This article was downloaded by: [University of Illinois at Urbana-Champaign]
On: 13 March 2015, At: 22:24
Publisher: Taylor & Francis
Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK

Transactions of the Botanical Society of Edinburgh

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/tped18>

III. On the Homologies of the Floral Organs of Phanerogamia and the Higher Cryptogamia

John Lowe M.D. ^a

^a Lynn.

Published online: 01 Dec 2010.

To cite this article: John Lowe M.D. (1863) III. On the Homologies of the Floral Organs of Phanerogamia and the Higher Cryptogamia , Transactions of the Botanical Society of Edinburgh, 7:1-4, 215-222, DOI: [10.1080/03746606309467821](https://doi.org/10.1080/03746606309467821)

To link to this article: <http://dx.doi.org/10.1080/03746606309467821>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever

or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

and (*m*) the undeveloped, wing of the pistil, the great wing being here on the right side.

- Fig. 13. Portion of the extremity of the same, showing a small irregularly-shaped lamina (*l*) turned over upon the anterior surface of the exposed portion of the ovule, between the apices of the carpels (*c*, *c*).
14. Portion of the extremity of the nucleus from a flower of the same age, with its leaf-like process (*l*) elegantly pointed. The carpels have been removed.
15. Longitudinal section of bract, with its flower at a stage corresponding to fig. 5; (*br*) bract, (*f*) flower.
16. Similar section, at a stage corresponding to that in fig. 9.
17. Similar section, corresponding to fig. 10.
18. Similar section, corresponding to fig. 12; (*p*) walls of pistil; (*ov*) ovule; (*x*) vascular bundle supplying the pistil; (*w*) mesial vascular bundle of the bract.
19. Similar section from cone in its third season (?).

III. On the Homologies of the Floral Organs of *Phanerogamia* and the *Higher Cryptogamia*. By JOHN LOWE, M.D., Lynn.

The theory of alternation of generation is evidently but an easy mode of getting rid of a difficulty, in the development of cryptogamic plants, which has been universally allowed. That it is unsatisfactory in its results, is tacitly admitted by many eminent botanists; but as yet no more available explanation of the received facts has been offered. The intricacy of the subject is so great, that years will probably elapse before we arrive at anything like a valid theory, which will serve to explain the seeming deviation of one of the subdivisions of the vegetable world from what we should consider to be the normal or typical formula of reproduction.

The real signification of the spores of ferns and their allies appears to me to have been to some extent lost sight of, in a too rigid adherence to, and observation of, their *order* of development; the different stages in the process having been regarded and compared *pari passu*. Confusion, too, arises from the term *spore* being imperfectly defined. It is applied indiscriminately to bodies having the greatest difference, both structurally and morphologically considered; hence their proper value and position become vague and obscure. The various definitions which

have been employed by authors, most of them imply that the spore is the ultimate germinating cell of the plant; a definition which would simply place the spore and gemma in the same category, since their developmental value is the same,—each being capable of giving rise to a prothallus and its sexual system, as in *Marchantia*. I do not propose to discuss in this place the difference in the value of the various spores, as these will be subsequently pointed out, but shall proceed to follow out the development of the plant (fern), taking the archegonial cell as my *point de départ*,—assuming (at anyrate for the sake of argument) that the archegonial cell is equivalent to the embryo or germ-cell of the phanerogam, as it is produced in a special organ provided for it, and is fertilized much in the same way as in the flowering plant.

I would therefore start with this as the first homology between the two groups; for, on consideration, it will appear that such is really the case. They are both impregnated by a similar process, and they each give rise to an ascending and descending axis. In the case of the fern, I consider the latter to be the true root which is given off at the same time that the *thallus* becomes apparent. The rootlets of the *prothallus*, as will be seen hereafter, are not to be regarded as true roots, but merely as *nutrient vessels* of a temporary nature,—a distinction of some importance.

The antheridium is already, by general admission, allocated to its proper position,—the phytozoa being the pollen grains. We now follow the ascending axis, and find the stem and leaves, which require no special mention. Arriving at what is ordinarily considered the stage of inflorescence, we find this to be, in the fern, of two kinds, terminal and axillary, as in phanerogams. These terms are used in relation to the vascular bundles which are given off from the midrib. The distribution of the vessels to the sporangium is effected by the breaking up of the primary bundle,—one or more scalariform ducts going to each capsule. This is seen in one of the figures sent, where a vessel which courses along the under surface of the indusium or reflected margin of the pinnule of *Adiantum* breaks up into its ultimate fibrils, which are distributed to the gemmæ or aborted sporangia. The process of growth or budding, at the termination of

these minute vessels, gives rise to the sporangium containing the spores, or, as in the abnormal figure alluded to, a gemmation.

The spore is not the result of an *immediately preceding reproductive act*, and therefore cannot, as I think, be regarded in any way as a seed or germ, but is simply a bud. I lay stress upon this point, for it is here that we experience the disadvantage of not having a proper definition of the term "spore," which I take to mean a special body, produced under the above conditions.

That an act of this kind is necessary to make the true spore fertile is evident, (an exception to this will be found in the early spores of the tree-fern, of which mention will be made presently); but I do not hold that it has any influence over the future plant, any more than the impregnation of a phanerogamous ovule has upon the fertility of the tree which is to spring from it. This influence *may* obtain in both cases; but of this we can know nothing, for we cannot imagine a tree which is not derived from a sexual act primarily, and we may therefore as reasonably assign an enduring influence to the act in the one case as in the other. The spore, then, I would regard as a *floral bud*, and the gemma as a leaf-bud. The coverings of the spore, as well as the sporangium, may be regarded, if we wish to carry out the analogy minutely, as scales and bracts respectively. On this point we need not dwell; but I wish to emphasize the view of the spore being a *floral bud*. The annulus may or may not be present, and may be regarded as a special provision for the distribution of the spores.

If, now, we could take a phanerogamic flower-bud, and, after removing it from the tree in its initial state, cause it to go through its normal course of development, we should see the analogy upon which a clear view of the case will rest. The scales may, as above stated, be regarded as the coverings of the spore; the floral envelope becomes expanded, and may fairly represent the prothallus, bearing the antheridium, which is equivalent to the staminal whorl, and the pistillidium, which is the ovary.

The rootlets of the prothallus may be regarded as nutrient vessels of a temporary nature, such as would be necessary for the growth and unfolding of the flower-bud

under the hypothetical condition which we have been considering.

By this method of procedure we arrive at our starting point, and find the central cell of the archegonium or the ovule in a condition ready for impregnation by the phytozoa, and for originating *de novo* the ascending and descending axes—the ovule itself, from its peculiar circumstances, not requiring a supply of pabulum to be laid up for its subsistence, as does the germ of the flower, which starts into activity at a more remote period. A supply of food is however stored for the development of the prothallus in the spore itself.

Adopting a view of this kind we get rid of any necessity for theories of alternate generation or parthenogenesis. And it is surely a more philosophical one than to regard the spore as an embryo. What an absurdity, for instance, would it be to imagine an animal ovum having the power, after separation from the parent, to produce sexual organs and effect its own impregnation!—and yet, would not this be parallel to the case of the cryptogamic spore, if we regard it as a germ or ultimate reproductive cell?

The following is a tabular view of the order in which I would arrange the parts of the plant as a homologous series:—

Monœcious or Dioecious.		Filices.	Lycopodiaceæ.
Phanerogamia.	Musci.		
<i>Embryonic cell.</i>	<i>Germinating spore.</i>	<i>Archegonal cell.</i>	<i>Archegonal cell.</i>
Descending axis.	Descending axis.	Descending axis.	Descending axis.
Ascending axis.	Ascending axis.	Ascending axis.	Ascending axis.
Stem.		Rhizome.	
Leaves.	Leaves.	Fronds.	Leaves.
Bracts.	Perichæatial leaves.		
Flower bud and nutrient ves- sels.		Spore and rootlets.	Macrospore.
Scales.		Sporular coverings.	Valves.
Floral envelope.	Paraphyses.	Prothallus.	Prothallus.
Staminal whorl.	Antheridium.	Antheridium.	Microspore.
Pistilline whorl.	Archegonium.	Archegonium.	Archegonium.
Ovary and seeds.	Capsule & spores.	Archegonal cell.	Archegonal cell.

Such is briefly what I consider to be the natural morphological arrangement of the parts of the cryptogamic plant.

In following out this view of the subject it has been my desire to avoid any strained or artificial conclusions as to the relative value of the different organs. The extent to which this object has been attained I must leave to the judgment of my hearers; but there remain one or two points to be considered, before bringing my paper to a conclusion, which will, I think, give additional support to the theory.

It should be borne in mind that the expansion of the fern-spore and the formation of a prothallus are necessarily antecedent to the production of the sexual organs, and these taken collectively, when fully formed, may well represent the flower.

The growth of a gemma is strictly analogous to that of a detached leaf-bud, each being a cellular, asexual phyton; the gemma originating a distinct individual, exactly as a leaf-bud does, without a reproductive act being necessary. And this is a point which throws much light upon the real nature of a spore; for whereas the gemma at once becomes developed into a plant, the latter dies unless the pistillidian cell becomes fertilized, in the same way that the phanerogamic embryo does unless it be exposed to the access of the pollen.

It is a well-known fact, that varieties of trees, variegated and otherwise, are easily obtained by horticulturists who propagate those abnormal parts which are found in plants having a disposition to "sport." The same tendency in ferns is rendered available for a similar purpose. Thus, the spores from a fern which has all its fronds "sporting" peculiarly, will every one of them produce the abnormal form. This was well shown by Mr M'Nab, who produced several hundreds of young plants from a single specimen of aberrant *Filix-mas*. Not one of these differed from the parent plant. But, what is more remarkable, if we are to consider the spores as germs, is the fact that the spores from a single pinnule, nay, even from the sporangium of a segment of a pinnule which "sports," will produce plants, every one of which will bear the characteristics of the part from which the spores were taken; while those from the remainder of the plant will retain the normal form. This can, I think, be explained only on the supposition that the spores are nothing more than buds, and that the real act of repro-

duction comes after their separation from the parent plant.

If the impregnation of the spore influences the whole future individual and its produce, as some suppose, would it be reasonable to expect such results as these? Would it not be an equally valid argument to hold that the fertilization of a phanerogamic embryo influenced in the same way the whole life of the plant which it produces? Some influence may possibly, indeed, be produced by the process, but of what nature we cannot tell. Whatever it may be, it seems reasonable to suppose that it is the same in both classes of plants; at least there is no proof to the contrary, so far as I know. On the question of the analogy of buds with spores, Professor Balfour observes,* that it fails, "from the fact of the sporoid bud passing through a reproductive stage before producing the frond."

From what has been said previously, it will be perceived that this very fact is the basis of the homology which I have endeavoured to establish, and that there is no failure in the analogy if we regard the spore as a floral bud, inasmuch as the two, buds and spores, are not fairly comparable. The analogy is between buds and gemmæ, and between spores and flowers, or rather floral buds. "But," says the Professor, "a question arises, Is it necessary that a sporiferous frond must pass through the reproductive stage? It would appear not; for in a tree-fern, while there is produced at first a prothallus with reproductive organs, yet this is not the case subsequently. It would appear, therefore, that a sporiferous frond may continue to be regularly productive without any direct impregnation."

Now, it is evident that if the failure in the analogy above mentioned were due to the "sporoid bud passing through a reproductive stage before producing the frond," the fact of the tree-fern spore being asexual would serve to establish the analogy. And so, to my thinking, it does; for the question here naturally suggests itself, Why should one spore be fertile, that is producing sexual organs, and the other not? and further, At what stage in the life of the plant does the fertile spore appear? The first of these questions may be

* On the Production of Ferns from Spores," Bot. Soc. Trans. vol. vi. p. 401.

most probably answered by the analogy which exists between the asexual spores and buds. It is well known that young and immature trees have a greater tendency to produce leaf-buds than flowers ; and this will serve to explain why the earlier spores of the tree-fern are asexual, if we regard them as *leaf-buds*. In later life the plant would naturally produce *floral* buds, and these, of course, would be provided with sexual organs. The time at which this would occur remains to be fixed by future observation.

It has been remarked, that there is no *perceptible* difference between the two kinds of spore, but it may well be that slight differences have escaped notice ; especially when we consider how difficult it is often to distinguish a phanerogamic leaf-bud from a floral one in its early stage.

In Mosses and Hepaticæ, the antheridia and pistillidia, which are produced only on the mature plant, are admitted to be equivalent to the anthers and pistils of flowering plants ; their receptacles and appendices are the homologues of the flower. The sporangia which arise from their pistillidian cells I would regard as ovaries containing true ovules, which are the result of a closely preceding generative process, therefore analogous to embryos.

In regarding the whole plant of the fern and equisetum as analogous to the sporangium of mosses and hepaticæ, Hofmeister argued upon the foregone conclusion that the prothallus with its organs formed one complete generation. The fallacy of this opinion I have attempted to show in the preceding remarks ; for, if there be any analogy between the impregnated pistillidian cell in ferns and mosses, there must be also the same relation between these and the embryo of flowering plants. It seems, moreover, a forced and unphilosophical idea to compare the permanent and complex condition of the whole fern plant to the comparatively simple one of the sporangium of a moss, which only subserves a temporary purpose.

In Rhizocarpaceæ and Lycopodiaceæ we have no spores which are analogous to those of mosses, but merely two sexual organisms ; the microspore, which is analogous to the male floral organ, and the macrospore, which is a female floral bud originating the archegonal cell or ovule, from which proceed the descending and ascending axis.

The possibility of ferns hybridizing is now an acknowledged fact, and serves of itself to show that there are not two distinct cycles of generation in the plant, but that the one cycle commences with the germ-cell, and proceeds according to the typical formula which exists in the order of vegetable development.

Before leaving this subject, I would express the hope that some of the more obscure and important points in connection with the germination of cryptogamic spores, especially those of the tree-fern, will receive the increased attention and study which their great interest demands, and that thus the two great classes of the vegetable kingdom will be brought into clearer and more perfect harmony as regards unity of design in the scheme of their development.

An abnormal form of *Adiantum tenerum*, which recently came under my notice, shows the development of the sporangia (which, in this case, are phylloid gemmæ) on the under surface of the detached indusium, which, with its veinlets, is clearly a folding back of the margin of the pinnule. The gemmæ are seen to originate from the termination of a vein which gives off a vessel to each. In its initial form the gemma is pedunculate, and surrounded by cellular hairs resembling the paraphyses of mosses; under the action of Liquor potassæ, it is seen to be composed of a number of compressed cellules. As the point becomes elongated and protruded beyond the margin of the indusium, it is expanded into a distinct emarginate frond.

I have been unable to detect anything like antheridia or archegonia upon them; but these may possibly occur, and, if discovered, will tend to show at once the validity of the view which has been brought before you.

IV. *Notice of Localities in Scotland for some Rare Plants.*

By Professor BALFOUR.

Chelidonium majus, near Hopetoun; *Alyssum calycinum*, Lochleven; *Silene noctiflora* and *Carduus arvensis*, var. *setosus*, St Andrews; *Mentha sylvestris*, near Perth; *Carex irrigua*, along with *Carex limosa*, Methven Bog; *Hordeum pratense*, St Andrews (Mr Howie).