in India.

Officinal Plants.

Cocculus palmatus.
Menispermum Cocculus (Anamirta Cocculus)
Cissampelos Pareira.

Poisonous Properties. — The seeds of *Menispermum Cocculus* contain a poisonous principle called *picrotoxine*. They are used to intoxicate fish that they may be caught: and have sometimes been employed to give bitterness to porter and render it more intoxicating. The seeds of this plant may be ranked among the acro-narcotic poisons.

ORDER LXXX.

RUTACEÆ.

Includes the *Simarubeæ* of some authors.

Characters.—*Trees*, *herbs*, or *shrubs*, with opposite or alternate, simple or pinnate leaves with pellucid glandular dots and without stipules; *calyx* monosepalous, of 5 (rarely 4) deep divisions; *corolla* of 4 or 5 petals, sometimes united and forming a kind of monopetalous corolla; *stamens* about 8 or 10, attached to a hypogynous disk which elevates the ovary; *ovary* with from 3 to 5 lobes and as many cells, each having 1 or more ovules attached to the internal angle, with a simple style, or divided at the base according to the number of lobes in the ovary, and a simple or 3- to 5-lobed stigma; *pericarp* of several capsules dehiscing by the summit and internal angle, or a dehiscent capsule with 2, 3 or 5 projecting sides; embryo in a fleshy albumen.

EXAMPLES.—Rue (*Ruta graveolens*), *Guaiacum officinale.*

MEDICINAL PROPERTIES.—The plants in this family are in general bitter, acrid, and aromatic. The leaves and herbaceous part of Garden Rue (*Ruta graveolens*) are stimulant, antispasmodic, and emmenagogue; they have a strong aromatic odour, and contain a volatile oil. The wood and resin of *Guaiacum officinale* are stimulant, diuretic, purgative, and diaphoretic. The leaves of Buchu (*Diosma crenata* or *Barosma crenata*) are sudorific, diuretic, and tonic, and have a place in the Dublin Pharmacopœia. Cusparia bark or Angustura bark is obtained from *Galipea Cusparia*, (formerly *Bonplandia trifolatia* or *Cusparia febrifuga*), and has been recommended in intermittent fever as a tonic; it was at first supposed to be the produce of *Magnolia glauca*. *Galipea officinalis* is possessed of similar properties. *Simaruba amara* (*Quassia S.*) and *Picraena excelsa*, (*Quassia e.*), two well known tonic bitters, belong to this family. Fraxinella (*Dictamnus albus*) has sometimes been used as sudorific and vermifuge. *Evodia febrifuga*, and *Hortia braziliana* are, according to M. Richard, used in Brazil as substitutes for Cinchona.

Officinal Plants.

Guaiacum officinale.	Galipea Cusparia.
Ruta graveolens.	Quassia Simaruba.
Diosma crenata.	Quassia excelsa.

ORDER LXXXI.

GERANIACEÆ.

Characters.—*Herbs*, rarely shrubs, with simple or compound leaves often opposite, and having stipules; *calyx* monosepalous, spurred at the base, of 5 deep divisions; *corolla* of 5 petals, regular or irregular; *stamens* 5 to 10, sometimes free, sometimes monadelphous; *ovary* of 3 or 5 projecting lobes with as many cells, having 1 or 2 or more ovules attached to the inner angle; style simple, long and terminated by 3 or 5 diverging stigmas; *pericarp* composed of 3 or 5 1-celled indehiscent pieces, with 1 or many seeds, united by a central axis, and separating from each other when ripe, carrying along with them part of the central axis and style; seeds without albumen.

Examples.—Geranium, Indian Cress or Nasturtium *(Tropæolum majus)*, Wood-sorrel *(Oxalis Acetosella.)*

Medicinal Properties.—Astringency is the prevailing character in this family. This property is very marked in Herb-Robert *(Geranium robertianum)*, and in Wood-sorrel *(Oxalis Acetosella)*, *G. sanguineum*, *G. pratense*, *G. maculatum*, and *Averrhoa bilimbi*, are also acid and astringent. The leaves of Wood-sorrel contain binoxalate of potassa, and are refrigerant, antiseptic, and diuretic. The *essential salt of lemons* is binoxalate of potassa obtained crystallized from the expressed juice of *Oxalis Acetosella*. This plant is supposed to be the true *Shamrock* of the Irish. Some are pungent, aromatic, and stimulant, as Indian Cress. This plant is a valuable antiscorbutic, according to M. Richard; the fruits and flowers are used as seasonings.

Officinal Plant.

Oxalis Acetosella.

ORDER LXXXII.

MALVACEÆ.

CHARACTERS.—*Trees*, *herbs*, or *shrubs*, with alternate leaves accompanied by stipules; *calyx* of 5 sepals, or monosepalous and of 5 deep divisions, and often closely surrounded by bracteæ, forming a kind of external calyx; *corolla* generally of 5 petals, often united at the base with the filaments of the stamens and with each other, twisted in æstivation; *stamens* numerous, monadelphous, sometimes 5 or 10; anthers 1-celled, dehiscing transversely; *ovary* of several 1- or many-seeded carpels somewhat projecting, more or less united, and placed round a common axis, each carpel or lobe 1-celled, 1 or many-seeded, and with a simple style; *pericarp* small nuts or capsules, arranged in a circle or united into a sort of berry; seeds with little or no albumen.

EXAMPLES.—Common Mallow *(Malva sylvestris)*; *Gossypium herbaceum*, the seeds of which, and of several other species of *Gossypium*, have a hairy or downy covering, which is the Cotton of commerce; *Hibiscus esculentus (Ochro* or *Gombo)*, the young fruits of which form an article of diet in some countries.

MEDICINAL PROPERTIES.—The plants in this family are of a very mucilaginous nature, and are accordingly mild and demulcent. Marsh Mallow (*Althæa officinalis*), *A. rosea*, *Malva sylvestris* and *M. rotundifolia*, are useful mucilaginous demulcents, and many exotic species are used for the same properties, as *Sida cordifolia*, *S. mauritiana*, *Sphæralcea cisplatina*.

Officinal Plants.

Althæa officinalis.
Malva sylvestris.

ORDER LXXXIII.

BOMBACEÆ.

These differ little from the Malvaceæ, except in their stamens arranged in 5 fasciculi, and their ovaries generally of 5 carpels; and they are mostly large trees. They are chiefly remarkable for their great size; the largest tree in the world is the Baobab or *Adansonia digita*. It contains a great quantity of mucilage, and its fruit is often eaten. It is found in Africa.

ORDER LXXXIV.

BYTTNERIACEÆ.

This family also bears a great resemblance to the Malvaceæ, and is included in the latter by some authors. They are distinguished from the Malvaceæ by having 2-celled anthers, and an ovary of 3 or 5 carpels. In their properties they are similar to the Malvaceæ. *Chocolate* is prepared from the seeds of *Theobroma cacao*, which also contain a thick oily matter, known by the name of *Butter of Cacao.*

ORDER LXXXV.

THEACEÆ.

This family is interesting chiefly on account of the Tea plants (*Thea bohea* and *T. viridis*), and the *Camellias*, which are now so much cultivated on account of the beauty of their flowers, particularly *C. Japonica*. Tea is also the produce of several species of *Camellia*, and other species of *Thea*. They are trees or shrubs, generally with large handsome axillary flowers, numerous sepals, petals, and stamens; one ovary, with 3 or 4 cells, 2 ovules in each cell, and a capsular pericarp of 3 or 4 cells.

ORDER LXXXVI.

GUTTIFERÆ.

CHARACTERS.—Resinous *trees or shrubs* with entire, persistent, opposite leaves without stipules; *flowers* occasionally unisexual; *calyx* monosepalous and many-lobed, or polysepalous; *corolla* of 4 or more petals, passing gradually into sepals; stamens many, unequal in length, distinct, monadelphous or polyadelphous, anthers adnate, sometimes 1-celled, and dehiscing by a pore; *ovary* superior, 1- or many-celled, 1- or many-seeded; style and stigma simple, the former sometimes absent; *pericarp* a dehiscent or indehiscent capsule, or a berry, hard externally, but soft and pulpy internally; seed with no albumen, and with a thin testa, and sometimes an arillus.

EXAMPLE.—The Gamboge tree (*Hebradendron Cambogioides*).

ECONOMICAL PROPERTIES.—The fruits in many of this family contain an agreeable acidulous pulp, as *Mammæa americana*, the Mangosteen (*Garcinia Mangostana*), and even those of *Garcinia Cambogia*, which yields a kind of gamboge.

MEDICINAL PROPERTIES.—Most of the plants in this family contain an acrid, yellow, milky juice, which is powerfully purgative, and almost poisonous. Gamboge, a drastic purgative, is a kind of gum-resin obtained from the bark and young shoots of ***Hebradendron Cambogoides*** (formerly referred to Stalagmitis Cambogioides, Garcinia Cambogia, and Xanthochymus pictorius.) ***H. pictorium*** is also said to yield Gamboge. The ***Dryobalanops Camphora*** (or D. Aromatica), which is supposed to yield the camphor of Sumatra, has been referred to this family in the dispensatories, but is placed by Blume in a separate order, ***Dipterocarpeæ***, with stipules and alternate leaves.

Officinal Plants.

Stalagmitis Cambogioides. (Lond. Pharm.)
Dryobalanops Camphora.

ORDER LXXXVII.

AURANTIACEÆ.

Characters.—*Trees* or *shrubs*, with alternate leaves, simple or compound, with the petiole often winged, and abounding in minute vesicles filled with volatile oil; *flowers* with an agreeable perfume; calyx monosepalous, urceolate, or campanulate, of 3 or 5 lobes or divisions; *petals* 3 to 5, enlarged at the base, sometimes slightly cohering, and inserted round a hypogynous disk; *stamens* occasionally 10, the same number as the petals, or some multiple of that number, placed on the disk, the filaments sometimes united in several fasciculi, and flat at the base; *ovary* many-celled, with a simple style and stigma; *pericarp* abounding in volatile oil, many-celled and many-seeded, the cells filled with a juicy pulpy matter; seeds solitary in each cell, or numerous, pendulous at the internal angle of the cell, or loosely scattered in the pulp, with no albumen, but thick cotyledons, and a distinct raphe and chalaza.

Examples.—The Sweet Orange (*Citrus Aurantium*), the Lemon (*C. Limonum*), the Seville or Bitter Orange (*C. vulgaris.*)

Economical Properties.—The uses of the Orange, the Lemon, the Citron (a variety of the Lemon), the Lime (*Citrus Limetta*, C. Limetta Bergamium of the London Pharmacopeia, formerly C. acida), and the Shaddock (*Citrus decumana*), are well known. They all contain an agreeable acid, which renders them favourites as dessert fruits, or for making acidulous drinks, for preserves, confectionaries, &c. The rind is bitter in some, and abounds in volatile oil. There are two principal varieties of Orange, the Sweet or China Orange, and the Bitter or Seville Orange, now made distinct species. The fruit of the Orange contains malic acid, that of the Lime and Lemon contains a large quantity of citric acid. All the parts of the plants also abound in a fragrant volatile oil. Oil of Bergamot is procured from *C. Limetta.* An agreeable distilled water is prepared from the flowers of the Orange (*Flores naphæ.*) Curacoa Oranges are the unripe dried fruit of the same plant.

Medicinal Properties.—The Orange and Lemon are deemed almost specific in scurvy, and they are also much used for refrigerant drinks, and stomachic infusions. The *Acidum Citricum Crystallizatum* of the London Pharmacopœia is prepared from Lemon juice.

Officinal Plants.

Citrus Aurantium $\left\{ \begin{array}{l} \text{C. Aurantium.} \\ \text{C. vulgaris.} \end{array} \right.$

Citrus medica (C. Limonum.)

ORDER LXXXVIII.

AMPELIDEÆ OR VINIFERÆ.

Vites or *Sarmentaceæ.*

CHARACTERS.—Trailing or climbing *shrubs*, supporting themselves by tendrils growing in the place of the peduncles; with simple or digitate leaves, opposite below, alternate above, having two stipules at the base, and small greenish flowers, arranged in racemes opposite to the leaves; *calyx* short; *corolla* with 4 or 5 petals, placed on a hypogynous disk, incurved in æstivation; *stamens* opposite, and generally equal in number to the petals; anthers versatile; *ovary* superior 2-celled, with a short style and simple stigma, each cell generally containing 2 erect ovules; *pericarp* a pulpy berry, often 1-celled and with from 1 to 5 seeds, with a hard testa, and cartilaginous albumen.

EXAMPLE.—*Vitis vinifera*, the Vine.

ECONOMICAL PROPERTIES.—The grape is the fruit of *Vitis vinifera*, belonging to this family, and the fruits of the other plants which the order contains more or less resemble that of this well-known plant. The leaves are in general acid and astringent. The use of the grape, either newly gathered, or dried, constituting the raisin, and the use of its juice, for making wine by fermentation, are familiar to every one. Grapes contain a considerable quantity of sugar.

MEDICINAL PROPERTIES.—The leaves of the Vine are somewhat acid and astringent, and have been used in chronic ophthalmia and in diarrhœa. *Verjuice*, a harsh acid juice, is obtained from the unripe grape; it contains bitartrate of potassa or tartar, and malic acid in considerable quantity. When ripe, the grape is deemed antiseptic, diuretic, and aperient. Tartar, an impure bitartrate of potassa, is deposited on the sides of the casks in which the wine is prepared; from this, *cream of tartar* is prepared. In a medicinal, as well as in an economical, point of view, however, the grape is most valuable on account of the wine which is prepared from it, so useful and indeed so essential, in diseases of debility, and during convalescence.

Officinal Plant.

Vitis vinifera.

ORDER LXXXIX.

ACERINEÆ.

THESE are trees with opposite leaves, without stipules, a calyx of 5 divisions, 5 petals, 8 stamens, a 2-lobed and 2-celled ovary, 2 stigmas, and a pericarp composed of 2 winged indehiscent capsules.

EXAMPLES.—Greater Maple or Sycamore (*Acer pseudo-platanus*), from the saccharine sap of which a kind of wine is made in some parts of the Highlands; Sugar Maple (*A. saccharinus*), the sap of which furnishes a large quantity of an excellent sugar, much used by the Canadians, and known by the name of *Maple sugar.*

ORDER XC.

MELIACEÆ.

CHARACTERS.—*Trees* or *shrubs*, with alternate leaves, destitute of stipules; *sepals* 3 to 5, somewhat united at the base;

petals 3 to 5, also cohering at the base, and occasionally unequal; *stamens* of the same number as, or double the number of, the petals, and monadelphous at the base, and sometimes, in their whole length, forming a tube round the pistil; *ovary* surrounded at the base by an annular disk, with 3 to 5 cells, 1 or 2 ovules at the internal angle in each cell, 1 style, and a faintly 3 to 5-lobed stigma; *pericarp* rarely fleshy, of 3 to 5 cells, each 1- or 2-seeded, and dehiscing by valves, bearing the dissepiment in the middle of their internal surface; or 1-celled by abortion.

Examples.—The Mahogany-tree (*Swietenia Mahagoni*), Bead-tree (*Melia Azedarach*). From the pulpy fruit of *Melia Azedarachta*, according to Richard, a thick oil is obtained, used for lamps in India.

Medicinal Properties.—The Meliaceæ are in general aromatic and stimulant. False Winter's Bark, sometimes substituted for that of *Wintera aromatica*, is the produce of *Canella alba*, and is reckoned a good carminative, and in America is valued as an antiscorbutic. The bark of *Swietenia febrifuga* (*Soymida febrifuga*) is bitter and febrifuge, and somewhat astringent, and has a considerable resemblance to Kino. The bark of *Swietenia Mahagoni* is very astringent, and slightly aromatic. The root of *Melia Azedarach* is bitter and nauseous, and is recommended by Drs. Barton and Valentin as anthelmintic.

Officinal Plants.

Canella alba.
Swietenia febrifuga.
Swietenia Mahagoni.

ORDER XCI.

POLYGALEÆ.

CHARACTERS.—*Shrubs* or *herbs*, with alternate leaves generally simple, without stipules; *flowers* in racemes or terminal spikes, generally small, and with 2 or 3 bracteas at the base; *calyx* of from 3 to 5 sepals, often irregular and unequal, often 3 exterior, (1 superior, and 2 inferior) and 2 interior; *corolla* of 3 petals, with 1 larger than the other 2, or of 5 petals, with 2 minute, the petals sometimes united at the base; *stamens* generally 8, and united by the filaments into 2 fasciculi, sometimes 2 or 3 distinct; sometimes 4; anthers 1-celled, and dehiscing at the apex; *ovary* 2 or 3 celled, each cell having 1 pendulous ovule (rarely 2); style and stigma simple; *pericarp* a minute capsule, sometimes a little fleshy, of 1 or 2 cells, indehiscent or dehiscing by 2 valves; seed pendulous, with a fleshy albumen.

EXAMPLES.—Milkwort (*Polygala*), Ratanhy (*Krameria.*)

MEDICINAL PROPERTIES.—The plants in this small family are in general slightly acrid, bitter, and tonic, as *Polygala amara* (P. uliginosa) and *P. Senega:* the latter is also a powerful stimulant, and emetic and purgative in large doses. The root of Ratanhy (*Krameria triandria*), contains much astringent matter, and the extract bears a considerable resemblance to kino in its properties and appearance. Ratanhy root "is one of the substances which, in conjunction with gum kino, is used for adulterating port-wine in England."—*Lindley.*

Officinal Plants.

Polygala Senega.

Krameria triandria.

ORDER XCII.

FUMARIACEÆ.

An order of little interest, chiefly bitter, tonic, and mucilaginous, as *Fumaria officinalis* or Fumitory, and *Corydalis solida.* The calyx is of 2 sepals, the corolla of 4 petals, the stamens 6 diadelphous, and the ovary 1-celled, with 1 style and a 2-lobed stigma.

ORDER XCIII.

PAPAVERACEÆ.

Characters.—*Herbs* or *shrubs* with alternate often divided leaves, *flowers* in general large and solitary, and a milky juice of a whitish or yellow colour; *calyx* of 2 concave caducous sepals; *corolla* generally of 4 caducous petals arranged in the form of a cross and plaited or wrinkled; stamens numerous, "often in 4 parcels, one of which adheres to the base of each petal,"—*Lindley*; anthers innate; *ovary* 1-celled from the contraction of the dissepiments, and with the placentæ projecting interiorly (parietal); style absent or very short; stigma 2-lobed or radiated, sessile; *pericarp* a 1-celled many-seeded capsule dehiscing by valves or by holes or pores under the permanent stigma, sometimes pod-shaped, with two placentæ; seed with a fleshy or oily albumen and a minute embryo.

Examples.—Red Poppy (*Papaver Rhœas*), Celandine, (*Chelidonium majus*).

Medicinal Properties.—The Papaveraceæ abound in a milky juice of an acrid and narcotic quality, and are in general of a deleterious nature. Opium, the most valuable of narcotics, is obtained from the juice of the leaves, stalks, and capsules of the *Papaver somniferum.* Opium contains three principles different from those found in other vegetables, meconic acid, narcotin, and morphia, a substance of an alkaline nature, and upon which the anodyne property of opium is believed to depend. The *Papaver orientale* is similar in its properties. The petals of the Red Poppy (*Papaver Rhœas*) are demulcent and slightly narcotic; they also contain a considerable quantity of red colouring matter, which, according to Dr. Duncan, they yield in infusion. The root of Celandine (*Chelidonium majus*) is a drastic purgative, and *Sanguinaria canadensis* is powerfully emetic.

Officinal Plants.

Papaver somniferum.
Papaver Rhœas.

Poisonous Properties.—Opium is one of the most powerful narcotic poisons; and the juice of Celandine is an acrid or irritating poison, extremely caustic and violent in its action. *Meconopsis napalensis*, a plant found in Nepal, is also a powerful poison.

These deleterious properties do not exist at all in the seeds of the Papaveraceæ; these contain a considerable quantity of a thick oil of a harmless nature.

ORDER XCIV.

NYMPHÆACEÆ.

An order of little interest in a medicinal point of view, but chiefly remarkable for the beauty of the flowers, and the diversity of opinion which prevails regarding its situation, some placing it among monocotyledonous plants, while others have referred it to the dicotyledonous division. The Nymphæaceæ are aquatic plants, with numerous sepals and petals passing insensibly into each other, many stamens, ovary many-celled and many-seeded, and an indehiscent pericarp. White Water Lily (*Nymphæa alba*), and Yellow Water Lily (*Nuphar lutea*) are examples. They are somewhat astringent, and were formerly deemed anodyne.

ORDER XCV.

CRUCIFERÆ.

Brassicaceæ, Lindley.

Characters.—*Herbs*, with alternate leaves and small white, yellow, or whitish-purple flowers; *calyx* of 4 sepals, caducous; corolla of 4 petals, deeply clawed, alternate with the sepals, and arranged in a cruciform manner; *stamens* 6, of which two are shorter, and solitary, the other 4 in pairs; *glands* on a kind of disk between the petals and ovary; *ovary* generally of 2 cells, with a partition (considered spurious) formed by the union of 2 elongated parietal placentæ, and with many ovules; style very short; stigma simple or 2-lobed; *pericarp* a siliqua or a silicula, dehiscing by 2 valves separating from the dissepiment (seldom 1-celled and indehiscent); seeds pendulous, attached to the placentæ in 4 rows, 2 rows on each side of the dissepiment, and without albumen.

Examples.—Wallflower (*Cheiranthus Cheiri*), Cabbage (*Brassica oleracea*).

This is one of the most natural families of plants, both in structure and properties: it is generally divided into two orders, according to the structure of the fruit, the *Siliquosæ* and the *Siliculosæ*; see Figs. 50 and 51, page 129.

This Family is divided by De Candolle into six leading tribes, depending on the number and character of the cotyledons.

I. Arabideæ or Pleurorhizæ, in which the two cotyledons are flat and *accumbent* (the embryo curved so that the radicle lies on the edges of both).—Cheiranthus. Arabis.

In the other tribes, the radicle is folded upon the side of one of the cotyledons, termed *incumbent*.

II. Sisymbrideæ or Notorhizæ, in which the incumbent cotyledons have the radicle folded on their back.—Sisymbrium. Erysimum.

III. Raphanidæ or Orthoploceæ; the incumbent cotyledons folded lengthwise.—Crambe. Raphanus.

IV. Erucarideæ or Spirolobeæ; the incumbent cotyledons folded spirally or circinnate.—Erucaria.

V. Subularidæ or Diplecolobeæ; the incumbent cotyledons twice bent or folded.—Subularia.

VI. Schizopetalidæ. Four cotyledons.—Schizopetalum.

These are divided into subsections, according to the structure of the pericarp.

Economical Properties.—This is a family of great importance in an economical point of view. Many of them contain a considerable quantity of mucilage, mixed, however, with an acrid principle; when the latter is softened by cultivation they become useful and agreeable articles of food. Their acridity is owing to a volatile principle, which is very fugacious. It is sufficient to mention the names of the leading plants in this family used in domestic economy. The

Cabbage (*Brassica oleracea*), of which the White Garden or Heading Cabbage, the Colewort, the Red Cabbage, the Blistered Cabbage or Savoy, the Borcole or Green Kale, the Cauliflower, the Broccoli, and the Brussels' Sprouts, are varieties; Rape (*Brassica napus*), used as a salad, and the seeds of which contain a large quantity of fixed oil; Garden Rocket (*Brassica eruca*); Turnip (*Brassica rapa*; Radish (*Raphanus sativus*); Sea-kale (*Crambe maritima*); White Mustard (*Sinapis alba*), the leaves of which are used as a salad; Black Mustard (*Sinapis nigra*), the ground seeds of which constitute a well known condiment; Garden Cress (*Lepidium sativum*), a favourite small salad; Winter Cress (*Barbarea vulgaris*); Water Cress (*Sisymbrium Nasturtium*); Scurvy Grass (*Cochlearia officinalis*); Horse Radish (*Cochlearia Armorucia*); Charlock (*Sinapis arvensis*), sometimes eaten as turnip-tops; Ladies' Smock (*Cardamine pratensis*), the leaves of which are sometimes used as a salad. Gold of Pleasure (*Camelina sativa* or *Myagrum sativum*), is much cultivated in France for the seeds, which yield a fixed oil much used for lamps.—*Richard.*

Medicinal Properties.—The plants in this family have an acrid or pungent taste, and are generally stimulating and aromatic, being valued in medicine chiefly as antiscorbutic. A pungent volatile oil is found more or less in them all, and in some it is extremely acrid, as in Mustard seed. They are said to contain a quantity of azote or nitrogen, an element more rare in vegetables. Ladies' Smock (*Cardamine pratensis*), is somewhat diaphoretic, and has been recommended in some nervous diseases. Scurvy Grass and Horse Radish (*Cochlearia officinalis* and *C. Armoracia*), and Water Cress (*Sisymbrium Nasturtium*) are stimulant and diuretic, and deemed antiscorbutic. Mustard seeds, from the *Sinapis alba* and *S. nigra*, are used to stimulate the intestinal canal, and externally for sinapisms.

Officinal Plants.

Siliquosæ.	*Siliculosæ.*
Cardamine pratensis.	Cochlearia Armoracia.
Sisymbrium Nasturtium.	Cochlearia officinalis.
Sinapis alba.	
Sinapis nigra.	

ORDER XCVI.

CAPPARIDEÆ.

Characters.—*Herbs* or *shrubs*, with alternate leaves, sometimes with spinous stipules; *calyx* of 4 sepals, sometimes united, sometimes irregular; *corolla* of 4 petals, clawed, arranged in a cruciform manner, and often unequal; *stamens* numerous (rarely 4 or 6); *ovary* with a stalk, 1-celled, many-seeded, with a simple filiform style or none; *pericarp* fleshy, baccate, or siliquose and dehiscent, with many reniform seeds attached to 2 or more parietal placentæ; embryo curved, without albumen.

Examples. — Caper-bush (*Capparis spinosa*), Bastard Mustard (*Cleome icosandra*).

Properties.—In properties this family bears a considerable resemblance to the Cruciferæ, being stimulant, diuretic, and antiscorbutic. The Caper, a well known pickle, is the young flower-bud of *Capparis spinosa*. The bark of the root of this plant is bitter and acrid, and diuretic, and several species of Cleome are used for sinapisms in some countries.

ORDER XCVII.

VIOLARIEÆ.

Characters.—*Herbs* or *shrubs* with simple leaves, generally alternate, accompanied by 2 stipules; *calyx* of 5 sepals, somewhat elongated at the point of attachment; *corolla* irregular, of 5 unequal petals (occasionally regular), convolute in æstivation; *stamens* 5, alternate with the petals, with short filaments and 2-celled anthers, with the filaments dilated and projecting beyond them; anthers almost cohering and closely surrounding the ovary, 2 of the anthers have often a gland at the base; *ovary* 1-celled, with many seeds attached to 3 longitudinal parietal placentæ; style simple, sometimes curved, with a stigma simple, or swelled and hollowed out into a semicircular depression; *pericarp* a 1-celled capsule, covered by the calyx, dehiscing by 3 valves bearing the seeds.

Example.—Pansy Violet (*Viola tricolor*).

Medicinal Properties.—The roots of most of the Violarieæ are acrid and nauseous, and are more or less emetic. *Ionidium Ipecacuanha* (formerly supposed to furnish the Ipecacuanha of commerce), *I. Poaya*, *I. parviflorum*, are much used as emetics in Brazil and Peru, and are part of the plants known there under the general name of Ipecacuanha. *Viola odorata*, *V. canina*, *V. tricolor*, and *V. arvensis*, have similar properties. *Emetine*, the peculiar principle which characterises Ipecacuanha, has been found, by M. Caventou, in *V. odorata*. *V. Ipecacuanha*, *V. calceolaria*, and *V. Itoubou*, are referred by M. Richard to *Ionidium Ipecacuanha*. The flowers of Sweet-scented Violet (*Ciola odorata*) have an agreeable perfume, and are used for making a laxative syrup, and also as a test for alkalis and acids. *Viola canina* and *V. arvensis* have been recommended in some cutaneous diseases.

Officinal Plant.

Viola odorata.

ORDER XCVIII.

CARYOPHYLLEÆ.

Alsinaceæ, *Silenaceæ*, Lindley.

Characters.—*Herbs* (rarely shrubs) with entire opposite leaves, often sessile and connate, and the stems enlarged at the joints; *calyx* often monosepalous, and of 5 teeth, or of 5 distinct sepals; *corolla* of 5 deeply clawed petals; *stamens* 4, 5, or 10, in the latter case, 5 being attached to the petals, and 5 inserted under the ovary, usually twice the number of the petals; *ovary* with from 1 to 5 cells, with as many styles and stigmas; stigmas sometimes sessile; *pericarp* a 1- or 5-celled capsule, dehiscing by 2- 5 valves, or by the separation of the teeth at its upper part, rarely fleshy or baccate, with central placentæ bearing many-seeds.

Examples.—Maiden Pink (*Dianthus deltoides*), Bladder Campion (*Silene inflata.*)

Medicinal Properties.—These are of little interest in this order. The flowers of Clove Gillyflower or Clove Pink (*Dianthus Caryophyllus*) are slightly aromatic, stimulant, and diaphoretic, but their only medicinal use is to give colour and flavour to a syrup. *Saponaria officinalis* is slightly bitter and mucilaginous, and has been recommended as a sudorific in gout and cutaneous diseases.

Officinal Plant.

Dianthus Caryophyllus.

ORDER XCIX.

LINEÆ.

Characters.—*Herbs* or *shrubs*, generally with alternate undivided leaves, without stipules; *calyx* generally of 5 sepals (3 to 5), persistent; *corolla* of 5 petals, clawed, caducous, twisted in æstivation; *stamens* 5 or 10, with the filaments united at the base, anthers innate; *ovary* with 5 or 10 cells, and as many styles, and 1 ovule at the upper part of the internal angle of each cell; *pericarp* a globular capsule with many 1-seeded cells, dehiscing by as many valves as there are cells; seeds compressed, and destitute of albumen.

Example.—Flax (*Linum usitatissimum*).

Economical Properties.—The uses of *Linum usitatissimum* are well known: the stems furnish flax, and the seeds furnish linseed-oil, while the cake which remains after the oil has been expressed, is used for fattening cattle, and known by the name of oil-cake.

Medicinal Properties.—Linseed is a valuable emollient and demulcent, and is much employed in medicine for poultices, fomentations, a kind of tea, &c.; the seeds contain a great quantity of mucilage and of a bland fixed oil. The mucilage resides in the testa or episperm, while the oil is found in the kernel or seed. Purging flax *(Linum catharticum)* is a mild purgative.

Officinal Plants.

Linum usitatissimum.
Linum catharticum.

PERIPETALEÆ.

Dicotyledonous polypetalous plants with perigynous stamens.

100. Saxifrageæ.
101. Crassulaceæ.
102. Ribesieæ.
103. Cucurbitaceæ.
104. Myrtaceæ.
105. Salicareæ.
106. Tamariscineæ.
107. Rosaceæ.
108. Leguminosæ.
109. Terebinthaceæ.
110. Rhamneæ.

ORDER C.

SAXIFRAGEÆ.

Characters.—*Herbs*, with simple alternate leaves, a monosepalous *calyx* of 4 or five divisions, adhering more or less to the ovary, a *corolla* of 4 or 5 petals inserted between the divisions of the calyx, 5 or 10 *stamens*, an *ovary* inferior, or semi-superior, consisting of 2 carpels, adhering to each other below, but separating above into 2 short styles, rarely 1-celled, and the *pericarp* a many-seeded 2-valved capsule.

Example.—London Pride, or None-so-pretty (*Saxifraga umbrosa*).

Properties.—This is an order of little interest in a medicinal point of view; it takes its name from the property of breaking down urinary concretions, which White Saxifrage (*Saxifraga granulata*) was formerly supposed to possess. The tubercles of this plant, and most of the plants in the order, are slightly bitter, acrid, and astringent. The root of *Heuchera americana* is said to be a powerful astringent.

ORDER CI.

CRASSULACEÆ.

Semperviveæ.

Characters.—Succulent *herbs*, with thick fleshy leaves, which are alternate or opposite, undivided or pinnatifid, without stipules; *calyx* monosepalous, of from 3 to 20 divisions; *corolla* of as many petals as there are divisions in the calyx, or monopetalous, with many divisions: *stamens* equal in number to, or twice as many as, the petals, or lobes of the corolla, in the latter case, one half of them being sometimes abortive or transformed into corpuscles of various forms; *ovaries* the same number as the petals, each 1-celled, and having many ovules attached to a sutural placenta placed at the internal side; *pericarps* many-seeded follicles, dehiscing by a longitudinal suture.

Examples.—Stone-crop or Wall-Pepper (*Sedum acre*), House Leek (*Sempervivum tectorum*), which contains malic acid.

Properties.—The plants in this family are, in general, somewhat acrid, but sometimes so mild as to be fit for use as articles of diet. Orpine or Stone-crop (*Sedum Telephium*) is used as a salad, and the young shoots of White Stone-crop (*Sedum album*), are boiled and eaten in some parts of France *Sedum acre* is emetic and purgative, and has been recommended as an antiscorbutic. Sempervivum tectorum is astringent.

ORDER CII.

RIBESIEÆ.

Grossularieæ, De Cand.—*Grossulaceæ*, Lindley.

CHARACTERS.—*Shrubs* generally armed with spines, with lobed alternate leaves; *inflorescence* a spike or axillary raceme; *calyx* monosepalous, 4 or 5 partite, adhering at its base to the ovary; *corolla* of 5 small petals, alternate with the divisions of the calyx, and inserted on it; *stamens* 5; *ovary* inferior, or semi-inferior, 1-celled, with many ovules, inserted on 2 parietal placentæ, and with a simple or bifid style; *pericarp* a globular, 1-celled, many-seeded, berry, surmounted by the persistent calyx, the seeds suspended in pulp.

EXAMPLE.—Gooseberry (*Ribes Grossularia*).

ECONOMICAL PROPERTIES.—This well known family is characterised by the agreeable union of sweetness and acidity found in the berries. They in general contain malic acid. The Red Currant (*Ribes rubrum*) is said to contain also citric acid. There is another species, the Tree Currant (*Ribes spicatum*), which Mr. Loudon recommends for cultivation.

The Cacteæ, or Indian Figs, were fomerly included in the Ribesieæ, but are now made a separate order, under the name of *Cacteæ* or *Nopaleæ*; they are known by the stamens being indefinite, the calyx and corolla imperceptible, or very minute, and their succulent character. The fruits of many of the Cacteæ are pulpy and refreshing. The milky juice of some of the plants of this family is very dangerous, as in *Cactus grandiflorus*, *C. flagelliformis*, and *C. divaricatus*, but in small doses used medicinally in Saint Domingo. The insect called Cochineal, or *Coccus cacti*, is found upon some species of Cactus, as *C. opuntia*, and *C. cocciferus*.

ORDER CIII.

CUCURBITACEÆ.

Characters.—*Herbs*, with climbing succulent stems, twining, or with tendrils; leaves alternate, petiolated, simple, often deeply divided, and covered with numerous minute tubercles; *flowers* generally monœcious, occasionally hermaphrodite; *calyx* monosepalous, of 5 teeth; *corolla* of 5 petals, or monopetalous of 5 lobes; *stamens* 5, inserted in the base of the corolla, sometimes distinct, sometimes united, (4 in 2 parcels and 1 free, or monadelphous); anthers long; *ovary* inferior, with a short simple or trifid style, terminated by 3 thick glandular stigmas, 1-celled, (rarely 1-seeded), with 6 or many seeds, attached to 3 parietal placentæ: *pericarp* a pepo (rarely dry and dehiscent), with the seeds scattered in a pulpy matter, and surmounted by the calyx; seeds compressed, with a crustaceous integument, no albumen, and an arillus.

Example.—Cucumber (*Cucumis sativus*).

Economical Properties.—The pulpy matter found in the fruit of most of the plants in this family is wholesome and often very nutritious, and may be turned to good account as an article of food, or as a pickle. The Melon or Cantaloupe, so much prized as a dessert fruit, is obtained from the *Cucumis Melo;* the common Cucumber is the fruit of the *Cucumis sativus.* Besides these, we have the Pompion (*Cucurbita pepo*), the Water-Melon (*C. sitrullus*), the Squash-Gourd (*C. melopepo*), the Warted Gourd (*C. verrucosa*), the Bottle Gourd (*C. Lagenaria*), the Orange Gourd (*C. aurantia*), and the Vegetable Marrow Gourd (*C. succado*).

Medicinal Properties.—All these fruits are more or less bitter and aperient; in some of this family these properties are highly developed, and it affords some of our most valuable purgatives. The pulp of Coloquintida or Bitter Apple (*Cucumis Colocynthis*) is a drastic purgative, and much employed in medicine: its bitterness, according to M. Vauquelin, resides in a resinous principle, which he has called *Colocynthine*. The juice which surrounds the seeds of the Wild Cucumber (*Momordica Elaterium*) affords *Elaterium*, one of the most violent purgatives which we possess. The roots of this plant and of Red-berried Bryony (*Bryonia alba* or *B. dioica*) are also purgative, and the latter is rubefacient when applied to the skin.

The active purgative principle, so abundant in the pulpy matter of the fruits in this family, is not found in the seeds. They are sweetish and mucilaginous, and contain a considerable quantity of a mild fixed oil; they are sometimes used for emulsions. *Jolliffia africana* affords a great quantity of expressed oil, said to be of as good a quality as Olive-oil.

Officinal Plants.

Cucumis Colocynthis.
Momordica Elaterium.

Poisonous Properties.—In large doses, *Cucumis Colocynthis* and *Momordica Elaterium* are poisonous. The latter contains *elatine*, which is an extremely active poison.

ORDER CIV.

MYRTACEÆ.

Myrti, Juss.—*Myrtineæ*, De Cand.

Characters.—*Trees* or *shrubs*, with generally opposite entire leaves, with numerous transparent glands or dots, and a vein parallel to the margin, generally persistent: *calyx* monosepalous, of 4 or 5 divisions, adhering to the ovary; *corolla* with petals equal in number to the divisions of the calyx; *stamens* often twice as many as the petals, or indefinite and numerous, distinct, or united by the filaments in several fasciculi; *ovary* inferior, with 1 to 6 cells, many seeds, and a simple style and stigma; *pericarp* 1- or many-celled, dry and capsular, or fleshy and baccate, or drupaceous; seed without albumen.

EXAMPLES.—Myrtle (*Myrtus communis*), Clove-tree (*Caryophyllus aromaticus.*)

ECONOMICAL PROPERTIES.—The plants in this family are in general highly aromatic; they abound in a pungent stimulating volatile oil, which renders many of them valuable as spices. *Cloves* are the unexpanded flower-buds of *Caryophyllus aromaticus*, formerly referred to Eugenia caryophyllata, and the unripe berries of the Pimento-tree (*Myrtus Pimenta* or *Eugenia Pimenta*), constitute *Jamaica pepper* or *allspice.* The Pomegranate is the fruit of *Punica Granatum ;* it contains an agreeable acid juice.

MEDICINAL PROPERTIES.—This family is characterized by two properties, which render it valuable in a medicinal point of view, astringency, and a warm aroma. The former of these is found in the Pomegranate (*Punica Granatum*), the bark and flowers of which are sometimes used in diarrhœa and dysentery, and in the brown Gum-tree (*Eucalyptus resinifera*), which is believed to yield some of the *kino* of commerce. It is not yet decided what plant yields the best or true kino: the Dublin College refer it to the *Butea frondosa*, belonging to the Leguminosæ; the London College adopt *Pterocarpus erinacea* as the source of kino; while the Edinburgh College give the *Eucalyptus resinifera* as the true source of this gum. The kino imported by the East India Company is the produce of the *Nauclea Gambir*, belonging to the Rubiaceæ.

The Myrtaceæ are valuable as warm carminatives, and even as stimulants. Cajuput oil is the volatile oil obtained from *Melaleuca minor* (*M. Cajuputi*), formerly referred to M. Leucadendron; it is a very powerful local and general stimulant. *Myrtus Pimenta* and *Eugenia caryophyllata* are valued as carminatives.

Officinal Plants.

Punica Granatum.
Eucalyptus resinifera.
Caryophyllus aromaticus.
Myrtus Pimenta (Eugenia P.)
Melaleuca minor.

ORDER CV.

SALICARIÆ.

Lythraceæ, Lindley.

Characters.—Herbs with opposite leaves, and sometimes quadrangular stems; a monosepalous, tubular, toothed, or lobed *calyx;* deciduous petals placed between the lobes of the *calyx*; *stamens*, the same number as, or some multiple of, the petals, and inserted below them on the calyx; anthers adnate; *ovary* superior, 2- or 4-celled, with a simple style and stigma, and many seeds: a capsular dehiscent *pericarp*, generally 1-celled, and covered by the calyx, and the seeds adhering to a central placenta.

Example.—Purple Loosestrife (*Lythrum Salicaria*).

Medicinal Properties.—The herb of *Lythrum Salicaria* is mucilaginous and astringent, and was formerly much employed in diarrhœa. The leaves of *Ammannia vesicatoria* are extremely acrid, and, according to Dr. Ainslie, are much employed in India as blisters, being simply bruised and applied to the skin.

Officinal Plant.

Lythrum Salicaria.

ORDER CVI.

TAMARISCINEÆ.

CHARACTERS.—Shrubs or herbs, with alternate leaves; a persistent calyx of 4 or 5 divisions; a corolla of as many petals; about 5 or 10 stamens; a superior ovary, with a short style and 3 stigmas; and a 1-celled, many-seeded, 3-valved capsule, with 3 placentæ.

EXAMPLE.—*Tamarix gallica*, which produces a very pure kind of sugar called the Manna of Mount Sinai.

ORDER CVII.

ROSACEÆ.

Rosaceæ, Pomeæ, Amygdaleæ (*Drupaceæ*), and *Sanguisorbeæ*, Lindley.

CHARACTERS.—*Trees, shrubs*, or *herbs;* leaves alternate, simple, or compound, often pinnate or digitate, and with 2 stipules often joined laterally; *inflorescence* very various; flowers generally white, seldom red or yellow; *calyx* monosepalous, tubular or spread out, sometimes accompanied by an external second calyx, of 5 divisions or lobes; *corolla* of 5 equal petals, inserted in the orifice of the tube of the calyx, or at the base of the divisions; *stamens* numerous; *pistils*, superior or semi-inferior, 1 or many, sometimes distinct, sometimes united into a many-celled ovary, sometimes many placed on the walls of a tubular calyx, often placed on an enlarged receptacle; each ovary 1-celled, with 1, 2, or a small number of ovules; style often lateral, or arising from the base of the ovary; *pericarp* a drupe, a pome, a follicle, or an achenium: seeds without albumen.

This extensive family is divided into six sections; the Amygdaleæ; Spiræaceæ; Dryadeæ; Sanguisorbeæ; Roseæ; Pomaceæ.

I. Amygdaleæ (Drupaceæ). Have a solitary carpel, becoming a drupe. Gum in their bark, and abound in hydrocyanic acid.—Amygdalus. Prunus.

II. Spiræaceæ. These have a fruit of 3 to 12 capsules or follicles, dehiscing by two valves.

III. Dryadeæ (Fragariaceæ). These have numerous pistils set on a gynophore, which is sometimes fleshy—and in the fruit numerous acheniums or drupes.—Fragaria. Potentilla. Geum. Rubus.

IV. Sanguisorbeæ. These are apetalous, sometimes unisexual. Stamens few. Ovary solitary. Calyx indurated.—Alchemilla. Poterium.

V. Roseæ. These have a tubular urceolate calyx, which becomes fleshy, containing parietal carpels, which do not adhere to the calyx or to each other.—Rosa.

VI. Pomaceæ.—In this section the pistils are from 2 to 5, united with each other and the tube of the calyx, rather inferior, and the pericarp is a pome.

The Dryadeæ, Spiræaceæ, and Roseæ form the Rosaceæ of Lindley. The other sections are Orders (or sub-Orders) in his System.

Economical Properties.—The fruits of many of the plants in this family contain a considerable quantity of saccharine matter, mixed with malic acid, and are much esteemed. The following are the principal kinds: the Strawberry (*Fragaria vesca*), the Musky or Hautboy (*F. elatior*), the Raspberry (*Rubus idæus*), the Bramble (*R. fruticosus*), the Cloudberry (*R. Chamæmorus*), the Dewberry (*R. cæsius*), the Stone Bramble (*R. saxatilis*), the Plum (*Prunus domestica*), the Cherry (*P. Cerasus*), the Gean (*P. avium*), which contains prussic acid; the Apricot (*P. armeniaca*), the Sloe (*P. spinosa*), which makes an excellent preserve; the Peach (*Amygdalus persica*), of which the Nectarine is a variety; the Sweet and Bitter Almond (*Amygdalus communis* and *A. amara*), the Apple (*Pyrus Malus*), the Quince (*P. Cydonia* or *Cydonia vulgaris*), the Pear (*P. communis*), the Service (*P. domestica*), the Medlar (*Mespilus germanica*), the Loquat Apple (*M. japonica*). Besides these, there are many others capable of forming good edible fruits when cultivated. *Prunus armeniaca*, *P. domestica*, and *Amygdalus communis*, furnish a kind of gum, which exudes from the trunk and branches.

Medicinal Properties.—These are various in this extensive family. In many of them there is a considerable degree of bitterness and astringency, as in the roots of the Strawberry (*Fragaria vesca*), which contain tannin and gallic acid; the roots of Silver-weed (*Potentilla anserina*); the whole plant of *Tormentilla erecta* (Potentilla Tormentilla), which has been sometimes used for tanning; Herb-Bennet (*Geum urbanum*), which was formerly in use as a febrifuge; the root of Meadow-Sweet (*Spiræa Ulmaria*); the leaves of Agrimony (*Agrimonia Eupatoria*), which are used for gargles; the petals of Red Rose (*Rosa gallica*), and the fruit of *R. canina*, which are used for conserves, &c. The Bitter Almond (*Amygdalus amara*), and the Sweet Almond (*A. communis* or *A. dulcis*) yield by expression, a bland oil much used for emulsions. The flavour of the Bitter Almond is owing to the presence of prussic acid, which is not found in the Sweet Almond, or at least in very small quantities. "The bland oil, called almond oil, is obtained from Bitter as well as Sweet Almonds, by expression, if no heat be employed; but if heated, the oil expressed from Bitter Almonds is impregnated more or less with the narcotic volatile oil, as is readily manifested by its smell and taste."—*Dr. Duncan.* Prunes, the dried fruit of *Prunus domestica*, are considered a mild laxative. Quince seeds, from the *Pyrus Cydonia* (Cydonia vulgaris), are supposed to have the power, in small doses, of repressing vomiting: they are very acid. The fruit of the Dog-rose (*Rosa canina*) is said to contain citric acid. The petals of the Damask-rose (*R. centifolia*) are used for distilling rose-water. *Brayera anthelmintica* is said to be almost specific against tænia; it is an Abyssinian plant, and is much used at Constantinople.

Officinal Plants.

Dryadeæ.
Geum urbanum.
Potentilla Tormentilla (Tormentilla erecta).
Agrimonia Eupatoria
Amygdaleæ.
Amygdalus communis.
Amygdalus amara.
Amygdalus persica.
Prunus domestica.
Prunus Lauro-cerasus (Cerasus L.)

Roseæ.
Rosa gallica.
Rosa centifolia.
Rosa canina.
Pomaceæ.
Cydonia vulgaris (Pyrus Cydonia).

Poisonous Properties. — The Amygdaleæ contain a considerable quantity of prussic acid in the leaves and in the seeds, and some of them are dangerous on this account. The *Cerasus capricida* proves fatal to goats which feed upon its leaves; the leaves of the Cherry-laurel (*Prunus Lauro-cerasus*, or Cerasus Laurocerasus) afford prussic acid by distillation; and this acid may also be detected in Peach blossoms and leaves, and in the bark of the Bird-Cherry (*Prunus Padus* or Cerasus Padus). Bitter Almonds are dangerous in any considerable quantity, and their essential oil is highly poisonous.

ORDER CVIII.

LEGUMINOSÆ.

Papilionaceæ, Tournefort.—*Fabaceæ*, Lindley.

Characters.—*Trees*, *shrubs*, or *herbs*, with alternate generally compound leaves (rarely simple), digitate, pinnate, biternate, or bipinnate, and with 2 persistent stipules at the base of each petiole and leaflet; *flowers* solitary, in racemes or in panicles, often with 2 bracteas under the flower;—1. sometimes they are irregular and *papilionaceous*, that is, with a tubular calyx, toothed at the summit, a corolla formed of 5 unequal and irregular petals, and 10 stamens, generally diadelphous, seldom free or monadelphous;—2. sometimes the flower is more regular, being composed of a calyx of 5 deep divisions, an equal and regular polypetalous corolla of 3 to 5 petals, and 10 free stamens, of which several are often abortive;—3. sometimes there is a calyx of 5 teeth, (corolla), accompanied by an external calyx, with no corolla, and numerous stamens, free or monadelphous:—*ovary* superior, 1-celled, generally many-seeded, with a simple style and stigma; *pericarp* a drupe or legume, generally the latter; the legume is most frequently 1-celled, many-seeded, and dehiscing by 2 valves; but it is sometimes of several cells, and jointed, dehiscing at the articulations; embryo without albumen.

This very natural family has been divided into three sections, the Papilionaceæ, Cassiæ, and Mimosæ.

1. *Papilionaceæ.*—These are characterized by the papilionaceous corolla, and have in general 10 diadelphous stamens, as Broom (*Spartium scoparium*, or Cytisus scoparius), Pea (*Pisum sativum*), Laburnum (*Cytisus Laburnum.*)

2. *Cassieæ.*—These have an equal and regular corolla of 3 or 5 petals, and 10 stamens, of which some are frequently

abortive, as the Senna shrub (*Cassia senna*), the Tamarind tree (*Tamarindus indica*).

3. *Mimosæ*. — These have a double calyx, the external small and of 5 teeth, the internal monosepalous and tubular (sometimes called corolla), and numerous stamens generally monadelphous, as the Sensitive plant (*Mimosa pudica*), the Gum tree (*Acacia vèra*.)

De Candolle divides the Papilionaceæ as follows :—

I. CURVEMBRIÆ.

Radicle bent back upon the cotyledons.

1. *Papilionaceæ*.—Calyx with distinct lobes; stamens perigynous; Corolla papilionaceous.

2. *Swartzieæ*. — Calyx bladdery, with indistinct lobes. Stamens hypogynous. Corolla none, or petals only 1 or 2.

II. RECTEMBRIÆ.

Radicle of the embryo straight.

3. *Cæsalpineæ*.—Petals imbricated in æstivation, and stamens perigynous.

 (1.) Geoffrieæ.—Have petals, and the stamens variously combined.

 (2.) Cassieæ.—Have petals, and the stamens distinct.

 (3.) Detarieæ.—No petals. Fruit drupaceous.

4. *Mimosæ*. — Sepals and petals valvate in æstivation. Stamens hypogynous.

Regarding this order, Dr. Lindley observes: "The most common feature is, to have what are called papilionaceous flowers; and when these exist, no difficulty is experienced in recognising the order, for papilionaceous flowers exist no where else. Another and a more invariable character is to have leguminous fruit; and by one of these two characters all the plants of the family are known."

ECONOMICAL PROPERTIES.—To man this is one of the most important families in the vegetable kingdom; indeed, with the exception of the Gramineæ, there is no one which furnishes, directly or indirectly, so many of the necessaries of life. Many are useful as food for man, but they are more important as furnishing excellent pasture for cattle. It contains the Pea (*Pisum sativum*), the Bean (*Vicia Faba*), the Kidney Bean or Haricot (*Phaseolus vulgaris*); Dyers' Greenweed (*Genista tinctoria*), used to dye a yellow colour; St. John's Bread (*Ceratonia siliqua*), the fleshy fruit of which is used as an article of food in the countries where the tree is common; Saintfoin (*Onobrychis sativa* or *Hedysarum Onobrychis*); White Trefoil or Dutch Clover (*Trifolium repens*), Common Clover (*T. pratense*), Black Medick or Nonsuch (*Medicago lupulina*), Lucerne (*M. sativa*), the South American Earth-nut (*Arachis hypogea*), used as food in New Spain. The leaves *of Indigofera Anil*, *I. tinctoria*, *I. caerulea*, and *I. argentea*, yield indigo, a valuable blue dye. The Tamarind, a pleasant acid fruit, is the produce of *Tamarindus indica*.

Medicinal Properties.—In a medicinal point of view this is a very important family. It affords the valuable purgative Senna, which consists of the leaves of *Cassia obovata*, *C. acutifolia*, *C. lanceolata* (*C. elongata*), *C. æthiopica*; the fruit and pulp of another species of Cassia, *C. fistula*, (*Cathartocarpus fistula*), and the pulp of the Tamarind (*Tamarindus indica*), are gently laxative. The stiff hairs of the pod of Cowhage (*Mucuna pruriens*, or *Dolichos pruriens*), and *M. prurita*, are used as anthelmintic. Tamarinds contain sugar, and citric, malic, and tartaric acids. The bark of the Cabbage-tree (*Geoffræa inermis*) is a powerful anthelmintic. *Genista tinctoria* is purgative, and in some parts of Russia deemed a specific in hydrophobia. Fenugric seeds, from the *Trigonella Phœnum-Græcum*, are emollient, and employed in veterinary medicine. The leaves of Bladder-Senna (*Colutea arborescens*) are employed as a purgative, and often mixed with Senna leaves. The Leguminosæ also contain some valuable astringents, as Catechu, or Terra Japonica, obtained from the wood of

Acacia Catechu; and the barks of *A. vera*, and of most other species which furnish gum, are highly astringent, and used for tanning in some parts of India. Gum Kino is said to be obtained from *Pterocarpus erinacea*, and *P. Marsupium*. Saunderswood, from the *P. Santalinus*, contains a red colouring matter, used in dyeing. Dragon's-blood, obtained from the *P. Draco*, has been deemed astringent, but, according to Dr. Duncan, is a pure resin, without any astringency. Logwood, the wood of *Hæmatoxylon campeachianum*, is somewhat astringent, but used chiefly as a dye. The tops and seeds of Broom (*Spartium scoparium*) are diuretic. Many trees in this family furnish a highly nutritious gum, valuable in medicine as a pectoral. The well known substance, Gum Arabic, is obtained from *Acacia vera* and *A. arabica*. Gum Tragacanth is the produce of *Astragalus Tragacanthus*, *A. verus*, *A. Gummifer*, and *A. creticus*. Some valuable balsams are found among the Leguminosæ, as Copaiva, from the *Copaifera officinalis*, or *Copaifera Jacquini*; Copaifera Langsdorfii, and C. coriacea, yield the Copaiva of Brazil: Balsam of Peru, from the *Myroxolon* (or *Myrospermum*) *peruiferum*, and Balsam of Tolu, from the *M. toluiferum* or *Toluifera balsamum*. The mild saccharine and mucilaginous substance, called Liquorice, is the extract of *Glycyrrhiza glabra*. Lac is the produce of *Erythrina monosperma*; and Gum or Resin Anime, of *Hymenea courbaril*: they are used for varnishing.

Officinal Plants.

Papilionaceæ.

Astragalus Tragacanthus.
Astragalus creticus.
Astragalus verus.
Glycyrrhiza glabra.
Pterocarpus Draco.
Pterocarpus Santalinus.
Pterocarpus erinacea.
Copaifera Langsdorfii.
Myroxolon peruiferum.
Myroxolon toluiferum.
Geoffræa inermis.
Mucuna pruriens (Dolichos pruriens.)
Cytisus scoparius (Spartium scoparium.)

Cassieæ.	*Mimosæ.*
Cassia Fistula.	Acacia vera.
Cassia lanceolata.	Acacia arabica.
Cassia obovata.	Acacia Catechu.
Hæmatoxylon campeachianum.	
Tamarindus indica.	

Poisonous Properties.—The seeds of the Laburnum *Cytisus Laburnum* are said to be poisonous, owing to the presence of a peculiar uncrystallizable principle, called *Cytisine*; and a few other plants in the order are deemed dangerous.

ORDER CIX.

TEREBINTHACEÆ.

Anacardiaceæ, Burseraceæ, Xanthoxylaceæ, Connaraceæ, Amyridaceæ, Lindley.

Characters.—*Trees* or *arbuscles*, with alternate leaves usually without stipules, and generally compound; *flowers* minute, in branched racemes, hermaphrodite or unisexual, monœcious or diœcious; *calyx* monosepalous, of 2 to 5 deep divisions; *corolla* of 5 petals, or absent; stamens of the same number, or twice as many as the petals, inserted along with the petals on a perigynous disk; *ovary* simple and superior, 1-celled or 2-5 celled, often 2 ovules in each cell; style simple and short, with a lobed stigma, or several stigmas; *pericarp* a dry or succulent drupe, with one 1-seeded nut, or several small nuts.

Examples.—Poison Ivy (*Rhus Toxicodendron*), Cashew nut (*Anacardium occidentale*), Mango Tree (*Mangifera indica*), which has a wholesome agreeable fruit.

Medicinal Properties.—This family abounds in balsams. Opobalsam, or Balm of Mecca, is the resinous juice of Protium gileadense (Balsamodendron g., or Amyris gileadensis) the same plant, according to some. Elemi is the produce of *Amyris elemifera* (Canarium commune), or *Icica Icicariba.* Olibanum, said to be the Frankincense of the ancients, is obtained from *Boswellia serrata*; Cyprus turpentine, from the *Pistacia Terebinthus;* Mastich, used to preserve the teeth, and strengthen the gums, from the *Pistacia Lentiscus*; and Copal, from the *Rhus Copallinum.* The seeds of *Pistacia vera* contain a large quantity of a mild fixed oil, and may be used for emulsions. Myrrh is said to be the produce of Protium kataf (*Amyris Kataf*, now referred to Balsamodendron Myrrha.) Resin acouchi is obtained from *Icica Aracouchini*, and Resin chibou from *Bursera gummifera.* The leaves of Poison Ivy (*Rhus Toxicodendron*) have been recommended in paralysis, and operate as a gentle laxative; applied to the skin they are extremely irritating, and produce erysipelas. They are full of a whitish resinous juice, and are extremely acrid.

Officinal Plants.

Amyris elemifera.
Amyris gileadensis.
Boswellia serrata.
Balsamodendron Myrrha.
Pistacia Terebinthus.
Pistacia Lentiscus.
Rhus Toxicodendron.

Poisonous Properties.—There are several plants of a dangerous nature in this family, as *Rhus Toxicodendron*, which is extremely irritating, and may be ranked among the acrid poisons, and *R. venenata* (Poison Ash, or Poison Sumach.) Some of the varnishes which are obtained in this order are dangerous when they come in contact with the skin.

ORDER CX.

RHAMNEÆ.

Characters.—*Trees*, or *shrubs*, with simple (rarely opposite) alternate leaves, generally accompanied by small stipules, and small flowers; *calyx* monosepalous, with 4 or 5 divisions; *corolla* of 4 or 5 petals, inserted in the orifice of the calyx, sometimes absent; *stamens* of the same number as the petals, often inserted on a perigynous disk: *ovary* generally superior, of 2, 3, or 4 cells, each with 1 ovule (rarely 2); style simple, sometimes divided at the summit, and with as many stigmas as there are cells in the ovary; *pericarp* sometimes dry and capsular, dehiscing by 3 valves, sometimes fleshy; seed with an erect embryo and a fleshy albumen.

Example.—Purging Buckthorn (*Rhamnus catharticus*), the berries of which, when prepared with gum-arabic and lime-water, yield a green dye.

Medicinal Properties.—The berries of *Rhamnus catharticus* are bitter and nauseous, and act as purgatives, and other species act in a similar way, as *R. Frangula*, *R. infectorius*. *Ceanothus americanus* and *Prinos verticillatus* have leaves and bark very bitter and astringent, and in some places are used as tonics. The fruit of the Jujube (*Ziziphus Jujuba*) is of a very different character, being of a mild and saccharine nature, and employed as pectoral. It is used in the preparation of *Jujube Lozenges*.

Officinal Plant.

Rhamnus catharticus.

CATALOGUE

OF

MEDICINAL PLANTS,

ARRANGED IN THEIR

NATURAL ORDERS;

SHEWING ALSO THE LINNÆAN CLASS AND ORDER OF EACH.

DIVISION I. CRYPTOGAMIA.

Fungi, 213.*

Boletus igniarius, *Agaric of the Oak.*
Acinula clavus, *Ergot.*

Lichenes, 217.

Cetraria islandica, *Iceland Moss*, or *Liverwort.*
Rocella tinctoria, *Dyer's Lichen*, or *Orchall.*

Algæ, 220.

Fucus vesiculosus, *Bladder Wrack.*

Filices, 230.

Aspidium Filix-mas, *(Nephrodium F.) Male Sheild-Fern.*

* The numbers after the orders refer to the pages in which they are described.

DIVISION II. PHENOGAMIA.

SECT. I. MONOCOTYLEDONEÆ.

I. MONOHYPOGYNEÆ,

Stamens hypogynous.

AROIDEÆ, 236.

Arum maculatum, *Wake Robin,*.......... .MONŒCIA POLYAND.
Acorus Calamus, *Sweet Flag,* ....HEXAND. MONOGYN.

PIPERACEÆ, 238.

Piper nigrum, *Black Pepper,*....	TRIANDRIA (DIANDRIA) TRIGYNIA.
Piper longum, *Long Pepper,*	
Piper Cubeba, *Cubebs,*....	

GRAMINEÆ, 240.

Avena sativa, *Oat,*..........................	TRIANDRIA DIGYNIA.
Triticum hybernum, *Wheat,*.............	
Hordeum distichum, *Barley,*.............	
Saccharum officinarum, *Sugar Cane,*...	

II. MONOPERIGYNEÆ,

Stamens perigynous.

PALMÆ, 246.

Cocos butyracea, *Mackaw-tree,*...........	MONŒCIA HEXAND.
Sagus Rumphii,..	

COLCHICACEÆ, 250.

Colchicum autumnale, *Meadow Saffron,*...HEXAND. TRIGYNIA.

Veratrum album, *White Hellebore,*....	POLYGAMIA MONŒC.
Veratrum Sabadilla, *Sabadilla,*..........	
Helonias officinalis,........................	

Asparagineæ, 252.

Smilax officinalis, *Sarsaparilla*,............Diœcia Hexandria.

Liliaceæ, 253.

Allium porrum, *Leek*,.........	Hexand. Monogyn.
—— sativum, *Garlic*,........	
—— cepa, *Onion*,......................	
Aloe spicata,..............................	
—— perfoliata (vulgaris), *Hepatic Aloe*,..................................	
Scilla maritima, *Squill*,...............	

III. MONOEPIGYNEÆ,

Stamens epigynous.

Irideæ, 258.

Crocus sativus, *Saffron Crocus*,...... ..	Triand. Monogyn.
Iris florentina, *Florentine Orris*,........	

Scitamineæ, 260.

Zingiber officinalis, *Ginger*,.............	Monand. Monogyn.
Alpinia Cardamomum, ...	
Curcuma longa, *Turmeric*,..............	

Marantaceæ, 262.

Maranta arundinacea, *Indian Arrow root*, Monand. Monogyn.

SECT. II. DICOTYLEDONEÆ.

I. APETALEÆ.

Aristolochiæ, 267.

Aristolochia Serpentaria, *Snakeroot* or *Birthwort*, ...	Gynand. Hexand.
Asarum europæum, *Asarabacca*,..........	Dodecand. Monogyn.

Cupuliferæ, 268.

Quercus pedunculata (robur), *Oak*,... Quercus infectoria, *Gall-nut Tree* or *Dyer's Oak*,...	Monœcia Polyand.

Coniferæ, 270.

Pinus sylvestris, *Scotch Fir*,......... —— Larix, *Larch*,.............. —— balsamea, *Balsam Spruce*,..... —— Abies, *Spruce Fir*,...............	Monœcia Monadelphia.
Juniperus Sabina, *Savine*,............... ———— communis, *Common Juniper*, ———— lycia, *Olibanum*,...............	Diœcia Monadelph.

Salicineæ, 273.

Salix alba, *White Willow*,............... —— fragilis, *Crack Willow*,........... —— caprea, *Great round-leaved Willow*	Diœcia Diandria.

Euphorbiaceæ, 275.

Euphorbia officinarum, *Euphorbium*,...	Dodecand. Trigyn.
Croton Cascarilla, *Cascarilla*,......... —— Tiglium, *Purging Croton*,... Ricinus communis, *Castor-oil Plant*,	Monœc. Monadel.

Urticeæ, 277.

Humulus Lupulus, *Hop*,......................	Diœcia Pentand.
Ulmus campestris, *Elm*,....................	Pentand. Digynia.
Morus nigra, *Mulberry*,.....................	Monœcia Tetrand.
Ficus Carica, *Fig*,..............................	Polygamia Triœcia.
Dorstenia Contrajerva, *Contrajerva*, ...	Tetrand. Monogyn.

Myristiceæ, 280.

Myristica moschata, *Nutmeg Tree*,. .	Diœcia (Monœcia) Monadelphia.

LAURINEÆ, 281.

Laurus Cinnamomum, *Cinnamon Tree,* ——— Cassia, *Cassia Tree,*............... ——— Camphora, *Camphor Laurel,*... ——— nobilis, *Bay Laurel* or *Sweet Bay,*........................... ——— Sassafras, *Sassafras Laurel,*...	ENNEANDRIA MONOGYNIA.

POLYGONEÆ, 283.

Rheum palmatum, *Palmated Rhubarb,* ——— undulatum, *Wave-leaved Rhubarb,*......	ENNEAND. TRIGYNIA.
Polygonum Bistorta, *Great Bistort* or *Snake-weed,*.................	OCTAND. TRIGYNIA.
Rumex aquaticus, *Water Dock,*......... ——— acetosa, *Sorrel,*.....................	HEXAND. TRIGYNIA.

THYMELEÆ, 285.

Daphne Mezereum, *Spurge Laurel,*......OCTAND. MONOGYN.

II. MONOPETALEÆ.

1. *HYPOCOROLLEÆ,*

Stamens hypogynous.

SCROPHULARINEÆ, 290.

Veronica Beccabunga, *Brooklime,*...... Gratiola officinalis, *Hedge Hyssop,*......	DIAND. MONOGYN.
Scrophularia nodosa, *Knotty-rooted Figwort,*........................... Digitalis purpurea, *Purple Foxglove,*...	DIDYNAMIA ANGIOSPERMIA.

Solaneæ, 292.

Atropa Belladonna, *Deadly Nightshade*, or *Dwale*,	Pentand. Monogyn.
Solanum Dulcamara, *Woody Nightshade* or *Bittersweet*	
Hyoscyamus niger, *Henbane*,	
Datura Stramonium, *Thorn Apple*,	
Nicotiana Tabacum, *Tobacco Plant*,	
Verbascum Thapsus, *Great Mullein*,	
Capsicum annuum, *Cayenne* or *Cock-spur Pepper*,	

Jasmineæ, 295.

Olea europæa, *Olive Tree*,	Diand. Monogyn.
Ornus europæus, or Fraxinus O. *Flowering Ash*,	Polygamia Diœcia.

Labiatæ, 297.

Mentha viridis, *Spearmint*,	Didynamia Gymnospermia.
—— piperita, *Peppermint*	
—— Pulegium, *Penny-royal*,	
Origanum vulgare, *Common Marjoram*	
—— majorana, *Sweet Marjoram*,	
Hyssopus officinalis, *Common Hyssop*,	
Lavandula spica, (L. vera) *Lavender*,	
Marrubium vulgare, *White Horehound*,	
Melissa officinalis, *Common Balm*	
Rosmarinus officinalis, *Rosemary*,	Diand. Monogynia.
Salvia officinalis, *Garden Sage*,	

Boragineæ, 299.

Anchusa tinctoria, *Alkanet*, ...Pentand. Monogyn.

Convolvulaceæ, 300.

Convolvulus Jalapa, (Ipomæa J.) *Jalap*,	Pentand. Monogyn.
—— Scammonia, *Scammony*,	

Gentianæ, 302.

Gentiana lutea, *Yellow Gentian*,.........Pentand. Digynia.

Erythræa Centaurium, *Common Centaury*. .... Menyanthes trifoliata, *Buck Bean*,...... Spigelia marilandica, *Perennial Worm-grass*, ...	PENTAND. MONOGYN.

APOCYNEÆ, 304.

Strychnos Nux-vomica, *Ratsbane*,.........PENTAND. MONOGYN.

2. *PERICOROLLEÆ*,

Stamens perigynous.

STYRACEÆ, 307.

Styrax officinale, *Officinal Storax*, ... —— Benzoin, *Benjamin Tree*, ...	DECAND. MONOGYN.

ERICINEÆ, 308.

Arctostaphylos Uva-ursi (Arbutus U.) *Bearberry*, ... Chimaphila corymbosa (Pyrola umbellata), *Winter Green*, ... Rhododendron Chrysanthum, *Golden-flowered Rhododendron*,.........	DECAND. MONOGYN.

CAMPANULACEÆ, 310.

Lobelia inflata, *Indian Tobacco*, ...PENTAND. MONGYN.

3. *EPICOROLLEÆ*,

Stamens epigynous.

COMPOSITÆ, 311.

1. *Corymbiferæ*.

Anthemis nobilis, *Chamomile*, ... —— Pyrethrum, *Pellitory of Spain*, Inula Helenium, *Elecampane*,............ Arnica montana, *Leopard's-bane*,........ Artemisia Absinthium, *Wormwood*,..... —— santonica, *Southernwood*,...... —— chinensis, ... Tussilago Farfara, *Coltsfoot*.......... .... Tanacetum vulgare, *Tansy*,................	SYNGENESIA POLYGAMIA SUPERFLUA.

2. *Cynarocephalæ.*

Arctium Lappa, *Burdock,*....................	SYNGENESIA POLYGAMIA ÆQUALIS.
Centaurea benedicta, *Blessed Thistle,*...	SYNGENESIA POLYGAMIA FRUSTRANEA.

3. *Cichoraceæ.*

Lactuca sativa, *Garden Lettuce,*.......... ——— virosa, *Strong-scented Lettuce,*. Leontodon Taraxacum, *Dandelion,*......	SYNGENESIA POLYGAMIA ÆQUALIS.

VALERIANEÆ, 315.

Valeriana officinalis, *Great Wild Valerian,*	TRIANDRIA MONOGYNIA.

RUBIACEÆ, 316.

Rubia tinctorum, *Madder,*	TETRAND. MONOGYN.

CINCHONACEÆ, 317.

Cephaelis Ipecacuanha, *Ipecacuan,* ..... Cinchona cordifolia, *Heart leaved Cinchona,*............................. ——— lancifolia, *Lance-leaved Cinchona,* .... ——— oblongifolia, *Oblong-leaved Cinchona,*.......................	PENTANDRIA MONOGYNIA.

CAPRIFOLIACEÆ, 319.

Sambucus nigra, *Common Elder,*	PENTAND. TRIGYNIA.

III. POLYPETALEÆ.

1. *EPIPETALEÆ,*

Stamens epigynous.

UMBELLIFERÆ, 294.

Anethum graveolens, *Common Dill,*	PENTAND. DIGYNIA.
Carum Carui, *Common Caraway,*	
Coriandrum sativum, *Common Coriander,*	
Cuminum Cyminum, *Cumin,*	
Pimpinella Anisum, *Anise,*	
Angelica Archangelica, *Garden Archangelica,*	
Conium maculatum, *Common Hemlock,*	
Ferula Asafœtida, *Asafœtida,*	
Daucus Carota, *Common Carrot,*	
Fœniculum vulgare, *Sweet Fennel,*	
Dorema Ammoniacum,	
Galbanum officinale,	
Opoponax chironium, *Rough Parsnip,*	

2. *HYPOPETALEÆ,*

Stamens hypogynous.

RANUNCULACEÆ, 326.

Delphinium Staphisagria, *Stavesacre,*	POLYAND. TRIGYNIA.
Aconitum Napellus, *Wolfs-bane,* or *Monkshood,*	
Aconitum paniculatum,	
Ranunculus acris, *Upright Meadow Crowfoot,*	POLYANDRIA POLYGYNIA.
——— Flammula, *Lesser Spearwort,*	
Helleborus niger, *Black Hellebore,*	
——— fœtidus, *Stinking Hellebore,*	
——— officinalis (Lond. Pharm.)	

MAGNOLIACEÆ, 328.

Wintera aromatica, *Winter's-bark-tree,*	POLYAND. TETRAGYN.

Menispermeæ, 329.

Cocculus palmatus, *Calumba*,.........	Diœcia Dodecand.
Menispermum Cocculus, *Moonseed*,...	
Cissampelos Pareira,.........................	Diœcia Monadelphia.

Rutaceæ, 330.

Diosma crenata, *Buchu*,......	Pentandria Monogynia.
Galipea Cusparia,.........................	
Quassia Simaruba, *Simaruba Quassia*,	Decand. Monogyn.
——— excelsa, *Lofty Quassia*,.........	
Guaiacum officinale, *Guaiacum*,.........	
Ruta graveolens, *Common Rue*,.........	

Geraniaceæ, 332.

Oxalis Acetosella, *Wood Sorrel*,...........Decand. Pentagyn.

Malvaceæ, 333.

Althæa officinalis, *Marsh Mallow*,......	Monadelphia Polyandria.
Malva sylvestris, *Common Mallow*,...	

Guttiferæ, 335.

Stalagmitis Cambogioides, *Gamboge-tree*,.....................	Polygam. Monœcia.
Dryobalanops Camphora, *Camphor-tree*,................	Polyand. Monogyn.

Aurantiaceæ, 336.

Citrus Aurantium, *Orange-tree*,.........	Polyadelph. Icosandria or Polyand.
——— limonum, *Lemon-tree*,..........	

Viniferæ, 338.

Vitis vinifera, the *Vine*,.........................Pentand. Monogyn.

Meliaceæ, 339.

Canella alba, *White Canella*,..................	Dodecand. Monog.
Swietenia febrifuga, *Febrifuge Swietenia*,................................	Decandria Monogynia.
——— Mahagoni, *Mahogany-tree*,...	

POLYGALEÆ, 341.

Polygala Senega, *Seneka*,........ ....DIADELPH. OCTAND.
Krameria triandra, *Ratanhy*,......... .....TETRAND. MONOGYN.

PAPAVERACEÆ, 342.

Papaver somniferum, *White* or *Opium Poppy*, ... } POLYAND. MONOGYN.
—— Rhœas, *Red Poppy*,..... . .. }

CRUCIFERÆ, 344.

Cardamine pratensis, *Cuckoo-Flower*, }
Sisymbrium Nasturtium, *Water Cress*, } TETRADYNAMIA SILIQUOSA.
Sinapis alba, *White Mustard*,......... }
—— nigra, *Common Mustard*,....... }
Cochlearia Armoracia, *Horse Radish*, } TETRADYNAMIA SILICULOSA.
—— officinalis, *Scurvy-grass*, ... }

VIOLARIEÆ, 348.

Viola odorata, *Sweet Violet*,..................PENTAND. MONOGYN.

CARYOPHYLLEÆ, 349.

Dianthus Caryophyllus, *Clove-Pink*,.......DECANDRIA. DIGYN.

LINEÆ, 350.

Linum usitatissimum, *Common Flax*, } PENTANDRIA PENTAGYNIA.
—— catharticum, *Purging Flax*,... }

3. *PERIPETALEÆ*,

Stamens perigynous.

CUCURBITACEÆ, 354.

Cucumis Colocynthis, *Bitter Cucumber*, } MONŒCIA MONADELPHIA.
Momordica Elaterium, *Squirting Cucumber*,......................... }

Myrtaceæ, 355.

Myrtus Pimenta, *Allspice-tree*,.......... Punica Granatum, *Pomegranate*,...... Eucalyptus resinifera, *Kino-tree*,....... Caryophyllus aromaticus, *Clove-tree*,..	Icosandria Monogynia.
Melaleuca minor,.................................. ——— cajeputi,..............................	Polyadelphia Icosandria.

Salicariæ, 357.

Lythrum Salicaria, *Loosestrife*,............ .Dodecand. Monog.

Rosaceæ, 358.

Dryadeæ.

Geum urbanum, *Avens* or *Herb-Bennet*, Tormentilla erecta, *Tormentil* or *Septfoil*,..................................	Icosand. Polygyn.
Agrimonia Eupatoria, *Agrimony*,.........	Dodecand. Digyn.

Amygdaleæ.

Amygdalus communis, *Sweet Almond*, ——— amara, *Bitter Almond*,...... ——— persica, *Peach tree*,......... Prunus Domestica, *Common Plumb*,... ——— Lauro-cerasus, *Cherry Laurel*,	Icosand. Monogyn.

Roseæ.

Rosa gallica, *Red Rose*,.................. —— centifolia, *Hundred-leaved Rose*, —— canina, *Dog-Rose* or *Hep-tree*,...	Icosand. Polygyn.

Pomaceæ.

Cydonia vulgaris, *Quince-tree*,............Icosand. Pentagyn.

Leguminosæ, 338.

1. *Papilionaceæ.*

Astragalus Tragacanthus,.................. ——— creticus,........................ ——— verus,............................ Glycyrrhiza glabra, *Common Liquorice*, Pterocarpus Draco, *Dragon's-Blood*,... ——— Santalinus, *Red Saunders-tree*,.............................. ——— erinacea, *Kino-tree*,......... Geoffræa inermis, *Cabbage-tree*,...... Mucuna pruriens, *Cowhage*,............ Cytisus scoparius, *Broom*,..............	Diadelphia Decandria.

Copaifera Langsdorfii, *Copaiva-tree*,... Myroxolon peruiferum, *Sweet-smelling Balsam-tree*,.............. ——— toluiferum ?..	DECANDRIA MONOGYNIA.

2. *Cassieæ.*

Cassia fistula, *Purging Cassia*,......... ——— lanceolata and C. obovata,.. ... Hæmatoxylon campechianum, *Logwood*,	DECAND. MONOGYN.
Tamarindus indica, *Tamarind Tree*,...	MONADELPHIA TRIANDRIA.

3. *Mimosæ.*

Acacia vera, *Acacia* or *Egyptian Thorn*, ——— arabica, *Gum-Arabic-tree*,...... ——— Catechu, *Catechu*,..............	POLYGAM. MONŒCIA or MONADELPHIA POLYANDRIA.

TEREBINTHACEÆ,

Amyris elemifera, *Elemi-tree*,......... ——— gileadensis, *Balsam of Gilead-tree*,..... .... Balsamodendron Myrrha,.................	OCTAND. MONOGYN.
Boswellia serrata, *Olibanum-tree*,..........	DECAND. MONOGYN.
Pistacia Terebinthus, *Chian Turpentine tree*, ... ——— Lentiscus, *Mastich-tree*,.........	DIŒCIA PENTANDRIA.
Rhus toxicodendron, *Sumach* or *Poison Oak*,..............	PENTANDRIA TRIGYNIA.

RHAMNEÆ,

Rhamnus catharticus, *Purging Buckthorn*,......................	PENTANDRIA MONOGYNIA.

CATALOGUE

OF

MEDICINAL PLANTS,

ARRANGED IN THEIR

LINNÆAN ORDERS;

SHEWING ALSO THEIR NATURAL ORDERS.

I. MONANDRIA.

Monandria Monogynia.

Zingiber officinalis,	Scitamineæ.
Alpinia Cardamomum,	Scitamineæ.
Curcuma longa,	Scitamineæ.
Maranta arundinacea,	Marantaceæ.

II. DIANDRIA.

Diandria Monogynia.

Veronica Beccabunga,	Scrophularineæ.
Gratiola officinalis,	Scrophularineæ.
Olea europæa,	Jasmineæ.
Rosmarinus officinalis,	Labiatæ.
Salvia officinalis,	Labiatæ.

Diandria Trigynia.

See *Piper* in Triandria Trigynia.

III. TRIANDRIA.

Triandria Monogynia.

Crocus sativus,	IRIDEÆ.
Iris florentina,	
Valeriana officinalis,	VALERIANEÆ.

Triandria Digynia.

Avena sativa,	GRAMINEÆ.
Triticum hybernum.	
Hordeum distichum,	
Saccharum officinarum,	

Triandria Trigynia.

Piper nigrum,	PIPERACEÆ.
—— longum	
—— cubeba,	

IV. TETRANDRIA.

Tetrandria Monogynia.

Dorstenia Contrajerva,	URTICEÆ.
Rubia tinctorum,	RUBIACEÆ.
Krameria triandra,	POLYGALEÆ.

V. PENTANDRIA.

Pentandria Monogynia.

Atropa Belladonna,	SOLANEÆ.
Solanum Dulcamara,	
Hyoscyamus niger,	
Datura Stramonium,	
Nicotiana Tabacum	
Verbascum Thapsus,	
Capsicum annuum,	
Anchusa tinctoria,	BORAGINEÆ.
Convolvulus Jalapa, (Ipomæa J.)	CONVOLVULACEÆ.
———— Scammonia,	

Erythraea Centaurium,	GENTIANÆ.
Menyanthes trifoliata,	
Spigelia marilandica,	
Strychnos Nux-vomica,	APOCYNEÆ.
Lobelia inflata,	CAMPANULACEÆ.
Cephaelis Ipecacuanha,	CINCHONACEÆ.
Cinchona cordifolia,	
—— lancifolia,	
—— oblongifolia,	
Diosma crenata,	RUTACEÆ.
Galipea Cusparia,	
Vitis vinifera,	VINIFERÆ.
Viola odorata,	VIOLARIEÆ.
Rhamnus catharticus,	RHAMNEÆ.

Pentandria Digynia.

Ulmus campestris,	URTICEÆ.
Gentiana lutea,	GENTIANÆ.
Anethum graveolens,	UMBELLIFERÆ.
Fæniculum vulgare,	
Carum Carui,	
Coriandrum sativum,	
Cuminum Cyminum,	
Pimpinella Anisum,	
Angelica Archangelica,	
Conium maculatum,	
Ferula Asafœtida,	
Dorema Ammoniacum,	
Opoponax chironium,	
Daucus Carota,	

Pentandria Trigynia.

Sambucus nigra,	CAPRIFOLIACEÆ.
Rhus toxicodendron,	TEREBINTHACEÆ.

Pentandria Pentagynia.

Linum usitatissimum,	LINEÆ.
—— catharticum,	

VI. HEXANDRIA.

Hexandria Monogynia.

Acorus Calamus	AROIDEÆ.
Allium sativum	LILIACEÆ.
—— cepa	LILIACEÆ.
—— porrum	LILIACEÆ.
Alöe spicata	LILIACEÆ.
—— perfoliata (vulgaris)	LILIACEÆ.
Scilla maritima	LILIACEÆ.

Hexandria Trigynia.

Colchicum autumnale	COLCHICACEÆ.
Rumex aquaticus	POLYGONEÆ.
—— acetosa	POLYGONEÆ.

VII. HEPTANDRIA.

Heptandria Monogynia.

Æsculus Hippocastanum	HIPPOCASTANEÆ.

VIII. OCTANDRIA.

Octandria Monogynia.

Daphne Mezereum	THYMELEÆ.
Amyris elemifera	TEREBINTHACEÆ.
—— gileadensis	TEREBINTHACEÆ.
Balsamodendron Myrrha	TEREBINTHACEÆ.

Octandria Trigynia.

Polygonum Bistorta	POLYGONEÆ.

IX. ENNEANDRIA.

Enneandria Monogynia.

Laurus Cinnamomum	LAURINEÆ.
—— Cassia	LAURINEÆ.
—— Camphora	LAURINEÆ.
—— nobilis	LAURINEÆ.
—— Sassafras	LAURINEÆ.

Enneandria Trigynia.

Rheum palmatum	POLYGONEÆ.
—— undulatum	

X. DECANDRIA.

Decandria Monogynia.

Styrax officinale	STYRACEÆ.
—— Benzoin	
Arctostaphylos Uva-ursi	ERICINEÆ.
Chimaphila corymbosa (Pyrola umbellata)	
Rhododendron Chrysanthum	
Guaiacum officinale	RUTACEÆ.
Ruta graveolens	
Quassia Simaruba	
—— excelsa	
Swietenia febrifuga	MELIACEÆ.
—— Mahagoni	
Copaifera Langsdorfii	LEGUMINOSÆ.
Myroxylon peruiferum	
—— toluiferum	
Hæmatoxylon campeachianum	
Cassia Fistula	
—— senna	
—— obovata	
Boswellia serrata	TEREBINTHACEÆ

Decandria Digynia.

Dianthus caryophyllus........................CARYOPHYLLEÆ.

Decandria Pentagynia.

Oxalis Acetosella............................GERANIACEÆ.

XI. DODECANDRIA.

Dodecandria Monogynia.

Asarum europæum.............................ARISTOLOCHIÆ.

Canella alba....................................MELIACEÆ.

Lythrum Salicaria.............................SALICARIÆ.

Dodecandria Digynia.

Agrimonia Eupatoria .... ROSACEÆ.

Dodecandria Trigynia.

Euphorbia officinarum..................... ...EUPHORBIACEÆ.

XII. ICOSANDRIA.

Icosandria Monogynia.

Myrtus Pimenta...........................	MYRTACEÆ.
Punica Granatum..........................	
Eucalyptus resinifera......................	
Caryophylus aromaticus....................	
Amygdalus communis........................	ROSACEÆ.
———— amara..........	
———— persica....	
Prunus domestica...............	
——— Lauro-cerasus	

Icosandria Pentagynia.

Cydonia vulgaris (Pyrus Cydonia) ....ROSACEÆ.

Icosandria Polygynia.

Geum urbanum..................	ROSACEÆ.
Potentilla Tormentilla......................	
Rosa gallica	
—— centifolia	
—— canina..................................	

XIII. POLYANDRIA.

Polyandria Monogynia.

Dryobalanops Camphora.....	...GUTTIFERÆ.
Papaver somniferum...........	PAPAVERACEÆ.
——— Rhœas..................................	

Polyandria Trigynia.

Aconitum Napellus..........................	RANUNCULACEÆ.
———— paniculatum............	
Delphinium Staphisagria.............	

Polyandria Tetragynia.

Wintera aromatica.................. ....MAGNOLIACEÆ.

Polyandria Polygynia.

Ranunculus acris ——— Flammula Helleborus niger ——— fœtidus ——— officinalis	RANUNCULACEÆ.

XIV. DIDYNAMIA.

Didynamia Gymnospermia.

Mentha viridis ——— piperita ——— Pulegium Origanum vulgare ——— Majorana Hyssopus officinalis Lavandula vera Marrubium vulgare Melissa officinali	LABIATÆ

Didynamia Angiospermia.

Scrophularia nodosa Digitalis purpurea	SCROPHULARINEÆ.

XV. TETRADYNAMIA.

Tedradynamia Siliquosa.

Cardamine pratensis Sisymbrium Nasturtium Sinapis alba ——— nigra	CRUCIFERÆ.

Tetradynamia Siliculosa.

Cochlearia Armoracia ——— officinalis	CRUCIFERÆ.

XVI. MONADELPHIA.

Monadelphia Triandria.

Tamarindus indica ....LEGUMINOSÆ.

Monadelphia Polyandria.

Althæa officinalis	MALVACEÆ.
Malva sylvestris	

XVII. DIADELPHIA.

Diadelphia Octandria.

Polygala Senega	POLYGALEÆ.

Diadelphia Decandria.

Astragalus Tragacanthus	LEGUMINOSÆ.
——— creticus	
——— verus	
Glycyrrhiza glabra	
Pterocarpus Draco	
——— Santalinus	
——— erinacea	
Geoffræa inermis	
Mucuna pruriens	
Cytisus scoparius	

XVIII. POLYADELPHIA.

Polyadelphia Icosandria.

Melaleuca minor	MYRTACEÆ.
——— cajeputi	

Polyadelphia Polyandria.

Citrus Aurantium	AURANTIACEÆ.
——— medica (limonum)	

XIX. SYNGENESIA.

Polygamia Æqualis.

Arctium Lappa	COMPOSITÆ CYNAROCEPHALÆ.
Lactuca sativa	COMPOSITÆ CICHORACEÆ.
——— virosa	
Leontodon Taraxacum	

Polygamia Superflua.

Anthemis nobilis	COMPOSITÆ CORYMBIFERÆ.
—— Pyrethrum	
Inula Helenium	
Arnica montana	
Artemisia Absinthium	
—— santonica	
—— chinensis	
Tussilago Farfara	
Tanacetum vulgare	

Polygamia Frustranea.

Centaurea benedicta.........COMPOSITÆ CYNAROCEPHALÆ.

XX. GYNANDRIA.

Gynandria Hexandria.

Aristolochia Serpentaria............. ARISTOLOCHIÆ.

XXI. MONŒCIA.

Monœcia Tetrandria.

Morus nigra.................................URTICEÆ.

Monœcia Hexandria.

Cocos butyracea	PALMÆ.
Sagus Rumphii	

Monœcia Polyandria.

Arum maculatum...........................AROIDEÆ.

Quercus robur (Q. pedunculata)	CUPULIFERÆ.
—— infectoria	

Monœcia Monadelphia.

Pinus sylvestris	CONIFERÆ.
—— Larix	
—— balsamea	
—— Abies	

Croton Cascarilla	EUPHORBIACEÆ.
—— Tiglium	
Ricinus communis	
Cucumis Colocynthis	CUCURBITACEÆ.
Momordica Elaterium	

XXII. DIŒCIA.

Diœcia Diandria.

Salix alba	SALICINEÆ.
—— fragilis	
—— caprea	

Diœcia Pentandria.

Humulus Lupulus	URTICEÆ.
Pistacia Terebinthus	TEREBINTHACEÆ.
—— Lentiscus	

Diœcia Hexandria.

Smilax officinalis	ASPARAGINEÆ.

Diœcia Dodecandria.

Cocculus palmatus	MENISPERMEÆ.
Anamirta Cocculus	

Diœcia Monadelphia.

Juniperus Sabina	CONIFERÆ.
—— communis	
—— lycia	
Myristica moschata	MYRISTICEÆ.
Cissampelos Pareira	MENISPERMEÆ.

XXIII. POLYGAMIA.

Polygamia Monœcia.

Helonias officinalis	COLCHICACEÆ.
Veratrum album	
—— Sabadilla	
Stalagmites Cambogioides	GUTTIFERÆ.

Acacia vera	LEGUMINOSÆ.
—— arabica	
—— Catechu	

Polygamia Diœcia.

Ornus europæus (Fraxinus Ornus)..........JASMINEÆ.

Polygamia Triœcia.

Ficus Carica..........URTICEÆ.

XXIV. CRYPTOGAMIA.

See page 369.

GLOSSARY AND INDEX

OF

ADJECTIVE TERMS.

Abnormal, when there is some departure from the usual structure.

Abrupt, ... 34

Acaules, . . . 42

Accrete, (adhering) growing together.

Acerose, (needle-shaped) like subulate, but more slender, and from a narrower base.

Acetabuliform, roundish, and concave, with the margin a little inwards.

Achlamydeous, . . . 96

Acinaciform, (scimitar-shaped) slightly curved, fleshy, flat on the two faces, the convex margin thick, the other thin.

Acrogenous . . . 45

Aculeate, *(prickly)* having prickles. See p. 66.

Acuminate, tapering gradually to a point.

Acute, sharp-pointed.

Adherent, . . . 98

Adnate, ... 106

Aggregate, . . . 127

Alternate, p. 58.

Alternately-pinnate, when the leaflets are alternate, not opposite, upon the common petiole.

AMPHITROPOUS, . . . 138

AMPLEXICAUL, inserted round for a considerable way, so as to embrace the stem.

ANASTOMOSING, when ramifications unite again.

ANATROPOUS, . . 117, 118

ANCEPS *(two-edged)*, flattened, and with two sharp edges.

ANGULAR *(angulose)*, with projecting corners, or rather longitudinal angles.

ANNUAL, . . . 32

ANTICAE, ... 107

ANTITROPOUS, . . . 138

APHYLLÆ, , . . 62

APOCARPOUS, . . . 114

APTEROUS, . . . 126

AREOLATE, the surface divided into a number of angular spaces.

ARISTATE *(awned)*, having a long, hard, straight, slender prolongation, coming abruptly from the apex.

ARTICULATE *(jointed)*, having distinct joints or articulations, at which separation readily takes place.

ASCENDING, . . . 116

AURICULATE (ear-shaped), having two small lobes or projections at the base.

AXILLARY, growing in an axilla, p. 89.

BARREN, . . . : 85

BEAKED, with a thick hard projection, somewhat like the beak of a bird.

BEARDED *(barbate)*, having tufts of hair at different parts.

BIENNIAL, . . . 32

BIFID, . . . 97

BIFOLIATE, when the petiole terminates in two leaflets.

BILABIATE, . . . 97

BILOCULAR, . . . 114

BIPINNATE, when the leaflets of a pinnate leaf are themselves pinnate.

BITERNATE, when the petiole divides into three petiolets, each bearing three leaflets.

BOAT-SHAPED (*cymbiform*), very like *carinate*.

BONY, hard, dense, firm, but somewhat brittle.

BOSSED (*umbonate*), round and flattish, with a projection about the centre.

BRISTLY (echinate), with hard firm hairs.

BUCKLER-SHAPED (*scutate*, *scutiform*), like a small shield or buckler.

BULBOUS, ... 35

CADUCOUS, . . . 61

CAESPITOSE, forming dense patches.

CAMPANULATE, (bell-shaped), p. 99.

CAMPULITROPOUS, . . 117, 118

CAPILLARY, (*hair-like*), very fine, like hair—finer than filiform.

CAPITATE (*headed*), thicker and swelled at the extremity.

CARINATE (*keeled*), with a sharp curved ridge, like the keel of a boat, and flat or concave on the other side.

CARTILAGINOUS, firm and tough, somewhat hard.

CARYOPHYLLACEOUS, . . . 101

CAUDATE, with a loose long prolongation like the tail of an animal.

CAULINE, growing from the stem.

CAULOCARPOUS, the stem enduring for many years, and bearing flowers and fruit annually.

CENTRAL, ... 115

CENTRIFUGAL, . . . 95

CENTRIPETAL, . . . 95

CHAFFY (*pallaceous*), with thin weak membranous scales.

Channelled (*canaliculate*), having a long furrow like a gutter.

Cicatrised (scarred), having the marks of parts fallen off

Ciliate, having fine hairs at the margin like the eye lashes.

Cirrhous, when the apex is prolongated into a flexible spiral body.

Circinate, rolled inwards in a downwards direction.

Cleft (*fissus*), . . . 97

Club-shaped (*clavate*, *claviform*), gradually swelling from a slender base to a thick round extremity.

Cochleate, twisted in a short spire, like the shell of a snail.

Compound, . . 61, 93, 102, 127

Compressed, flattened longitudinally on both sides.

Conduplicate, the leaf once folded, so that the two sides of the face are applied to each other.

Conical, or (*pyramidal*), like a cone, as carrot.

Conjugate. See Bifoliate.

Connate, when two opposite leaves are united at the base.

Conoidal, approximating to a cone in figure—often rounded at the base and apex.

Converging, passing gently inwards.

Convolute, when one leaf is rolled up within another in aestivation.

Cordate (*heart-shaped*), having two large round lobes at the base, like the figure of the heart in playing cards.

Coriaceous, hard and thick like leather.

Cornate (*corniculate*, *horned*), with projections like a horn—one, *cornate*, two, *bicornate*, three, *tricornate*, &c.

Corrugate (wrinkled), p. 104.

Cotyledonous, . . . 27

COTYLIFORM, like rotate, but with the limb erect.

CREEPING . . . 34, 43

CRENATE (notched), with rounded teeth in the margin not pointing towards either extremity.

CRESTED *(cristate)*, with a high curved ridge, like the crest of a helmet.

CRISPED *(curled)*, the margin indented and twisted, the divisions not in the same plane.

CROWDED, closely set.

CROWNING, situated at the top or summit of a part.

CRUSTACEOUS, hardish, but thin and brittle.

CUCULLATE, hooded, the apex and sides curved much so as to resemble a hood.

CUNEATE, wedge-shaped, triangular, with the apex lower.

CURVED, slightly bent.

CUSPIDATE, when the apex gradually tapers to a hard point.

CUT, having deep narrow somewhat regular incisions.

CYATHIFORM (cup-shaped), like urceolate, but not contracted at the mouth.

CYLINDRICAL, nearly of the form of a cylinder.

DECIDUOUS, . . . 62

DECOMPOUND, 210, page 61.

DECUMBENT, resting on the ground, but rising at the apex.

DECURRENT, a leaf continued down below the point of insertion.

DECUSSATE, in pairs, alternately crossing each other.

DEFLEXED, bent downwards.

DEHISCENT, . . . 125

DELIQUESCENT, when the main axis is lost among the branches.

DELTOID, triangular, with the apex farther from the base.

DENTATE (*toothed*), having sharp teeth with concave margins. See p. 97.

DEPRESSED, flattened at the extremities.

DIADELPHOUS, . . . 110

DICHLAMYDEOUS, . . . 96

DICHOTOMOUS, having the divisions and subdivisions always two.

DICOTYLEDONOUS, . . . 136

DIDYMATE, (*twin*), growing in pairs, or in two equal halves. See p. 35.

DIDYNAMOUS, . . . 110

DIGITATE, like palmate, but the segments narrower, and not spreading. See p. 35.

DIMIDIATE, imperfectly formed, only one half complete.

DIŒCIOUS, . . . 85

DIPTEROUS, (*Dipterate*), . . 126

DISCOIDEAL, circular, equally thick, with parallel sides.

DISTICHOUS, arranged in two opposite rows.

DOLABRIFORM (*axe-shaped*), roundish at the base, compressed, and expanded towards the extremity and one side, thick at one border, thin and convex at the other.

DORSAL, at the back, . . . 125

ELLIPSOIDAL, a solid such as would be generated by the revolution of an ellipse on its long axis.

EMARGINATE, having a sharp notch at the extremity, like a piece cut out.

EMBRYONATE, . . . 86

ENDOGENOUS, . . . 45

ENDORHIZÆ, . . . 137

ENSIFORM (*sword-shaped*), long, narrow, with nearly parallel margins, but acute at the point.

ENTIRE, not pinnatifid, or even, having no sort of division at the margin.

EPIGEOUS (*epigean*), growing close to the earth, . 136

EPIGYNOUS, . . . 111–12, 116

EPIPHYLLOUS, inserted on the leaf, p. 90.

EQUAL, when the figure is similar on both sides, or symmetrical.

EQUITANT, when leaves overlay each other, without being curved inwards.

ERECT, . . . 100, 116

EVERGREEN, . . . 62

EXOGENOUS, - . . 50

EXORHIZÆ, ... 137

EXSERTED, ... 110

EXTRA-AXILLARY, ... 90

EXTRORSE, turned outwards.

FALCATE, curved, and flattish, with the borders nearly parallel.

FASCIATED, when several parts grow together.

FASCICLED, several proceeding from a common point.

FASTIGIATE, nearly parallel, and pointing upwards.

FEATHERY, . . . 103

FEMALE, ... 85

FERTILE, ... 85

FIBROUS, with much loose fibre,—also see p. 34.

FILIFORM, (*thread-like*), about the thickness of a thread, or rather more.

FIMBRIATE. See Fringed.

FISTULOUS, cylindrical and hollow, but closed at each end, or at intervals.

FLABELLIFORM, (fan-shaped), radiating and plaited.

FLAGELLIFORM, (*whip-shaped*), long, slender, and tapering like a whip.

FLESHY, soft and juicy, but with some firmness.

FLEXUOSE, gently bending in alternate directions.

FLORIFEROUS, . . . 57

FLOSCULOUS, ... 103

FOLIACEOUS, like a leaf.

FOLIIFEROUS, . . . 57

Forked, (*furcate*), having two long divisions like the prongs of a fork.

Free, . . . 98, 115

Fringed (*fimbriate*), with long points at the margin, thicker than hairs.

Fugacious, falling off very soon.

Funiliform, (*rope-shaped*), with thick fibres, like a bundle of cords.

Furcate. See Forked.

Fusiform, ... 34

Gamosepalous, . . . 97

Gelatinous, resembling jelly.

Geniculate, bent like a knee-joint.

Gibbous, convex and much swelled.

Glabrous, smooth on the surface.

Globose, (*spherical*), nearly a true sphere in form.

Glaucous, covered with a fine soft moist whitish green powder, that is easily rubbed off.

Gnawed (*eroded*), irregularly toothed at the margin, as if bitten by an animal.

Granulated, having a number of little projecting knobs like knots.

Grumous, with a number of small crowded projecting granules.

Gynandrous, . . . 110

Half-terete, (*semi-terete*), roundish on one side, and flattish on the other.

Hastate, (halbert-shaped), with two acute lobes diverging sideways at the base.

Hermaphrodite, . . . 85

Heterotropous, ... 138

Hispid, with stiff short hairs.

Hoary (*incanus*), with very short and thickly set whitish hairs, having an appearance like hoar frost.

Homotropous. . . . 137

HONEY-COMBED, with a number of cells or excavations, like the section of honey-comb.

HORNY, like cartilaginous.

HYPOCRATERIFORM (*Salver-shaped*), p. 99.

HYPOGEAN, . . . 136

HYPOGYNOUS . . . 111–12, 115

HYSTERANTHOUS, when the flowers appear before the leaves.

IMBRICATE, . . . 104

INCLUDED, . . . 110

INCOMPLETE, . . . 125

INDEHISCENT, . . . 125

INDUPLICATE, when the margins are bent slightly inwards, touching the external part of the adjoining petals or sepals.

INFERIOR, . . 98, 111, 115, 16

INFLATED, bladdery, thin, very much swollen, transparent, . . . 97

INFLEXED, bent inwards, . . . 100

INFUNDIBULIFORM (*Funnel-shaped*) . . 99

INNATE, . . . 106

INORGANIC, . . . 7

IMPARI-PINNATE, when there is an odd leaf left at the extremity of a pinnate leaf.

INTERRUPTEDLY-PINNATE, when the leaflets in a pinnate leaf are small and large alternately.

INTRORSE, turned inwards.

INVERTED, . . . 138

INVOLUTE, the edges rolled inwards at each side in æstivation.

IRREGULAR, . . . 99, 100, 101

LABIATE, ... 100

LACERATED, having deep irregular incisions.

LACINIATE, deeper incisions than *cut*.

LACUNATE, having several deep broad depressions on the surface.

LAEVIGATED, very polished on the surface.

LANCEOLATE, an elongated ellipse, tapering at each end.

LATERAL, at the side, - - 113

LENS-SHAPED (*lenticular*, *lentiform*), like a double convex lens.

LIGULATE, (*strap-shaped*), flat, narrow, long, and rather broader than linear. See p. 103.

LINEAR, narrow, and with the sides nearly parallel.

LOBED, divided at the margin into several segments, not very deep, but broad at the base.

LOCULICIDAL, . . . 126

LUNATE (*crescent shaped*), like a crescent, or the figure of the new moon.

LYMPHATIC, . . . 6

LYRATE, obovate, and having several sinuosities on each side.

MALE, . . . 85

MARCESCENT, . . . 62

MARGINAL, at the edge.

MEALY (*farinose*), with a white powder or scurf on the surface.

MEDULLARY, with much cellular matter, like pith.

MEMBRANACEOUS, thin, flexible, and transparent.

MONADELPHOUS, . . 110

MONANDROUS, . . . 109

MONILIFORM (*necklace-shaped*, *bead-like*), cylindrical, but contracted at various intervals.

MONOCARPOUS, bearing fruit once and then perishing. These may be annuals (p. 32), biennials (p. 32), or may not bear fruit for several years, dying immediately after, as the AGAVE AMERICANA.

MONOCHLAMYDEOUS, . . . 96

MONOCOTYLEDONOUS, - . 136

MONOECIOUS . . . 85
MONOPETALOUS, . . . 98
MONOPHYLLOUS . . . 97
MONOSEPALOUS . . . 97

MUCOUS, slimy, more fluid than viscid.

MUCRONATE, having a short, hard, pointed projection, coming abruptly from the apex.

MULTIPLE, . . . 127

MUSCARIFORM, brush-shaped, with a number of hairs at one extremity.

NAKED, without any hairs, tubercles, roughnesses, &c. See also p. 96.

NERVED, a termination, indicating the manner in which the ribs or veins of the leaf are arranged—*pennerved*, ribs pinnate; *palminerved*, ribs palmate, &c.

NORMAL, when the ordinary structure prevails.

OBLONG, elliptical and elongated, but obtuse at each extremity.

OBOVATE, shortly elliptical, the upper end broader.

OBTUSE (*blunt*), rounded at the extremity.

OBVOLUTE, when the margins of two opposite leaves overlap each other in æstivation.

OLEAGINOUS, soft and fleshy, with oil.

ONE-RIBBED, with one leading projecting line.

OPPOSITE, p. 58

ORBICULAR, nearly circular.

ORGANIC, . . . 6
ORTHOTROPOUS, . . 117, 118, 137

OVAL, shortly elliptical, and both ends slightly obtuse but nearly equal.

OVATE, shortly elliptical and the lower end broader.

OVOIDAL, egg-shaped, like ellipsoidal, but narrower at one end.

PALMATE, having five lobes, and resembling somewhat the hand. See p. 35.

PANDURIFORM (*fiddle-shaped*), obovate, and having one deep indentation or sinuosity on each side.
PAPILIONACEOUS, . . . 101
PAPILEOSE (*pimpled*), with very small tubercles not hard.
PARASITICAL, ... 38
PARIETAL, . . . 115, 125
PARI-PINNATE, (abruptly pinnate) when there is no odd leaflet or tendril at the extremity of a pinnate leaf.
PARTED, very deeply divided into several segments.
PATELLIFORM, (knee-pan shaped).
PEAR-SHAPED, (*pyriform*), like a pear, more elongated than turbinate.
PECTINATE, (comb-shaped), like pinnatifid, but the divisions very narrow and closely set, like the teeth of a comb.
PEDATE, having five lobes, of which the external are lobed.
PELTATE, fixed to the stalk by the centre, or at a distance within the margin.
PENDULOUS, . . . 116
PERENNIAL, . . . 33
PERFECT, ... 85
PERFOLIATE, when the stem passes through the leaf near to its base.
PERIGYNOUS, . . . 111–2
PERSISTENT, . . . 62
PERSONATE, . . . 100
PETALOID, applied to a leaf, or part of the flower coloured and formed like a petal. See p. 106.
PETIOLATED, . . . 59
PHENOGAMIC, . . . 86
PILOSE, (*hairy*), with slender flexible hairs, rather short.
PINNATE, when in a compound leaf the leaflets are arranged on opposite sides of the common petiole.
PINNATIFID, divided laterally into a number of very

deep segments, so as to have the appearance of a feather.

PITTED, *(scrobiculate)*, having a number of small shallow pits or deep depressions on the surface.

PLAITED *(plicate)*, folded lengthways, like a fan.

PLANE, flat,

PLUMOSE, *(feathery)*, with long hairs, which are themselves covered with hairs.

POCULIFORM, cup-shaped.

POLYADELPHOUS, . . . 110

POLYCARPOUS, bearing fruit often, perennial.

POLYGAMOUS, - . . 86

POLYPETALOUS, . . . 100

POLYPHYLLOUS, . . . 97

POLYSEPALOUS, . . . 97

POSTICAE, . . . 107

PRISMATIC, *(prism-shaped)*, having several flat longitudinal surfaces, bounded by corresponding angles.

PROMINENT, . - . 106

PROSTRATE, lying flat upon the ground.

PROTERANTHOUS, when the leaves appear before the flowers.

PUBESCENT, *(downy)*, with short, soft, very fine leaves.

PULVERULENT, *(powdery)*, covered with a fine powder.

PUNCTATE, dotted.

QUADRIFOLIATE, where the peticle terminates in four leaflets.

QUINATE. See Quinquifoliate.

QUNQUIFOLIATE, *(quinate)*, when the petiole terminates in five leaflets.

RADIANT, (radiate) like radii from the centre of a circle. See p. 103.

RADICAL, growing from the root.

REFLEXED, bent backwards, . . 101

REGULAR, . . . 99, 101

RENIFORM, (*kidney-shaped*), somewhat like lunate, but with the extremities obtuse.

REPAND, the margin gently waved or undulating, with shallow broad indentations.

REPLICATE, when the upper part is bent back and applied to the lower.

RETICULATE, (netted), having a number of slightly projecting lines, arranged in a net like form.

RETRORSE, turned backwards.

RETUSE, rounded at the extremity, but having a depression or indentation in the centre.

REVERSED, . . . 116

REVOLUTE, the edges rolled outwards or backwards on each side in æstivation.

RHIZOCARPOUS, perennial roots, the stem perishing yearly, and a new one, bearing flowers and fruits, appearing annually.

RHOMBOID, having four margins, the opposite nearly parallel.

RIBBED, having several ribs, or projecting lines somewhat parallel, on the surface.

RINGENT, . - . 100

ROSACEOUS, . . . 101

ROSTRATE, (*beaked*), terminating gradually in a point, not very sharp.

ROTATE, . . . 99

ROUGH, (scabrous), with short hard points on the surface.

ROUNDISH (subrotund), nearly circular.

RUGOSE, like reticulate, the spaces between the lines being convex or swollen.

RUMINATE, when there are a number of dry cavities traversing any solid body.

RUNCINATE, lion-toothed, with several deep acute transverse segments, gradually diminishing from the apex to the base.

SAGITTATE, (arrow-shaped), prolonged into two acute projecting lobes at the base.

SCALY (*squamous*), with small scales on the surface. See p. 35.

SCABROUS. See Rough.

SCARIOUS, thin, dry, and somewhat shrivelled.

SCATTERED (sparse), irregularly arranged, and at a distance.

SCUTELLIFORM, like patelliform, but oval.

SECRETING, . . . 66

SECUND, one-sided, or *unilateral*,—on one side.

SELLAEFORM, saddle-shaped, oblong, with hanging sides.

SEMIFLOSCULOUS, . . 103

SEPTICIDAL, . . . 126

SERRATE, (*sawed*), with sharp angular teeth at the margin, like the teeth of a saw, the teeth pointing towards the apex.

SESSILE, . . . 59, 86

SETOSE, (*bristle-pointed*), passing gradually into a fine point, not hard.

SEXUAL, . . . 85

SHAGGY (*villose*), with long soft flexible hairs.

SHEATHING, (*vaginate*), surrounding or embracing the stem for a considerable distance.

SILKY, with very fine hairs, closely pressed to each other, shining, and soft and silky to the touch.

SIMPLE, . . . 61, 92, 127

SINUATE, the margin having broad, deep, obtuse indentions, deeper than repaud.

SOLITARY, . . . 89

SPATULATE, oblong, and having one end attenuated.

SPHEROIDAL, spherical, but slightly flattened at the opposite ends.

SPICULATE, with small softish points on the surface.

SPINDLE-SHAPED (*fusiform*), thick in the middle, and tapering towards each end.

SPINOSE, or spiny, having spines. See p. 66.
SPIRAL, like a corkscrew.
SPLIT, divided nearly to the base into a small number of segments, rather narrow.
SPONGY, having a texture like sponge.
SPREADING, (patent), passing gently outwards.
SQUARROSE, spreading out at right angles.
STELLATE, having a number of divisions, radiating from a common centre—star-like.
STIPITATE, elevated on a stalk. See p. 103.
STOLONIFEROUS, . . . 43
STRIATED, having several longitudinal lines on the surface.
STROMBUS-SHAPED, (*strombuliform)*, twisted in an elongated spire.
SUBEROSE, like cork.
SUBULATE (*awl-shaped*), like linear, but tapering towards the apex, and base rather broad.
SUCCULENT, containing a large quantity of juice.
SULCATE, (furrowed), having longitudinal furrows or channels on the surface.
SUPERIOR, - . 98, 111, 115, 116.
SUPERVOLUTE, where one margin is rolled inwards, and the other is rolled around it.
SUPRA-DECOMPOUND, . . 61
SUSPENDED, ... 116
SYNANTHOUS, where the leaves and flower appear together.
SYNCARPOUS, . . . 114
SYNGENESIOUS, . . . 102, 110
SYNORHIZAE, . . . 137

TERETE, (*taper*), roundish and slightly tapering, in contradistinction to angular.
TERMINAL, at the extremity.
TERNATE, three at a common point round the axis—See Trifoliate.

TETRADYNAMOUS, . . . 110

TETRAPTERATE, four-winged.

THREE-RIBBED, with three ribs proceeding from the base (*trinervis*).

TOMENTOSE, with hairs a little more stiff than downy.

TONGUE-SHAPED, (*linguiform*), thick and fleshy, like a tongue, long, convex, and obtuse.

TORULOSE (*knotted*), like moniliform, but more swelling and uneven.

TRAPEZIFORM, having four margins, the opposite ones not parallel.

TRANSVERSE, - - - 126

TRIFID, . . . 97

TRIFOLIATE, (*ternate*), when the petiole terminates in three leaflets.

TRIGONAL, (*triangular, three-angled, three-cornered*), with three longitudinal angles.

TRIPINNATE, a degree more divided than bipinnate.

TRIPTERATE, (tripterous), three-winged. - 126

TRITERNATE, a degree more divided than biternate.

TROCHLEAR, like a pulley.

TRUNCATE, as if a piece had been cut off at the extremity—abrupt.

TUBAEFORM, *trumpet-like*, tubular and expanding at one extremity, like a trumpet.

TUBERCLED, with small protuberances or warts on the surface.

TUBEROUS, . . . 34

TUBULAR, cylindrical and hollow within, . 97, 99

TUNICATE, . . . 35

TURBINATE, (*top-shaped*), like a top or inverted cone, contracted towards the point, usually rounded at the thick extremity.

TURGID, slightly swollen.

TURNIP-SHAPED, (*napiform*), like an oblate spheroid, that is somewhat flattened at two opposite points, like the common turnip.

TWISTED, (contorted), the whole as if twisted, and each piece overlapping the adjoining one.

UMBRACULIFORM, umbrella-shaped, plaited, radiated and concave.
UNARMED, not having any spines or prickles.
UNCINATE, (*hooked*), bent back at the point.
UNEQUAL, when a figure is different in its sides, or not symmetrical.
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URCEOLATE, (*pitcher-shaped*), - - 99

VALVATE, touching each other at the margins only.
VASCULAR, . . . 86
VENTRAL, . . . 125
VENTRICOSE, swelling unequally, more on one side.
VERMICULAR, (*worm-like*), nearly cylindrical, and tortuous.
VERRUCOSE. See Tubercled.
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VISCID, with a thick adherent glutinous exudation on the surface.
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WHORLED (*verticillate*), p. 59.
WOOLLY (*lanate*), with long thickly set hairs.
WINGED (*alate*), with a broad thin margin.

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