the fruit, frequently incorporated with which are other parts of the flower, as receptacle, calyx, &c. In gymnosperms the pollen-tubes, having penetrated a certain distance down the tissue of the nucleus, are usually arrested in growth for a longer or shorter period, sometimes nearly a year. Subsequently growth recommences; the tube advances to the apex of the embryo-sac, which it pierces, and reaches the mouth of the canal of the corpuscle. It either descends the canal or remains attached at the mouth. The fovilla is transmitted to the central cell, and fertilization is complete, the central cell giving rise to the embryo. In angiosperms usually only one embryonal vesicle is fertilized, and one embryo is produced—*monoembryony;* but in some plants where many embryonal vesicles are formed, as in Citrus and Scabiosa, several of them may be fertilized, and thus many embryos produced—*polyembryony*. Usually, however, only one develops, so as to be capable of germination or growth. In gymnosperms it is very common to have polyembryony, although produced in a different way, for each central cell of a corpuscle may produce four embryos, and as the central cell of more than one corpuscle may be fertilized a great many embryos may be formed. They do not, however, all come to maturity.

4. *Female Organs of Phanerogams after Fertilization.*

a.—The Fruit.

After fertilization various changes take place in the parts of the flower. Those more immediately concerned in the process, the anther and stigma, rapidly wither and decay, while the filaments and style often remain for some time; the floral envelopes become dry, the petals fall, and the sepals are either deciduous, or remain persistent in an altered form; the ovary becomes enlarged, forming the pericarp; and the ovules are developed as the *seeds*, containing the *embryo-plant*. The term *fruit* is strictly applied to the mature pistil or ovary, with the seeds in its interior. But it often includes other parts of the flower, such as the bracts and floral envelopes. Thus the fruit of the Hazel and Oak consists of the ovary and bracts and calyx combined; that of the Apple, Pear, and Gooseberry, of the ovary and calyx; and that of the Pine-apple, of the ovaries and floral envelopes of several flowers combined. Such fruits are by some distinguished as *pseudocarpæ*. In popular language, the fruit includes all those parts which exhibit a striking change as the result of fertilization. In general, the fruit is not ripened unless fertilization has been effected; but cases occur in which the fruit swells, and becomes to all appearance perfect, while no seeds are produced. Thus, there are seedless Oranges, Grapes, and Pine-Apples. When the ovules are unfertilized, it is common to find that the ovary withers and does not come to maturity; but in the case of Bananas, Plantains, and Bread-fruit, the non-development of seeds seems to lead to a larger growth, and a greater succulence of fruit.

The fruit, like the ovary, may be formed of a single carpel, or of several. It may have one cell or cavity, being *unilocular;* or many, *multilocular*, &c. The number and nature of the divisions depend on the number of carpels, and the extent to which their edges are folded inwards. The appearances presented by the ovary do not always remain permanent in the fruit. Great changes are observed to take place, not merely as regards the increased size of the ovary, its softening and hardening, but also in its internal structure, owing to the suppression, additional formation, or enlargement of parts. Thus, in the Ash (fig. 281) an ovary with two cells, each containing an ovule attached to a central placenta, is changed into a unilocular fruit with one seed; one ovule, *l*, becoming abortive, while the other, *g*, gradually enlarging until the septum is pushed to one side, unites with the walls of the cell, and the placenta appears to be parietal. In the Oak and Hazel, an ovary with three cells, and two ovules in each, changes into a one-celled fruit with one seed. In the Coco-nut, a trilocular and triovular ovary is changed into a one-celled, one-seeded fruit. This abortion may depend on the pressure caused by the development of certain ovules, or it may proceed from non-fertilization of all the ovules and consequent non-enlargement of the carpels. Again, by the growth of the placenta, or the folding inwards of parts of the carpels, divisions occur in the fruit which did not exist in the ovary. In Pretrea zanzibarica, a one-celled ovary is changed into a four-celled fruit by the extension of the placenta. In Cathartocarpus Fistula a one-celled ovary is changed into a fruit, having each of its seeds in a separate cell, in consequence of spurious dissepiments (*phragmata*) being produced in a horizontal manner, from the inner wall of the ovary. In Linum, by the folding inwards of the

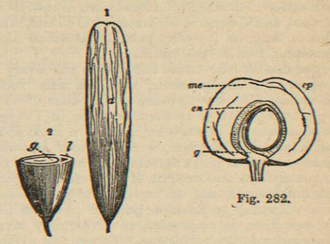

Fig. 281.

Fig. 282.

Fig. 281.—Samara or Samaroid fruit of *Fraxinus oxyphylla*. 1 Entire, with its wing *a*: 2. Lower portion cut transversely, to show that it consists of two loculaments; one of which, *l*, is abortive, and is reduced to a very small cavity, while the other is much enlarged, and filled with a seed *g*.

Fig. 282.—Drupe of the Cherry (*Cerasus*), cut vertically, showing the skin, or epicarp *ep*, the flesh or mesocarp *me*, and the stone, putamen, or endocarp *en*, enclosing the seed *g*, with the embryo.

back of the carpels a five-celled ovary becomes a ten-celled fruit. In Astragalus, the folding inwards of the dorsal suture converts a one-celled ovary into a two-celled fruit; and in Oxytropis the folding of the ventral suture gives rise to a similar change in the fruit. The development of cellular or pulpy matter, and the enlargement of parts not forming whorls of the flower, frequently alter the appearance of the fruit, and render it difficult to discover its formation. In the Gooseberry, Grape, Guava, Tomato, and Pomegranate, the seeds nestle in pulp, formed apparently by the placentas. In the Orange, the pulpy matter surrounding the seeds is formed by succulent cells, which are produced from the inner partitioned lining of the pericarp. In the Strawberry the receptacle becomes succulent, and bears the carpels on its convex surface (fig. 154); in the Rose there is a fleshy hollow torus or disk, which bears the carpels on its concave surface (fig. 153). In the Juniper the scaly bracts grow up round the seeds and become succulent, and in the Fig (fig. 150) the receptacle becomes succulent and encloses an inflorescence.

The pistil, in its simplest state, consists of a carpel or folded leaf, with ovules at its margin; and the same structure will be found in the fruit, where the pericarp represents the carpellary leaf, and the seeds correspond to the ovules. The pericarp consists usually of three layers, the external, or *epicarp* (fig. 282, *ep*), corresponding to the lower epidermis of the leaf; the middle, or *mesocarp*, *me*, representing the parenchyma of the leaf; and the internal, or *endocarp*, *en*, equivalent to the upper epidermis of the leaf, or the epithelium of the ovary. These layers are well seen in such

a fruit as the Peach or Plum, where they are separable one from the other; in them the epicarp forms what is commonly called the skin; the mesocarp, much developed, forms the flesh or pulp, and hence has sometimes been called *sarcocarp;* while the endocarp, hardened by the production of woody cells, forms the *stone* or *putamen*, immediately covering the kernel of the seed. The pulpy matter found in the interior of fruits, such as the Gooseberry, Grape, and Cathartocarpus Fistula, is formed from the placentas, and must not be confounded with the sarcocarp. In some fruits, as in the Nut, the three layers become blended together, and are indistinguishable. In Bladder Senna (Colutea arborescens) the pericarp retains its leaf-like appearance, but in most cases it becomes altered both in consistence and in colour. Thus in the Date the epicarp is the outer brownish skin, the pulpy matter is the mesocarp or sarcocarp, and the thin papery-like lining is the endocarp covering the hard seed. In the Medlar the endocarp becomes of a stony hardness. In the Melon the epicarp and endocarp are very thin, while the mesocarp forms the bulk of the fruit, differing in texture and taste in its external and internal parts. The rind of the Orange consists of epicarp and mesocarp, while the endocarp forms partitions in the interior, filled with pulpy cells. The part of the pericarp attached to the peduncle is called its *base*, and the point where the style or stigma existed is the *apex*. This latter is not always the apparent apex, as in the case of the ovary; it may be lateral or even basilar. The style sometimes remains in a hardened form, rendering the fruit *apiculate;* at other times it falls off, leaving only traces of its existence. The presence of the style or stigma serves to distinguish certain single-seeded pericarps from seeds.

Dehiscence of fruits.

When the fruit is mature and the contained seeds ripe, the carpels usually give way either at the ventral or dorsal suture or at both, and so allow the seeds to escape. The fruit in this case is *dehiscent*. But some fruits are *indehiscent*, falling to the ground entire, and the seeds eventually reaching the soil by their decay. By *dehiscence* the pericarp becomes divided into different pieces, or *valves*, the fruit being *univalvular*, *bivalvular*, or *multivalvular*, &c., according as there are one, two, or many valves. The splitting may extend the whole length of the fruit, or it may be only partial, the valves forming teeth at the apex of the fruit, and the dehiscence being *apicilar*, as in Caryophyllaceæ (fig. 283). Sometimes the valves are detached only at certain points, and thus dehiscence takes place by pores at the apex, as in Poppy (fig. 269), or at the base, as in Campanula. Indehiscent fruits are either dry, as the Nut, or fleshy, as the Cherry and Apple. They may be formed of one or several carpels. In the former case they usually contain only a single seed, which may become so incorporated with the pericarp as to appear to be naked. Such fruits are called *pseudospermous* or false-seeded, and are exemplified in the grain of Wheat. In such cases the presence of the style or stigma determines their true nature.

Dehiscent fruits, when composed of single carpels, may open by the ventral suture only, as in the Pæony, Hellebore, Aquilegia (fig. 300), and Caltha; by the dorsal suture only, as in Magnolias and some Proteaceæ, or by both together, as in the Pea (fig. 256) and Bean; in these cases the dehiscence is called *sutural*. When composed of several united carpels, two types of dehiscence may be recognized—a longitudinal type and a transverse type. In the longitudinal type the separation may take place by the dissepiments throughout their length, so that the fruit is resolved into its original carpels, and each valve will be a carpel, as in Rhododendron, Colchicum, &c. This dehiscence, in consequence of taking place through the lamellæ of the septum, is called *septicidal* (figs. 284, 285). The valves may separate from their commissure, or central line of union, carrying the placentas with them, or they may leave the latter in the centre, so as to form with the

Fig. 283.

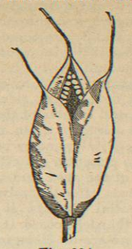

Fig. 284.

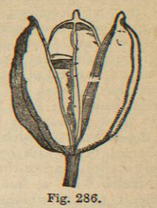

Fig. 286.

Fig. 285.

Fig. 287.

Fig. 288.

Fig. 283.—Seed-vessel or capsule of Campion (*Lychnis*), opening by ten teeth at the apex. The placenta is free central. The calyx is seen surrounding the seed-vessel, but not adherent.

Fig. 284.—Fruit or capsule of Meadow Saffron (*Colchicum autumnale*), dehiscing by three valves in a septicidal manner. The fruit is thus resolved into its three component carpels, with their styles and stigmas.

Fig. 285.—Diagram to illustrate the septicidal dehiscence in a pentalocular capsule. The loculaments *l* correspond to the number of the carpels, which separate by splitting through the septa *s*.

Fig. 286.—The seed vessel (capsule) of the Flower-de-Luce (*Iris*), opening in a loculicidal manner. The three valves bear the septa in the centre, and the opening takes place through the back of the loculaments. Each valve is formed by the halves of contiguous carpels.

Fig. 287.—Diagram to illustrate loculicidal dehiscence. The loculaments *l*, split at the back, and the valves separate, bearing the septa *s* on their centres.

Fig. 288.—Diagram to illustrate septifragal dehiscence, in which the dehiscence takes place through the back of the loculaments *l*, and the valves separate from the septa *s*, which are left attached to the placentas in the centre.

axis a column of a cylindrical, conical, or prismatic shape, which is termed the *columella*. The union between the edges of the carpels may be persistent, and they may dehisce by the dorsal suture, or through the back of the loculaments, as in the Lily and Iris (figs. 286, 287). In these cases each valve consists of a half of each of two contiguous carpels. The placentas either remain united to the axis, or they separate from it, being attached to the septa on the valves. This dehiscence is *loculicidal*. When the outer walls of the carpels break off from the septa, leaving them attached to the columella, the dehiscence is said to be *septifragal* (fig. 288), and where, as in Linum catharticum and Calluna, the splitting takes place first of all in a septicidal manner, the fruit is described as *septicidally septifragal;* while in other cases, as in Thorn Apple (Datura Stramonium), where the splitting is at first loculicidal, the dehiscence is *loculicidally septifragal*. In all those forms the separation of the valves takes place either from above downwards or from below upwards. But when the splitting only extends for a short distance, then dehiscence takes place by *pores*, which are situated either at the apex, base, or side, depending on the position of the valves. In the Poppy (fig. 269) the opening takes place by numerous pores under the peltate processes bearing the stigmas. In Campanula there are irregular openings towards the middle or base of the pericarp. In Frogsmouth or Snapdragon the pericarp gives way at certain fixed points, forming two or three orifices, one of which corresponds to the upper carpel, and the other to the lower. These orifices have a ragged appearance at the margins, which has given rise to the term *rupturing*, sometimes applied to this mode of

dehiscence. In Saxifraga a splitting for a short distance of the ventral sutures of the carpels takes place, so that a single large apical pore is formed. In Caryophyllaceæ (fig. 283) numerous small valvular splittings occur, forming teeth at the apex, and a single apical orifice is formed. In the fruit of Cruciferæ, as Wallflower, there is a form of longitudinal dehiscence (fig. 289) in which the valves separate from the base of the fruit, leaving a central *replum*, or frame, which is a phragma formed by a prolongation from the parietal placentas on opposite sides of the fruit, extending between the ventral sutures of the carpels. In Orchidaceæ (fig. 290) the pericarp, when ripe, separates into three valves, in a loculicidal manner, but the midribs of the carpels, to which the placentas are attached, remain adherent to the axis both at the apex and base, and form three arches, bearing the seeds, after the valves have fallen. In fruits with a free central placenta it is sometimes difficult to tell whether the dehiscence is septicidal or loculicidal, inasmuch as there are no dissepiments, and the placentas and seeds form a column in the axis. Their number, as well as alternation or opposition, as compared with the sepals, will aid in determining whether the valves are the entire carpellary leaves, as in septicidal dehiscence, or only half carpels united, as in loculicidal dehiscence. The other type of dehiscence is transverse, the dehiscence in this case being called *circumscissile*. In this dehiscence the upper part of the united carpels falls off in the form of a lid or operculum, as in Anagallis and in Henbane (Hyoscyamus) (fig. 291), and hence the fruit is often denominated *operculate*. In such instances we may either suppose that the fruit or seed-vessel is formed by a number of articulated leaves like those of the Orange, the division taking place where the laminæ join the petioles, or that the receptacle is prolonged in the form of a hollow cup, and the lid represents leaves united to it by articulation.

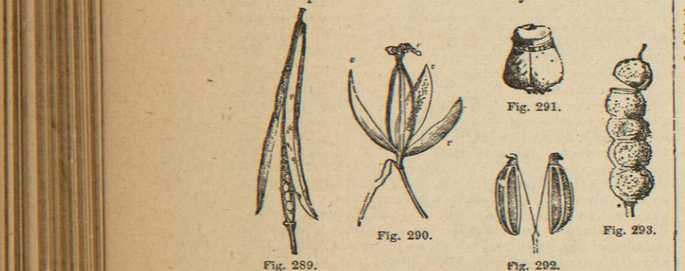

Fig. 289. Fig. 290. Fig. 291. Fig. 292. Fig. 293.

Fig. 289.—Siliqua or seed-vessel of Wallflower (*Cheiranthus Cheiri*), opening by two valves, which separate from the base upwards, leaving the seeds attached to the placentas in the middle, with a replum between.

Fig. 290.—Seed-vessel of an Orchid (*Orchis*), opening by three valves *v v v*, which bear the placentas and seeds in their middle. The midribs of the carpels remain united at the base and apex, and the withered floral envelopes *e* are seen attached at the apex.

Fig. 291.—Seed-vessel of Henbane (*Hyoscyamus niger*), opening by circumscissile dehiscence. The upper part of the seed-vessel comes off in the form of a lid, and the capsule has been on this account called pyxis or pyxidium.

Fig. 292.—The fruit of the Fennel (*Fœniculum vulgare*), arrived at maturity. It separates into two cocci or achænia, each of which is marked with obtuse prominent ridges on the surface, and is suspended from the summit of a process of the axis (columella), called a carpophore.

Fig. 293.—Lomentum or lomentaceous legume of a species of Sainfoin (*Hedysarum*). Each seed is contained in a separate cavity by the folding inwards of the walls of the legume at equal intervals; and the legume, when ripe, separates transversely into single-seeded portions or mericarps.

Sometimes the axis is prolonged beyond the base of the carpels, as in the Mallow and Castor-oil plant, the carpels being united to it throughout their length by their faces, and separating from it without opening. In the Umbelliferæ the two carpels separate from the lower part of the axis, and remain attached by their apices to a prolongation of it, called a *carpophore* or *podocarp*, which splits into two (fig. 292) and suspends them; hence the name *cremocarp* is applied to this fruit, which divides into two suspended mericarps. The general term *schizocarp* is applied to all dry fruits, which break up into two or more one-seeded indehiscent mericarps, as in Hedysarum (fig. 293). In Geraniaceæ the axis is prolonged beyond the carpels, forming a carpophore, to which the styles are attached, and the pericarps separate from below upwards, before dehiscing by their ventral suture (fig. 152). Carpels which separate one from another in this manner are called *cocci*. They are well seen in Euphorbiaceæ, where there are usually three such carpels, and the fruit is designated tricoccous. In many of them, as Hura crepitans, the cocci separate with great force and elasticity, the cells being called *dissilient*. In many Leguminous plants, such as Ornithopus, Hedysarum (fig. 293), Entada, Coronilla, and the Gum-arabic plant (Acacia arabica), the fruit becomes a schizocarp by the formation of transverse partitions from the folding in of the sides of the pericarp, and distinct separations taking place at these partitions by what has been termed *solubility*. In Cathartocarpus Fistula the schizocarp exhibits no evident depressions externally. Some look upon these pods as formed by pinnate leaves folded, and the divisions as indicating the points where the different pairs of pinnæ are united.

Fruits may be formed by one flower, or they may be the product of several flowers combined. In the former case they are either *apocarpous*, of one mature carpel or of several separate free carpels; or *syncarpous*, of several carpels, more or less completely united. These different kinds of fruits may be *indehiscent* or *dehiscent*. When the fruit is composed of the ovaries of several flowers united, it is usual to find the bracts and floral envelopes also joined with them, so as to form one mass; hence such fruits are called *multiple*, *confluent*, or *anthocarpous*. The term *simple* is perhaps properly applied to fruits which are formed by the ovary of a single flower, whether they are composed of one or several carpels, and whether these carpels are separate or

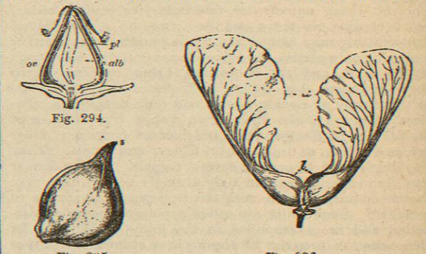

Fig. 294. Fig. 295. Fig. 296.

Fig. 294.—Fruit of a species of Dock (*Rumex*), cut vertically. It is a monospermous indehiscent dry fruit, called an achene, or achænium. The outer part, *ov*, is the pericarp or seed-vessel containing the seed, with its coverings The seed contains nourishing matter, called albumen or perisperm *alb*, and the embryo plant *pl*, with its cotyledons pointing downwards, and its radicle upwards. The seed is orthotropal, and the embryo is inverted. At the upper part of the pericarp two of the styles and stigmas are seen curving downwards. At the base part of the perianth is represented.

Fig. 295.—Achænium of Crowfoot (*Ranunculus*). A single-seeded seed-vessel, with the pericarp applied closely to the seed. Such fruits resemble seed in appearance; the style and stigma *s* aid in distinguishing them.

Fig. 296.—Seed-vessel of *Acer Pseudo-platanus* (Sycamore, called Plane in Scotland), composed of two samaras or winged monospermous carpels united; *a*, upper part forming a dorsal wing; *l*, lower portion corresponding to the loculaments.

combined. Simple fruits are hence sometimes denominated *monogynœcial*, as being formed by one gynœcium; while multiple fruits are called *poiygynœcial*, as being formed by many gynœcia.

Simple fruits are either *dry* or *succulent*,—the pericarp, in the former instance, remaining more or less foliaceous in its structure, and sometimes being incorporated with the seed, while it is in the latter thick and fleshy or pulpy.

The *achænium* is a dry unilocular monospermous indehiscent fruit, the pericarp of which is closely applied to the seed, but separable from it. It may be *solitary*, forming a single fruit, as in the Dock (fig. 294), and in the Cashew, where it is supported on a fleshy peduncle; or *aggregate*, as in Ranunculus (figs. 254, 295), where several achænia are placed on a common elevated receptacle. In the Strawberry the achænia (fig. 154) are aggregated on a convex succulent receptacle. In the Rose they are supported on a concave receptacle (fig. 155), and in the Fig the succulent receptacle completely encloses the achenes (fig. 150). In Dorstenia (fig. 163) the achenes are situated on a flat or slightly concave receptacle. In the Rose the aggregate achænia with their covering are sometimes collectively called *cynarrhodum*. It will thus be remarked that what in common language are called the seeds of the Strawberry, Rose, and Fig, are in reality carpels, which are distinguished from seeds by the presence of styles and stigmas. The styles occasionally remain attached to the achænia, in the form of feathery appendages, as in Clematis, and they are called *caudate*. In Compositæ, the fruit, Plate IX. which is sometimes called *cypsela*, is an achænium (fig. 197), to which the pappose or obsolete calyx remains adherent. Such is also the nature of the fruit in Dipsacaceæ. When the pericarp is thin, and appears like a bladder surrounding the seed, the achænium is termed a *utricle*, as in Amarantaceæ. When the pericarp is extended in the form of a winged appendage, a *samara* or *samaroid achænium* is produced, as in the Ash (fig. 281), Common Sycamore (fig. 296), and Hiræa. In these cases there are usually two achænia united, one of which, however, as in Fraxinus oxyphylla (fig. 281), may be abortive. The wing is either *dorsal*, that is, it is a prolongation from the median vein (fig. 296, *a*) or it is *marginal*, that is, formed by the lateral veins. It surrounds the fruit longitudinally in the Elm. When the pericarp becomes so incorporated with the seed as to be inseparable from it, as in grains of Wheat, Maize, Oats (fig. 297), and other Grasses, then the name

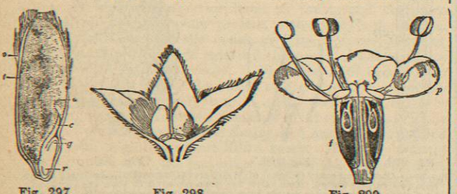

Fig. 297. Fig. 298. Fig. 299.

Fig. 297.—Caryopsis or single-seeded grain of Oats (*Avena*). The fruit and seed are incorporated. The pericarp *o* bears the styles and stigmas, and encloses the seed *t*, with its albumen, or perisperm, *a*, and its embryo, consisting of the cotyledon *c*, the gemmule *g*, and the root *r*.

Fig. 298.—Calyx and fruit of Comfrey (*Symphytum*), cut vertically. The fruit is divided by the folding of the ovary into four single-seeded portions or achænia, two of which are seen in the figure, and the style appears to arise from the base of the carpels.

Fig. 299.—Flower of Fennel (*Fœniculum vulgare*), one of the Umbelliferæ, cut vertically, showing the fruit *f*, composed of two single-seeded carpels, or achenes, united, so as to form a cremocarp. The pendulous seeds are seen in the carpels or mericarps. The two styles are seen at the apex of the fruit, with their dilated bases formed by an epigynous disk. The points (apicula) of the petals *p* are turned inwards. The calyx tube is adherent to the fruit, and the limb of the calyx is often obsolete.

caryopsis is given. There are some fruits which consist of two or more achænia, although originally the carpels were united into a syncarpous pistil, as in Labiatæ and Boraginaceæ (fig. 298). To this form of schizocarpic fruit, Plate III. as well as to that of Tropæolum and Mallow, the name *carcerulus* is given. The *cremocarp*, or the fruit of Umbelliferæ (figs. 292 and 299), is composed of two achænia Plate VII. united by a commissure to a *carpophore*, from which they are suspended at maturity. It is sometimes denominated *diachænium*, from the union of two achænia, which in this instance receive the name of *mericarps* or *hemicarps*.

The *nut* or *glans* is a dry one-celled indehiscent fruit with a hardened pericarp, surrounded by bracts at the base, and, when mature, containing only one seed. In the young state the ovary contains two or more ovules, but only one comes to maturity. It is illustrated by the fruits of the Hazel and Chestnut, which are covered by leafy bracts, in the form of a *husk*, and by the Acorn, in which the bracts and receptacle form a *cupula* or *cup* (fig. 147). The parts of the pericarp of the nut are united so as to appear one. In common language the term nut is very vaguely applied both to fruit and seeds.

The *drupe* is a succulent usually monospermal and unilocular indehiscent fruit, with a pericarp easily distinguishable into epicarp, mesocarp, and endocarp. This term is applied to such fruits as the Cherry (fig. 282), Peach, Plate XII. Plum, Apricot, Mango, Walnut, Nutmeg, and Date. The endocarp is usually hard, forming the stone (*putamen*) of the fruit, which encloses the kernel or seed. The mesocarp is generally pulpy and succulent, so as to be truly a *sarcocarp*, as in the Peach, but it is sometimes of a tough texture, as in the Almond, and at other times is more or less fibrous, as in the Coco-nut. In the Almond there are often two ovules formed, only one of which comes to perfection. In the Walnut, prolongations from the endocarp, which is of two layers, extend into the substance of the seed, and give rise to its characteristic convoluted lobate appearance. This fruit has been sometimes called *tryma*. In the Raspberry and Bramble several drupes or *drupels* are aggregated so as to constitute an *etærio*.

The *follicle* is a dry monocarpellary unilocular polyspermal (many-seeded) fruit, dehiscing by the ventral suture. It is rare to meet with a solitary follicle forming the fruit. There are usually several aggregated together, either in a circular manner on a shortened receptacle, as in Hellebore, Aconite, Delphinium, Aquilegia (figs. 300, 301) Crassulaceæ (fig. 172), Butomus, and Asclepiadaceæ; or in a spiral manner on an elongated receptacle, as in Magnolia, Banksia, and Liriodendron. Occasionally, follicles dehisce by the dorsal suture, as in Magnolia grandiflora and Banksia.

The *legume* or *pod* is a dry monocarpellary unilocular polyspermal fruit, dehiscing both by the ventral and the dorsal Plate V suture. It characterises Leguminous plants, as the Bean fig. 7. and Pea (fig. 256). In the Bladder-senna it retains its leaf-like appearance, and forms an inflated legume. In some Leguminosæ, as Arachis, Cathartocarpus Fistula, and the Tamarind, the fruit must be considered a legume, although it does not dehisce. The first of these plants produces its fruit underground, and is called earth-nut; the second has a partitioned legume and is schizocarpic; and both the second and third have pulpy matter surrounding the seeds. Some legumes are schizocarpic by the formation of constrictions externally. Such a form is the *lomentum* or *lomentaceous legume* of Hedysarum coronarium (fig. 293), Coronilla, Ornithopus, Entada, and of some Acacias. In Medicago the legume is twisted like a snail, and in Cæsalpinia coriaria, or Divi-divi, it is vermiform or curved like a worm; in Carmichaelia the valves give way close to the suture, and separate from it, leaving a division. Sometimes the number of seeds is reduced, as in Erythrina monosperma and Geoffroya superba, which are one-seeded, and in Pterocarpus and Dalbergia, which are two-seeded.

The *berry* (*bacca*) is a succulent syncarpous polyspermal unilocular indehiscent fruit, with seeds immersed in a pulpy

mass, formed by the placentas. The name is usually given to such fruits as the Gooseberry (fig. 302) and Currant, in which the ovary is inferior, and the placentas are parietal, the seeds being ultimately detached from the placenta, and

Fig. 300.

Fig. 301.

Fig. 302.

Fig. 303.

Fig. 300.—Follicle of Columbine (*Aquilegia vulgaris*), consisting of a polyspermal carpel, opening by the ventral suture.
Fig. 301.—Apocarpous fruit of Columbine (*Aquilegia vulgaris*), consisting of five separate mature carpels, with styles and stigmas.
Fig. 302.—Fruit of the Gooseberry (*Ribes Grossularia*), cut vertically, showing the seeds attached to parietal placentas, and immersed in pulpy matter, which is formed partly from the endocarp and partly from the testa of the seed. The fruit is called a bacca.
Fig. 303.—Section of the fruit of the Apple (*Pyrus Malus*), consisting of a fleshy covering partly formed by the calyx and disk, and five cavities in the centre with seeds. The fruit is called a pome.

lying loose in the pulp. Others have applied it also to those in which the ovary is superior, as in the Grape, Potato, and Ardisia, and the placentas are central or free central. The latter are frequently separated under the name *uva* (grape). In general, the name of *baccate* or *berried* is applied to all pulpy fruits. In the Pomegranate there is a peculiar baccate many-celled inferior fruit, having a tough rind, enclosing two rows of carpels placed one above the other. The seeds are immersed in pulp, and are attached irregularly to the parietes, base, and centre of the loculi. The fruit has been called *balausta*, and the tough rind is called *malicorium*. In the Baobab there is a multilocular syncarpous fruit, in which the seeds are immersed in pulp, to which the name *amphisarca* is given.

The *pepo* or *peponida*, another indehiscent syncarpous fruit, is illustrated by the fruit of the Gourd, Melon (fig. 262), and other Cucurbitaceæ. It is formed of three carpels, to which the calyx is superior; the rind is thick and fleshy, partly formed by the calyx; and there are three or more seed-bearing parietal placentas, either surrounding
Plate VI. a central cavity, or prolonged inwards into it. The fruit of the Papaw resembles the pepo, but the calyx is not superior.

The *hesperidium* is the name given to such indehiscent syncarpous fruits as the Orange, Lemon, and Shaddock, in which the epicarp and mesocarp form a separable rind, and the endocarp sends prolongations inwards, forming triangular divisions, to the inner angle of which the seeds are attached, pulpy cells being developed around them. Both pepo and hesperidium may be considered as modifications of the berry.

The *pome*, seen in the Apple, Pear, Quince, Medlar, and Hawthorn, is a fleshy indehiscent syncarpous fruit with the calyx attached, and has an outer skin or epicarp, a fleshy mesocarp, and a scaly or horny endocarp (the *core*) enclosing the seeds (fig. 303). Some look upon the so-called epicarp and mesocarp as formed by the prolonged receptacle on the inner surface of which a fleshy lining is developed, while the endocarp represents the true carpels. In this view the endocarp might be regarded as consisting of a number of indehiscent follicles (usually five) surrounded by a succulent receptacle. In the Medlar the endocarp (or what may be called the true pericarp) is of a stony hardness, while the outer succulent covering is open at the summit. The stones of the Medlar are called *pyrenæ*; some apply the term *nuculanium* to the Medlar. Taking this view of the pome it may be said to resemble in a manner the fruit of the Rose, the cynarrhodum producing achenes, and the pome closed follicles.

The name *capsule* is applied generally to all dry syncarpous fruits, which dehisce by valves of whatever kind. It may thus be unilocular or multilocular, monospermous or polyspermous. The true valvular capsule is observed in Colchicum (fig. 284), Lily, and Iris (fig. 286). The *porose capsule* is seen in the Poppy (fig. 269), Antirrhinum majus, and Campanula persicifolia. In Campanula the pores occur at the base of the capsule, and it has been designated a *diplotegia*. When the capsule opens by a lid, or by circumscissile dehiscence, it is called a *pyxidium*, as in Anagallis arvensis, Henbane (fig. 291), and Monkey pot (Lecythis). The capsule assumes a screw-like form in Helicteres, and a star-like or stellate form in Illicium anisatum. In certain instances the cells of the capsule separate from each other, and open with elasticity to scatter the seeds. This kind of capsule is met with in the Sandbox tree (Hura crepitans), and other Euphorbiaceæ, Plate XIII. where the cocci, containing each a single seed, burst asunder fig. 7. with force; and in Geraniaceæ, where the cocci, each con- Plate II. taining, when mature, usually one seed, separate from the carpophore, become curved upwards by their adherent styles, and open by the ventral suture (fig. 152). In the former case the fruit collectively has been called *regma*.

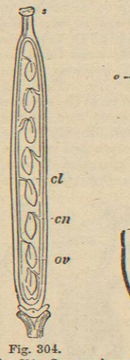

Fig. 304.

Fig. 305.

Fig. 306.

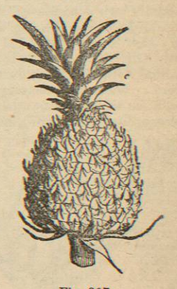

Fig. 307.

Fig. 304.—Compound ovary (siliqua) of Wallflower (*Cheiranthus*), consisting of at least two carpels united. One valve has been removed to show the partition or replum *cl*, formed of a double layer from the placentæ *cn* on either side, to which the ovules *ov* are attached by means of funiculi. The style and stigma *s* are at the upper part of the ovary.
Fig. 305.—Silicula of Whitlow-grass (*Draba*), opening by two flat valves *o* from below upwards, leaving the parietal placentas *pl* in the centre, united by a membrane or replum. The partition of the seed-vessel is broad, and hence the name latiseptæ.
Fig. 306.—Silicula or pouch of Shepherd's purse (*Capsella*), opening by two folded valves, which separate from below upwards. The phragma is narrow, and hence the name angustiseptæ.
Fig. 307.—Fruit of the Pine-apple (*Ananassa sativa*), consisting of numerous flowers and bracts united together so as to form a collective or anthocarpous fruit. The crown of the Pine-apple, *c*, consists of a series of empty bracts prolonged beyond the fruit.

The *siliqua* is a dry syncarpous bicarpellary bilocular polyspermal fruit with a replum, dehiscing by two valves from below upwards, the valves separating from the placentas and leaving them united by the replum. The seeds are attached on both sides of the replum, either in one row or in two. When the fruit is long and narrow it

is called *siliqua* (fig. 304); when broad and short, it is called *silicula* (figs. 305, 306). It occurs in Cruciferous plants, as Wallflower, Cabbage, and Cress. In Glaucium and Eschscholtzia (Papaveraceous plants) the fruit is siliquæform, the dissepiment or replum being of a spongy nature, and it has been termed a *ceratium*. In its normal state a siliqua is supposed to consist of four carpels, but two of these are abortive. There are four bundles of vessels in it, one corresponding to each valve which may be called *valvular* or *pericarpial*, and others running along the edge called *placental*. The replum consists of two lamellæ. It sometimes exhibits perforations, becoming *fenestrate*. Rarely its central portion is absorbed, so that the fruit becomes one-celled. It may become *lomentaceous*, as in Raphanus and Sea-kale, and it may be reduced, as in Woad (Isatis), to a monospermal condition.

It sometimes happens that the ovaries of two flowers unite so as to form a double fruit. This may be seen in many species of Honeysuckle. But the fruits which are now to be considered consist usually of the floral envelopes, as well as the ovaries of several flowers united into one, and are called *multiple*, *confluent*, or *polygynœcial*. The term *anthocarpous* has also been applied as indicating that the floral envelopes as well as the carpels are concerned in the formation of the fruit.

The *sorosis* is a succulent multiple fruit formed by the confluence of a spike of flowers, as in the fruit of the
Plate XIV. Pine-apple (fig. 307), the Bread-fruit, and Jack-fruit. Sometimes a fruit of this kind resembles that formed by a single flower, and a superficial observer might have some difficulty in marking the difference.

The *syconus* is an anthocarpous fruit, in which the receptacle completely encloses numerous flowers and becomes succulent. The Fig (fig. 150) is of this nature, and what are called its seeds are the achænia of the numerous flowers scattered over the succulent hollowed receptacle. In Dorstenia (fig. 163) the axis is less deeply hollowed, and of a harder texture, the fruit exhibiting often very anomalous forms.

The *strobilus*, or *cone*, is a fruit-bearing spike, more or less elongated, covered with scales (fig. 134), each of which represents a separate flower, and has often two seeds at its base, the scales being considered as bracts and the seeds naked, and no true ovary present with its style or stigma. This fruit is seen in the cones of Firs, Spruces, Larches, and Cedars, which have received the name of Coniferæ, or cone-bearers, on this account. Cone-like fruit is also seen in some Cycadaceæ. The scales of the strobilus are sometimes thick and closely united, so as to form a more or less angular and rounded mass, as in the Cypress; while in the Juniper they become fleshy, and are so incorporated as to form a globular fruit like a berry. The dry fruit of the Cypress, and the succulent fruit of the Juniper, have received the name of *galbulus*. The fruit of the Yew (Taxus baccata) is regarded as a cone reduced to a single naked seed, covered by succulent scales, which unite to form a scarlet fleshy envelope. In the Hop the fruit is called also a strobilus, but in it the scales are thin and membranous, and the seeds are not naked but are contained in pericarps.

The same causes which produce alterations in the other parts of the flower give rise to anomalous appearances in the fruit. The carpels, in place of bearing seeds, are sometimes changed into leaves, with lobes at their margins. Leaves are sometimes produced from the upper part of the fruit, which is then called *frondiparous*. In the genus Citrus, to which the Orange and Lemon belong, it is very common to meet with a separation of the carpels, so as to produce what are called horned oranges and fingered citrons. In this case a syncarpous fruit has a tendency to become apocarpous. In the Orange we occasionally find a supernumerary row of carpels produced, giving rise to the appearance of small and imperfect oranges enclosed within the original one. The Navel Orange of Pernambuco is of this nature. It sometimes happens that, by the union of flowers, double fruits are produced. Occasionally a double fruit is produced, not by the incorporation of two flowers, but by the abnormal development of a second carpel in the flower.

ARRANGEMENT OF FRUITS.

I. Monogynœcial fruits, formed by the gynœcium of one flower.
1. Capsulary fruits.—Dry, dehiscent, formed by one or more carpels; when by more than one, coherent.
a. Monocarpellary.—Legume; Follicle.
b. Polycarpellary.—Capsule; Pyxidium; Siliqua; Silicula; Ceratium; Diplotegia; Regma.
2. Aggregate fruits.—Polycarpellary; carpels always distinct.
a. Indehiscent.—Etærio; Strawberry; Cynarrhodum.
b. Dehiscent.—Follicles (Columbine).
3. Schizocarpic fruits.—Dry, breaking up into one-celled indehiscent portions.
a. Monocarpellary.—Lomentum.
b. Polycarpellary.—Cremocarp; Carcerulus; Samara (Acer).
4. Achænial fruits.—Dry, indehiscent, one or few-seeded, not breaking up. Achænium; Caryopsis; Utricle; Samara (Elm); Cypsela; Glans.
5. Baccate fruits.—Indehiscent; seeds in pulp. Bacca; Uva; Hesperidium; Pepo; Amphisarca; Balausta.
6. Drupaceous fruits.—Indehiscent, succulent, endocarp indurated, usually stony. Drupe; Tryma; Pome; Nuculanium.

II. Polygynœcial fruits, formed by the gynœcia of several flowers.
1. Succulent.—Sorosis; Syconus; Galbulus.
2. Dry.—Strobilus; Cone.

b.—The Seed.

When the ovule arrives at maturity it constitutes the seed, The seed. which is contained in a seed-vessel in the plants called *angiospermous*; while in *gymnospermous plants*, such as Coniferæ and Cycadaceæ, it is naked, or, in other words, has no true pericarp. It sometimes happens in angiosperms, that the seed-vessel is ruptured at an early period of growth, so that the seeds become more or less exposed during their development; this occurs in Mignonette, where the capsule opens at the apex, and in Cuphea platycentra, where the placenta bursts through the ovary and floral envelopes, and appears as an erect process bearing the young seeds. After impregnation the ovule is greatly changed, in connection with the formation of the embryo. In the embryo sac of most angiosperms there is a development of cellular tissue, enveloping, when not previously absorbed, the *antipodal cells*, and more or less filling the embryo sac. In gymnosperms, as already mentioned, the endosperm is formed preparatory to fertilization. The germinal vesicle in angiosperms, the central cell of the corpuscle in cryptogams, enlarges and divides, forming the embryo. The embryo-sac enlarges greatly, displacing gradually the nucleus, which may eventually form merely a thin layer around the sac, or it may completely disappear. The integuments also become much altered, and frequently appendages are developed from them.

The general integumentary covering of the seed is called *spermoderm*. In it are recognized two parts, an *external membrane*, called the *episperm* or *testa* (fig. 308, *te*), and an *internal membrane*, called *endopleura* or *tegmen*, *e*, which however is often incorporated with the testa, and hardly separable from it. The testa may consist of a union of the primine and secundine, or of the primine only, when, as occasionally happens, the secundine is absorbed; the endopleura, of a combination between the outer layer of the nucleus (sometimes termed the tercine), and the embryo-sac, or of one of these parts alone. Sometimes the secundine remains distinct in the seed, forming what has been called a *mesosperm*; and when it assumes a fleshy