

The use of the tube seems to be the preservation of a communication with the external air when the aperture is closed by the operculum. The following addition to Pfeiffer's description of *Anaulus* will be necessary:—

“Canali suturali interno profunde in caverna spiræ desinente, utrinque pervio.”

Cheltenham, 13th March 1856.

XXX.—*New Researches in Vegetable Embryogeny*.

By M. TULASNE*.

DR. HERMANN SCHACHT, a German phytotomist well known by numerous and important works, some months ago† allowed himself to be persuaded, that the doctrine of the generation of plants which he has embraced, namely that of M. Schleiden and the pollinists, was then peremptorily established and proved. His belief was founded upon some observations recently made by a young botanist of Berlin, M. T. Deecke, who, as was asserted, by an extremely fortunate dissection of the ovule of the *Pedicularis sylvatica*, had put it beyond a doubt, that the vegetable embryo is actually produced in the extremity of the pollen-tube itself, after the introduction of the latter into the embryonal sac. Two of the botanists most competent to judge of this difficult question, MM. Hugo von Mohl and W. Hofmeister‡, have strongly protested against allowing the memoir and anatomical preparations of M. Deecke the demonstrative value which was attributed to them; and although their criticisms have called forth long replies from MM. Schacht and Deecke, supported upon new observations§, there would certainly be cause for astonishment if their confidence in the correctness of their opinions had not been somewhat shaken, and their conviction had really remained entire.

The passage of every creature from non-existence to existence, its entrance into life, is a phenomenon too mysterious for us to flatter ourselves that we shall ever be able to understand exactly all its circumstances. Nevertheless, as the questions at issue between M. Schleiden and his opponents are questions of fact, antecedent to any doctrinal interpretation, and capable of being judged by our eyes, we need not despair of some day seeing less diversity of opinion amongst the botanists who occupy themselves

* From the *Comptes Rendus*, Nov. 12, 1855, p. 790.

† See the ‘*Flora*,’ 1855, part 10.

‡ See *Annales des Sciences Nat.* 4 sér. iii. pp. 209 & 219.

§ ‘*Flora*,’ 1855, no. 29, and *Botanische Zeitung* of Berlin, Sept. 14 & 19.

with embryogeny. At present, far from the hopes of M. Schacht being realized, or nearly so, I think, that if all discussion with regard to the Horkelian theory must be closed, as he would have it, it is by the condemnation and definitive rejection of this theory, rather than by its undisputed admission into science. Now, more than ever, I feel certain that it is founded upon a mistake; upon that error in which I formerly shared for a moment, which consists in taking the suspensor of the embryo for the pollen-tube inserted in the embryonal sac. During the past summer I have made a great number of dissections to establish the correctness of the results which I published in 1849 in the 'Annales des Sciences Naturelles' (3 sér. xii.); my brother also has devoted considerable time to similar researches, and we have both always been perfectly convinced, that the embryo, whether sessile or stipitate, that is to say, whether provided or not with a suspensor, never, at any moment, had the least real organic continuity with the pollen-tube: the embryo-sac, which is often thickened at its micropylar extremity, receives the close contact of this tube externally (it is even sometimes lodged in a fold of its membrane), but still without ever being torn or perforated by it; then on its inner face, either opposite to, or at some distance from the extremity of this fecundating filament, it gives attachment to the embryo.

In the Labiatae, which have especially furnished us with subjects for examination this year; in the Pansy, the Almond, the Sloe; in the Caryophyllaceae, such as the Pinks, the *Holosteum umbellatum*, L., the *Cerastia*, &c.; in the Scrophularineae, the Cruciferae, the Fir-tree, and a multitude of other plants, the embryo adheres to the generative sac by a very broad circular base, below which it contracts more or less, and again dilates almost immediately. This base of the embryo, when seen in front, looks like a large aperture in the membrane of the sac; but this is only an appearance, notwithstanding the opposite opinion of MM. Schacht and Deecke, for it is not very difficult to ascertain, as I formerly showed, that the sac is completely closed and continuous where the nascent embryo is implanted upon it*. This fact is of great importance, and contributes not a little to gain the cause for the opponents of M. Schleiden. I add, that the basal disk of the embryo is frequently of much greater diameter than the pollen-filament, even when the extremity of the latter, as is often the case, is thickened and enlarged: this circumstance is not more favourable to the Horkelian theory than the absence of a perforation in the membrane of the sac, and

* See our memoir already quoted in the 'Annales des Sciences Naturelles,' 3 sér. t. xiii. pl. 3-7, and especially pl. 5. fig. 10.

MM. Schacht and Deecke do not appear to have taken it into account.

Although amongst the gamopetalous plants with personate corollas, great dissimilarities separate the Scrophularineæ from the Labiatae, if we consider especially the structure of the fruit and seed, yet the study of the ovule and of the generation of the embryo reveals analogies between these two families which cannot be mistaken. From the simplicity of its structure and the softness of its tissues, the ovule of the Labiatae, which has hitherto been neglected by embryologists, is generally capable of easy dissection. As in most of the Scrophularineæ, the embryo-sac presents vesicular inflations and appendages of very various kinds both at its extremities and on the sides. The anterior inflation, or that near the micropyle, usually projects from the nucleus, and is sometimes sufficiently elongated even to pass the apex of the ovule; it is obovate and of middling size in *Lamium*; of the same form, but more developed, in the Motherwort (*Leonurus Cardiaca*); almost globular in various species of *Stachys*, *Nepeta* and *Teucrium*; of immense size, sac-like and often asymmetrical in *Betonica*, *Acinos vulgaris*, Pers., *Galeopsis* and *Dracocephalum*. Towards the middle of this cervical inflation is attached a tubular appendage, which is either short and simple (*Lamium*, *Stachys*), or very long, branched and spirally twisted (*Betonica*). The middle region of the embryonal sac is also usually furnished with a short lateral appendage (*Lamium*, *Galeopsis*, *Stachys*), or with a basal one, accompanied by long divergent tubes (*Dracocephalum peltatum*, L.). This same region alone is filled with the perispermic tissue, in the midst of which the nascent embryo is buried. The latter is always borne upon a long and very delicate suspensor, of the same form as in the Scrophularineæ, which is attached to the rounded apex of the sac; but as the very considerable increase of this embryoferous ampulla after fecundation often takes place asymmetrically, and especially at the expense of its lateral appendage, so as to divide it into two very unequal lobes, the suspensor may thus be seen fixed near the more or less deep notch which separates the latter, and consequently removed from the longitudinal axis of the ovule. The pollen-filaments are slender, but appear to be nearly solid, from the dense and very refractive matter with which they are filled. In order to penetrate into the cavities of the ovary, after having descended to the base of the style, they have to traverse the tissue of a portion of the gynobase; then meeting immediately with the funiculus of the upright ovule which exists in each compartment, they rise in the parenchyma of the funiculus itself and only quit it at the level of the micropyle,—hence they can only be seen

free for a very short space. Several pollen-filaments often introduce themselves in this manner into each ovuliferous cell, but it cannot be so frequently proved that the micropyle of the ovule gives entrance to more than one of them. Their extremity which comes in contact with the embryo-sac is obtuse and scarcely inflated; it applies itself to the surface of the embryo-sac by twisting in various manners, or lodges itself in a shallow depression which it sometimes causes. The point of insertion of the suspensor of the embryo usually corresponds with the point of contact of the fecundating tube.

The suspensor in the Caryophyllaceæ is far from being of the same tenuity as in the Labiatae; its diameter on the contrary is very considerable, and it is divided into several very unequal cells. It is attached by a broad base to the apex of the embryo-sac, and sometimes, as in *Alsine media*, L., for instance, is elongated in a remarkable manner at this point, without however quitting the sac, which appears rather to become intimately united with it. The pollen-filament of the Pinks is remarkably voluminous, and contracts such an adherence to the embryo-sac, that it easily resists the dragging inseparable from the dissection of the ovule; its extremity is often bifid, and then sits as it were astride upon the sac above the embryoferous disc. M. Schleiden's theory is here shown to be in fault in a most evident manner.

The unusual development of the suspensor towards the micropyle presented by *Stellaria media*, Sm., occurs also, but in a very exaggerated form, in the genus *Calendula*. In these plants, the suspensor, which is at first entirely enclosed in the embryo-sac, soon becomes formed of two distinct parts: one tubular, always enclosed and continuous with the nascent embryo; the other excessively inflated into an oval or elongated vesicle, the greater part of which is protruded from the sac. M. Schacht does not appear willing to admit that the suspensor may thus grow simultaneously in opposite directions at its two extremities. Would he therefore regard that of *Calendula* as a modified and metamorphosed pollen-filament? There is nothing, certainly, more improbable than such a metamorphosis.

The same author is also in the wrong in calling in the *Viola tricolor*, L., in support of his theory. Whenever we have been able in this plant to see the pollen-filament supporting its kneed extremity upon the embryonal sac, it has been manifest to us that it remained entirely out of the sac, that is to say, that between it and the more or less enlarged embryonal vesicle, the embryoferous membrane was always extended, in the form of an uninjured diaphragm.

The same circumstances may also be easily observed in *Helian-*

themum. Although very short, the suspensor, in these plants, bends in a remarkable manner in the middle, and is most frequently attached to the embryo-sac, beside the point touched externally by the twisted extremity of the pollen-tube.

XXXI.—*On the Tracheal System of Insects*. By THOS. WILLIAMS, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

To the Editors of the Annals of Natural History.

GENTLEMEN,

MAY I request that you will allow me the favour to announce in your Journal the results of a series of minute dissections which I have recently performed on the *Tracheal System of Insects and Myriapods*. In consequence of a letter on this subject from the late Mr. Newport, published in the 'Annals' of last year, calling in question the accuracy of my statements, I have ever since felt anxious to repeat the observations upon which those statements were made. That I have now done, and with the utmost care. I find, that not only are the results then stated true in every particular, but that they fall far short of indicating the real distinction between the "membranous capillary tracheæ," and those larger trunks in which the "*spiral*" is visible. My recent studies enable me now to state—

1. That the "spiralled" or larger tracheæ are mere conduits, like arteries or veins, and have nothing to do with, take no part in, the ultimate act of respiration.

2. That this function (that is, the interchange of the gases concerned in the respiratory act) has its seat exclusively in the capillary membranous tracheæ.

3. That the peripheric or extreme distribution of the tracheal system is conformable in plan to that of a blood-vascular system; that is, the capillary or membranous tracheæ are always placed intermediately between larger trunks, the branches of which they serve to connect,—standing to the larger trunks in the same relation as the capillaries of a blood-vascular system do to arteries and veins.

4. That the tracheæ can be discovered, in no single instance, to end in cæcal terminations,—always in mutual inosculations.

5. That this anastomotic arrangement establishes a close similarity between the tracheal system of Insects, Myriapods, and the blood-vascular system of the Annulosa,—a homology first theoretically suggested by Mr. Huxley.

6. That the tracheal system, however, is distinguished from the blood system in two striking anatomical particulars: in the



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. 1856. "XXX.—New researches in vegetable embryogeny." *The Annals and magazine of natural history; zoology, botany, and geology* 17, 343–347.

<https://doi.org/10.1080/00222935608697521>.

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DOI: <https://doi.org/10.1080/00222935608697521>

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