On the Development of the Flower, and especially the Pistil, in the Caryophyllaceæ.

By
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On the development of the flower, & es-
-pecially the Pistil, in the Caryophyl-
-laceæ.

My observations were made chiefly on the development of the flower in Agro-
-stemma flos-Jovis & Lychnis dioica.
In many points, these plants closely resemble each other in their floral de-
-velopment. They differ, however, in some important particulars; for exam-
-ple,— In Agrostemma, the flowers are "hermaphrodite". In Lychnis dioica, a more or less completely dicecious con-
-dition occurs, where, in the "female" plant, there is an early arrest, so to speak, in the development of the third and fourth foliar whorls of the flower (counting from the exterior), whilst, in the "male" plant, there are only four whorls developed, no trace of a fifth whorl, corresponding to the carpels, making its appearance.

Lychnis dioica & Agrostemma differ also in the mode in which the end of the placenta is developed; but I shall allude to this more particularly hereafter.

At an early period, the rudiment of the flower may be observed to consist of the five sepals, surrounding the rounded termination of the floral axis (Pl. I. fig: 1).

The five petals next make their appearance, alternating with the sepals (Pl. I. fig: 2).

A whorl of five rounded mammillæ next appear, alternating with the petals (Pl: I. Fig: 3); & then an inner whorl of five similar mammillæ, alternating with the last (Pl I. Fig 4).

In Agrostemma, & in Lychnis dioica (mas.), these two whorls are developed as stamens, whilst, in Lychnis dioica (fem:), they remain in a rudimentary condition.

After these whorls have appeared, the termination of the flower, hitherto hemi-spherical, assumes, in Agrostemma & Lychnis dioica (fem:), a slightly flattened pentagonal form, by the development, on its circumference, of five elevations, alternating with the inner staminal rudiments, or stamens (Pl: I. fig: 5). Shortly after this, a shallow depression is formed, internal to each of these elevations, by the growth of the surrounding parts, so that the termination of the flower appears as a pentagonal cushion, having a slight dimple contained in each angle (Pl. I. figs: 6 & 7). The young germen is now sketched out. The dimples are the future loculi, and are bounded, externally, by the five elevations before mentioned, which are now somewhat crescentic, & form the walls of the rudimentary germen; internally, by the slightly rounded termination of

* In these remarks, I employ the word Spermophore, which Schleiden has substituted for that in general use, — Placenta. Such terms as Placenta, Ovule, Umbi-licus, Chalaza, &c., only call up vague associations with the parts so designated in Ani-mal embryology, & may even lead the Student into wrong notions, as to the true digni-fication of the structures con-cerned.

the floral axis, which afterwards becomes the central spermophore*; & later-
-ally, they are separated from each other by the rudimentary septa of the germen. Later, these dimples be-
-come deepened by the further de-
-velopment of the parts bounding them, until the germen assumes the form of a five-celled cup, open at the top (Pl I. fig: 8, & Pl II. fig 1). The cells, or loculi, are separated from each other by septa extending between the wall of the germen & the central spermophore, which forms a central column continuous in direction with the axis of the flower. The free upper margins of the septa & wall of the germen are nearly in the same plane with the upper surface of the central column.

Later, the brim of the germen begins to grow inwards, opposite the five septa; & through the convergence of these points towards the centre, each

loculus becomes closed in by the ap-
-proximation, or folding together, of the
two halves of the margin of its outer
wall.

The five styles first appear at the time
the capsule begins to close. They are
gradually-developed prolongations of
the outer walls of the loculi, & alter-
-nate with the septa; the cells on this
internal aspect, become subsequently de-
-veloped in a papillose manner, so as
to constitute the stigmas.

In Lychnis dioica, about, or a little
before, the time that the capsule com-
-mences to close, the placenta becomes
developed, superiorly, into five branch-
-like portions, which remain in con-
-nection with the septa. These branches,
(which are short) taper off above, &
are lost in the septa, whose free margins
become approximated to each other,
in the middle line, by the closure
of the capsule. There is a somewhat

fusiform space left in the middle line, at the upper part of the carpels, between the branches of the placenta; & if a cross section of a young capsule be taken at that part, the appearance of a parietal placentation is presented, as in Pl: III., fig. 2. In Pl. II., figs. 2, 3, 4 & 5, I have represented the gradual closure of the capsule, with the development of the style, & the branching of the upper part of the spermophore, in Lychnis divica (Hoffm.). In Agrostemma, this division of the spermophore does not occur; it is only slightly concave on its upper surface.

In both plants, the ovules appear in double vertical rows, upon previously-developed placental ridges, or double cord-like projections, on the internal angles of the loculi. They (the ovules) first make their appearance a little before the capsule closes, and

are developed in order from above down-
-wards, the oldest ovules being at
the upper part of the placenta, the
youngest at the lower. Fig. 4, Pl. III.
represents the development of the ovules
in Agrostemma.

At a later period in the growth of the
capsule, the septa, as is well known,
become ruptured, leaving the spermophore
free in the centre of a one-celled seed-
-vessel.

In Lychnis dioica (mas), the capsule
is entirely absent, the termination
of the floral axis being prolonged,
beyond the inner staminal whorl, as
a slender style-like body, on which
some scattered hairs are developed.

Besides Lychnis & Agrostemma, I have
examined the earlier stages in the develop-
-ment of the gemmen of Silene maritima,
Arenaria Sp?, & Saponaria officinalis,
which do not differ essentially, from

in that respect, from the two first mentioned species, if we except the different number of cells in the germen, — in Arenaria & Silene three, in Saponaria two.

I have also examined the development of the originally-five-celled seed-vessel in Cerastium glomeratum & C. Pennsylvanicum, & of the three-celled capsule in Stellaria media. In these two genera, the point of chief interest is the very large size of the Spermophore, the rounded end of which continues to project (especially in Cerastium) beyond the brim of the germen, until the ovules have begun to appear. In Plate III. fig: 5, I have represented a flower of Cerastium pennsylvanicum in longitudinal section, shewing the young capsule, with a considerably prominent Spermophore.

In Spergula arvensis (Illecebraceæ), I have observed the germen at a stage corresponding to that of Agrostemma

represented in Plate I. fig. 7, which it exactly resembled, in miniature. At a more advanced period, the capsule is most distinctly five-celled.

The points of special interest connected with the development of the seed-vessel in Agrostemma & Lychnis, may be noticed under the following heads.

I. In these pistils, the germen is the part developed first, whilst the styles only appear as the capsule commences to close.

II. The central spermophore is manifestly the continuation of the floral axis, being a development of that hemispherical punctum vegetationis which we see in the earlier stages.

III. The seeds are developed in order, from above downwards, upon the spermophore.

IV. In Lychnis, the Spermophore is divided, at its upper part, into five branch-like portions, so that the placentation becomes parietal at the upper part of the Germen.

I. With reference to the first point, as to the mode of development of the pistil, I would remark, that the question raised by Schleiden, regarding the foliar or axial nature of certain superior pistils, is one involved in considerable difficulty, as authors are far from being agreed as to the mode of development of leaves properly so-called, upon which this question entirely depends for solution. Some, as Schleiden himself, assert, that in every case the parts of a leaf have a determinate or definite mode of development, — to wit — that in every case the distal parts of the leaf are those first developed, the proximal portion appearing subsequently.

* Trecul – "Memoire sur la formation "des feuilles" – Annales des Sciences Nat: 3ᵉ ser. Vol. XX p: 235; & "Note sur "la formation des feuilles" Idᵉ p. 183. Compare the latter with Payer's Observations Idᵉ p. 111–116. See also De Mercklin's "Observations sur "l'histoire du développement des "feuilles" Annales des Sciences Nat. 3ᵉ ser: Vol. VI. I have not entered into any criticism of the subject discussed in these papers, as it would require to be treated at considerable length; & I am scarcely competent to judge of a question about which I know so very little from personal observation.

P Schleiden's Principles of Botany – Lankester's translation p.p. 370 & 372.

On the other hand M. Trecul believes that the development of the leaf is determinate or basipetal in some cases, basifugal in others, while in another set of cases the development is what he terms mixed, i.e., partly basipetal, & partly basifugal *.

That a superior pistil may be, at least partially, axial, has been proved by Schleiden in Passiflora, where he finds that a cup-shaped elevation of the axis (the future gynaeceum) appears prior to the development of the stamens, from the edges of which cup the carpels arise, forming styles & stigmas.

Regarding the nature of the basifugally-developed pistils, in Leguminosæ & Liliaceæ, termed by Schleiden, Stem-pistils ¶, & to which, so far as the basifugal development is concerned, the Caryophyllaceous pistil bears a resemblance, I cannot venture to give an opinion, not having had

* Here I do not even except M. Duchartre, who studied the development of the flower in Rhodiola Quaveolens, but who clings, nevertheless, to the old idea that the inferior germen is formed by adhesion of the carpels by their outer surface to the receptacle, & that the septa, which separate the loculi of the germen, are formed by the inoculated edges of the carpels. He believes, however, that the central column which bears the seeds is axial. To me, such an adhesion of carpels to the receptacle is quite inconceivable; & a reductio ad absurdum of this notion, may be, I think, easily made, by simply imagining such an arrangement of parts upon an extended axis, instead of on the sides of a hollow cup: for what has

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sufficient experience in the study of leaf-development to enable me to form an independent opinion.

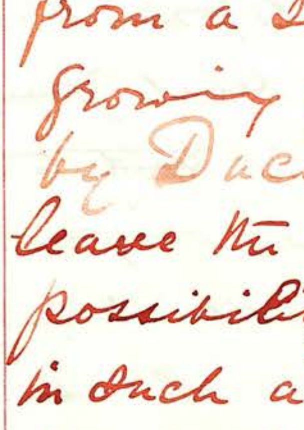
II. That the Spermophore in Lychnis & Agrostemma is an axial structure, must be evident to every one examining the course of its development.

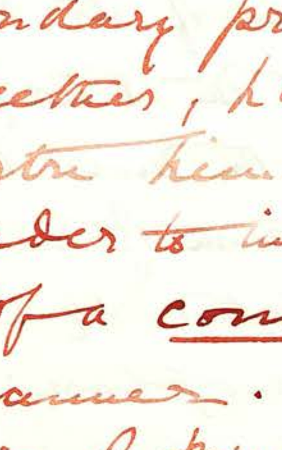
The further the study of development is extended, the more does it tend to confirm the truth of the law, originally enunciated by Schleiden, viz., that the Spermophore is in all cases an axial structure.

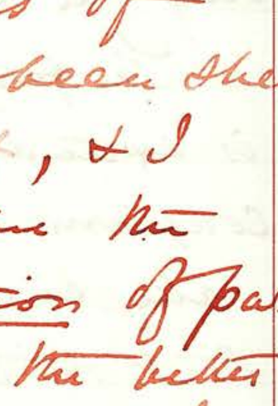
The Spermophore must, for example, be considered as axial in all cases of inferior germens, which Schleiden, & others who have studied their development, have shewn to result from a cup-shaped development of the receptacle*. The idea of a calyx-tube adherent to the structures internal to it, appears to me to be quite inadmissable, & Schleiden has, I think,

[Note continued]

we then? We have a leaf running down the axis from its origin, & adhering to it by the greater part of its external or inferior surface! That such an adhesion between leaf and axis does not result from a secondary process of growing together, has been shewn by Duchartre himself, & I leave the reader to imagine the possibility of a **connation** of parts in such a manner. For the better comprehension of this subject I have drawn three rough diagrams; Fig 1







represents what I conceive to be Duchartre's idea of a flower such as that of Oenothera, with an inferior

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justly characterized it as an absurd fiction.

The Spermophore is certainly apical in the Primulaceæ & other plants with a free central Spermophore; & the same may be said of all plants such as we have been considering, in which there is a true central Spermophore, connected by septa to the walls of the germen.

The only plants, regarding the nature of whose Spermophores there can be any doubt, are those with parietal placentation, including those Secondarily Central Spermophores which are found in the Liliaceæ &c., where an adhesion takes place, in the middle line, of several originally parietal Spermophores. There are now known, however, so many connecting links between the truly central Spermophores & the parietal ones, that little doubt can be entertained of their being all of

[Note continued]
germen; Fig: 2 shews the arrange-
-ment of parts as ~~they would~~ be
were the axis extended. Fig: 3
gives what I believe to be the
true interpretation of the phenom-
-ena. In the figures, the axial
structure is coloured orange, while
the foliar parts are coloured green.
Duchartre's paper, "Observations
"sur la fleur &c de l'Oenothera
"suaveolens H.P.", will be found
in the Annales des Sciences Nat:
2nd Series, Vol. XVIII Botanique.

the same nature; — but I shall revert to this anon.

III. The development of ovules in order from above downwards, or the central spermophores in Agrostemma and Lychnis, is perfectly analogous to the Centrifugal development of ovules described by Payer in Mesembryanthemum, Opuntia, Dianthema, Berberidaceæ, Phil-ca, &c. Of this phenomenon, I cannot profess to give an explanation.

This mode of development of the ovules does not, as might perhaps be supposed, in the least invalidate the claims of this spermophore to be considered an axial structure, since several instances are now known where the development of structures occurs after the same fashion, from above downwards, upon parts which are certainly axial.

1st, M. Duchartre finds that the development

* Annales des Sciences naturelles 3e Ser
Vol II Botanique.

of ovules occurs from above downwards on the free central Spermophores in the Primulaceæ *

2nd, M. Payer has observed in Opuntia a similar apparent anomaly in the order of development of the Stamens. I may give the following abstract of Payers observations. — The numerous Sepals & petals are developed, in Spiral order, from below upwards upon the receptacle. Shortly after the development of the petals, the rounded termination of the somewhat conical receptacle, is so developed as to become hollowed out in its centre, causing the receptacle to appear like a little hill with a crater at its summit. The border of this crater becomes fringed by a range of Staminal mammillæ, which are succeeded by a second range on the sides of the hillock, below, & external to the first; a third row then appears, & so on, until the

* Annales des Sciences Naturelles 3e Ser:
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sides of the hillock are covered with stamens, developed in order from above downwards. At the same time the hollowing of the receptacle advances, so that at last it appears like a wide funnel, covered on its internal aspect with stamens, the oldest of which are now towards the bottom of the funnel, while the youngest cover its superior margin. The ovules are developed in order from below upwards upon the internal aspect of that part of the funnel-shaped receptacle which forms the inferior germen. *

I have been thus minute in the above abstract, to let it be seen that the idea of a calyx-tube from which the stamens may be supposed to take origin, is here quite inadmissable, as the stamens appear on the sides of the receptacle while it yet retains its conical form. We cannot imagine this to be anything else than

what it seems to be, viz, a centri-
-fugal development of parts upon
an axis.

3d, M. Payer has shown that, in Mesem-
-bryanthemum violaceum, the numerous
stamens are developed spirally in
order from within outwards upon five
bosses, or elevated portions of the
receptacle, which alternate with
the five previously developed sepals.
After the stamens have appeared, the
numerous petals are developed, in
order from within outwards, con-
-tinuing the same series of spirals
as the stamens. In M. edule & M.
cordifolium, the stamens are developed
similarly upon the five angles of
the receptacle, there being no previous
development of bosses in these species.
In Mesembryanthemum, the ovules
are developed in several longitudin-
-al rows, in order from above down-
-wards, upon a central spermophore

* Ann: des Sc: Nat: 3^D ser vol xviii

** M. Payer, I find, is aware of this centrifugal development of stamens in Hypericum. He states that in almost all plants with polyadelphous stamens, such as Malvaceæ, Hypericaceæ, Theaceæ, Dilleniaceæ, Loasaceæ

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In M. cordifolium, the placental ridges with the ovules remain permanently in this position; while, in M. edule & violaceum, they ultimately become parietal, in consequence of a peculiar & gradual excavation of the receptacle, the oldest ovules becoming the most inferior, & vice versâ *.

4th I find that the polyadelphous stamens in Hypericum calycinum are developed centrifugally upon elevated portions of the receptacle, closely resembling the bosses described by M. Payer in Mesembryanthemum violaceum, only they are more prominently & sharply defined. As this has not so far as I know been described** & as it differs from Mesembryanthemum, inasmuch as the petals are definite in number, & are developed prior to the appearance of the stamens,

[note continued]
Cactaceae, Mesembryanthemaceae, Euphorbiaceae &c the evolution of the stamens is centrifugal; but that the polyadelphous stamens in the Myrtaceae appear centripetally. Annales des Sc. Nat. 5^{e} ser Vol XX p.p. 99-100

I shall give a short description of the phenomena, so far as I have observed them, with a few drawings of the principal stages.—

At an early period, before the rudiment of the germen has made its appearance, five cushion-like elevations are developed upon the surface of the receptacle. These are somewhat narrowed at their points of attachment, so that they appear in bold relief from the receptacle; they are placed, one opposite each of the five petals, & surround the punctum vegetationis, which as yet retains its original hemispherical form. These cushion-like eminences have a convex, slightly flattened surface, & lie somewhat obliquely to the horizontal plane, sloping from below upwards & inwards (Plate IV. fig: 1.).

In Plate IV. fig: 2, I have represented

a later stage; three staminal mam-
-millae now appear on the upper
margin of each of the cushions, one
larger, evidently older mammilla,
with a smaller younger one on either
side. The rudimentary germen
now appears as five slight some-
-what crescentic elevations, sur-
-rounding the end of the axis, which
is now somewhat flattened.
In Plate IV. fig. 3, the staminal mam-
-millae above mentioned, are seen
to be succeeded by a second row
of four (sometimes there are more) sim-
-ilar mammillae, below & external
to them. The mammillae of this second
row alternate with the ones previously
developed. The five crescentic ele-
-vations, representing the germen,
have now completely coalesced to
form a continuous, pentagonal,
and somewhat sinuous rim.
Stamens continue to appear in

similar order, from within and above outwards & downwards, until at last the cushion-like elevations become covered with stamens, the upper and more internal being the furthest developed, the lower and more external the least so.
In Fig 4 Plate IV, the staminal phalanges are seen tolerably far advanced, and the gradation in size from the inner to the outer stamens is well seen. The parietal placentæ are now very evident as thick rib-like projections upon the inner surface of the wall of the germen. The flattened termination of the axis is still seen at the bottom of the cavity of the germen. There is as yet no appearance of styles.
In Fig 5 Plate IV, I have represented a nearly mature capsule of Hypericum calycinum in horizontal & vertical section. It exhibits

-hibits the parietal spermophores which are now more or less intimately united together, with numerous ovules developed on their resolute edges, & enclosing a central space, at the bottom of which, there is a cluster of seeds developed upon the termination of the floral axis. A horizontal section of this capsule, taken above the level of the end of the axis, differs in no essential respects from one taken at the upper part of the capsule in Lychnis, while if the section be made below this level, as at the part indicated by the dotted line, we should have a central spermophore with five loculi, just as in Lychnis.

The idea has suggested itself to me that a very interesting parallel may be drawn between the groups & stamens in Mesembryanthemum,

* In my paper "On the compound nature of the Cormophyta" (Transactions of the Botanical Soc: Edin.ᵍ Vol VI p. 84), I have given what I believe to be sufficient reasons for considering the pollen-grain & the seed, as being respectively the male & female members of the plant-colony, and not the Stamen and carpel as was supposed by Steenstrup Owen & Forbes.

Hypericum &c, & those ovules which are developed centrifugally.
In both cases, we have foliar structures associated together in groups. Sister-hoods might be a convenient term to employ with regard to the ovules, whilst fraternities (in Linnean style) might be retained to express the staminal groups, although perhaps not so strictly correct*.
In both cases we have the structures developed upon elevated portions of the receptacle; on the placental ridges, & on the staminal cushions or bosses.
Lastly, in both cases the structures are developed centrifugally.
Although this does not bring us any nearer to an explanation of the essence of the phenomenon (the centrifugal development of the parts) it is yet sufficient to shew, that these staminal & ovular

* Annales des Sc. Nat: 3^Der vol XX p-96

groups are governed by some fun-
-damental law common to both.

M. Payer has shewn that ovules are very frequently developed centrifugally, both upon central & parietal spermophores, but that this is not invariably the case, for on the central spermo-
-phores in the Myrtaceæ & Philadelphaceæ, the ovules are developed from the middle of the spermophores upwards & downwards, — the oldest seeds being in the middle, the youngest at the upper & lower extremities of the spermophore.*

IV. The spermophore in Lychnis, as I before mentioned, divides at its upper part into five branch-like portions.

Naudin, in his Atlas, represents a similar phenomenon as occurring in Dianthus, where the spermophore

divides into two portions as it's upper part, & this statement I can confirm. I have found this division to occur in several species of Lychnis, & in Calandrinia (among the Portulacaceæ). In Agrostemma flos-Jovis it does not occur.

We have in the upper part of the germen in Lychnis, a true parietal placentation. If we take a cross section from this part of the germen in Lychnis (Plate III. Fig 2) and compare it with the cross-section of a capsule having a parietal placentation, such as I have figured in Hypericum calycinum (Pl IV. fig. 5), we see that there is no essential difference between the two cases; we have, in both, similarly shaped and similarly arranged parietal spermophores; & when we consider, in addition, that a section taken below the level of the punctum vegetationis in Hypericum, gives us a central body with five loculi,

just as in Lychnis, it is hardly to be doubted that they are susceptible of a common interpretation. In the germen of Hypericum Calycinum, we have in fact a transition form, between pure pari-etal placentation, & such as we find in Lychnis where the placenta-tion is mixed, which again leads us to the pure central form such as we find in Agrostemma flos-Jovis.

In the germen of Lychnis, the five spermophores above its upper part mani-festly continue upwards the structure which forms the central spermophore below, (compare figs. 2 & 3. Plate III.) &, consequently, these five divisions must be of the same nature as the central column. Now, as this column is axial, its five prolongations must of necessity be axial also. Since, then, we cannot interpret the parietal placentation in Lychnis by a car-pellary hypothesis, we are obliged

to interpret the spermophores in Hypericum as axial structures. Having determined this point, we ask — Do these parietal spermophores in Hypericum and Lychnis result from a simple division of the growing point, from a pentacho-tomy, so to speak, of the axis? Or, are they to be regarded as true branches, lateral offshoots from the main axis? Both of these questions must, I think, be answered in the negative.

The growing point is manifestly not divided in our Hypericum calycinum, as it remains quite distinct at the bottom of the cavity of the germen & there gives origin to a cluster of ovules.

Again, in an abnormal condition of the capsule in Dianthus caryophyllus, which seems to be very common in the double variety called in

* For the sake of connection with what has gone before, I have called them divisions in the Dianthus, parietal, although they had lost their connection with the wall of the germen, at the period when I examined them (when the flowers were in full blossom).

our gardens "white feather pink", I found, on opening the capsule, that the placentation at its upper part was parietal *, sometimes throughout two thirds of its extent, & that from the point where the divisions of the Spermophore separated from one another, there arose a second capsule, completely included within the first, containing a spermophore with ovules, & in most cases, closely resembling a normal capsule in miniature. This smaller capsule lay between the two parietal spermophores, with its Styles variously twisted & crumpled, from want of space for development.

In some cases I have seen, thus included, two, three, or even more, secondary pistils, when, however, they were usually but imperfectly developed. Often, in these cases, the included capsules seemed to be "monocarpellary", having only one Style. Where there were

several secondary capsules, however, the parts were generally so distor-ted & confused as to defy descrip-tion, & were almost useless for homological purposes.

In this abnormality, we plainly see that the placental divisions do not result from a dichotomy of the growing point, for that is pro-duced beyond the point whence the divisions diverge, & gives rise to one or more secondary pistils.

To return to Lychnis, we find, at the bottom of the space between the placental divisions, a small, rather flat surface from which the divis-ions diverge. In some genera this is better marked than in others, but there can be little doubt that it represents the punctum vegetationis. I have marked it (tm) in Pl. II. figs 2 & 3.

The question of a pentachotomy being now set aside, we ask, — Are

* Schleidens Principles. Lankester's transl: page 386

these parietal Spermophores to be regarded as secondary axes proceeding from the main Stem? This was the explanation which Schleiden offered of parietal placentation. I may quote the following. "The floral "axis is ramified in the cavity of the "Germen, & the shoots (axillary "shoots of the carpels) curve im- "-mediately from their origin toward "the side, and become blended with "the margins of the two carpels on "their inner side, as parietal Sper- "-mophores, bearing the seed-buds as "lateral buds (Spermophora parietalia "e.g: in Resedaceæ and Cruciferæ). "Here the Spermophores may be so "uniformly blended with the carpels "as to be indistinguishable as special "organs, or they may project by the "seed-bud-bearing margin into the "cavity, and even meet in its axis, "thus forming Spurious central Spermophores" &c*

In imagining these parietal Spermophores to be the axillary shoots of the carpels, Schleiden was obliged to have recourse to the clumsy expedient of supposing that each Spermophore curved immediately from its origin toward the side, in order to account for the fact that these Spermophores are not opposite the carpels, but alternate with them.

The fact, that in Hypericum, the Spermophores alternate with the carpels (if they are carpels); & that in Lychnis, the placental divisions do not arise near the base of the "carpels", besides alternating with them, militate against the idea that these Spermophores are axillary shoots of the carpels.

Again, the fact that in Lychnis the series of ovules are continued uninterruptedly from the central body below, on to the parietal Spermophores above (the rows of seeds, in each double series

* Against this hypothesis, I might have used the argument that it is extremely improbable that foliar structures in these cases should give rise either to other leaves or to buds. I cannot however assent to Schleiden's statement that "a normal bud & a leaf never originate regularly on or out of a leaf in the "Phanerogamia" (Principles, p. 370); for in Melastris paludosa buds regularly originate at the extremity of the leaf, & it can scarcely be supposed

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being continued upwards upon the contiguous edges of two parietal Sper-
-mophores), seems to indicate that these five divisions do not consist of secondary axes at all, but rather that the divisions above, and the central body below, are parts of one and the same axis; & from analogy I would refuse to consider the Spermophores in Hypericum also, as indepen-
-dent shoots.

Having thus set aside the three hypo-
-theses, 1st of the formation of parietal Spermophores from carpellary leaves*; 2nd, of these resulting from a division of the punctum vegetationis; & 3d, of their consisting of secondary lateral axes; the only other possibility which presents itself, is that view, which, I believe Payer was the first to suggest, & which I shall here describe from the able sketch of the morpho-
-logy of the pistil, in his "Éléments de

[note continued]
that either the buds themselves, or the fact of their being developed, are ab-normal conditions in this plant, since they always occur.
That such a condition is very excep-tional in phanerogamic plants, is true, & this is the only form in which the argument can be used against the idea of a carpellary placentation.

* Payer – "Éléments de Botanique" Vol I p 219

"Botanique" Vol I. p. 211-224. He com-
-mences his argument by alluding to the
fact that the receptacle may, by a
disproportionate development of its
central & peripheral parts respectively,
become hollowed out in the form of a
cup. He then takes an imaginary case,
which I shall quote in his own words.—
"Or supposons que dans le pistil du Tre-
"-mandra, où les deux feuilles carpel-
"-laires s'inserent sur les parois d'une
"sorte de toit placentaire, le sommet de ce toit placentaire, au lieu de
"rester horizontal, s'infléchisse dans
"son milieu, sur une partie de son
"étendue, n'en résultera-t-il pas que
"ce toit placentaire qui sépare les
"deux loges de l'ovaire prendra,
"à son sommet la forme d'une
"croissant, et que les deux loges,
"distinctes à leur base, se confon-
"-dront au sommet de l'ovaire en
"une seule et même loge*." He goes
on to say, that if the ovules are develop

both upon the base of this placenta & upon the borders of the crescent above, we have a pistil, biloculer with central placenta at the base, and uniloculer with parietal placentation above. Payer might have taken the pistil of Dictamnus as an actual exam-ple of such a phenomenon.

He then takes the pistil of Dictam-nus where the ovary is pluriloculer at the base, & uniloculer with three parietal placentæ at the summit. He says that the only difference be-tween this & the last case, is, that instead of the placental extremity of the receptacle becoming merely bifurcated it is trifurcated. From this there is only a step to Hypericum hirci-num, where the capsule is uni-loculer throughout, with three pa-rietal placentæ, & there are all possible transition-forms. We have, he says, only to imagine the ovary of Dictamnus

reduced to its upper part, or what comes to the same thing, the trifurcation extended to the base of the germen & we have an ovary similar to that in Hypericum.

This is the substance of Payer's view of parietal placentation. It is simple, consistent with the known facts, and appears moreover, to be the only possible explanation of the phenomena.

Parietal placentation, then, such as we have been considering, appears to result from a cup-shaped development of the floral axis; this cup not being entire, but divided into two or more lobes which constitute the individual placentæ. The punctum vegetationis is, of course, at the bottom of this cup — potentially capable of further extension, which extension actually occurred in the monstrous Dianthus mentioned above.

In conclusion I may advert to the theory which Payer advances regarding the mode of insertion of the carpels in superior pistils. He believes that in cases of parietal placentation, & in Pluriloculars ovaries with central Spermophores, the carpel is attached by its base to the placentæ & septa, & not by its edges as is ordinarily supposed. According to this view the base of the carpel is inserted into the whole length of the placental portion of the receptacle, the insertion being in the form of a horse-shoe ("en fer à cheval").

This theory is based upon a presumed similar mode of insertion of sepals in Cytisus Hypocistis; in Pelargonium; & in Erisma violaceum. Regarding this, I venture to assert that we need developmental proof that Cavities running down the

* Schleidens Principles p. 388

side or sides of the receptacle, from the bases of sepals, are not merely hollowed portions of the axis, before we can accept Payer's doctrine in this particular.

We should be very cautious in admitting the possibility of leaves running up an axis, which this theory requires. Schleiden, in referring to another matter, remarks, "We really know the so-called de-current leaves, but leaves run-ning up a stem are unheard of".

If I might give an opinion on this subject, without developmental study, I should certainly be inclined to agree with Schleiden, in considering the spur in Pelargonium as being a receptacular cavity; & to this I am led by comparing it with the spur in the not very distantly related Tropaeolum majus, where this structure

is manifestly a portion of the receptacle, giving rise as it does to two petals, & being situated below a well defined zigzag line which marks the union of the three sepals with the receptacle.

Alexander Dickson

Plate I. Figs 1–7 Agrostemma Flos-Jovis
Fig 8 Lychnis dioica (Joem)

cx = Calyx
pt = Petal
S = Stamen of outer whorl
S' = Stamen of inner whorl
gm = Gynaeceum

All drawn on the same Scale – divided in the plate into $\frac{1}{40}$ths of one inch –

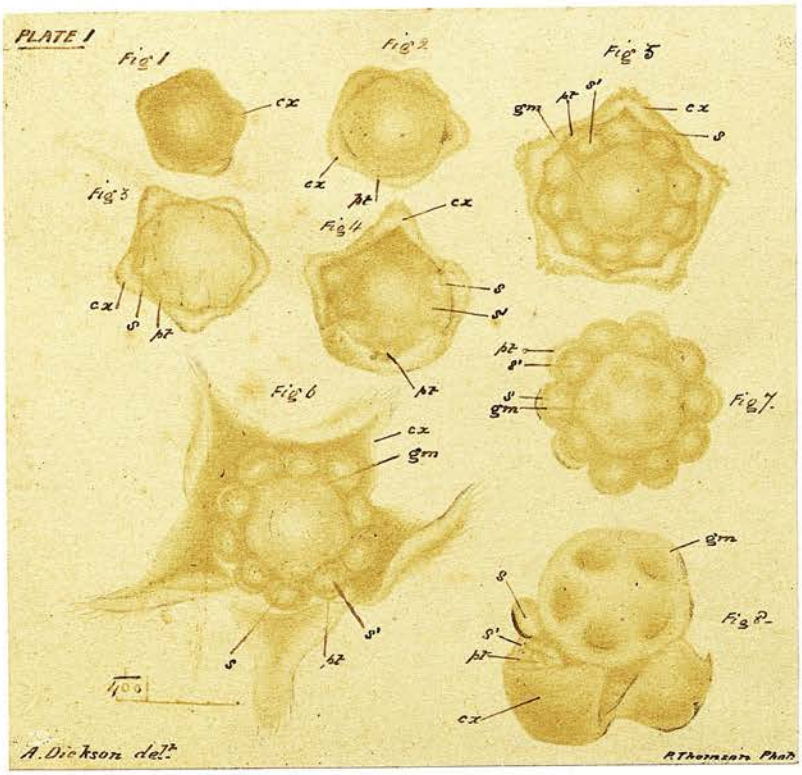
PLATE I
Fig 1
Fig 2
Fig 3
Fig 4
Fig 5
Fig 6
Fig 7
Fig 8
cx
at
s
s'
gm
A. Dickson del.
R Thomson Phot.

Plate 2 Lychnis dioica (fem).

Figs 2-5 Represent the upper part of the germen cut off, and seen from above.

cx, pt, s, s' ym, as before

pd = placental division

tm = flat surface from which the placental divisions diverge, & which is to be regarded as the punctum vegetationis.

st = Style.

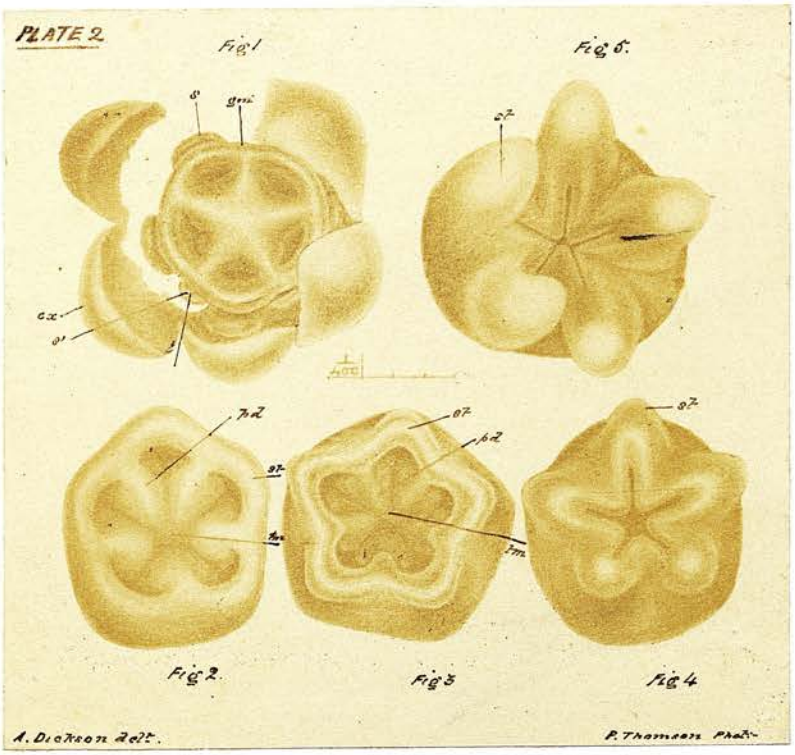
PLATE 2.
Fig 1
Fig 5.
Fig 2.
Fig 3
Fig 4
A. Dickson del.
P. Thomson Phot.

Plate 3. Figs: 1–3 Lychnis dioica (fem).
Fig: 4 Agrostemma flos-Jovis.
Fig: 5 Cerastium pennsylvanicum

cx, pt, s, s', gm, st, pd, as before.

Fig: 1 Upper part of pistil of Lychnis in Longitudinal section, to show the placental divisions

Figs 2 & 3 transverse sections of the germen of Lychnis at its upper & middle portion. From Lithographs published in Trans: Bot: Soc Vol VI part II

Fig 4 Young capsule of Agrostemma flos-Jovis with a style removed & a loculus opened, to show the placental ridge (pr) like a double cord extending along the internal angle, with ovules (ov.) appearing at its upper part.

Fig 5 Flower of Cerastium pennsylvanicum in Longitudinal section. (pl) = the prominent placenta — (gld) = the receptaculas "gland".

Fig 1 & Fig: 4 drawn on scale represented

(turn over

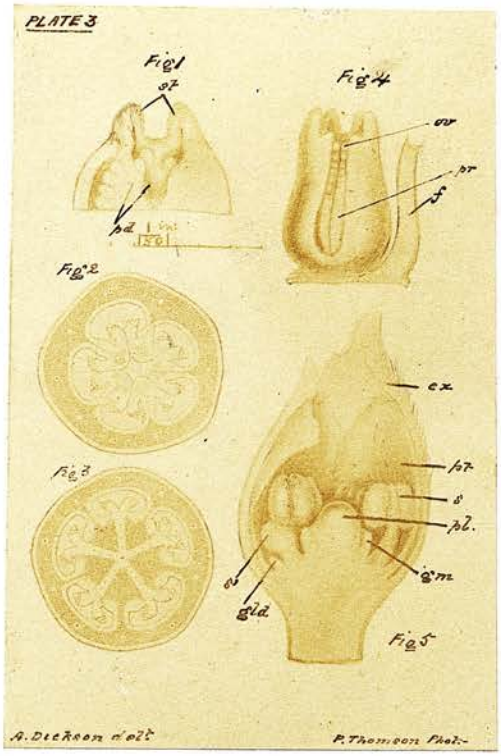
PLATE 3
Fig 1
Fig 2
Fig 3
Fig 4
Fig 5
A. Dickson del.
P. Thomson Phot.

which is divided into $\frac{1}{150}^{\text{ths}}$ of an inch. Scale on which the other figures are drawn undetermined.

Plate 4 Hypericum calycinum

Figs 1-4 shew the development of the Staminal phalanges, & the earlier Stages in the development of the Pistil; & are drawn on the Scale represented, which is divided into $\frac{1}{400}^{\text{ths}}$ of an inch.

Fig 5 Shews a nearly mature capsule in longitudinal & transverse section (In the fig: the perspective is somewhat false, in order to exhibit both sections well) — somewhat enlarged

Pt = petal.

Ste = Staminal eminence or cushion.

S, S' = older & younger stamens.

ph = phalanx of stamens.

t.s = transverse section.

l.s = longitudinal section.

tm = termination of floral axis.

cs = central space between the placentae.

PLATE 4.