

*A Thermometrical Journal of the temperature of the atmosphere and sea, on a passage from Oporto to Philadelphia, in the ship Apollo, by Capt. William Billings, continued.*

1791 Dates.	Time.	Places in at Noon.		Temp. of		NOTES.
		Lat. N.	Long. W.	Air.	Wat.	
Sept. 2	Noon.	40 57	55 26	70	72	
3	Midnight				71	
	Noon.	40 56	57 51	70	73	
4	Noon.	39 10	59 18	74	74	
5	Noon.	39 17	61 11	74	76	
6	Midnight				77	This rise indicates, the gulph stream.
	Noon.	40 06	63 20	74	78	
7	Noon.	40 36	66 03		75	
8	Noon.	40 01	67 23	73	77	
9	10 P. M.			71	73	This fall indicates the western side of the gulph stream.
	Midnight				72	
	4 A. M.				71	
	Noon.	39 29	71 17		73	
10	Noon.	39 19	72 08	73	73	
11	Noon.	39 04	72 33	74	75	
12	Noon.	38 57	73 21	74	74	
13	Noon.	38 53	72 31	74	75	
14	Noon.	39 21	73 31		75	
15	6 P. M.			74	69	
	8 A. M.				68	Sounded in 25 fathoms.

## N°. XXIV.

First Memoir of Observations on the Plants denominated  
*Cryptogamick.*

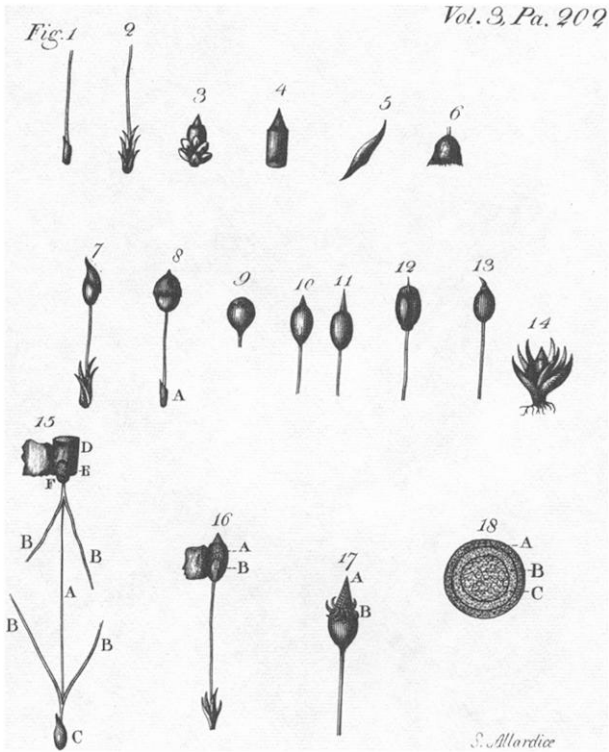
*Nusquam natura major quam in minimis.*

PLIN.

Read Feb:  
17, 1792.

**A**LTHOUGH the process of nature in the formation and reproduction of all organised bodies is evidently uniform, yet there are philosphers and naturalists who scruple to admit this general principle in all instances, and think it still liable to some exceptions.

More



- 1.** The calyx (perichætium) of only one piece, at the bottom of the tube.
- 2.** The same of many pieces, or folioles.
- 3.** The flower of the *Fontinalis*, furrounded by the calycine folioles.
- 4.** The cawl (calyptra) of the *Bryum extinctorium* of Linnæus.
- 5.** Another species of cawl which is more common.
- 6.** The hairy cawl of the *Polytrichum*.
- 7.** The complete flower of the *Hypnum*.
- 8.** The same in the *Mnium Polytrichoides* (Linn.), the cawl of which is hairy.
- 9.** A very small tubular corolla, the opercule of which is obtuse. *Sphagnum*.
- 10.** A corolla, of which the opercule is conic. *Hypnum, Bryum, &c.*
- 11.** A corolla, of which the opercule is pointed. *Bryum, Mnium*.
- 12.** A corolla, the opercule of which is in the form of a chapiter, flattened at the base. *Polytrichum*.
- 13.** A corolla the opercule of which is in the form of a chapiter, rounded at the base. *Bryum*.
- 14.** The corolla, stalk, leaves and root of the *Phascum*.
- 15.** The corolla of the *Polytrichum commune*, opened after its explosion.
- A.** A thread shut up in the tube.
- B.** The tube opened.
- C.** The calyx.
- D.** The flower opened.
- E.** The capsule torn off, after maturity.
- F.** The apophysis.
- 16.** The corolla of the *Hypnum velutinum* (Linn.) opened after the escape of the pollen.
- A.** The pollen, or fecundating powder.
- B.** The capsule, furrounded with the fecundating powder.
- C.** The calyx.
- 17.** The corolla of the *Hypnum* at the moment of fecundation.
- A.** The interior cills.
- B.** The exterior cills.
- 18.** An horizontal portion of the urne, seen with the microscope.
- A.** The epidermis.
- B.** The fecundating powder,
- C.** The capsule and seeds.

More than nineteen twentieths of the animals and vegetables which are known to us are regenerated by means of certain essential parts, inherent in their organick constitution. These parts or organs of generation are so apparent, and so easy of demonstration, that no plausible system can be founded on the contrary hypothesis. This is not the case with those individuals the organization of which is more simple, and of which the sexual parts especially are so extremely minute, and so concealed from the eye, that they have hitherto escaped the observation of philosophers. Hence have sprung those more or less ingenious, but always erroneous, systems, which, at the same time that they do credit to the genius of their authors, are clearly repugnant to reason. Hence, those numerous dissertations filled with captious reasonings, and in some respects not without depth of research, but in direct opposition to the eternal laws of nature. Hence, again, the endeavours of some systematical men, to destroy that principle so generally recognized, and which so many facts concur to demonstrate, *omne vivum ex ovo*.

Notwithstanding the very great probability of the regeneration of all animals by the conjunction of two individuals of different sexes, as in quadrupeds, in birds, and in insects; or by the asperision of the seminal liquor of the male on the spawn ejected by the female as in the fishes; notwithstanding it is proved to demonstration, that the seed of vegetables are fecundated by the pollen of the antheræ; notwithstanding the conviction of these and many other facts, equally well known and ascertained, still some philosophers refuse to extend this principle to the whole of the animal and vegetable creation. The simplicity and minuteness of the organs of worms, and especially of the polypi, and the singular faculty which some observers have attributed to the latter of regenerating themselves by the

fection of their parts, have induced some naturalists to believe, that these little animals were not subject to the general law by which all the others are governed. Thence, they concluded that the principle of regeneration by means of the sexual organs was not exclusively necessary for the multiplication and reproduction of every individual.

This system, however opposed to what comes under our daily observation, has, nevertheless, found, and still continues to find, many warm supporters, and has been much strengthened by the analogy which has been discovered between the mosses and the mushrooms, the sexual organs of which were not determined till I made my observations on the subject, so that these plants were thought to be to the vegetable, what worms † and polypi are to the animal world.

I shall not, in this place, undertake to refute this opinion with regard to the polypi, which do not come within the limits of these observations, but until more accurate experiments shall have brought us to the certain discovery of the manner by which these little animals are reproduced, I shall remain satisfied with the observation of Bernard de Jussieu on the polypus, and shall reject every system which tends to favour an opinion, that nature, who in all other things, and in those which are most within the reach of our observation, ever acts by constant and by uniform laws, could have become so different from herself and have adopted partial rules in favour of a very small number of individuals. Here I shall confine myself to some of those plants denominated *Cryptogamick*, which I have observed with great care and attention, and which (as I shall endeavour

† I might have dispensed with mentioning the Polypi in particular, as they are comprehended under the general appellation of worms; but I thought it best to make special mention of them, as of all animals they are those of which the most fabulous accounts have been given, and which have afforded the greatest scope to the wild ideas of fanciful imaginations.

vour to demonstrate) are provided with the same organs of reproduction which we observe in other vegetables.\*

It has never yet been controverted, at least as to the mosses, that these individuals are essentially a part of the vegetable kingdom. They all have very distinct and obvious organs, which are easily distinguishable from the roots, the leaves, and the branches, and which, by analogy, must be considered as blossoms, containing such parts as are necessary to the reproduction of every individual.†

The opposers of the system of sexual regeneration, have considered these organized parts as an useless *supervegetation*; “for,” says a zealot of this sect, “there are mosses which are destitute of those parts which the sexualists call fructification‡.” On the contrary, the friends of the sexual system are all agreed in considering these parts as the real organs of reproduction, although they differ as to the nature and use of those parts. Some are of opinion, that the urn§ (Fig. 3. 7. 14.) is the male part, and that the stars which appear at the extremities of the branches, as in the *Polytricum* and several species of the genus *Mnium*, are the female-organs¶. Others, with more reason, suppose that the urn contains both sexes. According to these naturalists,

\* I have not only submitted these observations to the Academy of Sciences of Paris, in the years 1782, 1783, 1784, and 1785, but I have shewn them the objects themselves in detail, especially to Messrs. Adanson, de Jussieu, and de la Marck. I have repeated before the Academy several of my experiments; I have demonstrated to them the existence of the Capsule within the Urn of the Mosses, the irritability of the Cilia and their spontaneous convulsive motions immediately after the falling of the Opercule, which is the moment of fecundation. I have shewn them the irritability of several Mushrooms when they emit their seeds, and especially in the *Peziza*, the *Nesloc*, &c. the Capsule which is formed at the extremity of the point of a non descript species of *Hydnum*; and lastly, I have shewn the duplicity of the blades of the *Agaricus* of Linnæus, which, in the manner of pods or siliquæ, contain a prodigious quantity of small oval bodies, which I take to be the seeds. If these authorities are not sufficient to convince certain skepticks, I exhort them to make the same observations themselves, and I have no doubt but that they will very soon be convinced of their truth.

† The structure of the mushrooms being different from that of the mosses, these general observations cannot be applied to them. When I treat of those plants, in another memoir, I shall be particular in the description of their organical parts.

‡ M. Necker, botanist to the Elector Palatine, in his Physiology of Organized bodies.

§ This is the name which has been given to the fructification of the mosses.

¶ Linnæus and his followers have adopted the opinion of Dillenius.

lifts, the cilia are the male organs, and the pollen contained in the urn is the feed§. Others, again, adopt an opinion entirely different, and pretend that the urn is a capsule which contains the feed, and that the glandular parts situated under the foliola, or little leaves, of the stellated branches (as in the *Polytricum* and *Mnium*) are the antheræ, or organs which contain the prolific liquor. The questions which now divide the naturalists on this subject are the following :

1st, Whether the parts of which we are speaking are in fact the sexual organs of the mosses.

2dly, To determine the use and the nature of each separately in regard to the functions which are attributed to them.

These two questions being solved, there can remain no doubt as to the mode of regeneration of these plants, and every contrary system must fall to the ground. Of this I have become fully convinced by means of some very simple and very easy observations, which may be made by others, with the greatest facility.

I shall not here attempt to refute the several opinions which I have thus slightly mentioned. Men of information, and those devoid of prejudice, will easily determine how far these opinions are worthy of confidence, particularly after they shall have read the following detail of my observations on the subject.

## OF

§ Hill and Meese. Their system, the most ingenious of all, is extremely plausible, but it cannot be admitted, 1st. because the Pollen, which they consider as seeds, has all the characteristics of a fecundating pollen, such as its convulsive and impetuous emission, its inflammability, and its great difficulty of incorporating with water. 2d. Because the Cilia not being uniform or constant in all the mosses, and being sometimes found of two different species in the same individual, cannot be direct organs of generation, but only (as I shall presently demonstrate) accessory and secondary organs, intended to protect and facilitate the act of fecundation.

The other systems are still less admissible, because they cannot be applied to all the species of mosses, and are liable to exceptions which are sufficient to demonstrate their fallacy.

OF THE MOSSES.

The fructification of these vegetables, commonly known by the name of *Anthera*, or *Urn*, is uniform and constant in all the family. It has the shape of a little club, more or less elongated (See Fig. 3. 7. 14).

It is composed

The *Perichæti-um*. { of a single piece in the form of a tube, in the *Bryum*, the *Mnium*, and *Polytricum* (Fig. 1. 8A. Fig. 15. C.): of several pieces, or foliola, more or less imbricated, as in the *Hypnum* and the *Fontinalis* (Fig. 3. 7. 16. C.).

An *Anthera*, or *Urn*. { It is sessile in the *Phascum* and the *Fontinalis* (Fig. 3. 14.): standing upon a filament of different lengths in the *Bryum*, the *Hypnum*, the *Polytricum*, the *Splachnum* and the *Mnium* (Fig. 7. 13.).

The urn before its maturity is composed

Of an *Operculum*, or *Opercul*: { more or less subulated in almost every one (Fig. 9. 13.); and in the form of a chapter of a column in the *Polytricum*, and some species of the *Bryum* (Fig. 12. 13.)

Of a *Calyptra*, or *Cawl*, { It is smooth and more or less transparent in the greater part (Fig. 4. 5. 7.): hairy and coloured in the *Polytricum*, and in the *Mnium Polytrichoides* (Fig. 6. 8.). There is none in the *Sphagnum*, and it is very caducous in the *Phascum*.

When these parts are ripe, the opercule and calyptra fall off; then the urn appears mutilated at its extremity, and the orifice, or opening, is either naked or covered with cilia.

Such

Such is the detail of that part of the mosses which we call the fructification, and which Dillenius and Linnæus believed to be the male organs. I shall here annex a table, in order to enable the reader, by a comparative view of the whole subject, to form a more precise judgment of my observations\*.

Being led by a natural inclination to the study of this family of vegetables, which, I am afraid, has not been sufficiently attended to, I have devoted my whole attention to it. I have observed them in their different states and periods of vegetation, as well in the places of their spontaneous growth, as at my own home, that I might the better discover the moment when the pollen was bursting from the urn. The following is the result of my observations.

I found that what the naturalists have considered as a thread, or filament, supporting the urn, is, in fact, a real tube, continued to the urn, which is a part, and the end, of it. I denominated the whole a corolla. This tube being carefully opened with a very sharp penknife, discovers a white transparent filament, extending itself to the urn (Fig. 15. A.). The urn being opened, in like manner, when fully ripe, is found to contain the fragments of the dilacerated capsule (Fig. 15. E.). These fragments are of the same colour and nature as the filament contained in the tube.

After having discovered these vestiges of an unknown organization, I was desirous of observing the same in the urn before the emission of the pollen. I made choice of the *Polytricum commune* of Linnæus, as being larger and more proper for my observations. I took off the opercule, without injuring the other parts, and, for this purpose,  
I always

\* I have made no particular mention of Hedwig's system, which seems to have been adopted by several naturalists. It is not, however, more admissible than the rest: it is liable to an infinity of exceptions, which are a sufficient reason for rejecting it. At a future period, I shall demonstrate the fallacy of this new opinion, which mistakes for male organs the glandular bodies, which are situated at the extremities of the stellated branches.



I always preferred a blossom almost ripe. I then opened the urn on the side; I carefully took out the pollen, and by this method, I discovered an oval body, of an herbaceous colour, situated in the centre. This kind of capsula, as I call it, is strongly fixed to the bottom of the urn, and although I did not observe it sticking to the internal filament, I am much inclined to think it is the termination of it. At another time, I cut off horizontally, a part of a ripe blossom, and exposing it to a magnifying glass, I discovered 1. the epidermis of the corolla (Fig. 18. A.), 2d. the pollen surrounding the capsule (Fig. 18. B.), 3d. small globules sitting between the fibres of a kind of net, which appeared to me to be the seeds (Fig. 18. C.). These observations, I have successively repeated on all the mosses to be found in the neighbourhood of Paris, and Lille in Flanders, and I observed, with satisfaction, that every one, without an exception, was organized in the same manner.

Having arrived at this important discovery, I determined to proceed farther. I examined and tried the yellow dust which surrounds the capsule, and I became convinced, from its inflammability, and from the difficulty with which it mixed with water, that it was of the same nature with the pollen of other vegetables. It now remained to prove that the small oval body surrounded by the pollen is a true capsule, including the seeds. The observation which I had formerly made with the microscope proved it, indeed, but not in a manner sufficiently satisfactory, as there did not appear to be any direct communication between the pollen and the seeds, which are contained in the capsula. I had recourse, again, to observation, and I fortunately caught nature, as it were, in the fact, and discovered the use and operation of each of the parts of which the urn of the mosses is composed. As I was, one day, examining, with attention, the *Hypnum velutinum*, of Linnæus,

I endeavoured gently to take off the opercule with my fingers, which was very easily done, as the blossom was fully ripe. The opercule having fallen off, the cilia which detained it being thus free, and loosened from their former state of tension, I was a witness to their curious manner of operating : they were in an almost continual convulsive agitation, and contraction, approaching to, and alternately receding from, the internal cilia, which seemed to me to open a little towards their extremity, at the same time that the others contracted themselves by a contrary motion. I distinctly observed the pollen thrown out through the space that opened between the internal cilia, near their basis, as fast as the external cilia fell back. Hence, it occurred to me that the position and motion of these various organs are intended to restrain the impetuosity of the pollen : and if we consider how the pollen and seeds are disposed, it will be easy to conceive that the former cannot come out without meeting the latter. Thus, nature, ever consistent in her productions, has formed these cilia to moderate the convulsive emission of the pollen, and to bring it into contact with the seeds before it escapes.

There is nothing more admirable than the operations of nature in these little plants. I have made the same experiment on an infinite variety of mosses, and it has always succeeded when the blossom had attained its full maturity. I have repeated it in the presence of several persons, as well as in private for my own amusement, and every time, I had additional reason to admire the wise dispositions of the Great Lord of the Universe, who, by constant and by uniform rules, preserves and multiplies all the individuals of his Creation.

O JEHOVA,

O JEHOVA,

*Quam ampla sunt Tua Opera !*

*Quam sapienter Ea fecisti !*

*Quam plena est Terra possessione Tua !*

David *Psal. CIII. 24.*

From the preceding observations, it follows

1st. That these plants are endued by nature with the same organs of fructification as all others, to wit, a *flower* (Fig. 3. 7. 14.).

2dly. That this flower has two essential parts, which seem to be the organs of generation, viz. a fecundating pollen, and a capsule containing the seeds (Fig. 15. 16. 18.):

3dly. That besides the pollen and the seeds, there are other accessory parts, relative and proportioned to the construction of that flower, and destined (Fig. 7. 14. 17.):

1st. To protect the sexual parts when young, the cawl (fig. 4. 8.), the opercule (fig. 9. 14.), the cilia (fig. 17.):

2dly. To prevent the too rapid emission of the pollen, that thus the business of generation may be the better accomplished, the internal cilia (fig. 17. A.).

3dly. To diminish the effect of the impetuosity of the same pollen, by checking its motion, and by detaining it for a moment at the orifice, when the fecundation is performed. This is done by the external cilia, by means of their irritability and oscillatory motion (fig. 17. B.).

4thly. It appears that the urn is a bi-sexual flower, containing a capsule more or less pedunculated, according to the length of the tube.

5thly. That the smallest mosses, as well as all other vegetables, are reproduced by their own particular organs; that they observe the general law of all organized bodies, and that they furnish an additional proof of the great axiom, *omne vivum ex ovo.*

I have something more to add concerning that part which I have denominated the *Star*, and which some naturalist have supposed to be the female, whilst others have imagined it to be the male, part.

The small glandular parts included under the foliola of the branches, certainly possess the faculty of reproduction; and I have very frequently obtained a few individuals from them. Still, I cannot admit that they are the only seed of the mosses, and much less that they are antheræ containing the prolific liquor.

We are, indeed, acquainted with some plants which, besides their hermaphrodite flowers, have on the same or another stalk, semi-sexual flowers, either male or female: why, therefore, may not the same thing take place in the mosses?—why may not the *Polytrichum*, the *Mnium*, and the *Splachnum* be polygamous plants, like the *Parietaria*, *Acer*, and several of the *Mimosæ*, or like the *Diospyros*, the *Ginseng*, &c?

We also know some plants, as the *Lilium bulbiferum*, the leaves of which are furnished with small bulbous glands, which being put into the ground shoot up into individuals of their species, without altering in the least, the fructification of the flowers of the same plant. Why, then, may not the mosses have the same faculty of reproducing themselves?

Whether we consider the star of the mosses as a true flower, or as containing bulbs, like those of the *Lilium bulbiferum*, which is more probable and natural, it cannot affect the fact which I have established respecting the reunion of both sexes in the urn. Why should we look upon that part as being either the male or female organ, since the greater number of mosses have no starred branch? how then, could those systematists conceive or explain the re-production in the *Phascum* (Fig. 14.), which consists

only

only of some roots, and of a few small leaves, in the center of which is the urn, which is not *tubulated*? all the mosses, on the contrary, bear an urn, or flower, in which any one may observe a pollen, or fecundating powder, and a capsula, containing small round bodies, which much resemble seeds: thence follows their analogy to other vegetables, with respect to their fructification.

The emission of the pollen, and the irritability of the cilia, may be exactly compared to those convulsive motions which are common to all organized bodies, when they arrive at the moment of their re-production. Is it possible, then, after what I have demonstrated, to follow other opinions, which cannot apply alike to every individual? From thence, I am authorised to conclude, that the opinion which results from my observations is preferable to all the former systems, not excepting that of Mr. Hedwig, which is too inconsistent to be admitted.

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ber of the Academy of Sciences of Paris.