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NOTULÆ AD PLANTAS ASIATICAS.

Part II.

ON THE HIGHER

CRYPTOGAMOUS PLANTS.

BY THE LATE

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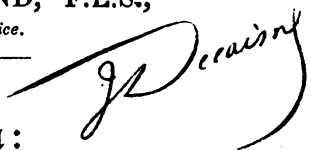
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NOTULÆ AD PLANTAS ASIATICAS.

PART II.

ON THE HIGHER

Acotyledonous Plants.

General Remarks.

1. Acotyledonous Plants are divisible into Sexual, and Asexual.

The Sexual, which comprehend all except Fungi, Algæ, and Lichens, are divisible into those with, and those without Pistills.

The developement of the sexes is in opposition to that of vegetation, sexes being most developed in Musci and Hepaticæ : and least developed in Ferns and Lycopodineæ ?

So far as ferns go, this is not very extraordinary ; for the frond is not a leaf, and if the true leaves are the ramenta, ferns are very slightly foliaceous.

Besides, there are no necessary relations between developement of the sexual, and the foliaceous organs from which they are derived ; witness *Grantia*, etc.

The Pistilligerous families are—Musci, Hepaticæ, and *Azolla*.

The Epistilligerous—are Ferns, Isoets, *Anthoceros*, *Marsilea*, and Lycopodineæ ?

The Pistilla when they exist, contain an *ovulum* : (a single pendulous cell) which in Mosses becomes the terminal cell of the seta, as well as in *Jungermannia* and the Vaginulate Hepaticæ. In the Evaginulate, it *becomes* (?) the membrane inside the capsule, containing the seeds.

In these, fecundation is direct, the end of the style, first being sphacelated, then the canal, then the single cell is affected.

In the others it is indirect, and does not act on a pre-existing special palpable punctum, but on the parenchyma of the frond: this is distinct in *Anthoceros*, and probably is the case also in Ferns.

As we see the more perfect pistillum gradually disappear, leaving only the male, so do we see the male gradually disappear, leaving no sex at all?

The action of the male is not appreciable in *Isoetes*.

The male is unknown in *Azolla*. In this and *Isoetes*, the so called males have the same early structure as the females: and in *Isoetes* become subsequently similar to the spores.

In *Azolla*, one pistillum produces by fecundation, one set of organs: the other, another. Probably both are reproductive.

In *Marsilea* the males are unknown, the thecæ contain two sorts of bodies of different modes of development; one only resulting from division: the other not analogous to a male.

Azolla is the connecting point between those with, and those without Pistills, in having two sets of organs developed by fecundation. It is in this respect like *Marsilea* among the *Epistelligerous*.

Anthoceros is the connecting point between the same, as regards palpable fecundation without a Pistillum.

Observation is wanted to complete our knowledge of *Azolla*, and *Marsilea*, and to commence our knowledge of Ferns, *Lycopodium*, and *Salvinia*.

It is also required, as to the fate of the Ovulum of *Evaginulate Marchantiaceæ*.

The male of Mosses, *Hepaticæ*, *Anthoceros*, and *Ferus*, is referrible to the earliest stage of a *Phænogamous* anther, when it is a cellular mass containing a grumous fluid.

The males of Ferns are proved to be so, by their universality, time of function, and by their analogy to males of certain Mosses.

2. The following are the results of analysis of this subject.

FERNS.

No Pistilla.—No apparent fecundation.—Product of development similar.

ISOETES.

No Pistilla.—No apparent fecundation.—Product of development laterly dissimilar—(abortive sporules).

MARSILEA.

No Pistilla.—No apparent fecundation.—Products of development, absolutely dissimilar from an early period.

AZOLLA.

Pistilla, or ovula.—Traces of fecundation.—Products of development absolutely, but irregularly dissimilar.

ANTHOCEROS.

No Pistilla.—Fecundation.—Product of development similar, anisochronous. Antheridia confervoid.

MUSCI AND HEPATICÆ.

Pistilla, ovula, fecundation.—Product of development similar. Antheridia.

CHARA.

Pistilla, or ovula.—Fecundation.—Product of development similar. Antheridia confervoid.

ESQUISETUM.

No Pistilla or ovula.—Product of development similar.

PSILOTUM.

No pistilla.—No male.—Product first similar, then dissimilar, lastly similar: sporules developed in secondary parent cells.

Note. What are the green globuline spherical headed, bodies of *Funaria*?

PILULARIA.

No Pistilla.—No antheridia, Product at first similar, capsules, sporules by abortion dissimilar.

3. Hence the Cryptogamia of Linnæus appear divisible into Pistilligerous, Gymnospermous, and Cryptogamous.

To the first belong Musci, Hepaticæ.

To the second, Azollinæ, Salvinidæ, and Charidæ.

To the third. Filices, Lycopodidæ, Isoetidæ, Marsilidæ, Anthocerotidæ, and Equisetidæ.

Uniform — Musci, Hepaticæ, Anthocerotidæ, Equisetidæ, Filices, and Charidæ.

Difform — Azollinæ, Salyinidæ, Lycopodeæ, Isoetidæ, and Marsilidæ.

Can the curious development of the spores of Azolla, be made analogous to the polyembryonism of Gymnospermous Exogens, in as much as the body, usually single, is composed of several? And, if they germinate from as many points as there are groups of spores, which is not improbable, the analogy is a sound one.* Is it analogous to Loranthus?

Chara is the only genus in which the process ends with the development only of one spore: it is that in which the greatest degree of representation of the organs of vegetation is kept up in the female and male.

The obvious action of something analogous to fecundation, followed by the development of the pedicellate bodies, is an argument in favour of fecundation in Ferns, the development of their capsules being so similar to that of these bodies in Azolla.

The development of the Pistilla of Musci, is not without a parallel in Balanophoræ; and that of the ovulum of Azolla, is much the same as that of the Pistillum of Naias, the examination of which is again required.

* It is also curious that in Gymnosperms, the Pollen is at its maximum development, so also in Azolla.

In *Azolla* the diformity is extreme, it would not be capable of identification, but for the large yellow sac, which is obviously a form of the spore, as pointed out by the trilined apex. The ternary division of the frondose lobes, suggests the idea of their being metamorphosed spores. And there will be little difficulty in adopting this, if the spores, or small yellow sacs of the pedicellate bodies, are not limited to 4 to each parent cell. This would be an analogy with Mimoseous pollen.

AZOLLA.

4. Examination of the middle stage of development of the monogongylus body of *Salvinia*, shews satisfactorily that the yellow sac is a preponderating spore, so much so, that all the rest are abortive, this is plain.

It satisfactorily shews that the same is the case in *Azolla*, the only difference being, that the other sporules do not entirely so abort, but that a definite number assume an unusual structure, not dissimilar to those changes in the contents of the normal capsules.

The great size of the germinating spore, shews that the larger sporules of *Isoetes* and *Psilotum*, are to be considered the germinators?

Appearances are in favour of the spores of the other organs being abortive?, they are empty, at least until they are quite enclosed in the cellular masses; they are not incrustated; they are like the certainly abortive ones of the oblong body of *Salvinia*, only yellow.

An evident tendency to *Azolla*, occurs in *Salvinia*, as shewn by the greater number of peripheral cells in the upper half of the body.*

* Points for consideration. Original difference in the nucleus of the ovulum, on which the number of protuberances depends? The time of first change.

The situation of the two in *Azolla*, the gongylus is always (?) underneath, when associated with a normal capsule.

The chief differences with *Azolla*, are the lobed nucleus in both, even at a very early period, the development of gongylus is observed in more than one lobe, and *that not the central*; and the abortion of all the spores but one, that one being surrounded by incrustation.

In the other body, the only difference is the greater number developed, and the cellular mature mass being one.

On comparing the developments, it appears that the chief difference consists in the original nucleus, and the preponderating development of one cell or spore, and the difform cellularity of a definite number of the others. But in the abortion of many, and the containing cells being fewer than they ought to be, sufficiently marked agreements are to be traced.

The order of Development is as follows.

1. Cavity.
2. Grume.
3. Puncta.
4. Division.
5. Enlargement of nucelli, (spores) enlargement of Parent cell.
6. Separation of spores, disappearance of all the Parent cells.
7. Appearance of secondary cells.

The parts of the phenomena whose description has been attempted, appear to me to be the following.

The early structure of the bodies, (presenting an analogy to the antitropous ovula) and the presence of grains in the neck of the ovula, presenting analogies to fecundation.

This will render necessary the consideration of the paraphysiform bodies.

The development of the capsule and spores in Mosses, has always appeared to me singular, but its extension to *Azolla* and *Salvinia* (in a less complicated degree,) is an indication of its generality among higher Acotyledonous Plants.

The term, *Capsula communis*, is the most appropriate for the outer covering of the organs both in *Azolla* and *Salvinia*.

It cannot be fairly objected to, while the term *Capsula* is applied to the fructification of Mosses and Hepaticæ. In which the part so called formed no part of the *Pistillum*, I prefer using it to the invention of a new name which would be necessary, if it were advantageous in the present state of our knowledge to have specific names, for specific developments.

It has at least a much nearer reference to the real nature of the organs, than the term *Indusium*, or *involucrum*, the application of which is not countenanced by any analogy yet known, although the first term is only known among *Acotyledonous* plants.*

The condensed points in the nucleus are tolerably numerous, but I have not been able to count them. I am of opinion that they are cotemporaneous with the appearance of the yellow sac, which is in favor of a membrane being developed round each of these condensed points of the nucleus. I have also seen instances in which the membrane, or future frondose lobe contained two, or even three of the points, although when the lobes are fully marked out, I have not observed more than one central one.

I have an impression that, in both the frondose lobes and contents of round capsules, there is much analogy, both being cellular, and both radicular on the inner surface.

The whole mass forming *Brown's upper loculus*, is at one period perfectly homogeneous, and even when the lobes are nine, evidently cellular, the axis, or common portion, is grumous and homogeneous. The fibrous appearance is a late one, and is not one of the least remarkable parts of this complex structure.

The *involucrum* is not closed, at least *ab origine*. It is, in

* It may be expected, that *Chara* should be noticed; although its early state is reduced to that of *Salvinia*: with the exception, that the covering of the nucleus are tubes of the stem; yet afterwards, it presents little or no analogy? the nucleus is the reproductive part. In this the representation of the axis is kept up minutely in both male and female.

the earliest stage examined, very cucullate, the point deflexed anticously and meeting the axis.

It contains at this time two nuclei, one rather more advanced than the other : protruding from the cup or annulus, rudimentary paraphyses, and confervoid filaments occur, but these have no relation with the ovula, beyond that of being contained in the involucre.

These filaments, appear to begin to get access to the ovula at the time when the nucleus is just enclosed by the tegument, but the access is by degrees, for at this period, two were observed only just entering.

The grains disappear very slowly, a few may be found even when the capsules are really mature, or the gongylus quite marked out.

One very remarkable circumstance was noticed regarding them : in one instance, a bundle of them was seen attached to the axis, and one or two single ones in which some of the joints were a good deal enlarged, of a yellow green tint, with two evident nuclei approached either end (or one, when the enlarged joint was terminal) *near its base*, sometimes with a rudiment of a third : those unchanged in size, still often presented important changes ; thus those near the terminal one had become divided into two, by a line across the middle ; the joints hence resulting being broader and more beadlike, in others again, at the ends of each was a small nuclellus, corresponding with the upper and base one of its next neighbour ; and near this was the shadowing out of a large cell !!

All this is quite confervoid, and opens a rich source of speculation. At the same it may throw difficulties in the way of proving the grains to be pollen, at least with some.

Appearances are in favour of the condensing points being at some period ternary, or quaternary, always they are angular, often appearances are seen of division ; but this is so obscure, as to probably arise from suggestions of analogy.

Appearances are in favour of the nucleary grume developing

the yellow sac in its lower half, and in its upper, the condensed points.

The trilineal mark of the apex of yellow sac is evidently its relation with the superimposed mass, for in the young state it appears here puckered up, as if it were trifacial.

Appearances indicate a similarity between the condensed points and abortive sporules, but the difficulty is, that this is uniform, affecting the central points of the lobes equally, which it should not do.

The hair like processes of incrustation of yellow sac, are not organic.

These anomalies I do not pretend to explain, the phenomena nevertheless are worthy of the attention of observers, and are in my opinion entitled to the explanation I have endeavoured to give them. I therefore beg to propose to Botanists, Salvinidæ and Charidæ as the naked seeded types of Acotyledones.

SALVINIA.

5. The incrustation has, I think nothing in common with the original grume: it first appears as an incrustation of very minute granular matter: it continues so, until it has acquired considerable thickness. Then cavities appear to be formed in it, and it hence it assumes a cellular aspect; but I have not observed these seeming cells to be provided with a proper membrane. The incrustation adheres firmly at an early period.

The contents of the smaller pedicelled bodies are solid, white, opaque. I have not observed them to be distinctly cellular, in which respect the organisation is less advanced than in *Azolla*, even under 1-16 they appear like condensed grume, with indications of cellular looking sub division on the edges. Pressure shews them to contain trifacial cells, of a yellowish colour, together with larger globules, which I do not think are cells, but analogous to the globules in the incrustation. The

trifacial cells are readily recognisable by their colour, and less their more defined outline.

In both the capsules, the cells forming the walls present greenish granules, in irregular masses ; generally towards the centre, these granules are violetted by the application of tincture of iodine.

The brown tint, or subsequent mature colour takes place in all, even the abortive ones : the earliest and most completely abortive, present a dark brown grumous disk, such being the grume lining the cavity. In others less abortive, the mass of grume is more independent, presenting many granular coagula, in others these are mixed with small trifacial cells, in others again the trifacial cells are many, disposed irregularly of a larger size ; but not uniformly so.

The three lobes of the incrustation are very well seen in the younger stage : they alternate with the striæ (Pl. 123, Fig. III. e,) around which the incrustation is not deposited, or if so, in a small degree. At this time the slightest puncture causes the escape of a grume from the secondary capsule, which grume is granular mucilage. I imagine the incrustation to be a deposit of its granules. In this grume also, a few trifacial cells will generally be found.

The next change is the *appearance of its* cellularity, in the form of oil globules, or cavities. It appears to present a slight attaching process, which is to be found in the centre of the vertex, shorter than the tri-section, and arising from the confluence of the three lines.

In Chara, the early formation is much the same, but the enclosure of the nucleus which is the continuation of the branch, is not derived from a general development of an annulus around its base, but from 4-5 distinct puncta, as many in fact as there are spiral tubes in the mature state. The apparent stigmata are nothing but smaller tubes growing from the larger screwy ones.

Now this is an additional reason why Nitella is not distinct from Chara. If Nitella were organically distinct, the same

should occur in the organs as in the branches, viz. that external tubes should not be developed.

The trifacial cells were once seen in the female of *Chara furcata*. In *Chara* there is the strictest conformity in both sexes, with the structure of the axis.

6. In *Pilularia globulifera*, it would appear that the first stages resemble a good deal those of *Marsilea*, the thecæ or capsules containing sporules, or the bodies derived by ternar, or quaternarisation. But they are similar, not dissimilar as in *Marsilea*.

Afterwards, of all the sporules, 8 or 10 to each sac, one part only of one, continues its development. The three other parts of that one, disappearing. All the others aborting, and undergoing changes exactly such as they do in *Isoetes*.

That one fourth becomes the reproductive germinating body, and it remains enclosed in the parent cell, which again becomes covered by a testaceous outer opaque coat; it presents slight indications of its original sporous origin.

Now, *Pilularia* is a more prolonged development than *Isoetes*, for in this the sporules always evince their origin.

Instead of *Acrogens* being said to be of indefinite germination, they should be said to produce a thallus or frond, before they produce any part of the ordinary axis. All the higher *Acrogens* agree in this, whereas Mr. V. shews that in *Pilularia* the germinating point is prefixed.

7. It is a remarkable fact, that dorsiferosity appears invariably connected with the frondose form of the axis: this at once suggests the non analogous (foliaceous) nature of the fronds of Ferns. The dorsiferosity may be disguised, as in many *Hepaticæ*, but still, dissection shews that the origin in all, (see *Asolenium*, *Anthoceros* etc.) is from the same layer, and that when not obviously dorsiferous, it is due to Mechanical causes.

I Essential points! for consideration with reference to fecundation.

1 Prior development of the nucleus.

2. The absence of grains in the neck of the ovulum before the entrance or attachment of the Confervoid Filaments.

3 The absence of sphacelation before the attachment of the same.

II Essential points with reference to the development.

The minute examination of both ovula in order to ascertain if there is any difference in the mode of fecundation.

2. The minute examination of the frondose mass at early stages, to reconcile it with the ordinary development of spores.

3. The minute examination of the process of confer-rumination, and number of germinating points.

MUSCI AND HEPATICÆ.

8. It is a remarkable fact that in Musci, and the vaginulate Hepaticæ, the ovulum undergoes no change except in situation, it forming the tip, or point of the seta. And that in Azolla, the nucleus undergoes no change whatever, being detectible even when the spores are completely *conferruminata*.

It is only changed analogously, to non vaginulate Hepaticæ, in the frondose-producing one.

Memo. Bear in mind the unchanged nucleus being the apex of the axis, and the pedicellate bodies being developed round its base, from above downwards, this is in favour of its being due to fecundation.

The analogy of Chara, is in favour, of the frondose mass, and big yellow sac-like body, being the developed female.

To what can the capsule of Mosses and Jungermanniaceæ be strictly rendered analogous?. The question is reduced somewhat in difficulty if we examine the last, for in these the cell pre-existing in the cavity of the Pistillum, is developed by fecundation into a simpler form of reproductive organ.

In these plants we have the common occurrence of an ovulum, existing in the cavity of the ovarium, but we have the uncommon fact of this ovulum not becoming the receptacle of the reproductive bodies, but becoming removed unchanged to a greater or less distance from its original situation.

If the phenomena incident to fecundation affected this cell, this ovulum,—the reproductive organs of both families might fairly be assumed to be analogous to a seed, containing many embryos. The mere quantity of these really reproductive organs, could scarcely be urged as an objection, because such an increase is to be expected in descending the series of animals and vegetables.

Thus in Coniferæ, which are doubtless analogous to reptiles, a partial increase is of common, perhaps of general occurrence in fecundation, aëration, or squamation.

But so far as I am aware, there is nothing analogous to the steps of the phenomena as they do occur: for although we are acquainted with instances in which the developement of the embryo is altogether extraneous to the body of the ovulum, the direction of the growth is completely reversed, the original ovulum remaining fixed, the new growth being protruded from it. This may perhaps hereafter be reducible to the distinct manner of growth in Exogens, Endogens, and Acrogens.

And here we have a marked reference to the simplicity of the reproductive organs in ferns, the growth of whose axes is either identical with, or approaches nearly to that of Endogens.

Marchantiacæ are apparently more reducible to an ordinary type than Mosses, but this greater facility of reduction, does not affect the consideration, as it only depends on the shortness of the seta, and the comparative simplicity of the capsule.

Distant analogies between the capsule of mosses and its contents, and the seeds of more perfect plants, may doubtless be found, both in the compound nature of structure, and the

alteration of the original tissues during development, as well as in the plurality of reproductive bodies, and their inclosure in the finest of all the coats, viz the embryonary sac. The circumcission of the operculum also has its analogies, but the columella is unrepresented.

In these plants we have three decided points of opposition to the usual Phænogamous structures, for the Pistillum does not act as a protecting organ to the growing ovulum, or enter into the composition of the fruit, nor does the ovulum enter into that of the seed. Nor has the young reproductive organ during the greater part of its growth, any connection but that of contiguity with the parent plant.

Can they be adduced in favour of the doctrine of compensation?

If so, then these the most simple of all flowering plants, have the most complex products of fecundation, are the most complex in structure, the most complex in effects, in as much as the embryos derived from each distinct act of fecundation, are beyond all comparison indefinite.

The growth of the seta may without any strained argument be compared with that of the embryonary growth in Rhizophora.

Concluding Observations.

9. I have elsewhere stated such objections as have presented themselves to me, to which, (and some of them are unsatisfactory) : there is to be opposed the constant access of the moniliform filaments to the interior of the ovulum of Azolla, and the subsequent changes in the foramen and nucleus or basilar protuberances of this organ. Some of the objections might give rise to much speculation. For it can scarcely be doubted that the moniliform filaments of Azolla, could be described as a Confervideæ, and would have been taken for one, had the organs of reproduction not been examined. Etc. etc. etc.

But though obvious difficulties are presented, an explana-

tion is not to be rejected (because it is only partial, or may be, insufficient) until a better one has been offered. That which I have given, is calculated to reduce the number of Asexual Plants, and so to cause greater harmony with the theory—*Omne vivum ex ovo*, and it offers a beautiful analogy with certain Phænogamons plants, of a marked organisation, themselves the analogues of as marked an Animal organisation. These are broad grounds for theory, but they are captivating, and perhaps seductive.

Much of the imperfect knowledge of the higher Acotyledonous plants, is due to the writings of those who have insisted that these plants are sexless, or that their sexual organs are not analogous to those of Cotyledonous plants. But, had the Linnean name Cryptogamia, and above all, the writings of the great Hedwig been kept in mind and studied, such exhibitions would not have occurred. Objectors will do well to bear in mind, the readiness with which the fovillar doctrine of fecundation was, until very lately every where received. Yet if Mr. Brown's ideas of the nature of the fovilla, and the general doctrine of M. Schleiden be found correct, few hypotheses will appear so absurd, as that which supposed the discharge of the fovilla on, or in the stigma, and the independent passage of granular matter down the style, into the ovarium, and to the ovulum which it vivified, often in a direction opposed to gravitation. Certainly this hypothesis which they received eagerly, is much more untenable than that which attributes a pistillum to Musci and Hepaticæ, a naked ovulum to Azolla and Salvinia, and, fecundation to all! And as they then admitted at once, what has been found to be inadmissible, let them not reject at once, what may be found to be admissible.

Objections Stated.

1st. *Partial Objections.* Salvinia, attributable to three kinds of bodies.

Azolla: no anther, yet pollen (assumed) highly developed.

Change in grains while attached to the axis, no elongation of the paraphysiform hairs.

2nd. *General Objections.* Moniliform filaments of *Azolla* on the capsule of *Salvinia*.

Dissimilarity of the process in the two.

The brown matter is opaqueish and grumous.

The general development of the granules is from above downward, beginning with grume containing slightly moving points.

Some of the cells contain sometimes one or two large globules, which are perhaps only gigantic granules.

A developed cell contains granules and globules of all sizes, but especially the former, endowed with motion.

Hairs are found just below the conical growing point, the base of which is beset with protuberant cells to fulcrum roots and hairs.

In mature roots I do not discern them. Appearances such as suggest a general development of the contents from above downwards, are observed, and also an enlargement of the granules.

NOTE.—The foregoing remarks appear to have been written at various periods between 1835, and 1845. They bear no dates.

FUNGI.

Geastrum elegans Gr. Pl. CXXX. Fig. II.

Phallo affinis Pl. CXXX. Fig. I.

Found on decayed bamboos in the Cantonment Moulmein, by Capt. Ellis, H. M. 41, During the rains, 1834.

1. Young fungus.
2. Front view of stalk.
3. Plant more advanced.
4. Stalk.
5. Veil, portion of.
6. Fully developed fungus.
7. Portion of the veil magnified.

Phallus fetidus. Pl. LXIII. Fig. 1.

Odour indescribably abominable, and very strong, representing the worst sorts of putrescence.

Direction of the plant obliquely ascending.

Capite vel glande, initio rubro, demum viscosa lucida aterima tecto laxa, membranacea.

Stipite rubescens celluloso-rugosa, apicem versus striata.

HAB. Barren Hill on the way to Bharowul, alt. 4000 ft. April 10, 1840.

CHARACEÆ.

CHARA.

1. *Chara involucrata*, Roxburgh?

Planta pedalis, nigro viridescens. Caulis glaber vel spinulosus.

Ramis sub 10, subulatis, ascendentibus, ramellis numero duplice, subulatis suffultis.

Ramuli ultimi parvi, infra flores cæterum minimi vel etiam obsolete.

Articulo ultimo vel 2 ultimis nitelloideis.

Flos fœm. super. masc., infer: ad latus internum articulum inferior., fœm., ramulis 3-5 subulatis, subæquantibus suffult. Masc. quasi nudum.

Fl: Infimi multo minus præcociores, cæterum more solito. HAB. Serampore in aquis stagnantibus dulcibus.

Facile cognoscitur, colore atrescento, ramisque oculo nudo, simplicibus.

It agrees tolerably well with Roxburghs scanty character: it looks more like a *Nitella* than a *Chara*. The cells of the branch joints are scarcely, if at all spiral. Those of the stem are, I think, shorter than ordinary.

Are the suffulting ramules analogous to stipules?: they are one on either side, and are what would not be incorrectly called decurrent, they certainly protect the young branches. The contents of the *spore*, or reproductive organ, are violeted by iodine.

Iodine colours the male nuclei dark, leaving the membrane white; $\frac{1}{2}$ of an inch does not shew the septa, $\frac{1}{1500}$ does, but not very plainly.

The male organs of *Chara* are far more complex than those of any other *Cyrtogam*, perhaps in accordance with the greater similarity of the female to that of ordinary *Phanerogams*. It is however still reconcilable hypothetically, to the type of an anther of *Phanerogams* in their younger periods

of evolution, the filaments being composed of cells, containing nuclei, in the stage just preceeding the ternary or quaternary division of Phanerogams. The only unusual thing is their disposition, unless indeed each filament is formed in a separate cavity.

The anthers of Musci on the contrary, represents a much less advanced stage of Phænogams, viz. that in which the cells contain a grumous mass, antecedent to the cellularity of this.

Few things will be more interesting than the full examination of Chara in the youngest states of developement of each organ.

Nitric acid shews that the female when half developed, consists of a certain number of spiral green tubes disposed round a central bag, containing granular matters. Beyond this bag the spirality ceases, but each tube is surmounted by a short cell, like the spiral cells, organised exactly as the cells or tubes of the axis.

That is, an outer coriaceous or tougher tube, colourless, of simple membrane, and an inner membranous much finer one, the inner surface of which is studded with green globules, and in which the circulation takes place.

At an earlier period, these tubes are quite straight, and the amyllum-bearing central bag, projects a little beyond the bases of the terminal cells. And between these is a short colourless tube, the continuation of the amylliferous one. Many of the smaller granules have the appearance of a Dicotyledenous embryo.

The male organ in its middle state, consists of an outer hyaline thick covering, the cells of which have a fasciculate arrangement, each fasciculus representing a star or radiate body. These appear to have some connection with the filamentiferous tubes. Then there is a globular sac, on which granules of red are disposed. Into this so formed globe, the short stalk passes to some distance, it has the same organisation as the other tubular parts. It gives origin to another tube, (or perhaps to more than one), *from the apex of which the*

filamentous bodies are produced; and beyond the filaments which form a pencil of whorls, the tube is again continued.

The fasciculate radiate cells are a multiple of four, being partly seen when the globe is viewed vertically.

After maceration a short time in nitric acid when nearly mature, it will be found that the radiate cells may be dissected out, each carrying away with it, the tube that passed from the centre, around the new free apex of which, the confervoid filaments are arranged.

Although it is not easy to trace the radiating cells: inserted distinctly on the end of the radii, yet I have seen instances in which they were really articulated to it, as would be expected.

It is singular that the tube of attachment is the only part whose contents are violeted by iodine. These tubes are of some size and formed of beautiful hyaline membrane, the filaments do not spring immediately from it, but are in tufts, arising really from a whorl of short cells.

One result of this is, that the supposed males have a different organisation from what is usually ascribed to them.

And as the female so minutely represents an axis of a *Chara*, so the male has its own analogies equally curious. For the involucre is doubtless to be considered as arising from the cohesion of a number of parts, all consisting of tubes, radiating from a *tube*. This tube is again a branch of the axis, and the filaments are nothing but simple shortened tubes, placed end to end, arising from a *point*, the very place, and the only place in which branches are produced, and in some, indefinitely.

See Diagram (right lower corner, plate LXIV) which represents a section through the axis.

- a. Radiating cohering branches.
- b. Branch of radiaton.
- c. Filament.
- e. Branch or pedicel.

The most reasonable consideration is, to regard the reproducing point (or female) as a bud. Because in no instance is the fruit of Acotyledons so manifestly a modification of the axis.

Because in no instance does the fruit contain only one germ.

Because the structure is quite different from the others, and nothing like the pollinia development takes place in the female.

2. *Chara Spagnoides* Gr. LXIII. Fig. II. See Itinerary Notes, Book II, Chap. II, Number 149. p. 356.

1. Plant natural size.
2. Portion of a branch.
3. A single cell of a whorl.
4. Branch and reproductive organs.
5. Reproductive organs in early stages.
6. Mature ditto opaque.
7. Spiral covering of ditto detached.
8. Mature reproductive organ, in water
9. Apex of its membrane shewing that these teeth are distinct cells.
10. Portion of ditto intended to shew that the spires are inflected, as must be the case if the coat is formed of 5 spiral cells.
11. Section of nucleus.
12. Corpuscles or amylaceous granules.
13. A representation of what I thought, was an embryo, the appearance only occurred three or four times.

HAB. Common in stagnant fresh water at Cabul. So much incrustated, that at first sight it resembles Sphagnum.

3. *Chara Erythrogyna*. Ramis plurimis: patentibus, (suffultis processibus ramulis omnino similibus)--nitellinis.

Ramulis pluribus--nitellinis.

Monoica: fl. masc. in ramulor sub axillis vel solitariis vel Fl. fœm: vel more solito supra masc. vel omnino segregato, solitarii vel gemini: colore insolitissimo maris nempe aurantiaceo.

HAB. Serampore.

This plant is remarkable for the Nitelline rami, and of course ramuli, also for the size of these which are nearly equal to the internodii of the rami, as well as for the mixed disposition of the sexes, and for the red colour of the females, which have invariably the outer membrane uncoloured, and the nucleus blackish.

To the naked eye it has a green and white mottled appearance, from which, and the abundance, and colour of the flowers, it is rather conspicuous. This species was obtained for me by Haloodar, Dr. Voigt's principal native Gardner.

Some of the branches have only females; ramuli even longer than internodii, some variety occurs in the depth of red.

Nitella as a genus, certainly cannot stand, it is only retainable when compared with the more perfect Charæ, in which only the ultimate ramules are simple.

Serampore, Sept. 24, 1841.

4. *Chara.*

Axis pedalis, in horto Serampore.

Internodii tenuiter striata: striis hinc illinc anastomose conjunctis sub spiralibus.

Rami verticillati, plures, circiter 12, juniores sub adpressi maturatæ patentis: verticillus basi setis stipatis, setis ramis numero duplicibus? alternis ramis oppositis, alternis cum his alternantibus.

Axis non semper solitaria, altero scrotino hinc demum evoluto.

Rami internodiis breviusculis, striis rectis!

Ramulis verticillatis, sub 12: introrsis, majoribus simplicibus, inæqualibus extrosis minoribus aliquando obsoletis, an ob lapsu: simplicibus.

Floribus utriusque sexus? approximatis, mascula inferiora: (without any obvious relation to the verticil. Fæm, superiore in verticillo sed vix axillaris: utroque sesili.

Masc. decidua globosa, nucleo rubro. Fæm. oblonga 5 sul-

cato, nucleo conform intersulco ultra nuclea in stigma? 5 lob. (lob rectis) producta. Fructus vel nudi vel ramulis persistentioribus, stipate oblique directione (ovalia) ovati; stigmato fere immutato terminat, corpora nucleari fibra spirale notat.

Tegument exter, separabili, membrana spiras leviter notata, interna duro, atro, ob spiras projicientes quasi echinato (along the sides,) materies farinaceo, en viscosa mixta granulis amylo-sis quam maxima inæqualibus. The young rami, as well as all the ramuli have no outer cells, hence *Nitella* is chara in an earlier state.

It is obvious that the so called stigmata are not so, for they present no change at any period.

In Musci,—the lowest pistilliform plants, the stigma undergoes manifest changes.

Nor has the male any relation to the males of the lower orders.

Serampore, Sept. 1841.

5. *Chara soluta.*

Caules tenerrimi simplicis, internod. matur. longis: articulis nodosis.

Ramis verticillatis simplici serie: ramosissimis, ramulis confertis, (densely tufted) apice ramellis 2-3 gerentib.

The joints consist of an outer hyaline rather tough coat, and a central green lining membrane

The ultimate joints are acute, and may be seen terminating the ramella.

Inner central lining membrane consists of a layer of irregular roundish or angular globuline, held together by nothing appreciable even to 500 magnif.

Hurdwar, April, 1841.

NITELLA.

1. *Nitella furcata*

Chara frucata Roxburgh.

Internodiis secundariis? summis abbreviatis, ramis dense

verticillaris, ramulis ultimis 2, 3 dentiformibus; florib. masculis terminalibus solitariis, ad apicem ramorum axeosve; fæmineis vel terminalibus solitariis vel 3-5 congestis inter verticillos.

Planta in horto Seramporensi, spithamæa tenera, raro calcareo incrustat (crusta, ad apices ramulorum vel medium versus, definita)!

Linea alba, ramorum etc. secta. Ramorum superiorum, verticillis dense congestis, summis juvenissimis corpus oblongum echinatum simulantibus.

Fl. foem: congesti inter verticillos, uno centrale terminato? raro solitarii, membrana exteriora solubilia citissime., apice in stigmatibus? 5 acutis productis. central. e sporis 5, etiam solubilib. Nucleus centralis. Materia amylacea corpusculis inæqualibus farctis! Fl. masc.? albi., nucleo rubro; sæpius solitariis in apicibus ramulorum penultimorum, rarius immixti, fæmineis extrorsis.

The solution of the inner spiral coat is remarkable, for there is nothing then to hold together the granules, which are, as usual very large, very unequal, and subangular.

The stucture of the male I do not understand; the triangular separation is manifest, but the divisions between its component parts do not attain to the centre or meet, and as the centre is red-granular, and this is produced into each peripheral division, it is obvious, that the cell must be considered as simple, with divisions radiating from the circumference towards the centre. How has it the red nucleary appearance? the red cells must obviously be confined to it.

This is distinct from all known to me in the aggregation of the female flowers, their often being terminal, and in the male flowers being developed most towards the summit of the axis, and in their being terminal.

It is a Nitella with the female of Chara, as Endlicher says Nitellæ have no stigmata. The outer membrane is very soluble, and in all the specimens yesterday put into water, the spires were to day unrolled, leaving a nucleus of a hyaline sac, gorged with granules.

The older parts became mottled with white.

Chara evidently shews, that from a number of amylaceous granules a new plant may be formed; is there any distinction between these, does iodine act differently on any of them?

LYSIMOSCEPAS. *Nov. Gen.*

Differs from the species known to me in the nature of both the teguments of the female, particularly the inner, which in ordinary structure is crustaceous and persistent.

It has also minor differences, such as regard the situation of the organs of reproduction, which in genuine Charæ are arranged along the inner side of the branches; the female above, the male close to it, below.

My knowledge of this remarkable family is so limited, and I am so unacquainted with the structure of the groups supposed to be conterminous, that I propose this genus with some hesitation. In neither of its organs does it present, as appears to me, any great affinity with the higher groups of acotyledonous plants: some may be imagined between its filaments, and the male organs of certain Musci, and perhaps the whole of Ferns, but the structure of the case containing these, is altogether peculiar.

While the female has a marked external resemblance to the pistillum of Phænogamous plants, it is probable that there is no affinity in structure between them. For the so called stigma never presents any of those remarkable changes subsequent to its having received the male influence, although these changes are very manifest in Mosses, which are among the least developed pistilligerous plants.

The germination of Chara is tolerably well known, and is very remarkable: each female producing one axis, and not several as might analogically be supposed. No embryo has I believe been detected, most of the amylaceous granules act perhaps as albumen.

It differs from all higher Acotyledons, in the female organ

producing one plant only ; in Ferns, Mosses, etc. there is not even as indication of an approach to defined number.

Chara bears, I think, upon the question of the so called Rhizantheous embryos, it being apparent that from a collection of amylaceous or albumenis granules a young plant may originate.

Lysimoscepas may be regarded perhaps as representing Equisetaceæ ?

There is no very great difference between Nitella and Chara : for the young branches of the latter are certainly simple. Nitellæ therefore are simple by an arrest of development.

There are few plants in which there is such a marked analogy between the female, and the axis, each consists of two membranes, the *inner being green*, containing granules, the 5 stigmata are to be considered as 5 branches : for they are divided from the *tubes* by a septum.

Perhaps after all, the females are nothing but buds !

There ought perhaps to be some differences in the structure of Chara and Nitella, viewed in this light, Nitella ought to have tubes.

1 *Lysimoscepas Voigtii* Gr. Pl. LXIV.

1. Portion of Plant magnified.
2. Apex of a branch.
3. Inner lining of globuline, this shrivels up when the plant is dying.
4. 4. 4. 4. 4. Illustrate the situation of the reproductive organs.
5. Male organ? 6. Two triangular scales, to shew that they are only compound towards the circumference.
7. Filament, magnified 200.
8. Do. 500 times. 8 *a*, is a younger one, the structure is obviously a single series of cells, each with a nucleus of *grume!* the cells are exceedingly fine, and perhaps the septa are not definable.
9. 10. Female organs.

11. Same outer coat dissolved into a flat fine membrane ; the inner commencing to separate, the spore is seen to be without a proper coat.

12. Same, rather imaginary.

13. *Spore* or seed broken up : the five straps still coiled up, but somewhat disarranged.

14. Amylaceous granules of spore.

The name *Lysimoscepas*, is proposed for the genus, from the solubility of the membranous integument. The species is named in honor of Dr. Voigt, the supporter and superintendent of the late Dr. Carey's Botanic Garden at Serampore, and Surgeon to the Danish establishment at that place, an excellent systematic Botanist.

HEPATICÆ.

General Remarks.

In making the following observations it is not my intention to enter into details of the anatomy of the plants of the order Hepaticæ, particularly as that of the cuticulate species has already received abundant notice in the celebrated memoir of M. Mirbel on Marchantia

The usual form of the order is frondose, although the number of foliaceous species of *Jungermannia*, probably far exceeds that of the species of all the remaining genera.

The frondose species are chiefly remarkable for their great tendency to a binary division. They may be conveniently divided into.

Cuticulate, and Ecuticulate.

If the former, the upper cutis is supplied with large open orifices; the existence of which, although it had been alluded to, does not appear to have attracted much attention before the publication of M. Mirbel's memoir. Their organisation is in all the species the same; and they may be considered as characteristic, their existence out of the order, having only I believe, been ascertained in *Kaulfusia*

The under cutis presents nothing remarkable except its tendency to assume a more or less purple colour.

The radicles are excessively numerous, and are, at least in the frondose species, always simple. They are in fact nothing but an elongation of some of the cells forming the lower stratum of the uncoloured parenchyma. In the ecuticulate species, they pass to their destination without interruption, but in the cuticulate, the inferior cutis is obviously interposed. It is owing to this origin of the radicles, and to the force which they exert in passing towards the veins, that the universal presence, and the direction of the scales on the under surface of the fronds of these species, is to be attributed. These ra-

dicles have a great tendency to run towards the central vein, along which they for the most part strike root exclusively, although, as might be expected, they do not originate from the vein itself. It is a curious fact, that those of the fructiferous portions of fronds, do not generally strike root until they have arrived at that portion of the frond, from which the fructiferous part was developed. And it will be seen that in obedience to this tendency, curious means are in many species contrived for conducting them to this point.

In their younger states they contain numerous active molecular granules, but I have not been able to ascertain that these are subjected to any circulation.

These granules disappear as the radicles lengthen, and are subsequently not to be met with, This may be considered as corroborative of Mr. Brown's suggestion concerning the nutrient functions of the granules contained in the pollen tubes.

With regard to the foliaceous species which are confined to *Jungermannia*, of which genus they form by far the larger portion, it appears to me that the authors who have studied the genus have mistaken its structure. I am unable at present to state whether there are material objections against considering these species as the result of the maximum division of the frondose forms. My ideas of the structure will be found under the genus. I shall here only point out in addition, that the ampullaceous lobes, which are evidently due to cohesion of the margins of concave lobes, become again expanded in the leaves surrounding the organs of both sexes.

The receptacula of authors are in all cases, except in *Asolenium*, to be considered as modified portions of the frond, the peduncle being a continuation of the central vein, and its overlying structures. This portion will hence, always correspond to the sinus of the emargination of the lobes of the fronds, from which it is indeed almost universally exerted. And it will hence as obviously follow, that both peduncle and receptacle will have the exact structure of the portions of the frond to which they correspond.

The peduncle is provided either with one or two grooves, down which the radicles pass to the vein of the Frond. I believe it will be found that two grooves alone exist in those species in which the radicles are, during their course along the vein of the frond, divided into two bundles. In *Marchantia*, the portions closing in the grooves correspond to the innermost scales overlapping the bundles of radicles in their passage along the vein itself. M. Mirbel first I believe pointed out, that the surface of the peduncles which corresponds to the upper surface of the frond, is in the cuticulate species, similarly provided with stomata; while the under surface of the receptacle gives origin to similar radicles, which produce by disruption similar scales.

The outer involucre in the cuticulate species, are modifications of the inferior cutis; in the ecuticulate they are productions of the inferior stratum of parenchyma. In others again of this last section, they are mere elongations of the upper surface.

The inner and partial involucre (perianthia) of some authors are of later origin, and are extensions of the tissue immediately adjoining the base of each pistillum.

The male organs or antheræ vary a good deal in situation; generally they consist of a simple membranous sac, the membrane appearing rarely to become compound.

In the foliaceous species they are axillary, in the frondose they are contained either in cavities of the frond itself, or in receptacles, which are indefinitely divided into cells, and which are less frequently pedunculated than those bearing the female organs. In these cells they are generally solitary, they invariably communicate exteriorly by means of an opening in the cell through the upper surface. Generally speaking they are less developed than the similar organs of Musci, although in some species of *Anthoceros*, they may be considered as attaining the maximum of evolution. Their contents are similar to the fovilla of Pollen. It is impossible not to be struck with the close similarity they present in appearance

in their earlier stages, with capsules of Filices at similar periods of development.

In the female organs a good deal of diversity exists.* *Jungermannia*, in the primary evolution of its peduncle bears an exact analogy to *Musci*. I am not aware whether this has been *noticed* previously, although the vaginulation is clearly represented in the figure of *J. saccata*, Hook. *Musc. Exot. t. 16*. Putting this inverseness of evolution aside, the general form of the order, excepting in *Riccioideæ*, and *Anthocerateæ*, is to have the fecundated ovarium provided with an interior free membrane, immediately enclosing the young sporula. The Pistillum is similar in structure to that of *Musci*, they are generally aggregate; and it is a curious fact that in those species of *Jungermannia*, the involucre of which are closed, owing to the nearly complete cohesion of the component parts, they appear to be solitary, while in those with open involucre they are aggregate. This is just the contrary to what we should expect. As in *Musci*, the pistillum only appears to perform an important part during the first changes consequent on fecundation. That portion which corresponds to the ovary, owing to the enlargement of the inner membrane, soon assumes a membranous appearance, and is subsequently ruptured, and always as it appears, irregularly. In no instance does it, become separated by its base, or become carried upwards, although it has received the name of calyptra, and although the young capsule of *Anthoceros* is stated to be tipped by a Calyptra. It rarely disappears entirely, traces of its base being generally present, although from their extreme tenuity they are very liable to be overlooked. Throughout the stages antecedent to its rupture, and in many cases even after this, it is always to be recognised by its style.

The inner membrane subsequently becomes the capsule,

* They are either terminal as in the foliaceous *Jungermannia*, endophyllos as an *Riccia*, *Anthoceros* etc. or hypophyllos, as in *Marchantia Targionia*, etc.

and at the time of full maturity bursts, either in a regular, or generally in an irregular manner. It is almost always sessile or nearly so. There is nothing very remarkable to be observed in it, except the frequent presence of fibres in the cells of its inner surface. It contains either sporula only, or sporula and elaters.

No genuine plant of the order is furnished with a columella. In Riccioideæ and Anthocerotæ it does not exist; in the former all the changes are carried on in the ovarium, which hence subsequently becomes the capsule. In the latter it is difficult to refer the capsule to either of these membranes, although from the total absence of a style, it is more analogous to the inner, than the outer.

The peculiar and characteristic bodies, *Elaters*, are by no means universal in the order, and hence too much importance has in my opinion been attached on them. They are almost universally associated with the existence of fibrous cells of the capsule: and this would seem to corroborate the truth of Mr. Mirbel's conjecture, that they are modifications of such cells. In fact, the transition between these cells and the elaters, is very evident in *Jungermannia epiphylla*. In their younger states they consist of an elongated cell, containing one or more grumons nuclei. They are not to be confounded as has been done by Sprengel with the remains of cellular tissue, which occurs intermixed with the sporula in some genera. Too much stress has, I think, been laid on these organs as inducing the despersion of the sporula, neither do I see in any instance, that the sporules adhere to the elaters.

In all the genera, the formation of the sporula appears the same, consisting in the ternary or quaternary division of an originally simple nucleus, and the subsequent separation of these divisions, each of which becomes a perfect sporule. In *Anthoceros* the formation of these organs is gradual, and as it were indefinite, the degrees of evolution being beautifully shewn in the mature capsule, from the original, undivided, and simple cell which may be found near its base, to the perfect

sporule which exists only towards its apex. This again is another remarkable, through casual analogy which these organs bear to pollen. A far more remarkable one exists in the fact, which will probably be found general, that the sporula consist of two membranes: The outer one is in some exceedingly distinct, forming the "tunica" of authors, and in such, it is compound, in others it is of difficult demonstration, owing to its adhesion with the inner membrane, and in such cases it appears to be simple or granular.

With regard to the much mooted question as to the occurrence of fecundation (by means of anthers) in this family, I have no direct evidence in favour of it to offer. Still for reasons so obvious that it is almost unnecessary to advert to them, I do not doubt that such does take place. The difference in the steps of the process between such plants and Phænogamæ, I have mentioned in the remarks prefixed to the *Muscologia Itineris Assamici*. As presumptive evidences, I would lay particular stress on the existence of distinct gemmæ in most, and perhaps in all,—on the fact that the anthers are generally enclosed in sacs from which they cannot escape,—on their dehiscence,—on their composition which is totally unlike that of gemmæ,—on their contents, which are similar to the fovilla,—on means for its escape exteriorly,—on the correspondence of the development of the anthers with that of the pistilla, which although not absolutely ascertained in all, is so conspicuous in some, as to leave little doubt that it always occurs, and on the invariable sphacelation of the styles.

And lastly on the fact that in *Anthoceros*, in which the developement of the sporula is gradual, there is a corresponding gradual developement of the male organs, and on the peculiar means which are had recourse to, in order to ensure the requisite communication by means which are obviously necessary, from the peculiar organisation of this genus, to which I shall allude more fully under the genus itself.

Misapplication of terms, or at any rate, their most inconsistent application, has been carried to a great extent in this

order. Calyx, perianth, corolla, perichæatial leaves and exterior calyx, change places in an extraordinary manner in the writings of eminent cryptogamists.

In one instance the capsule of *Anthoceros* is described as pedunculated, and the cellules of the surface as furnished with a spore in the centre, neither of which correspond with my own observations, neither have I observed that the sporules are ever attached to any part of the capsule. The perianth of *Targionia* becomes an involucre in *Jungermannia*; the term perianth being applied to the inner involucre, becoming calyx in the description of *Marchantia conica*, which I may here remark, would be sufficiently characterised as a distinct genus, by the male receptacles being sessile, and the peduncles of the female ones furnished with one groove. The application of the term stipulæ to the third series of leaves in this genus appears to me as unnatural, as its applications to similar parts in *Musci*, on which I have elsewhere remarked.

In the otherwise excellent *Musci Exotici*, in the description of *Jungermannia Phyllanthus* t. 95, the calyptra is said to be a corolla. The term too, perichæatial leaves, is not as appears to me, strictly applied, for in the frondose species they become the exterior calyx.

Sprengel in *Lunularia* turns the capsules into calyces, while in *Fimbriaria* they become the involucre. But it is quite useless to aduce further examples.

I shall now proceed to notice the genera which occur in the collection.

Of *Jungermannia* 31 species exist, I may remark that the separation of this genus into a distinct order, as has been done in Dr. Lindley's excellent *Nixus*, will not in my opinion hold good, at least on the grounds there mentioned. But whether the separation may not with property be adopted on account of the genus being vaginulate, is another question.

In the character of *Marchantia*, I have described the perianth of Dr. Hooker as the inner involucre, as it seemed to me the most consistent course. The term involucre is

otherwise limited to the immediate covering, partial or complete, of the capsula externa.

Plagiochasma is a remarkable genus, it is the only one in which the peduncle is not a *continuation* of the apex of the central vein : hence it is not exerted from the sinus, but passes up from the vein, and through the substance of the frond itself. Neither has it the structure so characteristic of the others, as the overlying structures are not carried up, so to speak, with it. I have hence described the capsules as stipitate. It is further remarkable for the presence of elaters, and the absence of fibrous cells of the capsule, of this want of assimilation, it is the second instance in this collection.

Askepos is an obscure genus, and described from imperfect materialis, as I have not seen the mature capsules.

Monosolenium is chiefly remarkable for the very distinct remains of broken up cells that surround the sporula, at least in their younger stages.

Octoskepas is perhaps singular in the nature of the inner involucrem, which at an early period is only quadrivalvular, the valves subsequently becoming divided.

Synhymenium is worthy of notice on account of the valvular dehiscence of the capsule, although it is incomplete, and for the membrane by which the valves, at first four in number, are originally held in connexion. It is curious too, that the fibres only exist in the cells forming the valves themselves. .

Anthoceros presents so many peculiarities, that I shall be excused for entering into its consideration at some length, so far at least as regards the female organs. The first indication of the development of these, consists in the appearance of a convexity on the upper surface of the frond, which is at once distinguished by a sort of lucid whitish appearance. Over this convexity, is spread an excessively fine membrane (to the existence to which the lucid appearance is probably to be attributed) which at the centre of the convexity is inflected inwards in the shape of a process resembling a good deal the beak of a funnel. The extent to which this process pene-

trates, is variable ; but it never appears to be very great. The only indication of the female organ at this period, consists in a partial density of the parenchymatous tissue. This I think subsequently becomes, what may not inappropriately be called, the bulb of the capsule.

This bulb in its early stages has the appearance of a cup.

At a rather later period the convexity visible on the Frond has become a gibbosity ; the membrane is now more evident as it has assumed a brownish tint, which is particularly evident in the inflected portion. I have observed likewise about this period, a sort of obscure sphacelation of the surrounding tissue. The dense portion of parenchyma has now nearly assumed the form of a bulb, having protruding from its centre, a very short cone, the rudiment of the subsequent capsule.

No change takes place in the membrane ; at some period of the existence of which, minute adhering granules are generally visible, and I am unable to state at what period it disappears. The next stage consist in the complete evolution of the bulb, and the enlargement of the young capsule. A striking change soon occurs in the tissue situated between the membrane and the bulb, consisting in a gradual solution of continuity, until a cavity is formed, the base of which is occupied by the young capsule, and the upper portion by the dislocated tissue and the inflected process, to which very generally the adjoining broken up cells adhere with some firmness. This mass begins to assume a brownish colour, and is gradually encroached upon by the growth of the capsule, and is so compressed, or submitted in such a way to presuree, that except at its base, its consistence is greater than perhaps at any previous time. It is likewise owing to this presure, often twisted into the lax base of this mass, that the apex of the young capsule extends, and carries it up with it. It does not remain long however after the capsule has burst through the apex of the now vaginiform involucrem.

It will be at once seen that this mass has very little in common with the character of a calyptra, and nothing in

common with this organ as it exist in this order. But unless attention be paid to its earlier stages of existence, a superficial examination may easily lead one to suppose it to be a true calyptra.

I know of no analogy to the membrane, but it appears to me to be one of the very numerous means of adaptation, resorted to in cases of anomalous conformation. I look upon it as a fecundating, or rather conducting membrane, by which the influence of the granular contents of the anthers, are enabled to act upon a point which it is obvious they could not otherwise possibly reach. I may mention as a curious fact, that the cells of the surface of the apex, at least of the convexities, contain no green parenchyma. See fig. 5, Pl. LXXV. E. and moreover, that they have a tendency, though slight, to the appearance of sphacelation.

The formation of the sporula is now so well known, that any further description is needless. It would appear however, that occasionally, the nucleus is formed by the caulescence of 3 or 5 granular puncta. The various stages of their evolution are associated with a tendency to the dislocation of the tissue of the capsule itself, proceeding from below, where the cells are adherent, to the apex where they are laxly packed.

Connected with this genus, are several other interesting points which I have neglected. But I must observe, that all the observations given above, were made during the sufficiently hurried marches of our Deputation to assam.

Assam, 1836.

Affghan Hepaticæ.

With the exception of *Marchantia polymorpha* from Upper Kaloo, without fructification, (No. 28, of the annexed list) all the species of *Marchantia* are from the extreme eastern parts of Affghanisthan, a locality where, (as will be often mentioned,) there is a curious mixture of Affghan and Himalayan vegetation, the former prevailing in the valleys and the lower hills, while the latter is almost exclusively prevalent above an elevation of 5,500 ft.

The genera to which the Afghan plants of this family appear referrible are *Targionia*, *Plagiochasma*, *Reboiullia*, *Marchantia*, and *Jungermannia*. *Plagiochasma*, I suspect will subsequently absorb *Antrocephalus*.*

Ricciaceæ are remarkably distinct, in having the spores contained in a capsule, (the original pistillum) not a secondary development as in all the genuine plants of the family known to me, and which consequently would be described as having no calyptra†, I find two distinct modes of development of the peduncle. In one, and this is very evident in *Marchantia*, the peduncle is a narrow elongation from the apex of the frond, with which its surfaces correspond remarkably in structure. And tho' in some as in *Reboiullia*, the whole substance of the frond would not appear to be continued in the peduncle, judging from the absence of aërating cavities and organs on the face corresponding with the upper surface of the frond, yet I have not met with any in which the capitulum is not manifestly a part of the frond, and which do not present one furrow at least in the ventral

* This genus, *Antrocephalus*, is identical with a mss. genus, *Asolenium*, which I sent home to my friend Mr. R. H. Solly in 1836-7.

† This term should be discontinued: it is obviously a contradiction in terms, and besides, does away, technically, with one of the greatest distinctions between *Hepaticæ* and *Musci*. It is applied in the latest works with great laxity. In *Ricceaceæ* (Endlich. *Genera*) it is applied to an involucre, while the sporangium is described as terminated by a persistent style, which at once shews that it is the *Calyptra*, or the *Pistillum*.

In *Anthoceros*, as I have said, I believe it to be applied to a dislocated part of the tissue of the frond itself.

In the above most useful and excellent work, I may add, none of the diagnostic marks (p. 43, sub *Hepaticæ*: p. 46 sub *Musci*) between *Hepaticæ* and *Musci*, are free from exception. In *Sphagnum* the calyptra does not separate by its base, but is lacerated by the capsule growth, as in *Marchanteaceæ*. *Jungermannia* is vaginulate, *Andræa* has no operculum, and lastly, many *Marchanticeæ* do not present elaters.

face of the peduncle, for the protection of the radicles arising from the under surface of the capitulum.

In the second form, the peduncle derives its origin from the *central stratum*, is not terminal, and is homogeneous in structure, having no provision for the passage of radicles, which are not produced on the under surface of the capitulum, and which last is not manifestly a part of the frond. Indeed the capitulum in these cases, consists of one or more follicular-formed involucre, united by their bases, and not presenting the same structure as the frond.

This form is so far as I know, limited to *Plagiochasma*, and is remarkable, in as much as the otherwise universal characters of *fructificatio hypophylla*, may be said to be departed from.

Both this genus and *Antrocephalus*, are distinguished by the origin and structure of the peduncle, and consequently of the capitulum.

I cannot reconcile *Plagiochasma*, of Lehmann, with the description quoted by Endlicher of Bischoffs fig. *Sedgewickia hæmisphærica*, Nov. Acta XVII. 2, t. 70 IV. which though it may be analogous to these plants, still appears a true *Ricciacea*.

From what I can understand of Lehmanns paper on *Antrocephalus hepticus*, its distinction depends upon marks, of which alone, the transverse dehiscence of the involucre is worthy much notice. For it will be at once seen that the capsule varies a good deal, and also that one Affghan species varies remarkably in the number of involucre. I have likewise a *Khasya* sp. with similar transverse dehiscence of involucre, of which it has 2-3. The last genus will probably have to be combined, at present it is only to be known by the transverse dehiscence of the involucre.

Anthocerotæ.—The distinctive character of this family I take to be the absence of the Calyptra, or rather pistillum, the linear univalvular or bivalvular capsule, and the linear setiform columella. Further observations may likewise make known remarkable peculiarities in the manner of fecundation.

So much so, that in my opinion the family is not admissible into the group Hepaticæ. So far as my observations go, there is nothing analogous to the pistillum, but the capsule is developed at first at a considerable depth within the substance of the frond, and it is the cellular substance between it and the surface that becomes dislodged, and which is called by botanists the Calyptra. My observations go to shew that over the surface corresponding to the situation of the nascent capsule, there is a funnel shaped filament, the narrow end of which penetrates some distance into the substance of the frond: this I take to be the manner of action of the male influence. The great development of the anthers, their obvious dehiscence, and the free communication they have outwardly by means of the large aperture of the chambers, connected with the absence of a pistillum, and the correspondence again of the appearance of the young capsules, with the brown filament just mentioned, appear to me worthy of attention.

The following list of Afghan Hepaticæ is sometimes referred to.

ANTHOCEROTEÆ.

19. Anthoceros.—In crevices of rocks Pushut. Wet or dripping banks, Otipore.

RICCIACEÆ.

21. Riccia,—Otipore.—Sands of Cabul river Julalabad, also along the — „ — Sutlege with Phasum.
 22. — „ — natans?—In jbeels Peshawur. Common, not observed in fructification.

MARCHANTIACEÆ.

23. Targionia.—Shady banks, and under rocks, Otipore.
 24. Plagiochasma.—Otipore, rare, found mixed with numbers 20, 26.
 25. Plagiochasma?—Otipore (capsule pedicellate.)
 26. Reboiullia.—Moist banks under bushes, Otipore.
 27. Reboiullia.—Shady banks Otipore. (Capsula circumscissa) Grimaldia auctor.
 28. Marchantia.—Moist banks Otipore, male, and *M. polymorpha*, immature female. Wet banks upper Kaloo.

29. *Jungermannia*.—On trees and rocks, Bharowul 6500, to 7000 feet.
 30. " " "
 31. " " "
 32. *Jungermannia* (*Gymnomitrium*) Under rocks in shady places Otipore.
 33. *Marchantiacea*, efruct.—Dripping rocks Gundumuck.
 34. " Wet banks Otipore with *Hypnum*.
 35. " Under rocks Kojuck Pass, the only one seen in the western parts of Afghanistan.)

The following is an enumeration of the genera in Sprengel's Genera according to my ideas. Those marked with an † I am unacquainted with, except from some sketches.

I. JUNGERMANNIACEÆ

Jungermannia.

† *Blasia*? I have never seen perfect specimens of the frondose species in fructification.

‡ *Systasis* Gr.

II. MARCHANTIACEÆ.

† <i>Lunularia</i> .	} Cuticulosæ.
† <i>Marchantia</i> .	
† <i>Fimbriaria</i> .	
† <i>Grimaldia</i> .	
† <i>Plagiochasma</i> .	
† <i>Antrocephalus</i> .	
‡ <i>Asolenium</i> .	
† <i>Targionia</i> .	
‡ <i>Askepos</i> Gr.	} Ecuticulosæ.
‡ <i>Monosolenium</i> Gr.	
‡ <i>Octoskepos</i> Gr.	
† <i>Corsinia</i> .	
‡ <i>Synhymenium</i> Gr.	

III. RICCIOIDEÆ.

† *Brisocarpus*.
 † *Oxymitra*.
 † *Spharocarpus*.
Riccia.

IV. ANTHOCEROTEÆ.

Anthoceros.
 † *Monoclea*.
 † *Carpobolus*.
Dubia.
 † *Blandovia*.

N. B. New genera described by the author, are added to the list and marked thus, ‡.

HEPATICEÆ.

SECT. I. JUNGERMANNIACEÆ.

Vaginulatæ (pedunculo capsulæ internæ, axi inverse evoluto). Capsula quadrivalvis.

I. JUNGERMANNIA.

Character generis idem ac sectionis. Plantæ polymorphæ, nunc foliaceæ, nunc et rarius frondosæ, terrestres vel arboreæ. Radiculæ confervoideæ? Folia disticha vel tristicha, integra vel divisa, lateralia semper oblique axi affixa, hinc basi sæpe auriculata, (auricula vel planiuscula vel concava vel ob margines coalitos ampullacea) interdum subtus lamellis verticalibus instructa (*Hooker*); serie tertia axi æqualiter affixa, vel postica vel rarius? antica, nunc difformia minora, nunc conformia subæquantia, nunc quasi sparsa, nunc f. lateralium seriei unicæ, nunc et rarissime? seriebus ambabus respondentia. Adsunt etiam interdum folia squamiformea minuta sparsa (*Hooker*).

Antheræ solitariæ aggregatæve, in speciebus foliaceis axillares.

Flores fæminei specierum foliis instructarum terminales; interdum, axi abbreviatâ, axillares videntur, specierum frondosarum endophylli.

Involucra evalvia, in his vaginiformia, in illis foliacea, vel aperta, vel clausa. Pistilla in speciebus foliaceis involucro clauso donatis solitaria! cæterum aggregata, unico tantum fæcundato.

Capsula externa (Calyptra auctorum) eruptione interna varie lacera, basi saltem semper persistens. Capsula interna pedunculata, parieti interno e cellulis fibrosis conflato. Elateres heteromorphæ, vaginulatæ, fibra spirali simplici vel duplici. Sporula subrotunda, glabra vel echinata.

General Remarks on Jungermannia.

Jungermannia of all the genera of Hepaticæ is that which approaches most to Musci, agreeing with this order especially in the structure of its pistilla, and in the inverted origin of the Theca. It is in fact as much a vaginulate genus, as any genus Musci

The cells of the endothecum are in all the instances I have examined fibrous, and it is curious too, that its colour is owing to the colour of the theca, and that it always agrees in this respect, both with the elaters and sporules.

In Jungermannia epiphylla, the transition from the cells of the endothecum, to perfect elaters, is well shewn. This fact I was aware of early in 1832.

With regard to the insertion of the leaves, these in all instances are oblique, and form nearly half a spire round the axis. The upper margin is usually anticous, but in some instances it is posticous.

Although the accessory leaves forming the third rank in so many species, are generally situated posticously, yet the inverse is sometimes the case. To call these appendages stipulæ, is in direct violation of all laws of analogy. Not only are they single organs, but almost always are only appended to the leaves of one side, and hence alternate, but they frequently are inserted on different planes with the leaves. The only analogy they have with the usual form of stipulæ, is in extending over the surface destined to promote aëration.

The transition from the leaves into the perianth, may be always traced, in some, very distinctly; it is remarkable that perianthia appear to be only present in those, the pistilla of which are solitary. This is exactly the reverse of that which we would be led to expect.

The appendages visible on the inferior margins of the leaves of many, are nothing but lobes the margins of which, except at the base, cohere intimately. It is singular that these lobes become again expanded in the perigonial, and perianthial leaves

This genus shews us that difference in the forms of the elaters, cannot be considered of generic importance; it is probable that the double fibre only originates from a continuation of an original simple one.

I FOLIA DISTICHA INDIVISA.

1 *Jungermannia* sp. Pl. LXX. Fig. I.

Caulis prostratus, vage ramosus. Rami subclavati, ascendentes, interdum elongati. Fol. arcte imbricata disticha, superiora gradatim majora. Concaviuscula, orbicularia, integerrima, areolis oblongis rotundatisve, juniora conduplicata, foliis decurrentibus.

Radiculæ e basi externa foliorum exsertæ.

Folia perianthialia oblongiora majora: suberecta cupulam formantia.

Perianth tubulosum, membranaceum plicatum, apice apertum, sub fimbriat., basin versus f. perianthialibus adnata.

Calyptra basin supra circumscissa, vel lacera, membranacea tenuis, persistens, stipes demum deciduus, perianthia longitudine vel duplo fere superans.

Theca 4 valvis, valvis patentissimis lanceolatis rubro-brunneis: cellulis elongatis, fibre completa vel incompleta.

Elateres minutæ vix vaginatæ, fibra duplicata.

Pistilla plura minima sessilia stylo brevi circa calyptre basin disposita.

HAB. In regione Assamica alta; ad ripas fluvii (vel rivuli) Manmoo, Negrogam versus, agra Singfoensis. Et Deboroo ad Kujudoo et Rangagurrah, agri Muttack. *Jan. A. D.* 1836.

Var? *A.* Foliis majis opacis. Periantheo dentato. Thecis majis exsertis; valvis capsulæ latioribus. Sporulis globosis lævibus.

HAB. Mamloo, Collium Khasyensium, altitudine circiter 4300 pedum.

2 *Jungermannia* sp. Pl. LXX. Fig. II.

Dense cæspitosa, caules ramique prostrati, radículas rubro-ferrugineas, infra per totam longitudinem exserentes.

Folia disticha *plana*, suborbicularia, integerrima, decurrentia, conspicua cellulosa, areolis irregularibus sæpius oblongis.

Folia perianthialia majora, marginibus recurvatis.

Perianth. his basi adnat, angulatum ore dentato.

Calyptra apice lacerato fissa, persistens basi pistillis pluribus abortivis obsita.

Theca exserta, valvis ovalo-lanceolatis.

Elateres, sporulaque (immatura) ut præcedentia.

Præcedente proximum discrepant., ramis etiam prostratis, foliisque planis magis cellulosis.

HAB. Assam, in agro Muttack, tractu Theifero, Tingrei dicto. *Feb. A. D.* 1836.

Mamloo, Collium Khasyensium, et Moflong altitudine 5642 pedum

3 *Jungermannia sanguinolenta* Pl. LXX. Fig. III.

Dense cæspitosa : caules sæpius simplices, elongati ascendentes, unciales vel paullo ultra flexuosi.

Folia magna, dilute sanguinea, disticha conduplicato-carinata orbicularia, semi-plexicaulia, areolis 6 gonis rotundatisve, conspicue cellulosa, sursum gradatim majora summa perianthii basi adnata.

Perianth saturatius coloratum, obovato-ventricosum apice, sub 5 fidum, laciniis irregularibus mucronatis.

Calyptra apice lacerata rupta persistens.

Pistilla pauca abortiva. Theca (secundaria) longe exserta : valvis oblongis atro-brunneis, madore conniventibus cellulis basilariibus tantum fibra completa donatis.

Sporula ut in aliis generibus 3-4 evoluta.

Elateres primo e cellula oblonga, massam coagulatam continente.

Uti præcedentes videtur dioica.

HAB. Ad Bogapanee Collium Khasyensium, altitudine circiter 4500 pedum, in arenosis. Nov. A. D. 1835.

4. *Jungermannia* sp. Pl. LXXII. fig. 4.

Caules cæspitiosi elongati filiformes.

Fol. disticha, distantia, oblique inserta margine superiori postico, oblonge rotundata, integerrima opaciuscula, insertione inferiori decurrentia.

Ad Moflong legit *D. McClelland*. Nov. 7, A. D. 1835.

Affinis ut videtur, *J. repandæ*. *Hook Musci Exot t. 86*.

5 *Jungermannia* sp. Pl. LXIII. fig. iv. 5.

Caulis repens ramique ambitu lineares prostrati.

Fol. disticha subscalpelliformia, oblonga oblique inserta, basi simplicia apice rotundata parce denticulata, margine inferiore antica inserta.

Fol. perianthialia minora, varie divisa integrave dentata.

Perianth apert. profunde 3 partito, laciniis fimbriato-dentatis.

Calyptra apicem versus lacera, persistens basi cincta pistillis pluribus abortivis.

Theca breviter exserta: fusco-rubra, stipitis apice incluso, valde dilatato brevissimo.

Endothecii cellulæ, conspicue fibrosæ.

Sporula minuta globosa lævia.

Elaters breves, vaginatae, apice utrinque solidæ an ob immaturitatem, nec ne fibra spirali duplice.

HAB. In sylvis Theiferis prope Negrogam. Jan. A. D. 1836,
In sylvis Surareem, Collium Khasyensium altitudine 5600 pedum.

„ Mamloo.

6 *Jungermanniæ* sp. Pl. LXXIV. Fig. II.—6.

Caulis elongatus ramosus, rami simplices vel sæpius dichotomi.

Folia disticha, cuneato-scalpelliformia, valde obliqua, oblique inserta, insertione utraque sed præsertim inferiore decurrentia, apice rotundato et parce spinuloso-dentata, areolis mediocribus rotundatis.

Folia perigonia arctius imbricata, rotundato-oblonga, concava, apicibus reflexo-patula, integerrima, vel sporulosa, denticulata, inferiora vacua, superiora antheras axillares foventia.

Anth. paucæ 3 5, stipitatæ, globosæ viridescens, constantes e sacculo materia grumosa effæta, inter quam moliculæ plurimæ diffformes mobiles adsunt.

Folia perianthialia repanda magis æquilatera et dentata.

Perianth cæterum nullum.

Calyptra apicem versus lacera, crassiuscula persistens basi pistillis paucis abortivis obsita.

Theca breviter exserta brunnea, valvis ovato-lanceolatis, endothecii cellulæ fibrosæ, sporula hispidula.

Elateres e vaginatæ longæ, plurimæ affixæ, fibra spirali.

Legi in Pinetis Moflong. Nov. 5. A. D. 1835.

Fruct: in Assam altæ, regionibus Muttack et Singfo.

HAB. In regione Assamica alta Negrogam versus.

In agro Muttack dicto, Hæc exemplaria mascula sunt. In Pinetis Moflong.

„ Churra Punjee, Collium Khasyensium altitudine 4349 pedum.

„ Surureem in sylvis.

„ Surureem: vix eadem.

Affinis *J. Adiantoida* Hook. *musc. Exot t. 90.*

7 *Jungermanniæ* sp. Pl. LXXV. Fig. II. 7 etc.

Caulis repens, rami ascendentes ambitu lineares seseunciales, hinc illinc ramulis filiformibus, apice folia novella gerenti-

bus crebre punctis oblongis, cellulosis et quasi cicatrices referentibus notatis, summis majoribus in folia sub abeuntibus profertentia.

Fol. disticha, oblique inserta, lineari-oblonga, apice conspicue areolata.

Flos fæmineus terminalis, fol. perianthialibus oblongis rotundatisque fimbriata divisis cinctus.

Pistilla plura sessilia, stylo crasso mediocra terminata.

Calyptra persistens, crassiuscula, longitud. rupta, in basi pistillis abortivis cincta.

Thecam non vidi ut in aliis stipelibus bulbum supra secedit, bulbo vaginata incluso remanentia.

HAB. Negrogam versus. Jan. A. D. 1836.

II. FOLIA DISTICHA BASI HINC AURICULATA.

8 *Jungermannia* sp. Pl. LXXII. Fig. V.

Caulis repens, ramique apice dichotome, cæterum pinnatiramosi prostrati.

Fol. disticha distantia inæqualiter biloba, rotundato-scalpelliformia, integra, margine superiori antico, inferiori decurrente, lobo postico sub quadrato, opaciuscula.

HAB. Negrogam versus. Jan. A. D. 1836.

9 *Jungermannia* sp. Pl. LXX. fig. 9

Caulis repens, vage ramosus. Rami ascendentes, ambitu spathulata.

Fol. disticha conduplicata inæqualiter biloba, lobo antico rotundato-oblonga, denticulato; postico duplominora, rotundo integrimo, areolis inconspicuis, nucleo opaco occupatis, difformibus.

Fol. juniora cellulis ovatis fuscentibus sponte solubilibus, nucleos 1-2 continentibus dense tecta.

HAB. Ad cataractum Moosmai, Collium Khaseyensium, Churra Punjee circiter altitudines.

III FOLIA TRISTICHA, SERIEI TERTIÆ MINORA, DIFFORMA,
NUNC INTEGRATA NUNC DIVISA.

* *Folia lateralia indivisa.*

10 *Jungermannia* sp. Pl. LXXII. Fig. II.

Caules repentes elongato-simpliciusculi.

Folia tristicha: lateralia aliquoties majora disticha lanceolata, sub integerrima, areolis sub 6 gonis conspicue areolata, margine superiori antico.

Postica foliis alternis tantum adjecta reniformi orbicularia integerrima patula.

HAB. In Pinetis Moflong: mixta occurrit cum sequente.

11 *Jungermannia* sp. Pl. LXXII. Fig. I.

Caulis elongatus, repens, sub simplex.

Folia tristicha; pilis acutis pulcherrime ciliata, opaciuscula; lateralia disticha, rotundato-oblonga, obliquiuscula inserta.

Antica! foliis omnibus adjecta! et eadem plane inserta, reniformio-orbicularia, margine uno (alternative) auriculata, præcedentibus brevius ciliata.

Novella cellulis (gemmaeis?) facillime separantibus tecta, anne interdum binata compositis.

HAB. In Pinetis Moflong. Nov. A D. 1835.

12 *Jungermannia* sp. Pl. LXXI. Fig. III.

Caules ramique repentes: vel prostrati.

Folia arcte disticha, levissima secunda, orbicularia integerrima areolis valde conspicuis, margine inferioribus sub oppositis!

Accessoria lunulato, reniformia integra vel dentata serie unico tantum sub opposita.

HAB. Ad Mamloo in terram. Sequenti proxima, a qua vix distinguitur non nisi foliis densius imbricatis levissime secundis; margine superiori antico, difformibusque majoribus.

13 *Jungermannia* sp. Pl. LXXII. Fig. VI.

Arborea. Caulis ramique prostrati.

Fol. tristicha, lateralia arcte disticha : quadrato-orbicularia, integra, oblique inserta, margine superiori postico ! areolis rotundatis conspicuis.

Postico minima lunulata, axi adpressa, alternis tantum adjecta : obscurata, radiculis infra insertionem viruntibus.

HAB. Myrunga in sylvis, Collium Khaseyensium altitudine 5040 pedum variat, foliis apice dentatis.

14 *Jungermannia* sp. Pl. LXXIV. Fig. III.

Caulis elongatus valde et pinnate-ramosus, dendroideus. Rami ramulique dichotomi dichotomiis sæpius fructigeris.

Folia arcte disticha difformia, lateralia multo majis disticha, concaviuscula ovato-scalpelleformia, obliqua, oblique inserta, basi simplicia acuta : apice denticulata.

Fol. postica orbicularia, marginibus revolutis integra, vel parce denticulata.

Fol. perianthialia majora, majisque denticulata.

Flos fæmineus sub sessilis, terminalis.

Perianthium obovato-oblongum, complanatum, basi ventricosum, 6 plicatum, breviter apiculatum.

Pistillum unicum, stylo æquanti, apiculatum, post fecundationem clavatum. capite globoso.

Sporula immatura angulata.

Elateres immaturæ apice dilatatæ, fibra spirali simplici.

HAB. Ad Surureem et Moflong, affinis numero 23.

Var? A. Statura major, brunnea. Moflong et Surureem. Oct. A. D. 1835.

Var. B. Statura major, albicans. Churra Punjee in rupibus? Mumbree, non exta.

15 *Jungermannia* sp. Pl. LXXIV. Fig. I.

Caules elongati, sub pinnate-ramosi.

Folia tristicha, difformia integra, lateralia disticha obliqua

late ovata breviter apiculata, hinc illinc apice minuta denticulata, margine inferiore leviter incurvo.

Postico omnino libera, semi-amplexicaulia, orbicularia, medium supra denticulata, marginibus recurvis, foliis omnibus adjecta.

Flos axillaris, vel potius intermedius sub sessilis, suffultus foliis tribus, quorum 2 lateralibus similia, postico f. posticis similis.

Perianthium ventricosobovatum sub 10 plicato, alatum, apice apiculo obtuso brevi coronato, initio clausum.

Pistillum solitarium! oblongum, medio sub constrictum, stylo æquante coronatum.

Nota dignum ob pistilla solitaria, perianthia evoluta et evolutionem thecæ secundariæ, thecæ Muscorum omnino similis.

HAB. Negrogam versus.

Jan. A. D. 1836.

16 *Jungermannia* sp. Pl. LXXIII. Fig. III.

Caulis repens, rami simplices vel apice dichotomi. Rami novelli filiformes, squamis ovatis concavis hinc illinc vestiti ex axillis f. post. interdum prodeunt.

Folia (siccatione secunda) tristicha, lateralia disticha oblique inserta, oblongo-ovata, subscalpelliformia, basi inferiorem marginem secus semel repanda, insertione simplicia, grumoso opaciuscula apice, sæpius 3 dentata.

Postica orbicularia, semi-amplexicaulia, directione axeos, obsolete denticulata.

HAB. Surureem. Oct. A. D. 1835.

- „ In Regione Assamica alta?
- „ Vart. A. Statura minor.
- „ Churra Punjee.
- „ Vart. ? B. Statura minor, rami apice attenuata.
- „ In Pinetis Moflong.

17 *Jungermannia* sp. Pl. LXXIII. Fig. VI.

Caulis repentes, Rami apice filiformes, subdenudati.

Folia arctissime tristicha, lateralia aliquoties majora, oblique inserta, orbicularia, apice inæqualiter emarginata, margine superiori antico, areolis hexagonis conspicue areolata.

Postica alternis tantum subjecta semi-amplexicaulia, insertione recta, repandiuscula lunulata bipartita, axi parallela.

HAB. Ad Mamloo. Oct. A. D. 1835.

18 *Jungermannia* sp. Pl. LXXIII. Fig. II.

Caulis repens, rami elongati ascendentes.

Folia tristicha, lateralia multoties majora, disticha, scalpeliformia, obliqua, obliqueque inserta, insertione utraque decurrente, summa quasi auriculata extrorsum flexa : fimbriatimdentata, potius supra auriculata, auriculata extrorsum flexa.

Postica *alternis* *abjecta* ambitu sub orbicularia, capillacia fere divisa, directione axeos.

Flores foeminei terminales.

Folia perianthialia majora cæteris.

Perianth. e foliis 2 orbicularibus, secus marginem unum tantum coalitum.

Pistilla plurima.

Proxima no. 7 p. 304, cujus forsán varietas.

HAB. Negrogam versus.

** *Folia lateralia triloba.*

19. *Jungermannia* sp. Pl. LXXV. Fig. III.

Caulis ramique prostrati dichotomi.

Folia arcte disticha, lateralia disticha, aliquoties majora, linearia, acute bifida, cæterum integra, opaciuscula, insertione obliqua, areolis oblongo-rotundatis angulatisve nucleam grumosam continentibus. Postica recta, semi-amplexicaulia, al-

ternis tantum adjecta et eadem plana inserta, reflexa fimbriatim-divisa.

HAB. In Agro Muttack.

* * * *Folia lateralìa triloba.*

20 *Jungermanniæ sp.* Pl. LXXI. Fig. I.

Caules mediocres et foliorum basibus persistent. gerentes denudati, simplices vel parce ramosi, aliquando dichotomi, sæpe apice incurvato.

Folia densissima et aspectu primo 5 fariam, imbricata, profunde triloba, lobis duabus majoribus cordato-ovatis cuspidato-acuminatis, subtus concavis, tertia lateri inferiori adjecta, minori lanceolata acuminata, spinuloso-dentata, subtus concava, margine supero nempe revoluto recurvove.

Fol. accessoria foliis unius lateris tantum respondentia, ad basin fere biloba, lobis linearie-lanceolatis, acuminatis, spinuloso-dentatis.

Species inter alias Khasyenses distinctissima.

HAB. In arenosis Bogapancee, sequenti proxima.

Affinis *J. squarrosæ Hook, Musc. Exot t. 78* et hanc speciem et *J. fimbriatam ejusdem auctoris librique t. 79* quasi intermedia.

21 *Jungermanniæ sp.* Pl. LXXI. Fig. II.

Caules simplices.

Omnia præcedentis sed statura minor. lobaque intermedia foliorum tertiæ superiorisve in modum spinuloso dentata.

Affinis *Jung. squarrosæ Hook Musc Exot: t. 78* et hanc speciem et *J. fimbriatam (t. 79)* intermedia.

HAB. In arenosis Bōgapanee, a præcedente tantum (an satis?) distinguenda, ob staturam minorem, foliorumque lobam intermediam etiam dentatam.

*** *Folia lateralìa basi auriculata*22 *Jungermanniæ sp.* Pl. LXXII. Fig. IV.

Atrovirens, arborea.

Caulis e basi repens ascendens ramosus. Ramie fructiferi, dichotome ramosi.

Fol: arcte tristicha, lateralìa oblongo ovata, subscalpelli-formia, obliqua, oblique inserta, margine superiori antico, sub integerrima, margine inferiori revoluto, et basi auriculata, auriculo-denticulata.

Postica alternis tantum adjecta cuneato-orbicularia, marginibus leviter revolutis.

Flores faminei terminales in dichotomis, sessiles, vel ramo uno dichotomiæ abortivo?, laterales.

Folia perianthialia sub conformia, ascendentia, apicibus reflexo-patulis.

Perianth. monophyllum oblongo-ovatum, plicatum, sub 3 gonum e foliis 3 coalitis format.

Pistillum solitarium, stylo æquante terminatum.

Calyptra apicem versus irregulariter rupta, persistens.

Affinis *J. crispata* Hook *Musc. Exot. t.* 143. discrepans auricula minima rotundata denticulata.

HAB. In agro Muttack in arboribus videtur

23 *Jungermanniæ sp.* Pl. LXXV. Fig. I.

Caulis elongatus valde ramosus filiformis.

Folia difformia tristicha, lateralìa majora, orbicularia, integra, planiuscula, oblique inserta.

Postica recta orbicularia 3 plo minora, basi utrinque recurva, foliis alternis tantum adjecta, et cadem plana inserta, sed nec adnata. Adsunt etiam corpora galeiformeo-cucullata, breviter stipulata, foliis lateralibus marginis inferioris base appendiculatis, galeæ ore deviso et introrsum spectante.

Flores masculi aggregati, ramulos breves axillares terminan-

tes, initio subsessiles constant e foliis distichis arcte imbricatis navicularibus, bilobis; foliis posticis infimis tantum adjectis basi lineatim, apice lunulato emarginato, prioribus axillis tantum antheriferis, infimis valvis, inæqualiter bilobis.

Antheræ subternæ, quælibet axillæ globosæ grumosæ, opacæ, stipitem simplicem, æqualiter terminantes, in sacculo moleculas (in Icone 5, sed erroneo,) mobiles, forma irregulares, viridescentes continent.

Flores fæminei ramuli breves terminales solitarii.

Folia perianthialia inappendiculata, inæqualiter biloba.

Perianthium plicatum apiculatum.

Pistillum unicum.

HAB.* Pineta Moflong.

** Pineta Moflong.

Affinis *J. lobulatæ* Hook. *Musc. Exot. t. 109.*

24 *Jungermanniæ* sp. Pl. LXXIII. Fig. I.

Caulis elongatus filiformis sub pinnatim-ramosus.

Folia tristicha, lateralia aliquoties majora, disticha orbicularia integerrima, insertione obliqua, margine infero postice basin prope appendicula, ampullacea, breviter stipitata, ore infero vel inverso gerente, potius—resembling an inverted pouch.

Postica axi paralella, insertione recta suborbicularia, ad medium usque fere bipartita, sinu sublunulato, foliis alternis (rectis) adjectis.

Flores masculi ramuli breves laterales, apice demum proli-fero terminantes.

Folia perigonialia pauca disticha, navicularia, inferiora vacua, appendiculata superiora, bifida, appendicula nempe dilalata.

Antheræ solitaræ, præcedentibus conformes.

Appendiculæ initio extrorsum concavæ, postremum marginibus unitis, basin prope exceptis, ampullas formant, transitio subita.

HAB. Negrogam versus.

25 *Jungermannia neckeroides* Pl. LXX. Fig. 25.

Caulis elongatus repens pendulus? sub pinnatim ramosus.

Fol, arcte disticha difformia, lateralia, biloba, lobo antico oblique, ovato oblongo, apice rotundato ibidemque spinuloso, dentato, areolis conspicuis 6 gonis mediocribus, lobo postica minimo lineare axi parallelo sæpius integerrimo, areolis densioribus.

Folia accessoria his conformia et interjecta, nullomodo foliis lateralibus pertinentia, areolus ut alia.

Perianth nullum

Folia perianthialia integra, orbicularia, repanda, magis dentata.

Calyptra longitudinaliter rupta, stylo coronato, basi pistillis pluribus stipata.

Theca breviter exserta, valvis ovatis crassiusculis, cellulis ob hanc causam incospicuis fibrosis.

Sporula oblongo rotundata hispidula.

Elateres varie tortæ, vaginatæ, fibra spirali simplicci.

HAB. Assam altæ versus Suddya; in arboribus Mumbree Collium Khasyensium, allitudine circiter 5940 pedum.

 IV. FOLIA TRISTICHA CONFORMIA SUBAQUALIA.

**Folia biloba.*

26 *Jungermannia* sp. Pl. LXXI. Fig. IV.

Fol. undique trifaria imbricata, accessoriis nempe lateralibus, subæquantibus.

Caules elongati, cæspitiosi, pinnatim-divisi, rami secundi præsertim inferiores qui filiformes, apice attenuati, reliqui madore squarrosi. Caulis apice decurvo.

Folia trifariam imbricata, conformia serie postica paululam minori, profunde biloba, integerrima, linea pellucida, vel semi-diaphana in lobos excurrente notata, lobi lineari sicc: mad: sub secundi, plus minus, acuminata divaricati: lateralia oblique inserta, postica æqualiter, lateralia margine inferiori plus minus revoluta.

Fol. caulina saturata fuscescentia, linea pellucida inconspicua.

Affinis presertim habitu *J. scolopendræ* *Hook Musc. Exot. t. 40.*

HAB. In rupibus Moflong.

** *Confervoidea, Folia quadripartita vel supra decomposita.*

27 *Jungermannia microphylla* Pl. LXXIII. Fig. V.

Caulis flexuosus pinnatim-ramosissimus, rami elongati, filiformes, (caulesque fragiles) apice sæpe flagellifera, et sub denudata.

Fol minutissima disticha, admedium usque fere trifida, cellulis sub quadratis conspicue areolatis caulina cæteris minutiora 4 partita.

Flores masculi ramos. terminantes incurvati. Fol. perigoniali arcte imbricata, concava, ovate bipartita.

Antheræ solitariæ? an semper, breviter stipitatæ.

Confer *Jungermannia microphylla, Hook musc. Exor t. 80*

HAB. Surureem.

Planta Khasyensis, statura minima.

28 *Jungermannia quadridigitata, nob.* Pl. LXXI. Fig. V.

Foliis undique imbricatis, accessoriis nempe lateralia æquantibus.

Plantula minutissime confervoidea, axis bi-tri-pinnata.

Folia caulina distantia, ramina conferta e seriebus tribus consimilibus ad basin usque fere in laciniis 4 filiform, subulatis

a medio supra e cellulariarum superimpositarum unica serie compositis, lateralibus incurvis.

F. minutissime oculo nudo minima conspicienda, lateralia etiam subæqualiter inserta.

HAB. Churra Punjee in rupibus madidis, præcedente proxima.

29 *Jungermannia* sp.

Læte viridis, partibus novellis glaucis.

Plantula elegantissima, *Lycopodium cernuum* habitu aspectu (minute) referens.

Caulis ramique qui leviter deflexiusculi, pinnatim-ramosisimi, madidi ambitu cylindranei.

Ramuli flexuosi.

Folia alterna, subquaternatim divisa, pinnata et capillaceim-fimbriata, supra decomposita, e cellulis, singula serie superimpositis.

Folia conformia tristicha, dense imbricata, lateralia paullo majora, minuta oculo bene armato tanto bene discernenda, quaternatim-divisa, vel potius binatim-divisa, segmentis dichotomis, divisionibus supra decompositis, e cellulari simplici serie super impositis conflata.

HAB. Bogapan ee et Nunklow in rupibus.

Ex pulcherrimis totius gentis, *Batrachospermum æmulans*.
Habitus (siccas) sphagnoideus.

V. FRONDOSÆ, BLASIA ?

30 *Jungermannia* sp. ?

Frondes cæspitosæ teneræ cuticulæ, expertes, divisæ. Divisiones lineares vel spathulato-lineares, elongatæ sub repandæ apicibus altenuatæ, obtusæ præcurva vena crassa fuscescente.

Fructificateo epiphylla. Vagina brevis cylindræa, ore lacero fimbriato, thecæ ? basi cingens.

Theca ? sessilis : fusco brunnea cylindræa apice aperta, apicem divisionem versus sita, et vena insidens, basi dilatata intus vestita membrana cellulosa tenui.

Theca cylindræa, stipitata, demum evanida.

Elateres copiosissimæ simplices duplicatæve evaginatæ.

In ripis (Naga hills) March 1836.

Vix dubito quin species *Jungermanniæ* sit vel hinc generi proximum, an distinctum ob thecam cylindræam.

Iterum examinanda, vidi tantum thecam unicam immaturam :

HAB. In collibus Nagensibus Gubroo Purbut regionis Assamicæ altæ confinibus etiam.

Negrogam versus.

31. *Jungermannia* sp.—Pl. LXXVII. Fig. III.

Frondes prostratæ, fucoideæ, varie lobatæ, carnosæ, viridescentes.

Vaginæ elongatæ albidæ, aspectu cellulosæ basi fronde elevato-lacerato. cinctæ.

Theca fusca longissime exserta, stipite gracili seseunciali. Valvæ lineares, Endothecæ cellulæ elongatæ conspicue fibrosæ

HAB. Tingrei agri muttack.

II. SYSTASIS.

Diagnosis ponitur in Capsula oblonga, apice integra, inferne valvatim 4 fissa.

Char. gen. Involucrum cyathiforme ore fimbriato. Perianth tubulosum. Calyptra apice perforata. Capsula longe exserta, cylindræa, inferne fissuris 4 valvatis dehiscens, cellulis fibrosis Spora elateribus commixta.

Estomatosa, frondosa, intricata. Frondes lineares, ut plurimum simplices undulatæ emarginat. subtus radicantes secus axim, vel lineam centralem frondes. Radiculæ conferroideæ

breves, seta alba, cellulosa, solida, cylindracea. Perianth. involucri duplo longius. Capsula brunnea, Elaterum fibræ duplices, apicibus continuæ.

In locis aquosis, umbrosis, inter colliculos, Ching, cum Zalacca megalostachya. Zalacca coarctata, etc. Oct. 1842.

I was first led to gather this by observing the cylindrical capsules.

Malacca, Oct. 21st. 1842.

Pl. LXXV. A.

Fronds with the exception of the central line, entirely cellular: superficies of both sides similar, consisting of oblong cells, but whereas in the upper, the green globuline which is beautifully developed, for the most part adheres to the parietes of the cells, while in the under surface they chiefly occupy the face: among the spherical, or spherico-compressed cells but generally perhaps with the more superficial, occur ovate green bodies with a more defined margin, and these generally have some connection with the parietes, or rather *faces of union*. Some of these are oblong, as if composed of two or three confluent oval ones. These occur on the faces.

With the exception of the central thickened line, the frond consists, (as seen on a transverse section) of a simple series of large cells of an oblong or parallelogrammic shape, The central thickened part consists of angular cells with very little globuline, and that of a paler tint, except both superficies which have the usual quantity etc. These also viewed longitudinally are long: the center is occupied by a fascicle having a striate appearance under $\frac{1}{4}$ C. A. This striate fibrous line ceases within the apical emargination of the frond, and within the thickened line, which reaches to the emargination.

The involucrium is formed from an early period: the tube is short, fleshy, cellular, the margin or limb deeply divided and fimbriate, and some of these divisions are so disposed as to

shelter in some degree the young female flower. There is little or no green matter in the cells of the involucre: the fimbriæ are composed of a simple series of cells. The involucre is directly continuous with the outer part of the frond, within it is the female flowers situated on soft greenish tissue, from the base of which rises the perianth, which is at the epoch of fecundation very rudimentary, consisting of nothing but irregular confervoid filaments, which form the fimbriæ of its subsequent, (mature) obscure mouth, or apex.

The plane of insertion of the female flower is a little above the plane of the superficies of the frond, but the plane of insertion or origin of the Perianthium is the same as that of the upper surface of the frond.

There are several pistilla, in every respect similar to those of Musci; of these, the laxer have the apices of the styles dilated, and to me evidently opening a communication with the canal; this last is conspicuous, and in those which retain their virginity, rounded, and entirely closed. The origin (intimate) of the Pistilla, is from a very short conical pedicel, base rather below the plane of insertion of the Perianthium. There is no evident connection with the *midrib* or fascicule of fibres.

The fecundated Pistilla are perhaps the uppermost, and there seems a tendency to produce rudimentary ones round the base of the gynophore. The style is about 4 gonial, and the series of cells towards the apex have a twisted appearance, an attempt as it were to assume the form of a spire.

The cavity of the ovary in some, looks like a mere space obscured by grume, occurring between the four rows of cells, of which the ovary is principally composed, and which run up from it, forming the style;—but when it has increased in diameter, the contracted appearance of the cells ceases, and the ovary then presents the appearance of a distinct central oblong cell: in one, it looked erect, in the other, the outline is traceable all round, and this had a grumous nucella.

Pressure under 1-10, in both instances only caused the the ovary to burst and discharge a finely grumous fluid,

there was no separation of the apparent cell, such as takes place in some instances, at least under similar circumstances in Musci. The pressure shews the canal of the style to be continuous with the obscure slit-like cavity seen in Fig. II.

In the young unfecundated ovary, the style is certainly closed, the termenal cell looking as if forming part of the canal: this on reaching the ovarium becomes dilated like a thermometer bulb: there is no appearance of a distinct body within.

In all these respects; such as stucture, closure of the virgin style, evident canal, and its obvious dilatation in the ovary, it agrees exactly with Musci, see Valentines: Paper Linn. Trans. etc. etc.

Query is the advanced stage of this period antecedent to the appearance of the embryo?

Systasis Pl. LXXV. A. Fig. I.

1. Female flower and minute Perianth. Involucrum removed.

2. Plan of the same; perianth intended to be open in order to shew the pedicel on which the Pistilla are arranged.

3. Youngest and outermost Pistilla of the above, looked as if consisting of 4 rows of cells, with a wide canal between.

4. Another more advanced.

5. Ditto ditto ditto.

6. After browning of the apex of the style, but not after dehiscence. The canal is seen on pressure to communicate freely with the opaque cavity in the ovary. Spirality of the apex commencing.

7 After dehiscence of apex; now an evident appearance of a central body in this, evidently nucellar.

7, Fecundated Pistillum. It is the central one of the group.

7a. Rudimentary seta, 7b. Style, $\frac{1}{4}$ M.

8. Ditto Ditto $\frac{1}{4}$ M.

9. Very young Pistillum, the outer one of the same group.
 10. Another Pistillum of the same, on which the male influence appears to have been exerted.

All under $\frac{1}{4}$ Achromatic and measured.

In the distinctly fecundated pistillum, the ovary is much enlarged, greenish from minute globules, and opaque enough not to be seen through, but appears to contain a central moveable body. The style is distinctly twisted. Apex irregular, as if crowned with uninform brown *glue*, style canal distinctly browned nearly to the base, as usual, irregular flakes of light glue-like substance, visible about apex of the style. The other pistella are either virgin : or have the same change in the style-apex, but none in the ovary, which remains as in fig. 6.

The Pistillum now contains a body : attached by its upper end, or that next the style, consisting of cellular tissue. Cells large, situated next the apex, but one per paria binat. seriat. The cells are turgid and swollen out, nevertheless the terminal cell is still visible. See 7. 7a. 8.

From some appearances presented by a virgin young pistillum and a fecundated one of the same set, the central cavity of the ovary would appear to be occupied by a pendulous simple cell, this accords with theory, and the structure of the seta. See 9, 10l. Fig. I.

It is also very evident from the examination of other specimens, that the style apex, in some presents a dilated lacerated appearance : in others there is an appearance of some liquid or air rendering the whole of the canal opaque, and filling up the greater part of the cavity of the ovary. See 11, Fig. I, in which the cellular structure of the dilated apex is scarcely if at all discernible.

The lacerated dilated apex has been only observable in abortive cases, in one of which the style was very spiral as if imitating the elaters.

In this genus I have confined the illustrations to the development of the seta. The apex of this (see Fig. II. 4) a time

when seta and its head are a little more than half the length of the perianthium (now complete) preserves its original soft texture and appearance, and in this respect is considerably different from the remainder, which is of compact tissue, and tinted greenish. Having described *Osyris* and *Psilotum* before, and the development of the sporules and elateres being well known, I have made no observation on them. At the period represented in (Pl. LXXV. A.) 1, 2, Fig. II. the cellular tissue of the head of the seta is not separate, the walls of the capsule are well developed, the substance consists of well greened grume, in which a nucleary aggregation has commenced to be apparent, these aggregations have no distinct membrane.

The style is unchaged ; in this instance the brown which is decided, reaches $\frac{1}{2}$ way down, and the upper half of *this* was constricted, and decidedly withered. The fibres of the central fascicle are very fine and very closely packed : as soon as the ovary swells, it becomes opacified by grume. I suppose the prelude to the formation of more cellular tissue, so that its internal structure, or contents, are not visible without dissection or the employment of pressure.

The earliest state at which I have seen the young fecundated pistillum is 8, Fig. II. In this there was no inner separable body, but it is to be remembered, that this was not the pistillum proper, which is 6. Fig. II.

The fig. 8, had a style lacerated at the apex ; only one pistil appears to be perfected.

Systasis. Pl. LXXV. A., Fig. II.

1. Young fruit, perianth and involucreum.
2. Long section of same : involucre removed ; its attachment shewn at *e.*, *a.* Perianth, *b.* Calypthra, *c.* seta and young capsule.
3. Seta and young capsule, detached.
4. Apex of seta.
5. Female flower : and young perinth.

6. Fecundated (not central) pistillum.
7. Young seta.
8. Another Pistillum enlarged, but containing no separable body, style lacerate at apex.

Systasis. Pl. LXXV. A. Fig. III.

- a. Plant, nat. size.
- b. Female flower. Perianth now of confervoid filaments united at the base.
- c. Pistilla separated.
- d. Perianth separated.
- e. Long section of young fruit, cut through the involucre and perianth.
- f. Apex of seta.
- g. Young fruit and its calyptra.
- h. Portion of upper part of involucre.
- i. Capsule.
- j. Portion of its parietes, inner surface.
- k. k. Sporula, $\frac{1}{2}$, 1-16 M.
- l. Elatere, $\frac{1}{2}$.
- m. One end of Do. 1-16, *no. membrans.*
- n. Long section of involucre and perianth after destruction of upper part of seta and capsule, shewing the perforation of the Calyptra. The seta should be withered.
- o. Seta of the same.

Explanation of the same figure. (Pl. XXV. A. III. Fig.)
but in somewhat different words

- a. Plant natl. size, bit of.
- b. Longitudinal section of the female flower.
- c. Group of pistilla separated, central one fecundated.
- d. Involucrellum, or rather Perianthium.
- e. Long section through a bit of the frond, involucre and perianthium. Capsule and its vaginulate musciform seta in situ, for the most part contained in the Calyptra.
- f. Apex of the seta.
- g. Calyptra or pistillum, and the capsule or theca detached, apex

of seta naked, as it projects beyond the base of the Pistillum or Calyptra.

- h.* Segment lacinate of *involucrum*,
- i.* Ripe Capsule dehisced, and nearly empty.
- j.* Portion of the same, inner surface shews no spiral cells.
- k. k.* Sporule: respectively 1-250 and 1-650.
- l.* Elatere one end 1-250.
- m.* Apex of the same 1-650.
- n.* Long section through the central line of lobe of frond and through the involucrem. Perianth: Calyptra in situ: perforated at apex by seta.
- o.* Apex of a seta after fall of upper part with capsule.

GYMNOMITRIUM.

Frons parva: in parte humefusa carnosâ, crassa, infra radices brunneâ supra divisiones, hæ insertiones valde obliquæ, imbricatæ, undulatæ crispatæ.

Calytra non soluta, lacera apice.

Pedicellus Capsulæ brevis.

Capsula , irregulariter lobata demum quasi solubilis, cellulis parietis interioris rotundata, fibris erectis, discretis.

Elateres.

Sporula.

On banks under rocks in shady places common.

Inflorescentia centralis? Vel. terminalis?

SECT. II. MARCHANTIACEÆ.

Evaginulatæ. Capsula externæ frondi externa sita, interna irregulariter, rarissime valvatim, dehiscens.

Herbæ frondosæ, habitu variæ, cuticulosæ vel ecuticulosæ. Frondes binatim divisæ. Flores monoici vel dioici.

Masculi, antheræ in sacculis e frondis substantia conflatis paginam superam hiantibus contentæ, solitariæ (an semper ?) receptaculo sessili, vel rarius pedunculato.

Feminei, unico (Asolenio) excepto hypophylli, solitarii vel aggregati, plerumque frondis partem deformatam (receptaculum auctorum) pedunculatam occupantes, involucro simplici et valvato, vel duplici et vel in complete valvato, vel evalvato oblecto. Pedunculus receptaculi uni-vel bisulcatus.

Capsula externa demum eruptione interna varie lacera, basi sæpissime persistens; interna plerumque sub sessilis, pariete interna e cellulis fibrosis vel simplicibus conflata.

Elateres vel heteromorphæ vel nullæ, sporula tunica composita vel simplici instructa.

* *Cuticulosæ.*

Cuticula supera stomatibus maximis quasi perforata, infera estomatosa, radicularum e parenchymatis strato infimo ortarum cursu hinc illinc disrupta in squamas margine uno tantum affixas, venam versus attenuatas, et oblique convergentes.

Essential Points of Marchantiaceous Structure.

Radiately frondose, (when there is an apparent axis with foliaceous expansions, these are obliquely inserted, and generally irregular in size etc.)

Organs of aëration, none in the so called foliaceous species, or in many of the frondose ones, but in the more typical ones they are highly developed, and indubitable apertures from solution of continuity.

Sexes present.

Ovula developed by fecundation into an inner membrane containing the seeds. Anthers in the frondose typical species immersed in separate apartments of the frond; this by its growth ruptures, but never detaches the pistillum from its base, except in *Riccia*, in which the capsule is formed from the original pistillum.

Capsule frequently with fibrous cells in its inner layer, having no organic connection with the axis, with no operculum, inner membrane, or columella.

The genus *Marchantia* is the typical genus of *Hepaticæ*: it reaches that degree of perfection as to develop its male organs in a disc, similar to that of the female.

Nothing can prove the perfection, i. e. complication indicated by the cuticles of *Marchantia* and other genera, clearer than the fact, that a young gemma of *Marchantia* is without any cutis, and emits its first roots indifferently from either surface, this therefore shews that the frondose ecuticulate species are lower in the scale of organisation.

Of all the genera I know, *Riccia* is the least developed, yet in its fruit, it has more affinities with *Phænogams* than any other plants of the family.

Unless the elaters germinate, I cannot imagine any special use they may be of, because no means are visible to further the association with the sporula—the only organs for which they can with reason be supposed to be provided. They are subject to precisely the same contingencies as the sporula at the dehiscence of the fruit, a period when they are in their state of greatest perfection. I am by no means sure whether the scales protecting the radicles are in all cases originally continuous with that intro-marginal portion of cutis, which is entire, or if they are in their free ends capable of growth, which is not improbable, because in no. 25 (of the preceding list, p. 297) these ends do not only, not correspond with the inner margin of the intro-marginal cuticle, but actually extend beyond the margin of the frond, giving it a ciliated appearance.

The stomata vary a good deal in size and structure, in the more cellular frondose species they are but little elevated, and are nothing but a space existing between a certain number of the cells of the cutis, but in the more perfect types, as *Marchantia*, they terminate rounded elevations above the surface, and all the cells entering into their formation which have no green matter adhering to them, are distinctly radiate and pluriseriate.

The appearances presented by a transverse section of the frond, are deceptive so far as regards the roots, for they then appear to occupy chiefly two spaces on either side of the mesian line, each space being cut off on either side by scales, but they are in reality developed indiscriminately from the under surface (except from that which may be called the intro-marginal space,) and they are deficient here, probably because this is not in contact with the soil? They do not form any continuous line, except perhaps exactly along the centre, but form oblique lines in the same direction as the scales, converging towards the central part of the frond.

The exact nature of this cuticle, can only be determined by examining the young fronds.

There is no distinguishing essential mark between nos. 25, 26, and 27, (p. 297), except that derived from the point of departure of peduncle from the frond; of the value of this I am not aware. The capsular dehiscence is in all probably circumcision. No. 25 has no stomata on its caput, but I am not aware what value is to be attached to this, or to the stalk of its capsule, it may be, that the subgenus No. 27, is the most developed, and borders closely on *Marchantia*, to which in its peduncle it approaches, except in its being es-tomatose, and only having one groove.

It is evident from these three species, that the perfection of the frond is in direct ratio with the complication of the peduncle, (*of course*); and in No. 25, in which it is not terminal, the frond is laxly cellular, equally in proportion is the stomatosity of the caput.

II. MARCHNTIA.

Receptaculum utriusque sexus pedunculatum. Capsula stipitata apicem versus subvalvatim lacera.

Involucrum duplex, exterius generale bivalve, interius partiale membranaceum, evalve apice apertum.

Plantæ terrestres; frondes varie divisæ; Gemmæ lenticulares in capsulis sursum hiantibus contentæ. Peduncula bisulcata. Receptacula lobata, subtus squamato-paleacea. Antheræ celluloso—membranaceæ. Pistilla plura.

Involucrum exterius initio cellulosum, cyathiforme demum ampliatus scarioso-membranaceum, apice apertum. Capsula sub exserta. Endothecii cellulæ fibrosæ, elateres fibra duplici instructæ, sporula angulata, lævia.

Marchantia assamica. Pl. LXIX. A. Fig. II.
and Pl. LXIX. B.

Frondis divisiones lineari-spathulatæ, sub ascendentes. Pedunculus receptaculi masculi uncialis, vel semi-uncialis, fæminei biuncialis gracilior.

Receptaculum masculinum convexum, fæmineum conico hæmisphæricum, pluries lobatum, lobis sæpius obsolete emarginatis.

Involucra exteriora, sub membranacea, marginibus repandis, cum receptacula lobis alternantia, interiora integra pistillum unicum tantum, vel pauca fæcundata.

Capsula externa demum omnino ut videtur evanida.

Pedunculus capsulæ seminiferæ involucro interiore cinctus et hujus fere longitudine, basi nudus.

Capsula vix exserta, apicem versus irregulariter lacera, parietis interioris cellulis oblongis, fibra nunc completa nunc incompleta donatis.

Elateres longissimæ, plures capsulæ affixæ.

Sporula brunnea, tunica simplici.*

HAB. Ad ripas fluminis Burrampootur et Koondil, florens Maio.

M. assamica. Pl. LXIX. A. Fig. II.

1. Female receptacle.
2. Section of portion of do. carried between the valves of one of the general involucria.
3. Capsule and inner involucrium.
4. Do. with base of inner involucrium.
5. Cells of the inner wall of the capsule.
6. Elater.
7. Sporula.

M. assamica. Pl. LXIX. B.

1. Female plant natural size.
2. Receptacle and involucria viewed underneath 3, 4, 5, 6. sections of the receptacle, all carried between the valves of the general involucria shewing various degrees of development.
7. Fecundated Pistillum in situ: involucria generalia removed.
8. Young pistilla before fecundation.
9. 10, 11, 12, 13, 14, Shew different stages of the inner involucria, and that they are developed without regard to fecundation.

* In this a succession of sporules is kept up; not as in *Anthoceros*, by the progressive development of those of one theca; but by that of two or three thecæ, which arrive at different periods at maturity.

The genus agrees with *Jungermannia* in the stipitation of the secondary theca, and differs from all in the presence of a distinct perianth.

The young pistilla, at least the outer ones, are surrounded here and there with articulate irregular threads, perhaps analogous to paraphyses.

The perianthia of all, even the abortive pistilla, assume a considerable development, and these in particular often assume the appearance of a bilabiate corolla, generally, and especially in the fecundated ones, they appear oblong.

15. Long. section of young capsule exposing the inner sacculus.
16. Elaters and sporula of do.
17. Young pistillum not fecundated.
18. Do. do. soon after fecundation.
19. Do. do. long section. Inner sacculus exposed.
20. Portion of contents of do.
21. Portion of a scale of the under cutis of the receptacle, shewing that the marginal cells occasionally become elongated into radicles.

Marchantia Polymorpha.

Female frond Pl. LXIX. Fig. II. Banks Otipore. Immature.

1. *Marchantia* (*Grimaldia*?) female head, under surface.
2. „ „ ditto longitudinal section.
3. Group of female flowers and scales detached.
4. One of these scales.
- 5, 5, 5, 5. Female flowers at various stages, one shews the usual tendency to red colour so prevalent in the scales of this tribe.
6. Pistillum and included sac, (ovulum) containing nothing but grumous matter.
- 7, 7. Stomata of frond, representing their invariable appearance, one is partially opened from pressure.
8. Portion of upper surface of frond, shewing the limitation of one stoma to one areola: the stomata ought to be represented of brown colour, and quite opaque.

Marchantia polymorpha Pl. LXIX. A. Fig. I.

Male frond Pl. LXIX A. Fig. I. Otipore April 25th 1840.

1. Apex of a lobe of a frond shewing the disposition form etc of the scales.
2. Transverse section of do., $\frac{1}{2}$ only represented.
3. Section of transverse male peduncle.
4. „ of female, shewing the perfection of this in having stomata etc.

5. Section of frond shewing origin of male peduncle.
6. „ origin of female peduncle.
7. Male head, upper surface.
8. Transverse section of do.
9. Anther.

PLAGIOCHASMA.

Capsulæ (2-3) aggregatæ vel solitariæ, peduncula terminantia, rimis longitudinalibus dehiscentes et demum irregulariter circumscissæ. Involucra bivalvia. Tunica composita.

Planta terrestris habitu Targioniæ, pedunculus structura homogenus! esulcatus! præsertim apice paleaceo-squamatus. Cellulæ capsulæ interiores simplices! Sporula globosa; tunica composita, hinc trigona, hinc cupuliformis, cupuli fundo conum gerente. Elateres fibræ simplices vel duplices.

Obs. Genus distinctissimum ab omnibus aliis cuticulatis pedunculo fictis discrepans structura pedunculi homogenea, et ab omnibus ordinibus mihi cognitis pedunculo e sulcato frondem perforante: Notu dignum est ob capsulæ internæ cellulas simplices.

Plagiochasma paradoxa Gr. Pl. LXIX. E. Fig. I.

HAБ. In rupibus calcareis Moosmai Collium Khasyensium, fructiferam invenimus mense Octobris A. D. 1835.

Fronde divisæ, depressæ cæspitosæ divisiones apice proliferæ oblongo lineares, coriaceæ sub repandæ, supra virides subter sanguineo-purpureæ; novellæ fructiferæ sub ascendentes obovatæ, profunde emarginatæ; margines sacculateæ insigniter involutæ. Squamæ paginæ inferioris secus marginem inferiorem liberæ! Parenchyma viride in evolutis parietibus compositis divisum.

Pedunculus $1\frac{1}{2}$ linealis subteres solidus utrinque striatus, rubro-sanguineus hinc illinc sed præsertim apice paleaceo-squamatus, squamis concoloribus summis reflexis.

Involucra 1-3, sub globosa, semi-bivalvia, valvis, si capsula

solitaria, transvers. cæter. longitud., sub coriacea, rubro-sanguinea. Pistilla, uti judicare licet ex exemplaribus maturatis, solitaria.

Capsula erecta vel transversa, basi c. internæ basi cincta, ramis longitudinalibus irregularibus pertusa apice clausa demum irregulariter circumscissa, cellulæ oblongo quadratæ quadratæve fuscescentes efibrosæ, sporula brunnescentia, tunica hyalina, elateres plurimæ, liberæ, mediocres pallide fuscescentes.

1. Portion of a plant magnified.
2. Portion of upper surface.
3. Stoma, and portion of the green parenchyma, viewed from within.
4. Peduncle and involucre, of the valves.
5. Peduncle terminated by one capsule and its involucre.
6. Section of no. 4, half of each valve remaining.
7. Apex of capsule, circumscissid.
8. Portion of tissue of do.
10. Sporula viewed on different faces.
11. And 9, Elaters.
12. Transverse section of peduncle.

I find that the appearance of the valves here represented is due to pressure in drying; they are only so when there is one capsule only.

HAB. Assam.

Plagiochasma (Antrocephalus) pedicellatus Gr. Pl. LXVIII.

Pl. LXVIII. Fig. II.

Planta dioica cæspitosa.

Frondibus oblongis, proliferis, apice dilatatis, margine denticulatis, supra areolis cellulosa, subtus squamis (insertion obliquis) imbricatis dense vestita, quarum exterior ultra marginem projiciens.

E. part. inferior. dense cellulosa, solide, et superiori in loculis plurimis segregatis, cuique stoma unicum, divisum centrum frondis, cæteris partibus densior. Radices plerumque,

e centro inferior. originem ducunt etiam e lateribus ex infra squamis centro (venæ) appropinquatis. Squamis exterior. e radicibus expertibus.

Frons mascul. similis fæminicæ secus centrum, papillis elevatis vix apertis? cum loculis totidem segregatis communicant ad singulam loculam, anthera solitaria.

Involucrum longe stipitat., stipite celluloso omnino, striato, e thallo inferior. originem ducens, parce squamoso-pilosa, dense ad apicem.

Involucra (3-4) cellulosa omnino extus rima (vix in valvis duabus) dehiscent: unifloro vel abortu perspers.

Calyptra irregulariter lacera immota stipitem fere æquans.

Capsula subexserta, brunnea deorsum spectans: valvis pluribus, admedium fere devisa, valvis demum irregularibus.

Cellulis endothecii oblongis, fibris distinctis transversis.

Sporula.

Flos. fæmenea initio sessilis, squamis linearibus acuminatis incumbentibus antea pluriseriatis obtect.

Invol: tunc gemmiforma, virida carnosa, unumquodque involucellum anticum sulcatum, sulca supra giving exit to the stigma.

Pistillum unum cuique involucello sub transversum, structu ordinario massa cellulosa, pendula, more solito (setæ futuræ rudiment.) cuique pistilla.

It is this which constitutes its chief peculiarity, the similarity to gemma is excessive, both in structure, green colour and situation. Real gemmæ do not, I think, exist.

Mixed with these fronds are curious globular bodies consisting of a hyaline thick substance in which are variously twisted articulated green filaments, the growth of these filaments is by the apex, and by the addition of globular cells, one by one, hence at the apex they are moniliform, assuming a merely articulated appearance from subsequent pressure in the direction of their length.

The scales underneath are oblique and are curious in their not all covering radicles, because this shews that their pre-

sence does not always depend upon the growth of the radicles from the whole of the inferior surface of the frond.

The terminal ones are inflexed over to the proliferous apex of the frond. They are more or less inclined to be red : they obviously represent the leaves, so called of some *Jungermannias*, and also the ramenta of Ferns ?

The anthers I have not seen : but from other instances I imagine that the membrane is excessively fine, and either adheres to the inside of its loculus, or disappears ; it obviously cannot escape by the elongated papilla communication with the cell. This papilla perhaps opens by circumcission : they are obviously hollow, but appear closed up during their earlier stages by a grumous mass.

Such instances as this and *Marchantia*, are fatal to the idea of the anthers growing, their dehiscence is most apparent, they cannot escape from their cells, while the whole phenomena are consonant with what we know of impregnation. The exertion of the stigma, the papillose canal for allowing the contents of the anther to escape, and these two effects existing simultaneously, are proofs in favour of the idea of their sexuality.

The apex of the style appears in this species really stigmatic, that is, its canal is terminated by a mucus looking-rounded mass the sphacelation is subsequently manifest, and in this as well as in all other similar cases, the stigma appears disorganised, with minute granules adhering to its irregular margin.

Of Cuticulate *Marchantiaceæ* there are three principal types known to me ; of these one, *Marchantia* has the inflorescence supported on a stalk which is a continuation of the whole frond, is hence terminal and the head has also the frondose structure ; the opposite to this is furnished by the present species and some others, in which the stalk is cellular, not terminal, and a prolongation upwards of the under layer.

The third? is in *Targionia*, in which the inflorescence is sessile at the apex of the frond, this form is intermediate, because the inflorescence has not the frondose structure.

Pl. LXVIII. Fig. I.

The septa as seen in the section of the Frond, are of a different nature from the septa of *Marchantia*, in which these are of the same tissue as the reproductive thallus. In this they merely consist of irregular aggregations from expansion of the frond, and of the aërating tissue. If this be a correct observation they do not exist in young fronds.

*Plagiochasma** Pl. LXVIII. Fig. II.

Frondes dioicæ immixtæ provenientes.

Plantæ cæspitosæ.

Frons : spathulato-oblonga repens, apice biloba in loborum sinu ; in fronde fæminea gemma florifera. Textura e duplici systemate, superior cuticula distinctissima, poris perforata, donata e laxa tela continua cellulari globulas virides continente.

Cuticula supera alba, crassa stomatosa.

Infera tenuis, metallica atro-purpureo, ultra supera prominens, margin versus integra, costas versus disrupta (radicibus) in squamis obliquis.

Inferior. omnino a virid, tela densior præsertim cutem versus. Superficies supera areolata, areolis centro-stomatiferis ; infra squamas, obliquissimæ radicellæ laterales obtegentes, plus minus sanguineo-tectæ, these scales projecting beyond the frond give the margin a blood purple colour.

Antheræ secus centrum dispositæ immersæ in loculis, distinctis e thallo inferiori intus et extus dehiscentes, poro papilliformi erecto ; not seen for the same reasons as in former species.

In all, the aërating tissue exists between the cuticle and the upper surface of the andræcium, and it is only over this that the green tissue is interrupted.

* This was at first supposed from the transverse laceration of the calyptra to be a *Rebouillia*, but the drawing is (together with Fig. 1. of the same Plate) numbered 25, in the proceeding list, p. 297.

Flores fæminæ in capite frondis simili structura, longe stipitata sita. Caput subhæmesphæricum supra stomatosum, radicellæ emittuntur, which run down a solitary central groove in the peduncle, which has no stomata. Involucra bivalvia, vel potius unico dehiscente, celluloso-membranacea.

Capsula sessilis, tela ad apicem reduct., apice magna immersa viridescente globosa, vix $\frac{1}{2}$ exserta, atro-brunnea, cellulis fibrosis nullis, circumscissa, exacte Sporula tunica cellulosa nuclei brunnei.

Elateres brunneæ, thick and stiff scarcely elastic, fibræ dispire, terminantes. The spires not seen.

In statu juniori flos. fæminea sessilis in sinu loborum, et squamis angustis obsit. These scales remain at the foot of the peduncle: the head having neither scales nor giving out externally roots: in the want of scales it is the reverse of the former species.

The central tissue also has the power of producing lateral female flowers, a curious circumstance: these consist of a short squamate axis, rooting along its centre underneath, and dilated towards its apex into a small frond, similar in structure to the parent one.

The under cuticle is as distinct as the upper, and in perfect fronds is of a black purple metallic lustre; along the margin, and from within for about $\frac{1}{3}$ of the width of the frond it is entire, projecting beyond the upper cutis, within, it is disrupted into scales of very oblique attachment, these scales being formed by the roots, and by their invariably tending to coalesce with those of the (only naked one of the cuticulated species) vein or middle line of the central tissue.

The want of fibres of the cells of the endotheca is no proof against the elaters not being a mere form of them, in a distinct state, and with this view it is requisite to examine how many layers the theca presents under the two circumstances alluded to. What is the cause of the variation in the structure of the peduncle?.

In this it consists of a single layer, the circumscission

takes place irregularly between the cells, or rather between the two outer

The terminal central scales of each frond or its lobe, are as usual inflexed over on the upper surface.

In this the young roots abound with granular matter, but the mature ones are quite empty, a curious resemblance with the pollen tubes.

Curious from its lateral female flower buds, and from the aërating tissue being uninterrupted by septa; whereas in some others each stoma has a compartment of its own.

REBOUILLIA.

Rebouillia graminosa. Capsula circumscissa Pl. LXIX.
Fig. I. found in shady banks at Otipore.

(*Rebouillia* Pl. LXVII.)

Fronde spatulatæ, oblongæ bilobæ, dioicæ semper, structuræ typicales, nempe e cute supra stomatosa, pagina viridi uninterrupteda, et tela infera densiore e partibus duabus, supra densissima, purpurascens, inflorescente origine dense et infera minus densa, dicolorata, infra radiculos emittens, secus centrum *venæ*? excepta cuticula inferna, colorata atrosanguinea; cute supra latiore, extus integra adhærente, intus (radicibus) dislocata: in squamis obliquis adhærentibus fronde.

Flos fæmin. initio sessilis, squamis cellulosis longis angustis imbricatis obsit. Occupying a depression in the sinus of the lobes, caput 4 lobum: lobis extus unia notulis, unifloris, ovario nudo.

Fructus longe stipitatus, stipite 3 uncialibus erecto, structura fere Marchantiæ, sed stomatibus nullis, one groove, but a tendency to have an aërating upper surface, as testified by the presence of obsolete cells, under its cuticle, infra glabratus vel hinc illinc piloso squamatus, apice densiuscula piloso-squamata in initio capitis junioris obtegent villosa.

Caput conico-globosum radiato 4 lobum, superficie supra stomatosa, involucria bivalvia, membranacea.

Capsula sessilis, seta nulla immersa, ore irregulariter dentata : ut videtur circumscissa cellulis simplicibus, calyptra reliquæ p resert.

Moist banks under bushes. Otipore.

Præcedenti propinqua discrepans structura frondis, statura majori stipitis apice squamosopilosa, gemmis floriferis laterilibus nullis et capsulæ ore dentato.

ANTROCEPHALUS.

Planta monoica.

Fronde oblongo-spathuiatæ, sæpe bilobæ marginibus undulatis, coloratis, subtus squamosæ et intricate radiculosæ.

Stomata inconspicua.

Masculus discoideus sessilis, discus reniformis superficies in papillas loculis antherigeris respondentibus product. Anth. non observat.

Pedunculis 2-8 uncialis, sulcato-striatus medio nudus, basi squamata apice paleacea, paleæ inter involucria $\frac{1}{2}$ recondit. vel inferiora patentia, membranaceæ subintegreæ.

Involucria folliculariformia magna, chartacea apice cuspidata mucronata ? per totam longitudinem dehiscentia bivalvia.

Capsulæ solitariæ sessiles, irregulariter laceræ : (ante dehiscent. sed non observatæ) membranæ internæ cellulæ fibrosæ.

Pistilla investigiæ circa basin.

Elateres fibræ duplices.

Sporula marginata, disco areolato convexo, trigona. in umbrosis Otipore cum Reboullia

Antrocephalus. polycarpon Gr. Pl. LXV. Fig. I.

1. Plant magnified.
2. Oblique view of capitulum.
3. Longitud. section of do.
4. Remains of capsule.
5. Forked elater $\frac{1}{4}$ M.
6. One end of a simple elater 1-16 M.

7, 7, 7. Sporula.

8. Transverse section of peduncle.

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Antrocephalus megacarpus Pl. LXV. Fig. II.

1. Frond with male flower and remains of a peduncle.
2. Lateral view of a female capitulum in which only one capsule and involucrem is fully developed, one only being abortive.
3. Vertical view of the apex of the same. In this the capsules are represented as they seem before dehiscence.

TARGIONIA.

Fructificatio (immediate) hypophylla. Involucrem bivalve. Capsula. irregulariter lacera, sporula elateribus mixta; tunica composita.

Plantæ terrestres. Frondes lineares spathulatæve, indivisæ, apice proliferæ. Involucrem venæm central. apicem versus insidens demum decidua. Pistilla plura. Capsula externa basi persistens, pedunculum globosum insidens. C. internæ cellulæ fibrosæ. Elateres fibra duplici. Sporulorum tunica composita.

Targionia sp. Pl. LXIX. E. Fig. II.

HAB. In ripis Mumbree, et in rupibus arenosis Mahadeb, ascensu collium Khasyensium allitudine circiter 2000 pedum.

Cæspitosa atro-viridis. Frondes depressæ, spathulato-lineares; fructifera abbreviata, oblonga ovalis vel interdum lanceolata, basi attenuata, subsascendens.

Involucrem madore clausum, valvis atro-sanguineis glabris.

Capsula, basi reliquis, capsulæ externæ cincta, sessilis in apice pedunculi brevissime globosa, pistilla abortiva plura subcircumscissa lacerata.

Cellularium fibræ completæ. Sporula globosa, brunnea,

tunica e cellulis pluribus angulatis conflata vestita. Elateres minutissimæ, vaginatæ, brunneæ, fibra albida, pauca affixa.*

Targionia hypophylla, Pl. LXIX. F. Fig. I.

1. Longitudinal section of a young frond : the swollen part is nearly solid : but the excavation is commenced : from the wall of the excavation corresponding with the more solid part, cellules may be seen projecting inwards : inclosing a brown nucleus, in the cavity several brown sporule-like bodies were visible, the roots are attached even to the swollen part

2. Longitudinal section of a frond in which the fructification was very visible, about 2-3 the mature size. The theca is but little developed, it presented at its apex 2 styliform bodies adhering. The inner lining of the upper surface of the cavity in the frond is not adherent, owing to the developement of the papillæ which push it downwards, forming a decided cavity. The pistilla appear to be first an elongated cellular form, the divisions appearing subsequently. In pulling away the theca the large trough is left where it was attached to the swelling imbedded in the substance of the margin of the frond.

3. Theca while young. The cells have no adherent granules, the sporules have advanced, no elateres are yet visible.

4. Sporule from No. 2, they are connected together by a grumous substance which in some parts is connected into threads, the rudiments of the elateres, but very indistinctly, there is no appearance of division of the sporules into cells.

1. Transverse section of a stoma, and the stoma itself magnified. I think that the cellules forming the parietes of the opening, are laid over the cellules forming the superficial shell, in an imbricated manner.

1. Frond portion of, and involucria.
- 1b. Do. do. after the fall of involucria.
2. Long section carried between the valves of involucrum.
3. Theca.

* I remember that Mirbel says I am wrong in regard to the sporula of *Targionia* appearing cellular, but they do appear so, owing to the tunic.

4. Sporula.
5. Capsule after dehiscence, removed with the globose foot-stalk of the capsula externa.
6. Do. do. base of capsula interna remaining, shewing the remains of the capsula externa.
7. Cells of the capsules inner surface.
- 8, 8. Elaters.
9. Sporula.
10. Portion of frond, shewing the direction of the scales.
11. Stoma.

** Ecuculosæ.

ASKEPOS.*

Receptaculum (fæm.) pedunculatum, involucra evalvia.

Plantæ Terrestres, pedunculus bisulcatus, receptaculum peltatum sublobatum. involucra lobis opposita? Pistilla plura. Sporula elateribus mixta.

Askepos brevipes Pl. LXXV. B. Fig. II.

HAB. In sylvis umbrosis Tingrei agri Muttack Legimus mense Feb. A. D. 1836.

Fronde divisæ, sub-coriacæ fusco-virides; divisiones steriles lineari-oblongæ, apice bilobæ; fertiles late obcordatæ basi angustatæ, ex apicibus steriliū more prolifero orientes.

Vena divisionum uti solet unica centralis. Radiculæ undique e pagina inferiore ortæ ad venam currentes et massam densam hanc superimpositam efformantes, his involucri pilos mentientibus. Pedunculus brevissimus, glaber, postice bisulcatus.

Receptaculum supra planum.

Involucra convexa, pilis paucis rigidis (radiculæ) hispida extorsum sursumque rima inconspicua longitudinali hiantia.

* Nomen ob involucra evalvia.

Pistilla plura deorsum spectantia uno sæpius tantum fecundato, nuda.

Capsula (externa) globosa subsessilis, stylo coronata, sub horizontalis. Capsula interior inclusa, perjunior tantum visa sporula (immatura) elateribus immaturis plurimis mixta.

1. Portion of a plant with female fructification, α , rimæ of dehiscence of involucria.
2. Receptacle and involucria, viewed from below.
3. Long section of Receptacle carried thro' two involucria.
4. Pistillum fecundated, or young capsula primaria surrounded at the base by abortive pistilla.
5. Abortive pistillum.
6. Young capsula primaria half cut away, exposing the real capsule.
7. Very young sporula.
8. Do. do. Elater.
9. Transverse section of peduncle.

MONOSOLENIUM.*

Receptaculum (fæm.) pedunculatum, (mas.) sessile. Involucria semibivalvia capsula.

Planta terrestris pedunculus brevissimus uni-sulcatus. Receptaculum (fæm.) peltatum lobatum; Involucria lobis alterna extrorsum per dimidium superum hiantia. Pistilla solitaria. Receptaculum (mas.) pedunculi basin prope situm multi-loculare.

Monosolenium tenerum Gr. LXXV. B. Fig. I.

НАВ. In agris arenosis Cheikwar Suddya prope, regionis Assamicæ alt, nuperius reperi copiose in sylvis humidis Tingrei.

* Nomen ob pedunculum uni sulcatum.

Dense cæspitosum. Frondes depressæ, lineares spatulatae, simplices vel divisæ, apice bilobæ, amæne virescentes teneræ; vena centralis crassa purpurascens. Radiculæ longæ, simplices, granulas numerosas continentes demum promone vacuæ, his receptaculi per pedunculi sulcum decurrentes. Receptaculum (fæm.) breviter pedunculatum, lobatum, lorum marginibus undulatis erectis vel inflexis, supra concaviusculum punctis albis opacis multis notatum, infra plicato-convexum.

Pedunculus linealis, postice sulcatus. Involucra tot quot lobi receptacula, extrorsum hiantia, oris margine supero truncato.

Pistillum cuique involucro solitarium, brevissime stipitatum, stylo mediocri terminatum.

Capsula externa sub sessilis, (junior tantum visa) capsula interna hiuc conformis, subsessilis. Sporula juniora tantum visa cellularum reliquis, nonnullis capsulæ parietibus adherentibus, immixta.

Receptaculum masculinum vena insidens, rotundato depressum, superficie supera papulosa, papillis apice apertis. Antheræ cellulosæ?

1. Portion of a frond, female receptacle cut thro longitudinally, but rather laterally.
2. Female receptacle viewed from beneath, one of the involucra cut away.
3. Young capsule.
4. Do. secondary.
5. Portion of membrane of do. remains of cells are seen here and there attached to its sides.
6. Very young sporula in different stages, intermixed with irregular grumous bodies.
7. More advanced sporula, intermixed with remains of dislocated cellular tissue.
8. Long section of male receptacle.
9. Anther, (probably incorrect)
10. Portion of an old radicle.
11. Represents a curious thing adherent to the receptacle.
12. Portion of do. this has nothing to do with the plant.

OCTOKEPOS.

Receptaculum (fæm.) pedunculatum (mas.) sessile. Involucrum duplex exterius e frondis substantia, e valve, extus apertum, interius membranaceum, apicem versus octo-valve. Capsula apicem versus irregulariter dehiscens.

Planta minima terrestris habitu quodammodo Marchantiæ.

Receptacula (mas) epiphyllia, sessilia, pedunculi basin prope. Pedunculus uni-sulcatus, capsulæ cellulæ fibrosæ! Elaterum fibra duplex. Tunica sporulorum composita hinc trigona e cellulis, tribus grandibus, hinc angulata e cellulis pluribus minoribus conflata.

Obs. genus involucro interiore 8 valvi, capsulaque cellulis e fibrosis notanda. Tunica sporulorum fere ut in *Asolenio*.

Octoskepos Khasyanum Gr. Pl. LXIX. D. Fig. I.

HAB. Infra rupem in Pinetis Moflong, Collium Khasyensi-um parce legi, mense Nov. 1835.

Fronde depressæ divisæ tenerrimæ, glauco albid M., divisiones lineares, repandæ, apice emarginatæ sinu pedunculigero (more ordinis) Radiculæ ad venam centralem unicam convergentes, seniores vacuæ.

Receptaculum masculinum minimum, depressum, superficie superiori papillosum, multi locale loculis per papillos hiantibus. Antheram solitariam includentibus.

Pedunculus gracilis, tener, postice sulcatus, canaliculo-radiculas deorsum conducting.

Receptaculum reniforme, orbiculatum, oblique peltatum supra planiusculum margines versus irregulariter dentatum, dentibus rotundatis.

Involucra sæpius 2-3 dentibus receptaculi non respondentia, stipiti apicis contigua.

Exterius e frondis substantia, ore subcirculari, integro, extus hiante. Interius sublageniforme, celluloso membranaceum, apice exsertum maturatum per dimidam superum in valvis 8 lineari-subulatis, paullo inæqualibus, madore conni-

ventibus, siccitate connivente, erectiusculis fissum junius quadri valve! per junius verosimiliter integrum. Pistillum solitarium. Capsula globosa, sessilis, involucris inclusa, basi nuda, apicem versus irregulariter dehiscens (an circumscissa?) cellulæ irregulares simplices.

Elateres plurimæ, breves, fibra irregulari modo simplici modo duplici in elatere eadem.

Sporula globosa, fuscescentia, tunica hyalina.

Pl. LXIX. D. Fig. I.

1. Portion of a plant magnified.
2. Peduncle and female receptacle of do. viewed from beneath.
3. Portion of receptacle with the involucre and capsule.
4. Do. Both involucre laid open.
5. Capsule separated before dehiscence.
6. Inner surface.
- 7, 7, Sporula.
8. Elateres.
9. Young inner involucre laid open exposing the pistillum.

SYNHYMENIUM.

Fructificatio immediate hypophylla, involucre e valve, extus hians. Capsula apice 8 valvis.

Habitus Ricciæ.

Synhymenium aureo-nitens, Gr. Pl. LXIX. D. Fig. II.

HAB. In rupibus arenosis ad margines torrentum Moosmai, sepius et parcissime in ripis Mumbree.

Frons sub membranacea, circularis, diametro sub unciali, humi adpressa, radiatim lobata, lobi late cuneati, marginibus repandis. Aspectus velutinus et aureo-nitens, structura e cellulis parvis varie angulatis. Radiculæ sine ordine exsertæ.

Fructificatio marginalis. Involucre celluloso-membrana-

ceum, per dimidium superum circiter hians, marginibus revolutis basi clausa fere globosa, pilis longiusculis (radiculis) hispidum.

Capsula sessilis, basi reliquis. C. externæ tenuissimis, pedunculum brevem terminantibus vestita, apice valvatim dehiscens, valvis initio mediante membrana e cellulis heteromorphis connexis, demum membrana rupta initio quadri-valvis, valvis cito bipartitis. Capsulæ paries singulus, cellulis valvarum brunneis fibrosis, oblongis, reliquis *simplicibus*, minoribus, varie angulatis.

Sporula fusco brunnea majuscula globosa, conspicue echinata.

Elateres paucæ, plures capsulæ parietibus (valvis exceptis) affixæ paucissimæ liberæ, fusco brunneæ, fibra albida duplici.

S. Aureo-nitens, Pl. LXIX. D.

1. Portion of a frond with two involucre viewed under.
2. Capsule before dehiscence.
3. Ditto after dehiscence.
4. One of the valves tipped with a portion of the connecting membrane.
5. Portion of the membrane.
6. Portion of an elater.
7. Sporula.

SECT. III. RICCIOIDEÆ.

Capsula externa seminifera, secundaria nulla evoluta.

Plantæ sæpius cuticulæ omnino orbatæ. Frondes circulares radiatim lobatæ.

RICCIA.

Capsulæ frondes substantia immersæ.

Antheræ solitariæ in loculis e frondis substantia confatis, superne apertis. Plantæ monoicæ ? vel dioicæ.

Riccia sp. Pl. LXXV. F. Fig. I.

HAB. In sabulosis humidis fluminis Brahmapootræ confinibus copiosa occurit. Fructiferam legi per menses frigidos.

Frondes humi adpressæ, aspectu spongiosæ, lobis plerumque cuneatis, bifidis vel bipartitis, laciniis omnibus apice emarginatis; fæmineæ griseo-virides superficia supera præsertim, centrum versus hinc illinc crebre (capsulis nempe propulsis) erosæ; masculæ magis spongiosæ, supraque rubro pulchre tinctæ.

Anatomia. Substantia e parenchymata supero crassiore viridi, meatibus distinctis traversa; et parenchymata infero densiore decolorato, infra vel superficie radículas gignente. Cuticula quam maxime rudimentaria parenchyma viride superstrata, membrana obsoleta alba rete irregulare mentiente.

Antheræ plurimæ, loculi sursum in collum paginam superam supra prominulum ore minuto hiantè producto, sparsi Sacculus e membrana simplici ? materia grumosa, ante dehiscentiam turgidus, demum quam maxime flaccidus, et membranam tenuissimam mentiens.

Capsulæ sine ordine sparsæ, uti antheræ, cum parenchymata, decolorato-annexæ, centrum frondis versus maturatæ, peripheriam versus gradatim juniores, stylis sub inclusis aspectu semper terminatæ (juniorum styli ultra paginam superam conspicue prominuli,) membranacæ globosæ gradatim per paginam superam propulsæ, demum irregulariter ruptæ, e cellulis simplicibus formatæ; membrana interior prorsus nul-

1a. Sporula brunnea convexo-trigona, *tunica* potius membrana quam maxime externa, inconspicua, arcte adhærenti membranæ internæ brunnea, sublentem centies augentem vestigia compositionis non ostendens: membrana interna subhyalina.

HAB. In humidis prope Negrogam regionis Assamicæ altæ, sæpe cum priori consociata.

Frondes humifusæ, teneriores et aspectu magis membranacæ quam in precedente, lobi dichotoma pinnatifida, laciniis spathulatis apice emarginatis; pagina supera plana, infera hinc illinc ob capsulas prominulas gibba. Cuticula prorsus nulla.

Capsulæ fere præcedentis sed pauciores, secus loborum centrum crassiores dispositæ, per paginam inferam erumpentes, ad epocum maturitatis partialiter fere denudatæ; cellulæ fibrosæ.

Membrana interior nulla.

Sporula rotundato-angulata, brunnea tunica sub lentem centies augentem cellulis minutis areolata ideoque composita.

Ricciæ Pl. LXXV. F. Fig. I.

1. Long section of a lobe of frond.
2. Young capsule.
3. Nearly mature do.
4. Style, the process dipping down, doubtful.
5. Portion of capsule } of no. 2.
6. Portion of contents }
7. Young sporula.
8. Nearly perfect do.
9. Perfect sporula of *Riccia* no. 2.
10. Portion of upper surface of frond.
11. Do. do. shewing the obsolete cuticle.
12. Portion of male frond.
13. Long section of do.
14. Anther in situ. } before dehiscence.
15. Do. removed. }

SECT. IV. ANTHOCERATEÆ.

Capsula (primaria) e substantia frondis exserta, nunquam styligera!

General remarks on Anthoceros.

Radiately frondose, estomatous.

Essential points of Anthoceratious structure.

Decided male flowers, of the ordinary acrogenous structure with most evident dehiscence, *enclosed in common apartments in the frond.*

Female flower pre-existing, none, but consequent on impregnation; the process of which consists in the application of the fertilising matter to the upper surface of the frond, into which it penetrates, causing the origin at *particular* or promiscuous? spots of the young capsules, to carry in their growth upwards up a calyptroid process formed from the substance of the frond.

Capsules spirally 1-2, valvular with columella.

ANTHOCEROS.

Capsula sursum bivalvis, columella centrali libera instructa.

Plantulæ monoicæ. Frondes varie lobatæ. Antheræ in cavitatibus, frondis sursum ore lacero hiantibus contentæ, aggregatæ, centrales evolutiones; cellulis pulchre reticulatim areolatæ, apice dehiscentes.

Capsulæ sessiles, basin frondi immersæ, involucro e frondis substantia primo clauso demum apice lacero inferne cinctæ, subsemibivalves initio missa cellulosa (calyptra auctoribus quibusdam pessime dicta) terminatæ. Sporula processibus cellulosis immixta, convexo-trigona.

Anthoceros.

HAB. Per totas colles Khasyenses et per totam regionem assamicam altam.

Variat. magnopere statura etc.

Distinctio specierum difficillima, tantumque e vivis eliminanda.

Anth. *major* : capsulis longissimis Pl. LXXV. C.

HAB. In. colles Khaseyendes ad Moosmai.

Anth. *crispata* : minor, frondibus crispatulis Pl. LXXV. D.

HAB. Ad Nunklow collium Khasiyensium.

I have evidently confounded two species, one has anthers as represented in the drawing, the other has globose anthers, the sac being probably simple.

Anthoceros crispata Pl. LXXV. D.

1. Portion of a frond, the section carried laterally through the involucre and the subglobular base of the capsule. The cells visible in the frond, and involucre are filled with a mucilaginous fluid.
2. Base of capsule detached ; remains of its attachment visible.
3. Base itself of capsule detached.
4. Portion of one of the valves of the capsule.
5. Portions of the columella.
6. Perfect sporula.
- 7, 7, 7. Cellular processes mixed with the sporula.
8. Transverse section of capsule near its base.
9. Do. do. a little higher up.
10. Do. do. still higher up.
11. Do. do. Towards the point of dehiscence.
12. Do. do. Immediately beneath the valves.
13. Sporula at a very young period.
14. Do. do. more advanced.
15. Do. do. do.
16. Do. do. do.
17. Do. do. do.
18. Do. at the time of separation of the original nuclei.

Anthoceros major Pl. LXXV. C.

1. Portion of a frond with male inflorescence in different stages.
2. Section of an antheriferous cavity.
3. Do. at a more advanced stage.
4. Fasciculus of anthers with the floor of the antheriferous cavity, shewing that there exists in one fasciculus all stages of developement.
5. Perfect anther before dehiscence, viewed as a transparent object.
6. Portion of its contents.
7. Anther after dehiscence.
- 8, 9. Sections of fronds and involucre shewing the young capsule tipped with the dislocated cellular tissue.
10. Young capsule detached.
11. Do. wall of the capsule removed.
12. Cellular cap of do. Calyptra of Sprengel etc.
13. Upper portion of a capsule after eruption from the involucre, tipped with the cellular cap.
14. Cellular cap of do. long section of

Anthoceros P. LXXV. F. Fig. II.

1. Long section of portion of a frond carried through the point of developement of the future female organ at a very early period. The funnel shaped membrane has already made its appearance. The first steps are seen to consist of a thickening of part of the tissue which subsequently becomes the bulbous base of the capsule.
2. The same at a rather more advanced stage.
3. Do. more advanced, the dislocation or breaking up of the tissue between the apex of the very young capsule and that of the involucre is very distinct.
4. A somewhat oblique section of a rather more advanced stage, shewing the mode in which the funnel-shaped membrane is spread over the apex of the young involucre. Portion of it is reflexed.

Anthoceros, Pl. LXXV. E.

1. Section of portion of a frond : young capsule more advanced.
2. Do. more advanced. Dislocated tissue has now assumed the form of a cap.
3. Cap, more of do. the beak of the funnel-shaped membrane is seen included ; to the base of this, granules are seen attached.
4. Section at a stage less advanced than no. 3, carried through the young capsule and its bulbous base, granules are seen adhering to the membrane.
5. Apex of a convexity shewing that the cells contain no green parenchyma and are tinged with brown.
6. Portion of superficial cellular tissue.
7. Section of a frond carried through two antheriferous cavities.
8. Anthers at a very early period.
9. Mature do. before dehiscence, viewed as a transparent object.
11. Anther some time after dehiscence, the yellow colour disappears.
12. Section of a frond shewing the situation of the gemmæ.

Drawing of a Marchantiaceous Plant.

Marchantiaceæ Pl. LXIX. C.

1. Entire frond, considerably enlarged shewing the stomata, which correspond with the divisions marked out on the upper surface of the frond. Those towards the base being much the largest.
2. Stoma and surrounding portion of the frond, viewed opaquely.
3. Longitudinal section of a portion of a frond.

4. Do. Transverse of an entire frond. These figures shew that the cavity of the frond contained between the upper and lower cutis are subdivided by cellular septa, in which no vesicles containing globuline are developed.

5. Root.

6. Stoma viewed from above.

7. Stoma from the base of a frond.

8. 9. Stomata viewed from above, and on their inner surface.

10. A cell from the upper cut is detached with its enclosed green globules. In this I could not detect any membranous covering enclosing the green globules, which are chiefly composed of an aggregation of greenish active molculæ.

11. Portion of lower cuticle.

Pl. LXIX. C.

The plant from which these drawings) illustrative of the Mirbels description of *Marchantia* were made,) occurs in abundance on the walls of an old Pagoda at Mergue. I have never seen it in fructification. It is evidently a *Marchantiaceous* genus, although most probably not a *Marchantia*. The apertures are of immense size, and are easily visible with a common lense.

The correspondence of the apertures with the divisions marked on the external surface of the frond is pretty constant. It has a distinct cuticle; on the inferior surface of which no large vesicles containing parenchyma (globuline) are developed.

Calcutta, Botanical Garden, July 22, 1835.

EQUISETEÆ.

EQUISETUM. Pl. LXIX. F. Fig. II.

Caules erecti, steriles paulo altiores articulati, articulis tumidis internodiis sulcatis, sulcis sinubus dentum vaginarum respondentibus: vaginis secus internodium coadnatis ad articulos liberum, spacelato-dentatis, dentibus 9, subulato-planis: *folia* medium caulis occupantia, basi versus et apice versus vel nulla vel obsoleta: infra articulos exserta! verticillata, perfectione *nonatim*, et semper dentibus vaginarum alternantia incompleta pauciora, summa sæpe ad anum redacta. Cauli semilia *erecta* eodem more (quo?) articulata: vaginis apice 4 dentatis! vaginis caulem summitatis numero redactis. Floriferis discretis sæpissime aphyllis, si foliosis quam maxim incomplete consimilibus, art. vaginarum dentibus, apicem versus caulis laxis et.

Ramuli basi vaginis sphacelatis laxiusculis subdentatis cincti, dentum vaginarum numerus variabilis nec ulla ratione definitus, vaginarum dentibus mutuo alternantibus.

Spici terminales, vagina (matura) hinc fissa basi stipat. breve stipitat. Stipit sub verticil. inferne annulo cincto, annulo repando, subcylindracea erecta. Receptaculi breviter stipitati, peltato (summis exceptis qui sparsi sine ordine) verticillato: sub 7, cuique verticillo peltato, facie extrorsa planiuscula, plus minus angulata: pars peltato verticaliter sita.

Thecæ: sub 7, basi affixæ, membranacæ, intus vel axim versus spectantes, introrsum quoad axim longitudinaliter dehiscentes.

Tegumenta bina, exterius e cellulis longitudinaliter dispositis oblongis, interius e cellulis oblongis in quibus fibra spiralliter revoluta est. Sporula rotundata viridia minuta, basi fibris 4 subclavatis ipso multo excedentibus circumdata: fibræ valde hygrometicæ, aqua immersa circa sporulum convolvuntur, et tunc sporula simulat cellulum endothecii ejusque spiram fibrosam nucleum continens.

Sporula matura virida grumosa e granulis? minutissimis constans continent.

Boga Panee in arenosis, Nov. 6-7, 1835.

I think that there is no ground whatever for Brongniarts' opinion: Its affinity so far as reproductive organs go, is certainly with Hepaticæ especially Marchantia: on thorough examination, it will I think be found that the spiral fibrous bodies, are mere separations of the cells of the endothecum, but somewhat modified, thus corroborating Mirbel's idea of the origin of Elateres. Instead of 4, I take them to be 2 attached to the sporule at their middles. If the fibre of the endotheical cells be double, my view will be strengthened. The whole subject is well worthy of reconsideration.

MUSCI.

General Remarks on Musci.

Essential points of Muscoid structure.

A distinct axis with expansions analogous to ordinary leaves in function and insertion, formed of simple series of cells, and no cutis. No stomata except at the base of the capsule where the structure requiring aëration is of considerable thickness.

Tendency to a perianth often very distinct in the male flowers.

Undoubted (from analogical and structural reasoning,) sexes.

Pistilla genuine, ovula one, undergoing no other subsequent change than one of situation. Pistillum torn up from its base by the growth of the theca. Capsule having no continuity of structure with the axis formed in the upper end of the growth from the original ovula; furnished with an operculum, an inner membrane with or without ciliar processes, and a columella.

Mosses pass generally into Marchantiaceæ through *Andræa*, and through *Jungermannia* partially, i. e. organs of vegetation by Bridels' filicoid division, i. e. leaves with oblique attachment.

On the Development of the Reproductive organs of Musci.

Both the really reproductive organs, and those by which such reproduction is supposed to be brought about are terminal and aggregate. The former are situated in fact on the apex of the axis which is here rather swollen and much more lax than the more inferior part. Several are situated together, mixed with cellular filaments and oblong cellular grumous bodies, of the nature of which I am quite ignorant. All these parts are surrounded and covered in by the concave perichæ-tial leaves.

These female organs are filiform, obtuse, with an enlarged

ovate base ; they appear to consist of a fine cellular continuous membrane, which except at the enlarged base is occupied with, and rendered turgid by a grumous fluid. The base is nearly hyaline, the apex or broader part, and adjoining the termination of the grumous matter being occupied centrally by what appears to be a vesicle.

The changes that subsequently take place are limited to one, and to the most central (?) of these bodies, and consists in the disappearance of the grumous matter, and the appearance of a sphacelated line running through the centre of the filiform part to the commencement of the enlarged base, when this has taken place, the cellular structure of the filiform part becomes very evident. At the same time the base enlarges, becomes cylindric and of a much firmer texture.

It is united to the apex of the axis very slightly.

The first origin of the part which subsequently becomes the seta, I have not yet seen : but I have no doubt that the above changes affect the vesicular body, always observable in the upper part of the dilated base.

Shortly after the above period, the dilated base will be found to be chiefly occupied by a cylindric, subulate body, attached to its apex and projecting into and filling the greater part of its cavity, now of some size.

This is entirely cellular, and it has a conical apex of remarkable structure, diminishing in the number of component cells until we come to the apex, which is always composed of one cell. I have no doubt that this is the original vesicle, separated from its original situation by the developement of intermediate cellular tissue.

No particular subsequent changes present themselves in the tubular or filiform part, this is usually persistent.

Considerable elongation, I should observe, of the dilated base takes place, but the growth of the new production, which is the future seta, outstrips it. and at some little time beyond the above period, its conical apex will be found to extend beyond the line of its attachment.

In the mean time the tissue of the apex of the axis has become softer still, and is even absorbed in part. Into this cavity the apex of the seta passes, and pushes before it the lax remaining tissue. This penetration only ceases when it comes into contact with the comparatively indurated inferior portion of the axis. In the present instance it penetrates about the depth of a line, no change whatever in situation has taken place in that which was originally the base of the female reproductive organ. It continues throughout the above time to enlarge, and to become more membranous, and more inflated. But at the above mentioned time the apex of the seta meeting with resistance, other means are resorted to, to ensure the necessary degree of elongation, and this acts of course upon the weakest place, which is the attachment of the female organ. This is then ruptured, and the female organ is carried more and more up as the seta lengthens, becoming the Calyptra, or veil.

After this the real base of the seta soon loses its original connection with the calyptra, to which however it continues closely applied.

It is still, especially towards its base of a very lax texture. The first change that I have observed consists in this part becoming green, and this is evidently I think attributable to the fact of its becoming excavated, or so to say, that its internal parts become softened down into a grumous greenish mass. This change however is not continued into its extreme base, which is conical and transparent. The change is carried on from above downwards, or rather continues increasing in the direction of the growth of the seta, until at length it reaches to a considerable distance.

When the seta has reached some length, the strume is very apparent, and beyond it the formation of the theca does not extend.

At this period, the greater part of its original base, now the apex, is hollow, and occupied by a cellular body, the commencement of the columella. As the theca commences to

assume its form, the operculum becomes more and more and more distinct, as well as its future line of separation.

The columella increases in size upward, and soon occupies the whole excavation being continued up, even to, or towards the apex of the operculum, with which it is there continuous; up to this time no rudiments of a peristome were observed.

The only change that in the mean time has taken place in the calyptra, is its becoming split along its under side, in the direction of the greatest pressure.

The chief points of enquiry are now to ascertain whether any change takes place in the male organs, and whether it is simultaneous or nearly so with those occurring in the female.

Whether the apex of the female is ever perforated, and whether the vesicle exists prior to the supposed impregnation.

To examine most minutely, and in detail, all the female organs, and why the change is limited to one.

With regard to the development of the theca, to ascertain——

When the peristome first appears, and what are the steps in its formation——

Which is formed first, the inner or outer?

On what does its presence depend: for *Gymnostomum* has an inner membrane lining its theca.

What becomes of the opercular part of the columella, in *Diphyscium*, it is persistent, is not the membrane of *Schistostega* and *Leptostomum* etc owing to its apex, adhering with the circumference of the stoma?

In such cases the operculum is generally **FLAT**: except in *Hymenostomum*.

What is the nature of the membrane of *Polytrichum*?

On what does the annulus depend?

Trematodon longicaulis. Pl. CXI.

1. Male flower! aggregate terminal.
2. One of them separated.

- a. a. a.* Continuation of the Columella to the apex of the operculum.
- b. c.* Young female.
- d. e.* Ditto.
- g.* Unimpregnated female.
- h. i. j.* and the figures without numbers, are seta in different stages of growth.
- f.* On outside of oblong body.

Sir J. Smith's description of these female bodies. (Rees Cyclop. article Musci) is not I think correct. According to the above instance at least, his description of their being most solid at the base only applies to them after the first changes have occurred. The subsequent description of the elevation of the style and stigma by the growth of the germen is applicable, but not so when he says, "still more by the production, or elongation of a peculiar organ, termed the fruit-stalk, on which the germen stands, and by whose sudden growth the young veil or calyptra is torn from its base and carried up along with the germen or young fruit." This he appears to give as Hedwig's view of the structure. About this I know nothing, except that Valentine has satisfactorily refuted all or most of Hedwig's notions.

The above cited passage is a lamentable instance of want of observation and consequently of precision, nothing whatever is said of the growth of the seta, added to which we have the appearance of a new organ, the calyptra totally unexplained. From what Sir James observes a little further on, he has evidently forgot that he had already impregnated the female flower, but he makes sure of it by the means of an after impregnation through the means of "a highly cellular or vascular mass."

This very remarkable structure has perhaps nothing analogous to it, although the earlier changes certainly resemble certain changes in certain ovula as in *Cynomorum* etc. ?

But then we have causes operating and producing effects of, so to say, a more complicated nature than in *Phœnogamous*

plants: for here we not only have sporules produced, but a highly complicated covering etc. for them.

Several things led me to suppose that impregnation does take place, and in particular the sphaeculation of the *style*: neither is this weakened by the fact such takes place in most of the female flowers, analogous instances occurring in some Phænogams as in *Santalum*.

The growth of the seta is highly curious, and was first pointed out I believe by Valentine in a paper read before the Linnean society.

It is particularly remarkable for this: that supposing impregnation to take place, the changes ought to occur in the vesicle itself, whereas we have seen that this never enters into the composition of the theca, but always forms the extreme apex of the included *real apex* of the seta.

Palisots idea is all wrong, because the columella is invariably solid.

Funaria Pl. CIX.

1. Male body or anther with two of the singularly beautiful cellular processes which always occupy the centre, the anther appears open.
2. Male bodies in different stages of developement.
a mature; attached is one of the cellular articulate processes.
3. } Arbortive Pistilla.
4. }
5. Three Pistilla from one female inflorescence.
6. 6a. 6b. 6c. Four do. from another inflorescence, these have various developements, and all have been impregnated.
6. Shews the first change in the Pistilla, consisting either in the enlargement of a pre-existing cell, or (and I think this most probable), the formation of a cavity for the commencement of the seta.
- 6a. Is the most developed: 6a bis, is the apex of the young seta detached.

- 6b. Is a stage intermediate between 6 and 6. c. in none but in 6 a. could I succeed in separating the seta.
- 6c. Stigma peculiar, as it were unilabiate, a young leaf is in attachment, and two cellular processes, in all these the structure of the style and its subsequent appearance speak for themselves.
- In this, and all others, before it is obscured by the brown colours, it is of rather late appearance, at least towards the bottom of the style, the lower part of style is gorged as it were with granular matter.
7. Female flower sometime after impregnation, but before protrusion of the stigma from the convolute leaves, at its base an abortive pistillum and the usual processes.
- 7, b. Seta detached, its apex is just buried in the solid base of the pistillum: in its apex the subsequent opercle is visibly commencing.
- 7c. Same, more enlarged the green part is solid: annular markings are visible on the opercle.
- 7e. Apex of the seta: terminal cell appears double, but this is from a fold in it from pressure, 7d, grumous green mass contained in the green part of the head of the seta.
8. Apex of another seta, shewing the terminal cell.

Funaria, Pl. CX. Fig. I.

Explanation of plates continued.

1. A curious misrepresentation, or rather a representation of a mistake, shewing a pistillum after impregnation submitted to considerable pressure, the commencement of the seta is visible towards its centre, and in connection with it, what appears exactly like a boyau. There being two boyaux, I looked more closely, and began to suspect that the pressure by dislocating the cells of the style had caused this elongated appearance, and I find this was the case.
2. Male flowers, terminal in one instance stem branched, one branch bearing male, the other female flowers.

3. Pistillum as it would appear on a longitudinal section sometime after impregnation, surrounded at its base by *processes*, shell of the pistillum after forming calyptra, *b.* dislocated cellular tissue, very lax, *c.* seta, the loose tissue is to give room for the growth of the seta, not found towards base pistillum.
4. Long section of young theca, *a.* outer coat *b.* cavity filled with reticulate branched cellular green tissue, of which *c.* is the unaltered or unabsorbed portion, *d.* commencement of inner membrane and columella, *e.* opercle. Stomata fully developed.
5. Long section more advanced, (same letters,) 5. *a.* columella and inner membrane detached, a few cellular processes adhering to inner membrane.
6. More advanced *a. b. c. d.* as before, *e.* space between inner surface of inner membrane and columella, *f.* occupied by sporules, *g.* opercle, *h.* rim of opercle and annular mouth of outer membrane of theca, *i.* peristome — the outer?
- 6.*a.* Part of inner membrane or rather apex of columella and part of outer peristome quite uncoloured, 6. *c.* annulus, 6. *b.* sporule.
7. Theca more advanced, same letters have same reference : peristomes both present, inner little developed, outer orangish. The inner membrane and columella now occupy the chief part of the theca.

7. *a.* sporula, 7. *b.* annulus.

Phascum and Funaria have two sorts of anthers and the reticulation is the same.

Can this in any way help us to a natural classification.

Pl. CX. Fig. II.

1. Columella etc. of a young theca age of no. 4 Pl. CXIII. line of separation? of inner membrane just perceptible, the apex of this structure adheres strongly to the inside of opercle.

2. Section of apex of theca, at a comparatively late period shews the prior developement of the outer peristome, *a* theca outer wall, *b*. opercle annulus omitted, *c*. inner membrane, *d*. columella, *e*. its apex, *f*. outer peristome, *2a*. sporula.
- 2*b*. Portion of apex of columella and of outer peristome detached.
3. Mature theca except so far as sporula and inner peristome are concerned, same letters same references, *g*. appearance of inner peristome, *h*. annulus, *i*. sporula.
4. Young theca : shewing the appearance of a cavity, it has undergone no change of situation.
5. More advanced, the theca has commenced pushing off the calyptra, same appearance of a cavity, but to a greater extent.
6. More advanced, viewed as an opaque object, shewing the extent of the stomatose part, the upper cavity has a peculiar green lisse appearance while the opercle looks horny.

The calyptras inflated part covers at this time the theca.

- b*. Section of same, *a* theca outer wall.
- b*. Cavity, *c*. mass to be absorbed, *d*. columella, *e*. opercle.
- c*. A stoma, nearly perfect.
7. More advanced, still enclosed in the inflated base of the calyptra ; same letters have same references.

The curious inversion of effect in Ferns and Mosses is worthy of remark ; the male organs of Ferns undergo in some degree analogous changes to those of the style and stigma of Mosses.

There are some parts worthy to be remarked on in Lindleys Introd. Mosses, both because that book is the production of one of the most justly celebrated botanists we have, and because it is in the hands of every beginner.

Of his hypothesis of the analogical nature of the organs of fructification it may be said, that ingenious as it is, it is only correct so far as the calyptra, that is the pistillum is concerned.

The other parallels however ingenious, are constructed on the supposition of the theca being analogous to a flower bud, whereas it is the fruit, and analogous altogether to the fruit of Phænogams, notwithstanding that its first developement is that of a Phænogamous ovule.

The formation of the parts of a theca are at variance with the hypothesis: the teeth of the Peristome are formed by a separation of certain portions of the apex of the columella, if they were leaves they must be developed from below upwards.

Plate CVIII. Fig. I.

Illustrations of Phascum. and the *Developèment* of Theca.

1. Phascum species of, smaller variety.
2. Ditto larger variety.
3. A leaf.
- 4, 5. Calyptra of smaller variety.
6. Ditto of larger, which is mitriform.
- 7, 8. Thecæ immature. 9. Long section of No. 7.
10. Theca with calyptra.
11. Female flower. 12. One of the cellular bodies found associated with the Pistilla.
13. Pistillum, base of highly magnified, shewing the cell from which the seta is developed.
14. Apex of style, shewing its peculiar structure and dilated stigmatiform apex.
15. Young sporula.

The same, Plate CVIII. Fig. II.

1. Portion of axis shewing the auxillary nature of the male flowers, and the terminal one of the female.
2. Anthers. and barren ditto? 3. One of these latter which are chiefly circumferential detached.
4. Abortive or immature Pistillum.
5. Mature ditto with a barren one, the situation of the OVULUM distinctly shewn.

- 6, 7. Ovula. not certain whether the terminal cell is solitary or double, as 6 would seem to point out.
- 8, 9. Farther stages of advancement of the ovuliform seta.
10. Pistillum, shewing spacelation of style and its evident canal, 8 belongs to this.
- 11, 12. Apex of styles.
13. Pistillum further advanced, 9 is its seta.
14. Ditto calyptra torn from its base.
15. Its seta and young theca detached.

On the different facts represented in these sketches, I have but little additional to add. The nature of the pistil, particularly when examined in its earlier stages, and the subsequent changes it undergoes, have all marked analogies with the changes in the pistilla of Phanerogams, consequent on impregnation. The stigma is most marked both in form and the dense sphacelation it undergoes, to say nothing of a dislocation occasionally of its proper cells which are generally, I think 5.

The changes in the male mosses, for they are generally dioicous, are contemporaneous, that is, so far as the yellow bodies or anthers are concerned, and these will among a group of individuals having the female already in developement, be found always to present the appearance of *functa officina*. The first change in the pistillum consists in an enlargement, and a bulging out of its upper third : and in this soon becomes visible a cell, which is the cell afterwards found on the apex of the seta, this cell may pre-exist, but I am not sure whether it does or not ; the growth is now rapid, consisting chiefly of that of the tail of the seta, but the limits of this organ are soon fixed and its conical point marks the site of the future operculum.

It continues to enlarge the apex being so to say pushed downwards, until it penetrates the apex of the axis, its elongation in this direction is terminated by the induration of the older parts of the apex of the axis, and the consequence is, the tearing up of the calyptra from its base, and the seta

henceforth elongates only upwards, previously it had elongated upwards and downward: the downward direction is stopped as I have mentioned, why the pistil does not go on enlarging is another thing. Before this rupture, the part which is to be theca: assumes an oval form more or less, pressure demonstrates a tendency towards a cavity in its centre, it contains grumous greenish matter.

I will here recapitulate the changes that take place in the pistilla (theca) of *Funaria*. The first change is enlargement, and the appearance of a cavity, which a short time afterwards is found to be occupied by a cellular body consisting of a few cells, of which the end one is always solitary; this becomes the apex of the seta. The seta grows rapidly upwards and downwards, enlarging also gradually towards its head where it is greener than elsewhere, as long as the tissue of the axis allows, the seta grows downwards, as long as the pistiles allow, it grows upwards. The head of the seta for a long time maintains a close connection with the apex of the pistillar cavity, occupying the place, which had previously been occupied by the cell forming the tip of the base of the seta. Its growth as long as this happens is equal, when it bulges or becomes unequal as it cannot do otherwise, the tube of the calyptra is pushed off gradually. On looking at a young theca in which this pushing off has just taken place, the opercle appears marked out as mammilla of denser tissue than the rest: in the body of the theca an obvious cavity exists I believe between the integument, and the central tissue, it is in fact a repetition of this that is shewn in the structure of the columella and inner membrane.

Very soon after, the central mass is evident, the upper $\frac{1}{2}$ or nearly so is divided obviously from the lower; the whole is separated from the wall of the theca by green tissue. Stomata now exist in plenty, occupying all that part of the theca, to which the central tissue, not columelloid, and which is afterwards absorbed corresponds. At this stage a theca consists of an outer paries, a mamillar termination which is to become

the opercle, and a central mass, separated from the wall by green parenchyma: the structure of this mass varies, above it is greenish, and towards the middle there is as it were, a stricture, the lower part disappears subsequently by absorption.

The changes henceforth consist in an enlargement of the columella and a corresponding reduction in the size of the cavity as well as of the central mass under the stalk of the columella, in the separation of the tissue of the outer wall at the base of the opercle, in the formation or appearance of a membrane round the columella, which still remains attached to the inside of the opercle. This is first indicated by an opaque line.

The inner membrane and columella go on enlarging, and finally occupy almost all the cavity of the theca, the opercle becomes more distinct, the annulus appears. Intervening between the apex of the columella, and the inside of the opercle appears a production from the inner membrane—the outer peristome and afterwards the inner, and including the corresponding changes in the sporula, the theca may be said to be perfectly developed.

The teeth of the outer peristome, are binary only at apex, the outer is just marked out, but not coloured when the ring of the opercle is first tinged with orange, the inner is barely traceable at this time.

The last thing organised is the inner peristome, it is just perceptible when all the rest of the parts except the sporules are perfectly formed.

It is probably the presence of the peristome, that causes the separation of the head of the columella from the inside of the opercle, it is at once obvious that in all peristomed mosses its points of adhesion, so strong originally up to a late date, must be much reduced, as *Hymenostomum*, *Lyellia*, etc.

The whole process is singular, first we have the greatest development downwards, then downwards and upwards, then upwards alone.

Then instead of the part, which we may reasonably assume most exposed to the fecundating influence, taking on the peculiar phenomena of reproduction, we have the growth of a body apparently of little use, certainly, not essential so far as its length is concerned. But this is not all: the changes going on in the part which has usurped the situation of the original cell, are limited for a long time, to the formation of a cavity for the containance of the reproductive essential organs, which are of late appearance.

The formation of this cavity is very *curious, it is peculiar*, the whole part to be excavated is at first occupied by highly developed green parenchyma, (compare the development of the stomata with that of this parenchyma) the aërating tissue of the leaves, this is subsequently absorbed, but not before *it has caused* the appearance of stomata, with which it is obviously, I think intimately united, not with the sporules, as Valentine appears to think, for from these they are cut off by a very effectual obstacle—a membrane, besides which the sporules are brown, or at any rate have no green parenchyma, so they have no need of aëration.

The sporules are not developed from the tissue of the columella, the contraction of this in size depends upon compression, the amount of which must be considerable, since every original cell of sporule becomes ternarily or quaternarily divided.

The processes about the female flowers are puzzling: they are vastly like some of the anthers or male organs? of Ferns, (see my sketches Plate CXIII. *Cryptogramma*,) and as fully developed, but they undergo no change, no withering, no indication of their having completed their functions, but they are to be found fresh at a late period, *how late* I have not yet determined, although, on this, great stress is to be laid, as well as on their comparison with ordinary hairs.

The stipitate articulate central bodies of the male flowers are more puzzling, because of the anthers appearing cellular: they are scarcely reconcileable to their type of growth.

The terminal globular cell reminds one strongly of *volvox*. If any part of the male flowers be capable of growth it is this; owing to their having highly developed green globules. And this leads me to ask those who say that the anthers are gemmæ, did they ever see gemma without green globules? And what analogy have these with the gemma, known to be such—of this order or of *Hepaticæ*. In these obscure questions, doubt between two organs as to which is concerned immediately in reproduction will be solved by the test of their universality, as in the general appearance of granular matters adhering to the stigma.

Plate CXIII. Fig. I.

Illustrates the Sexual Apparatus of Cryptogramma

- 1, 10. Male organs from first appearance to their full development—Long after they have performed their functions. 4. Represents one at the time of puberty. 5. 10. represent two in which distinct appearances of rupture were seen.
11. Apex of very young frond.
13. Pinnula of a ditto, ditto, lower portion back surface.
14. Ditto, ditto, under surface, in this all stages of development of males from time of appearance to time of performance of function visible.

Plate CXIII. Fig. II.

Represents same phenomena in ———

The resemblance of the males to ordinary hairs is at a maximum, but still the same changes, except perhaps the bursting, are to be traced as in *Cryptogramma*.

It appears to me, that in such questions as these, we may receive wonderful help from extending our views to the animal kingdom, where the best structural plates would afford hints as to analogies. And is not this tardiness of appearance of the embryo, after fecundation, a direct analogy with that

which occurs among the more perfect of the lower groups of animals. With reference to this, the examination of those plants absurdly called Synorhizal is important: is the funiculus of their embryo altogether developed before the embryo appears or not?

In certain plants in which the stalk of the embryo consists of several superimposed cells: are these cells formed altogether before or after the appearance of the embryo? If before, it is a direct analogy with this tardy appearance in Mosses and Ferns; because if 4 or 5 cells are formed before the embryo, there is no reason why 40 or 50 should not be formed in other instances. The marked resemblance between the development of the sporules, and of pollen, so far as the formation of these by division, and the growth of the sporula on germinating, have induced some to believe that these plants are essentially male plants, and that the pollen, which is assumed to be the essence of the function of reproduction in these, requires no nidus for its future development, being at once capable of growth. But the preliminary steps that occur in these plants are fatal objections to this, for they present every analogy with that of the operations of the sexes in Phænogams. Besides they are highly complicated, and it is illogical, I think to assume a higher degree of complication for one set of phenomena than for two mutually dependent on each other. Not a thing occurs in common with the development of pollen, until the inner membrane makes its appearance. It appears to me that some hints, why the females assume the form of males, may be deducible from the comparative structure of the lower groups of animals. In all such instances we must not look to one set of phenomena, but to all. Thus if we merely take into consideration, the structure of the seed, we should refer *Rafflesia* to Acrogens, whereas all its affinities are with Exogens. There is some reason for supposing that the earlier characters deducible from structure, are more valuable than later ones; thus several embryos appear acotyledonous, until we examine them at an early stage.

Plate CXII. Fig. I.

Bartramia and *Funaria* are in the structure of the theca and peristome very nearly allied. The opposition of the teeth of the peristomes in the latter arises from cohesion; each tooth of the inner being composed of two ciliolæ, belonging to different teeth.

This is indicated by the line which may be observed running along the centre of each, not being a continuation of the plication, as is invariably the case in all others, and by the analogy of *Bartramia*, in which the cilia of different teeth are approximated in pairs, but do not cohere.*

These genera agree likewise in the incompleteness of the longitudinal line, indicating the composition of the outer teeth. This line is interrupted in *Bartramia*, and appears totally obsolete in *Funaria*. Bridel observes under *Bartamia Bryol. Univ.* 2-32. "Habitus proprius vix tantella ad *Weissias ramosas accedens.*" This affinity so far as habit is concerned, is very strong, and is borne out by the structure of the sporules, and the apparent simplicity of the teeth of the peristome.

With regard to the value of this latter character; it would appear that not much reliance is to be placed on it, at least in certain of the subdivisions.

As I have before observed in *Weissia* and *Bartramia*, it varies in some species of *Neckera*; it is nearly, perhaps quite complete; and in one species is accompanied by a similar incompleteness of the teeth of the inner peristome, a very unusual character. In one species of *Pterogonium*, No. 589, it likewise occurs; but here it is perhaps observed by the opacity of the teeth.

In a species of *Bryum*, it is likewise complete. In *Dicranoidæ*, in which I include *Dicranum*, *Grimmia*, *Trematodon*, *Trichostomum* and *Didymodon*, this composition is

* Vide *Bartamia tomentosa* Musc. Exot. 1. t. 19.

complete, and would hence be a good and firm character. In Hypnoideæ, Leskia, Hookeria, Hypnum, etc., it is likewise complete.

In all cases, both peristomes originate from the inner theca, but the inner one is a continuation of the same. No value is to be attached to the point of exertion of the outer peristome; hence Entosthodon is not a distinct genus, or rather it is not made so by this character. So constant is this latter fact, that all have erred in asserting that Diphyscium has no outer peristome, whatever the nature of the plicate membrane may be, it is certainly analagous to an outer peristome.

The peristome Polytrichi has nothing analagous to that of other mosses, it is a continuation of the outer membrane, and presents no traces whatever of composition; it is in addition, liable to much greater irregularly as to number, than that of any other. It is probably a modification of the annulus. Bridel is mistaken in saying, that the epiphragma is seized by the apices of the teeth of the peristome. It is on the contrary, as it were, split opposite each tooth which is imbedded in its substance, when the membrane is contracted as it always is by dryness. For further remarks. *It ass.* 3, n. 126.

Bridels class Hypophyllocarpa, is altogether wrong, the seta is in these exerted from the axils of the leaves, and not of the accessory ones; so is Sir W. Hooker, I think, in calling them stipulæ, with which bodies they have nothing more in common than in being foliaceous. Leskia incompleta, and its fellow have evidently the same relation to Leskia, which Brachymenium has to Bryum, hence it must be separated. Taking the composition of the female flower into consideration, no terminal fruited moss ought to be associated with a truly lateral fruited genus. This derives confirmation from the fact, that the genera of pleurocarpi are very few, in comparison with those of acrocarpi. In Bridels Bryol Univ. there are about 70 genera of the former class, and only 29 of the latter. Fissidens is a strong exception, both sorts of exertion of the setæ being met with.

In *Gymnostomum*, (Pl. 112, Fig. II.) there is not even in a very early stage, any inflexion of the inner theca across the stoma to the columella; but on the contrary, this body totally occupies the whole dimensions of the stoma, the same is the case at the epoch of maturity.

The inner theca is formed from the columella, in a long section of which a dark line may be visible on either side near the circumference, Pl. 112 Fig. II., the sporules are not formed at the loss at least of the columella; for this is larger in the mature fruit than at any other period. The interposition of the sporula causes the inner theca to become gradually approximated to the outer, with which however it does not contract any firm adhesion. The columella is originally continuous with the outer theca and becomes separated by dislocation of tissue. This alludes to the period before which the inner theca has become separated. A considerable quantity of æri-form fluid is contained in the cells forming the irregular inner surface of the outer theca.

At a very early period there is no trace of the separation of the operculum, but it is completely continuous with what subsequently becomes the apiculus of the columella.

At a still earlier stage, Pl. 112. Fig. II., the body of the young theca presents a nearly uniform pulpy green mass, the part corresponding to the operculum and apiculus being white, and more conspicuously cellular. Traces of the separation of the inner columella are yet visible.

After dehiscence, the columella becomes exceedingly small, will be found, the fundus of the theca.

My *Hymenostylum* is a *Gymnostomum* differing in no important particular, because in some genuine *Gymnostoma* the inner membrane at the state of maturity forms an annulus within the external os thecæ.

The margin of this is entire, or nearly so, on the contrary, my *Leptostoma*, if they have as one would appear to have, deciduous membranous epistomata, they will be found different from *Gymnostomum*, with which Sir W. Hooker has joined them.

Gymnostoma have certainly affinity in habit and in the form of theca with Splachnoideæ.

Among several hypothesis that may be framed to reduce the singularity of the structure to something like the usual type, perhaps that is the most curious which is grounded on the developement of the seta, which resembles strongly in its earlier stage the developement of a phænogamous ovule; the question never arises, to what degree can the capsule, and frequently its highly complicated apparatus be made to assimilate with our notions of the structure of a seed, for the capsule is the produce of fecundation, applied to a pre-existing ovulum.

In this point of view the seta is the radicle, and it presents a remarkable structural, and a remarkable physiological affinity with the more perfect radicles of flowering plants, for the apex of the radicle is the first formed, and is not subjected to any particular subsequent change of structure. And as to functional analogy, the fruit of a moss is alone in communication with the foliaceous organs, by means of its seta, this communication not being one of continuity, but of mere contiguity. Its apex is likewise formed according to received notions of the structure of radicles, it certainly is, until hardened by age, the softest part of the tissue of a moss.

The main objection to this view is, the extraordinary complication of structure, to which we know nothing analogous, because the curious fact of a radicle, germinating in pericarpio is by no means without a parallel (for the rupture of the ovary has analogies) although perhaps it is in the direction the radicles takes, and in its rooting in the axis that gave it origin.

Nor will the opercular dehiscence perhaps be found to be unrepresented among Phænogams, as the plurality of embryos, or bodies capable of reproducing the species characterises a whole tribe of Dicotyledons.

The curious analogies above alluded to, are distinctly perceptible, but anomalies remain which are quite unexplainable, in

the peristome, and above all the columella. The first however presents a structure not much more complicated than the changes undergone by the teguments of some ovules in their progress to maturity.

Also the want of correspondence in relation between the embryos and the apex of the nucleus.

Also their germinating separately from the seed, but *Santalum* is analogous in some respects to this. Strong arguments in favour of this view are deducible from *Hepaticæ*, in which all the anomalies are reduced, and in some of which as *Riccia*, that alone involving the extreme plurality of embryos remains.

But so long as we view subjects in an isolated manner, however ingenious the hypotheses we may frame, proofs of their truth must always be wanting. We must instead of partial views, take a comprehensive view of the vegetable kingdom; as well of its corresponding divisions in the animal world, and it is perhaps one reason why botany is so backward, that no botanist has hitherto ever looked for illustrations of his views out of his own particular science.

Question, are not such mosses as *Schistostega*, *Fissidens*, etc., really frondose, in as much as their leaves are oblique in their attachment? At any rate, whether they are leaves or not, this obliquity affords a passage to *Hepaticæ*, in which the frondose insertion is so rigidly adhered to, that scales formed by the growth of the radicles obey the law.

It is a singular fact, that of the two most reasonable hypotheses, that of viewing the sporula as pollen grains, and mine as sketched above, the analogies are in a precisely reversed ratio. For the first steps in the development of a theca are fatal to its being considered as an anther; and the last steps in its development, fatal to the idea of its being a seed.

The antheriform hypothesis gives no explanation of the complication of the apparatus, although it fairly explains the columella, yet it does not do so with regard to the inner membrane, unless absolute reliance is placed on *Brongniarts* re-

marks on the pollen developement in *Cobæa*? The dehiscence it explains, as well as the developement of the sporules and their mode of germination.

To suppose the sporula analogous to pollen grains, is to out-herod the doctrines of a sexuality; becauset he male organs of Phænogams require no fecundation to cause their perfection, and we should have the incongruity of perfect male organs developed without sexual intercourse in plants, where the sexes are most obvious, and male organs developed thro' sexual intercourse in plants in which the existence of sexual apparatus has not been demonstrated.*

Affghanisthan Musci.

The number of species of this family my be taken as about 63.

The greater number were met with about Otipore; where, as I have mentioned, the mingling of Himalayan with Affghan forms takes place. Central and eastern Affghanisthan appears to be remarkable deficient.

From the remarkable absence of forests on the lines illustrated by the collections, it follows, that with the exception of those of Bharowul, that almost all are terrestrial, and it is

* The views of Greville and Arnott, and a host of others, on this subject are unphilosophical, inasmuch as they are opposed directly to the law of gradation of form, the most universal in the natural sciences.

They are also opposed to all analogies, even of the most evident kind. If living beings propagate universally, the organs concerned are second only to organs of vegetation or digestion, hence their presence in all tribes would appear to be an absolute necessity.

But still more absurdly, they allow, that the probabilities are vastly in favour of their being sexual, and yet will not listen to arguments which have a host of analogies in their favour.

As there is every possible gradation in general form, why should there not be every possible gradation of parts? For myself, I see no valid objection to the supposition of a plant consisting of a few cells, perhaps one, multiplying itself by the agency of its sexes, each of which consisting of nothing but a single cell.

to be also remarked that they are generally met with about cultivation, where the natural dryness is remedied by irrigation, or in the alpine tracts about places possessing natural sources of water.

The general proportion they bear to the general flora is small, not exceeding $\frac{1}{3}$ the proportion of those of central and western Affghanisthan may be roughly estimated as $\frac{1}{10}$ a proportion to be expected from the extreme dryness, the wants of forests, springs, umbrageous ravines, and dripping rocks.

It appears to me a remarkable fact, more especially as it obtains to a considerable degree with those from Otipore and Bharowul, that the forms are as decidedly European, as any of those of the Phænogamous families, although it is precisely in this family that a large intermixture might have been looked for, such I take to be illustrated by the occurrence of *Timmia*, *Desmatodon Encalypta*, *Anictangium*, and *Phascum*, the last of which has only been observed in dry parts of British India. The abundance of *Tortula* in British India Muscology and a general proportion of the forms of some of the species of *Bryum*, *Weissia*, and *Gymnostomum* *Grimmia* and all the *Orthotrichum*.

No *Splachnum* or *Polytrichum* were observed, although some of the localities of Kohi Baba appeared suited to the former, and the country generally to some forms of the latter.

The areolation appears to me also curious, it is lax at the base and colourless, the green matter makes its appearance as an incrustation along the upper and lower sides or ends of the cells, then it spreads so as to include the sides or septa, gradually incroaching so as to leave a small part uncovered. Indeed in the margin in which the incrustation is green, the uncovered part is a mere slit: these cells look like markings on some vessels, the marginal structure is continued into the pilus, where it is much more elongated. Among the *Tortulæ* will be found one which appears to me is remarkable for the appendages to the leaves, of which I only know of instances

being recorded in *G. ovatum* and *Polytrichum*, *Dawsonia* and *Lyellia*, so that it forms an instance of the recurrence of a remarkable structure in at least three sections of the family; although attached to the axis of the leaf, as those of *G. ovatum*, to which leaves those of this *Tortula* have a considerable resemblance, they resemble rather those of *Polytrichum*. They have appeared to me as a great number of confervoid filaments, simple or generally branched, arising from the central line which is thick and cellular.

The cells contain green globules, and generally present rudiments of two or four from the apex of the terminal cell.

Of the nature of these bodies I am quite ignorant, those of *Polytrichi* may from their direction, and arrangement in lines be considered perhaps as performing the same functions as the leaf. They are rather analogous to gemmæ, or in young leaves the appendage has comparatively a large size with the lamella of the leaf.

Among the *Weissia* occurs a species perhaps identical with *W. pomiform* Gr. and has in a remarkable degree, the habit of *Bartramaia*. It is not a little singular, that the same very simple nature of the *Peristome* occurs again in *Entosthodon*, which has in a similar degree the habit of *Funaria*, a genus closely allied to *Bartramaia*.

Musci of Assam and Khasyah Mountains.

Of these by far the greater portion were collected on the Khasya Hills, an elevated tract of country, forming a portion of the Eastern frontier of British India. The extreme distance from Teryah Ghat, at the foot of the Hills on the southern side, to Raneegaon on the northern side, does not exceed 60 miles; and that between Churra Punjee and Nunklow, both of which may be said to be on the edge of the higher portion of the plateau, 35 miles.

The heights of the places situated on the route between the above places, are as follows; they are taken from Capt. Pemberton's "Report on the Eastern Frontier of British India:"

	<i>feet.</i>
Churra Punjee,	4,349
Surureem,	5,600
Moflong,	5,942
Myrung,	5,940
Nunklow,	4,553

In addition to these places, I must mention Moosmai and Mamloo, near Churra Punjee; and at about the same elevation, Mumbree between Moflong and Myrung, one of the highest parts on the route; and the Bogapanee, a mountain stream rushing through a valley perhaps 1,500 feet below Moflong. The mean annual heat of these Hills, although it probably varies much relatively to the distance from the commencement of the descent on either side, may be estimated at 65° Fahrenheit; calculating the average height to be 5,100 feet, and adopting Baron Humbolt's ratio of a decrease of one degree for every 396 feet of vertical ascent. Very little is known about the climate of the central portions; but towards either descent, it becomes one of excessive dampness throughout the rains. The southern side receives the whole force of the S. W. Monsoon, and the fall of rain at Churra Punjee, the only place where it has been estimated, is, if the accounts be correct, prodigious. Mr. Cracroft states, that the total rain that fell in four months from June to September inclusive, and in two days of October, when 15,790 fell, was inches 225,789. But if we consider that this so far exceeds the maximum amount observed in other places, exposed more directly to the influence of the S. W. monsoon, we may reasonably question the correctness of Mr. Cracroft's observations.

So little attention has been hitherto paid to Indian Muscology, that no parallel can be drawn between the Muscology of the Khasya Hills, and of other mountainous tracts of India. The present collection forms about one-eighth of the whole number, taking Bridel's total amount ($\frac{1}{8}$ species) to be nearly correct. Some idea may be formed of the probable

great number of species that remain to be found, when I mention, that the whole of the Hill collection was formed between the 8th of October, and the 20th of November: and that the most interesting portions of the hills to the Eastward of the route mentioned were not visited.

I know no arrangements of the genera, except the artificial one employed by Dr. Hooker, and the artificial and natural ones of Bridel, as given in his *Bryologia Universalis*. Mr. Brown begins his account of the Melville Island Mosses with *Polytrichum*. No very satisfactory ordination of all the genera has, I believe, as yet been given; nor will it be, until additional characters have been discovered. At the same time, I think, that several types of organization exist, and that in the larger groups of these, every gradation of development, at least so far as the peristome is concerned, may be observed.

Sphagnum approaches, in some points, to *Hepaticæ*, but I doubt the correctness of its being stated to be evaginulate. I have not been able to examine its fruits at different periods, but it appears to me that the only difference between it and the usual form, exists in the cohesion of the true apex of the seta, with the interior of the vaginula.

Polytrichum, in the structure and origin of its peristome, has nothing in common with the usual form of mosses, in which both peristomes originate from the inner membrane. In the genus alluded to, and in one or two allied genera, it is an extension of the outer wall of the capsule, shewing usually no indications of composition, and is probably analogous to the annulus of the more developed genera of the order. Its processes too are liable to vary in number, and they are in some species much increased beyond the number 32, which is the maximum number of a single peristome of the usual structure, in which likewise no instance occurs of less than 16; for although *Tetraphis* has only four, and one or two genera only eight teeth, the composition, as indicated by longitudinal lines, is in all such 32. The smallest number, 16,

exists in some *Weissia* and *Didymodon*s. I believe that Mr. Brown was the first to direct attention to the composition of the teeth of the peristome in the above instances. One of the most curious peculiarities in *Polytrichum* exists in the inflection of the inner membrane, forming, as it were, a ring opposite the *neck* of the capsule. This is quite distinct from the inflection that occurs in some other genera, in which the inflected portion is the termination of the membrane.

The outer peristome of *Buxbaumia* is obviously of analogous origin with the peristome of *Polytrichum*; neither do I see any reason for not adopting the opinion of Bridel, that the inner peristome of *Buxbaumia* and *Diphyscium* is analogous to the epiphragma of *Polytrichum*. Bridel in his generic characters of *Catharinea*, *Pogonatum* and *Polytrichum*, describes the teeth of the peristome as seizing, by their apices, the epiphragma. This is incorrect; the teeth are seized by the epiphragma, which, in the dry state alone by contraction, leaves the interstices open; in the wet state it expands, covering the whole of the teeth as well as their interstices.

I have referred a species, which, with almost every character of *Dicranum*, has the peristome of *Didymodon*, to the former genus. Schwaegrichen however refers a nearly allied species with a similarly anomalous peristome to *Didymodon*; this however appears to be sacrificing a number of characters to a solitary one. But if such views are correct, my *Fissidens neckeroides* must be incorporated with *Didymodon*.

Fissidens has, I think, without doubt, terminal setæ, for in those cases in which they are axillary, they frequently become elongated, which, so far as I know, is never the case with those which have truly lateral setæ. Judging from the first developed leaves both of the stem and perichæcium, it would seem that the "duplicatura" of Hedwig is the true lamina, and that they differ only from highly carinate leaves in the ex-current vein being as it were alate, the dorsal ala being prolonged down the carina to its base. The only objection to this view is the frequent inequality of the two lamellæ.

In *Trematodon longicollis*, I had opportunities of ascertaining the correctness of the observations of Mr. Valentine on the development of the setæ. With those observations I am only however partially acquainted. The old and incorrect ideas appear nevertheless to still prevail, and are admitted into the second edition of Mr. Lindley's Introduction to Botany. The explanations too adopted in this excellent book as to the difference between a mitriform and dimidiate calyptra, and an outer and inner peristome, are likewise particularly erroneous.

With regard to the development of the setæ of Musci, I know of no analogous instances, excepting *Jungermannia*, which is undoubtedly vaginulate. The changes subsequent to fecundation are, in these, much more complicated than in Phænogamous plants, in which they are limited almost universally to the maturation of a pre-existing ovule; whereas in these, they are extended not only to the development of the sporula, but to the generally highly complex apparatus in which these are contained.

I am not aware whether any one has explained the opposition of the teeth of the peristome in *Funaria*. But looking at the situation of the carinæ or plicæ that exist in the membrane of the inner peristome, which are invariably alternate with the teeth of the outer peristome, and at the allied genus *Bartramia*, it is evident, that the anomaly arises from the cohesion of the component parts of different processes, each of which thus becomes strictly compound.

I have approximated *Pterogonium* to *Neckera*, on account of its habit, and the laterality of its setæ: in its capsule and peristome it approaches nearly to some *Weissia*.

Daltonia I have adopted in the sense of Bridel. *Neckera heteromalla*, which Dr. Hooker refers to *Daltonia*, agrees entirely with *Neckera* in its inner peristome, and must, if attention be paid to its mitriform calyptræ, be referred to *Polytrichum* of Bridel, or *Daltonia* of Mr. Arnott? I have no opportunity of examining *Anomodon*, which can only differ in

the degree of development of the membrane of the inner peristome, and its adhesion to the base of the outer. As the authors of the *Muscologia Brittanica* state that their *Daltonia* agrees well in the inner peristome with *Anomodon*, there is some reason to doubt the accuracy of the generic characters of both these genera, as given in the book alluded to.

In *Neckera*, I have included *Polytrichum* and *Cryphæa* of Bridel, and *Daltonia* of Arnott. It is certainly a heterogeneous assemblage, particularly as regards habit. I have been guided in this by the existence of every gradation between the truly dimidiate calyptræ of the true *Neckera* and its mitriform state in *Pilotrichum*. The existence of the appendiculæ, which appear to have first excited attention in *Drepanophyllum*, is now, I believe, for the first time, pointed out as occurring in *Neckera*. Neither are they limited to one section, although three out of the four species in which they occur agree tolerably well in habit; and all are characterised by a great tendency to elongation in their branches, to the lower part of which elongation the appendiculæ are usually confined. Their structure is that of *Paraphyses*; their contents similar apparently to the contents of the ordinary form of anthers. As *Paraphyses* are perhaps, in all cases, abortive anthers, these appendages may be considered as anthers at the maximum of development. The objections to this exist in their having no especial protecting organs, and in their never appearing to dehisce. The question will be best set at rest, by examining whether they ever co-exist with male flowers of the ordinary form. If such is not the case, such species cannot remain grouped with those which have male flowers of the ordinary form. *Neckera Hookeriana* and *Adiantum* have leaves of two distinct forms, the lateral and distichous ones being alone oblique. This they possess in common with some *Hookeriæ*, *Leskiæ* and *Hypna*. In all, this is only an instance of excess, as it were, of the difference perceptible in the obliquity of the lateral leaves, and the equilaterality of the anticous and posticous ones of many

other mosses, and especially of the falcate section of Hypnum. With *Stipulæ* they have nothing in common, for independently of their being single organs,—even when they *may* be considered referable to, or as belonging to the lateral leaves, it is only to one series of these, and only to one point of these (the lower point of insertion), that they correspond.

I do not know whether the nature of the compound hairs existing on the *vaginula* or *calyptræ* of many mosses has been hinted at. In *Neckera crinita* they are obviously reduced perichæatial leaves. Such is probably their nature in all cases. They are not to be confounded with the simple hairs existing in similar situations, such being referrible to *Paraphyses*.

Anhymenium I have ventured to propose as a new genus, remarkable for the proportionally very small teeth of the outer peristome, and for the great development of the processes of the inner peristome, considered relatively to the almost total absence of a basilar membrane. In this instance, the disparity between the membrane and the processes, in favour of the latter, is greater even than in *Climacium*.

Pleuropus, the seconded genus, which appears to me new, has the same relation to *Leskia*, etc. that *Brachymenium* has to *Bryum*. From the former genus it is alone distinguishable by the laterality of its *setæ*, and the accompanying difference in habit.

Almost the whole of the above descriptions were made from dried specimens. I trust that considerable indulgence will be shewn to the numerous errors that must exist, especially as regards the fabrication of new species. Advice in Muscology is not to be obtained in India; and by means of consultation are limited to Bridel's *Bryologia Universalis*, the *Musci Exotici* of Dr. Hooker, and the *Muscologia Britannica* of Dr. Hooker and Taylor. In means of comparison with authentically named specimens, I am altogether deficient: owing to this, I have not ventured to meddle with either *Leskia* or *Hypnum*, under any circumstances, a business of some difficulty, but one to me almost insuperable, on account of the unnatural arrangement of *Hypnum* by Bridel.

Sequence of the genera of the Muscologia Itineris Assamici.

No. of species.				No. of species.			
1.	Sphagnum,	...	1	14.	Didymodon,	...	4
2.	Polytrichum,	...	6	15.	Funaria,	...	2
3.	Diphyscium,	...	1	16.	Bartramia,	...	3
4.	Gymnostomum,	...	7	17.	Brachymenium,	...	3
5.	Orthodon,	...	1	18.	Bryum,	...	7
6.	Orthotrichum,	...	5	19.	Pterogonium,	...	4
7.	Schlotheimia,	...	1	20.	Neckera,	...	20
8.	Weissia,	...	3	21.	Daltonia,	...	1
9.	Barbula,	...	3	22.	Pleuropus,	...	3
10.	Grimmia,	...	3	23.	Anhymenium,	...	1
11.	Trematodon,	...	2	24.	Hookeria,	...	4
12.	Dicranum,	...	13	25.	Leskia,	...	7
13.	Fissidens,	...	10	26.	Hypnum,	...	28
				<hr/>			
				Total,	143

I. PHASCUM Pl. CVIII. see p. 364

II. SPHAGNUM.

Sphagnum obtusifolium. Pl. LXXVI. Fig. 1.

HAB: In humidis, circa Surureem et Moflong.

VAR: a. *S. cymbifolium* Brid. Bryol. Univ. 1. p. 2?

HAB: In humidis ad margines rivulorum Moosmai.

Fructiferum nunquam reperimus.

a. Back view of leaf.

B. Front. ditto.

a. B. Cellular structure of ditto. *It Ass.* 517.

III. POLYTRICHUM.

1. *Polytrichum (Catharinea) angustatum*, Pl. XCIII. Fig. III.

Hook. Musc. Exot. p. 5. t. 50. Brid. Bryol. Univ. 2. 105.

HAB: In collium Khasiyensium regionibus altioribus, vix inveniendum infra altitudinem 5,000 pedum.

Aggregatum: Caules simplices, semunciales, e basi foliosi.

Folia siccatione marginibus involuta, valide crispata tortiliacque, celluloso-membranacea, ascendenti-incurvata, subcarinata, lanceolato-lineararia, acuta vel obtusiuscula, undulata, a medio supra denticulata, dorso apicem versus aspera papillis in lineis oblique transversis dispositis; vena crassiuscula completa dorso apicem versus denticulata; lamellis rectiusculis subquinis basin folii fere attingentibus; marginibus subincrassulis sub lentem modice augmentem fibrosis. Perichætialia consimilia, interiora minora.

VAR: a. *A. atrovirens*: Caules longissimi, setas excedentes, simplices vel. subramosi, inferne foliorum venis persistentibus obsiti; folia longiora, magis repanda et incurva.

HAB: Sururreem in rupibus madidis.

VAR: b. *Majus*: folia longissima, 4—linealia, magis incurvata.

1. Capsule.

2. Portion of ditto and Peristome.

- 2a. The same.
3. Epiphragma.
4. Operculum long section.
5. Calyptra.
6. Cellular process of Calyptra.
7. Leaf.
8. Vein and its columella, portion of
9. Portion of margin of leaf. *It. Ass.* 562.

2. *Polytrichum falcifolium*, Gr. Pl. XCIII. Fig. I.

Caule simplici, foliis e basi lanceolata subulatis falcatim incurvis integris, capsula rotundato-ovata exapophysata inclinata.

HAB: In arenosis Boga Panee, Collium Khasiyensium.

Aggregatum: Caules breves vix lineas tres longitudine excedentes.

Folia siccatione tortilia et incurva, madore falcatim incurva, e basi lanceolata cauli adpressa longe subulatum acuminata, concava, obtusa, integra marginibus subinvolutis, percursa vena crassa completa, lamellis conspicuis subseptem intructa.

Perichætalia basi largiora magisque membranacea.

Seta stricta, longitudine unciam puallo excedens, rubrotincta, siccitate tortilis.

Vaginula mediocris, anguste cylindracea. Paraphyses subnullæ, pistilla pauca, styli longi apicibus solito dilatatiores. Capsulinclinata nutansve, siccatione interdum erecta, sæpius rotundato-ovata et inæquali, interdum suburniformis, ore vix coarctato nunc obliquo, fusco-brunnea, inconspicue areolata; membrana interna libera, apicem versus capsulæ in anulum inflexa.

Peristomium e dentibus 27—33, sed sæpius ut videtur 32, basi connexis, brevius, acutis, leviter inflexis, sublentem materie grumosa hinc illinc opaciusculis, inæqualibus, latioribus (ob cohesionem) pluribus apice subemarginatis medioque sulcatis.

Epiphragma demum liberum.

Columella inclusa, 4 anguslaris, fere 4-alata, apice planiuculo anulum membranæ interioris subattingens.

Cætera non visa.

1. Capsule.
2. Long section of Capsule.
3. Portion of Peristome.
4. Epiphragma.
5. Cauline leaves. *It Ass.* 560.

3. *Polytrichum proliferum*, Gr. Pl. XCIII. Fig. II.

Caule indiviso hinc apice innovatione prolifero, foliis falcato-incurvatis siccitate tortilibus e basi lanceolata longe linearibus argute dentatis carinatis carina medium supra denticulata, capsula erecta oblongo-ovata basi sub-apophysata, operculo conico breviter apiculato, calyptra villosissima.

HAB: Legi primum in umbrosis circa Churra Punjee sed absque fructificatione; serius fructiferum invenit D. Wallichius infra rupes in umbrosissimis prope Surureem.

Cæspitosum, atrovirens: caules spithamæi, basi denudati. Folia siccitate marginibus involuta incurvata et tortilia, longissima fere semuncialia, angustia, acuta, vena completa ab initio partis linearis angustissime lamellata, infima innovationum oblongo-lanceolata, vena ellamellosa. F. perichætialia conformia longiora.

Seta terminalis vel pseudolateralis, solitaria vel geminata, crassiuscula, basi rubra cæterum pallida, siccitate tortilis et flexuosa. Vaginula angusta. Paraphyses filiformes hyalinæ, inæqualiter septatæ, tenuissimæ. Pistilla subnulla.

Capsula æquilateralis, oblongo-ovata, interdum anguste urniformis, fuscoviridis, collo constricto.

Membrana interna libera ad collum capsulæ in anulum inflexa, annulo, operculo persistente, apice columellæ obturato.

Peristomium e dentibus 32 linearibus, æqualibus, æquidistantibus, inflexis, basi unitis, acutiusculis, pulchre coccineo-rubris, marginibus hyalinis.

Epiphragma tenue, hyalinum. centro opaciusculum.

Columella cylindracea, irregulariter alata, apice imo plana, longitudine fere capsulæ.

Sporula in acervulo sordide viridia, minuta, rotundata, lævis, inæqualia.

Operculum conicum breviter recteque subulatum. Calyptra dimidiata, fusca villis arcte implexis pallide ferrugineis.

1. Capsule and operculum.
2. Ditto, Ditto, divided longitudinally
- 3, 3. Portion of Peristome and Epiphragma dry.
4. Ditto, moistened.
5. Sporula.
6. Calyptra
7. Cauline leaf.
- 7a. Transverse of section of cauline leaf.
8. One of the lower leaves. *It. Ass.* 561.

4 *Polytrichum urnigerum*? Menz? Hook. et Tayl. Musc.
Britt. 49. t. 11.

Var : *Simplicicaule*.

HAB : In ripis in Pinetis circa Moflong.

Habitus fere *P. juniperini*. Medium videtur inter *p. urnigerum* et *aloides*, illi statura majore, colore, foliisque accedens, huic caule simplici. Dentes peristomii pallidi, inæquales, sub—
32. Calyptræ villi fulvi.

5. *Polytrichum alloides*. Hedwig Pl. XCII. Fig. 1.

HAB : In collibus Khasiyensibus vulgatim ; in ripis arenosis rivuli Deboro apud Kujoodoo et Rangagurrah, regionis Assamicæ altæ. Nuperius vidi allatum e collibus Aborensibus.

1. Capsule and Calyptra.
2. Capsule and operculum.
3. Apex of Capsule.
4. Ditto, long section.
5. Ditto, of apex of Capsule.
6. Portion of peristome.
7. Ditto, of Epiphragma.

- 8, 8. Sporula.
 9. Operculum in bad perspective.
 9a. Ditto long section.
 10. Calyptra villi partly removed.
 10a. Calyptra striped of villi. *It. ass.* 559.
 Variat magnopere statura, capsula læviuscula vel papulosa, operculique longitudine.

6. *Polytrichum*?

HAB: In collibus Aborensibus in solo arenoso.

Efructiferum tantum vidi. Caules elongati simplices basi nudiusculi. Folia undique imbricata, e basi latiuscula membranacea longissime lineari-subulata, concavo-canaliculata, apices versus tenuiter denticulata, percursa vena crassa anguste lamellosa, dorso apicem versus denticulata, madore incurva summa subsecunda, siccitate tortillia marginibus involutis.

P. prolifero valde offine. Habitu et foliatione Lyelliæ crispæ proximum, differt tantum foliis magis incurvis, tenuiter et apices versus tantum denticulatis.

IV. DIPHYSCIUM. WEB: ET MOHR.

1. *Diphyscium longifolium*, Gr. Pl. XCVI.

Caulescens, foliis (maximis) ligulatis acutis integris vel crenulatis, perichæatialibus vena excurrenti longe aristatis laciniis sæpidus dentiformibus, capsula semi-exerta, calyptra dimidiata.

HAB: In saxis rupibusque rorantibus ad Mõosmai et Surureem, etiam in rupibus in sylvis umbrosis Myrung.

Dense cæspitosum, sæpe pulvinatum: e locis madidis proveniens atrovirens. Caules longitudine variantes a lineis duabus usque ad semunciam, inferne denudati. Folia siccatione incurvata crispataque marginibus involutis, madore subrosaceim potentia, repanda, sæpius irregulariter crenata, prædita vena crassiuscula completa inferiora minora, reliqua bilnealia: areolæ minimæ.

Perichætialia plurima, erecta; exteriora foliis caulinis similia sed vena excurrente longe aristata, reliqua intus gradatim magis magisque membranacea, apice bifida sinu longe aristigero, laciniis integris vel breviter laciniatis, intima minima fere omnino membranacea.

Seta subnulla. Vaginula brevis conica, albida. Paraphyses paucae vel subnullae. Pistilla 3—5 breviter stipitata stylis longissimis.

Capsula alba, magna, oris margine irregulari. Membrana interna discreta, insidens stipite brevi conico, capsulae ope filamentorum cellulorum adhærens, ore constricto irregulariter lacero. Peristomium sub-16-plicatum, niveum. Columella inclusa, plana, latissima. Sporula globosa, lævia, valde irregularia, in acervulo læte viridia.

Operculum conicum, obtusum, vel acute rostratum, cum columellae apice secedens.

Calyptra subulata ad apicem usque fere fissa, operculi longitudine.

D. folioso proximum.

1. Plant magnified.
2. Capsule and Perichætial leaves.
3. Capsule and Paraphyses laterally.
4. Ditto, front view.
5. Capsule long section.
6. Capsule removed, inner membrane and base of capsule remaining.
7. Portion of capsule with operculum.
8. Operculum.
9. Ditto, long section.
10. Ditto, Ditto, base with capsule.
11. Apex of capsule.
12. Portion of ditto.
13. Portion of Peristome rather expanded.
14. Inner membrane detached and laid open.
15. Columella.
16. Sporula.
17. Leaf.

18. Operculum of the Myrung plant.
 19. Ditto, its calyptra.

GYMNOSTOMUM. HEDW. BRIDEL EX PARTIM.

SECT. I.—GYMNOSTOMA VERA.

1. *Gymnostomum repandum*, Gr.

Caule simplici, foliis congestis ascendenti-patentibus spathulato-lanceolatis acuminatis repandis apices versus serratis vena intra apicem evanida, capsula turbinato-hæmisphærica, operculo convexiusculo mammillato.

HAB: In terram circa Suddya vulgatim occurit. Per menses frigidos fructificat.

Pussillum, semunciam vix metiens. Folia marginibus simplicia; areolis magnis irregulariter parallelogrammicis: vena crassiuscula fere completa. Perichætialia magis ovata.

Seta brunnea, vix bilinealis.

Vaginula subcylindracea; paraphyses pistillaque subnulla.

Capsula brunnea hæmisphærica, sed ob apophysin spuriam basillarem turbinato-hæmisphærica. Sporula brunnescentia sphærica, sub lentem modice augmentem echinata. Calyptra basi ventricosa 3-4-fissa.

Species forsan vix distincta, intermedium videtur inter *G. sphæricum* et *G. pyriforme*.

2. *Gymnostomum pulchellum*, Gr.

Caule simplici, foliis congestis ascendenti-patentibus spathulato-lanceolatis apiculatis repandis marginatis subintegris vena in apiculum excurrente, capsula turbinato-pyriformi, operculo planiusculo umbonato.

HAB: In terram circa Suddiya.

Præcedente cum quo mixtum occurrit duplo triplove majus.

Folia conspicue areolata, areolis parallelo grammicis angulatisve. Perichætialia majora magisque ovata. Seta 3-4 linealis erecta, pallida. Capsula erecta brunnea, membrana in-

terna inter os hujus in anulum brevem inflexa. Sporula rotundata, sub lentem acre augmentem minutissime scabrella. Calyptra basi ventricosa fissa.

Verisimiliter intermedium inter *G. pyriforme* et *fasciculare*. Præcedenti valde affine.

3. *Gymnostomum atro-viride*, Gr. Pl. XCV. Fig 1.

Caule fastigiatim ramoso, foliis lineari-lanceolatis acutis carinatis integris patentibus siccitate incurvis vena subcontinua inferioribus subtrifariis, perichætialibus convolutis longe aristot-acuminatis, capsula erecta ovata vel rotundato-ovata, operculo oblique rostrato capsulam æquante.

HAB: In saxis Maamloo, in rupibus madidis Moosmai.

Dense cæspitosum, siccatione fuscoviride. Caules dense conferti, fastigiatim ramosi, vel dichotomi vel hinc innovatione tantum præditi, vix semunciales. Foliorum carina scabrella (an semper?), areolæ parvæ sæpius rotundatæ, perichætialium vena infra apicem evanida.

Seta trilinealis sanguineo-brunnea. Vagina subfusiformis. Paraphyses paucissimæ. Pistilla subnulla.

Capsula rubro-brunnea ore paullo constricto, exanulata. Membrana interna libera, stipitata, paullo infra os capsulæ inflexa, marginibus laceris. Sporula in acervulo fusco-brunnescentia, rotundata, lævia, suburiformia. Columella clavata, apice truncata et membrana obsolete marginata. Operculum basi convexiusculum. Calyptra dimidiata parva.

VAB. *a*. Foliis duplo angustioribus, perichætialibus acuminatissimis sed vix aristatis.

G. Xanthocarpo propinquum. An satis distinctum a *G. curvirostro*?

1. Capsule.
2. Long section of the young.
3. Ditto, ditto, mature.
4. Columella.
5. Sporula

6. Operculum.
7. Calyptra
8. Leaf.

4. *Gymnostomum inconspicuum*, Gr.

Caule simplici vel apicem versus ramoso, foliis siccitate tortilibus carinatis madore planiusculis patenti-ascendentibus oblongo-lanceolatis rigidis acutis integris, perichætialibus conformibus, capsula erecta cum apophyse cylindræceo obovata.

HAБ: Inveni mixtum parcissime cum *Dicranis* quibusdam in rupibus madidis, Churra Punjee.

Dense cæspitosum. Caules unciales vel breviores, basi decumbentes, simplices vel apices versus innovationibus fatigiatim ramosi. Folia undique patentia raro recurvata, superiora conferta lanceolato-linearia, marginibus basin versus recurvis inferiora oblongo-lanceolata subintegerrima, læta lutescenti-viridia, percursa vena intra apicem evanida, areolis densis opaciusculis punctiformibus. Perichætialia carinata, intima minora.

Vaginula brevis cylindræceo-ovata. Paraphyses plures hyalinae subfiliformes, brevissimæ. Pistilla pauca.

Seta pallida lineas duas longitudine vix excedens.

Capsula sub-inæqui-lateralis, ovato-cylindræcea, apophysin obconicam terminans, ore parum angustato. Membrana interna basi discreta, stipitata, ad collum capsulæ breviter introflexa. Columella subcylindræcea apice paullo dilatata, planiuscula. Sporula globosa lævia, immersa diaphana.

G. longirostro, Gr. affine, diversum præcipue setis omnibus terminalibus, foliorum marginibus nullo modo involutis, formæque capsulæ.

SECT. II.—HYMENOSTYLIIUM.

Capsulæ os clausum columellæ apice dilatato et membrana interna introflexa. Opeculum cum columellæ apice secendens.

5. *Gymnostomum longirostrum*, Gr. Pl. XCV. Figs. II. III.

Caule innovationibus prolifero vel simplici, foliis lanceolato-linearibus acutis solidiveniis integerrimis marginibus involutis, capsula erecta oblongovata, operculo longe et recte rostrato capsulam excedente.

HAB: In collibus Khasiyensibus sed locus mihi incognitus.

Cæspitosum. Caules decumbentes sæpe unciales, radiculis brunneis villosi, proliferi, et sæpe parce ramosi. Folia siccitate insigniter involuta et incurvata, madore ascendenti-patentia, inferiora oblongo-lanceolata, superiora lineari-lanceolata, luride viridia, subcarinata, marginibus flexuosis involutis, areolis minutissimis, percursa vena fuscescente completa.

Perichætialia conformia, interiora minima.

Seta brevis vix bilinealis lutescens, terminalis si solitaria, si plures terminales lateralesque, siccitate tortilis.

Vaginula cylindracea. Paraphyses filiformes hyalinæ. Pistilla pauca. Capsula exannulata, oblongo-ovata vel cylindraceo-oblonga, lutescens, parietibus tenuibus diaphanis collo contractiusculo, ore irregulariter denticulato rubro.

Columella clavata, inclusa, breviter stipitata basi reliquiis membranæ internæ cincta.

Sporula rotundata, lævia, immersa subdiaphana.

Operculum e basi conica rubra longe rostratum, capsulam paullo excedens, rostro lutescenti acuto, basi conica columellæ apice adhærenti otrusa. Calyptram non vidi.

Affinis *G. xanthocarpus*. Hook. Musc. Exot. p. 2 t. 153 præsertim capsula structura. Habitus, ut videtur, quodammodo *Calymperes Gardneri*.

Of this very distinct species, I have only seen one capsule before the fall of the operculum. The inner membrane is totally distinct from the capsule, and is connected only with the margin of the much dilated apex of the columella. It subsequently seems to become irregularly ruptured; the base alone remaining, and surrounding the lower portion of the columella.

1. (Fig. II.) Plant.
2. Capsule, seta, and inner Perichætial leaves.

3. Middle cauline leaf.
4. Upper ditto.
- 4a. Long section of capsule.
5. Sporula.
1. (Fig. III.) Plant.
2. Leaf.
3. Capsule.
4. Long section of capsule with section of operculum.
5. Operculum.
6. Inner membrane and base of capsule.
7. Long section of old capsule.
8. Columella of ditto, and remains of inner membrane.
- 5a. Sporula in water.

SECT. III.—DIASTOMA.

Capsula annulata, collo insigniter constricto. Operculum cum columellæ apice secedens.

Huic sectioni primo *D. Hookeri* propositæ pertinent *Gymnostomum julaceum* et involutum ejusdem auctoris. A *Gymnostomo* differt omnino habitu, et statione geographica, illo nempe boreali, hoc tropicali. Locus naturalis Barbulam. prope? A *Gymnostomis* veris posterum certe segregandum,

6. *Gymnostomum denticulatum*, Gr. Pl. XCV. Fig. IV.

Caule sub-simplici, foliis lingulato-oblongis acutis apices versus denticulatis vena sub-completa, perichætialibus intimis convolutis obtusissimis integris, capsula anguste cylindracea, operculo subulato.

HAB: In rupibus inter Syung et Myrung, et in terram circa Mofong. Nuperius legi in collibus Naga dictis altitudine circiter 1,000 pedum.

Cæspitosum. Caulis erectus, vix semuncialis. Folia siccatione incurvata, marginibus insigniter involutis, madore patenti-

recurvata, leviter repanda marginibus vix incurvis imo sæpa leviter recurvis, percursa vena crassa sursum valde attenuata et vix completa; areolis minutis.

Perichætalia exteriora conformia, marginibus superne involutis, interiora minora integerrima vena infra apicem evanida. Seta ob innovationes interdum pseudo-lateralis, filiformis, rubescens, siccitate tortilis. Vaginula obclavata, basi paraphysibus pistillisque paucis obsita.

Capsula leviter inclinata, subinæquilateralis brunnea, sub lentem modice augmentem areolatim striata. Annulus insignis, initio horizontalis, operculo detruso erectus. Membrana interna libera, subsessilis.

Columella filiformis, longitudine fere thecæ.

Sporula minuta, rotundata, lævia, in acervulo fusco-viridia, immersa diaphana, subunimia.

Operculum subulatum, capsula subquadruplo brevius, rostro sæpius declinato.

Calyptra dimidiata lævis, semel bisxe torta.

Variat statura, foliis madore etiam margine involutis, et obsolete denticulatis. An ideo posterum cum *G. involuto*. Hook. *Musc. Exot.* p. 2 t. 154, conjungendum?

1. Capsule and operculum.
2. Apex of capsule. Annulus reflexed.
3. Mouth of capsule (dry) vertically viewed.
4. Long section of capsule (hypothetical figure.)
5. Upper portion of columella.
6. Epiphragma, only seen once.
7. Sporula.
8. Operculum.
- 8a. Long section of ditto.
- 9, 9. Calyptra.
10. Leaf.—*It. ass.* 529.

7. *Gymnostomum recurvum*, Gr. Pl. XCII. Fig. II.

Caule ramoso, foliis ascendentibus lanceolatis acuminatis integerrimis marginibus recurvis vena crassa in mucronem excurrente, capsula ovato-cylindracea, operculo subulato.

HAB : In arenosis Bogapanne.

Cæspitosum, totum rufescens. Caules sæpius pluries ramosi, ramis subfastigiatis, inferne nudiusculi.

Folia caulis primarii dense, ramorum laxiuscule imbricati, siccitate adpressa, rigida, marginibus subincrassatis, areolis distinctis subparallelogrammicis.

Flos fæmincus terminalis, discoidius, cinctus foliis perichætialibus ascendenti-patentibus, concavis, cæterum caulinis subsimilibus. Paraphyses paucissimæ. Pistilla plura sub-octena.

Vaginula cylindracea. Seta vix semuncialis, rubescens, ob innovationem pseudolateralis, sicca tortilis. Capsula erecta, utrinque attenuata, rubro-brunnea. Annulus ut in præcedente.

Membrana interna libera.

Sporula in acervulo fusco-viridescens, inæqualia, rotundata, immersa diaphana.

Operculum subulatum, rectum vel obliquum. obtusum, capsula subtriplo brevis.

Calyptra subulata; dimidiata, ad medium fere fissa.

Variat statura et acumine imo foliorum sæpe diaphano.

1. Capsule and operculum.
2. Ditto, ditto.
3. Portion of capsule.
4. Inner membrane separated, and long section of base of capsule.
5. Portion of annulus.
6. Operculum.
- 7, 7, 7. Leaves.—*It. ass.* 534 and 535.

Hymenostoma encalyptroides Gr. Pl. CIII. Fig. II.

1. Plant natural size, each stem is brached 2 or 3 times.
2. Ditto enlarged.
3. Leaf.
- 3a. Tissue of ditto 1-20, near the base. These densely tissueed forms, shew the greatest perfection such forms of leaves can attain, i. e. the maximum of green matter.

4. *4a.* Female flowers in different stages *4a*: Pistillum, apice papillis scabrum, 4 apex of its ovulum or seta, *4a.* one of the cellular processes *4b.* same, more advanced, the coagulation visible in most of the cells, it is developed from above downwards.
5. Capsule and calyptra, etc., *5a*, opercle, which does not adhere with the calyptra.
6. Capsule detached from calyptra.
Mouth of the capsule, *7. 7.* are from the same specimen, but shew both sides of the capsule. The membrane is excessively fragile, with a tendency to separate into teeth; in structure it is similar to the inner membrane, but is so fine as to be scarcely entitled to the term cellular, it is opaque and minutely punctulate?
8. Base of capsule. long section.
9. Plan of mouth of capsule.
10. Sporula.
11. Stomata which are few in number, and very inconspicuous.
12. Portion of epiphragma.
13. Do. of inner membrane, this has a remarkable analogical appearance with the embryonary sac in exalbuminous vegetables.

VI. ORTHODON BORY.

1. *Orthodon subglaber*, Gr. Pl. LXXVI. Fig. II.

Caule erecto simplici, foliis oblongo lanceolatis acuminatis apice piliferis argute serratis, calyptra basi glabra apice papilloso scabra.

HAB: In arboribus vigentibus mortuive in sylvis Mumbree, in arboribus et rupibus in sylvis Myrung; in utroque loco satis copiosus.

Habitus foliatioque fere omnino *O. serrati*, sed folia dorso lævia, apice in pilum integrum diaphanum breviusculum exeuntia,.

Capsula erecta, oblongo-ovata, apophysin brevem obconicam terminans, siccitate subcylindræcea, collum infra angustata.

Membrana interna arcte adnata.

Peristomii dentes madore incumbenti-conniventes, siccitate erectiusculi apicibus inflexis, distantes, latiusculi, crassi, coriacei, lineis tribus, quarum centralis conspicuosior exarati, lineisque transversis plurimis; etrabeculati, sub lente acre augmentem minute punctualati.

Columella cylindræcea, inolusa.

Sporula in acervulo sordide lutescentia, irregularia, lævia, sæpius extremitate una alterave attenuata.

Operculum ut in *O. serrato*, sæpius cum calyptra secedens.

Calyptra mitræformis, basi ventricosa, et profunde 4-partita, lacinii abrupte inflexis, fundum vel os calyptræ claudentibus, apice subulata sub lentem papillis scabra, cæterum glabra.

1. Capsule (stiffly drawn.)
2. Portion of capsule and peristome seen internally.
3. Tooth of peristome.
5. Operculum.
6. Calyptra.
- 6a. One of the inflected laciniae pulled out.
7. Leaf.

VII. ORTHOTRICHUM, HEDW.

1. *Orthotrichum concavifolium*, Gr. Pl. LXXVI. Fig. III.

Caule fastigiatim ramoso squarroso, foliis cordatis vel cordato-ovatis concavissimis breviter apiculatis evanidiveiis perichæatialibus marginibus insigniter revolutis vena excurrenti cuspidatis, capsula oblongo-urceolata immersa, peristomio simplice, operculo conico.

HAB: Inveni specimen unicum fructiferum mixtum cum *Neckera aurea* e Mumbree,

Caulis erectus, sæpius fastigiatim ramosus, uncialis. Folia undique imbricata, siccitate arcte adpressa, madore patentissima,

convoluto-concava, integerrima, marginibus leviter revolutis, vena medium ultra evanida prædita, areolis minutis oblongis vel rotundatis, summa minora, cordata, brevissime acuminata obtusa.

Perichætialia subconformia paullo majora a medio supra reflexo-patentia, valde acuminata, marginibus insigniter revolutis, vena sursum ampliata excurrenti ibidemque scabrella per-cursa.

Vaginula (saltem nuda) brevissima rubro brunnea. Paraphyses Pistillaque pauca.

Seta brevissima, exserta et vaginula subnulla.

Capsula sublœvis, ore valide constricto, fuscoviridescens. Membrana interna adnata.

Peristomium e dentibus 16, brevibus, erectis, fragilibus, albis, punctulato-opaciusculis, marginibus scabrellis, lineis transversis conspicuis, centrali longitudinali subobsoleta.

Columella cylindracea, apiculata, inclusa. Sporula majuscula, uniformia, globosa, laevia, immersa opaciuscula. Operculum conicum breve, rubrum.

Solum est inter *Orthotricha* Khasiyensia forma boreali gaudens.

1. Plant magnified.
2. Cauline leaf.
3. Perichætial leaf.
4. Capsule.
5. Mouth of capsule and peristome.
6. Portion of peristome and capsule seen internally.
7. Sporula.
8. Operculum.

2. *Orthotrichum Moorcroftii*, Pl. LXXVI. Fig. IV.

Hook et. Grev.

Fig. IV. in Edinb. Journal of Science, 1824, 1 p. 116, e. Bridelio. *Leiotheca Moorcroftii*, Brid. Bryol. Univ. vol. I. App. p. 727.

HAB: In rupibus arboribusque per totos colles Khasiyanos inter Churra Punjee et Nunklow.

Variat colore fuscescente foliisque madore minus patentibus. Folia siccitate incurvatim tortilla. Perichætialia exteriora conformia, interiora oblongo-lanceolata cuspidato-acuminata. Vaginula cylindræa angusta, ubique paraphysibus plurimis hyalinis, summis longissimis, basinque versus pistillis pluribus obsita. Capsulæ os incrassatum, lucidum, sulcatum. Dentes Dentes peristomii pallidi, albidi, vix per paria approximati, lineis compositionis inconspicuis.

Sporula magnitudine summopere varia, opaciuscula.

1. Casule and calyptra.
2. Capsule and operculum.
3. Capsule and operculum remaining attached to the exerted point of the columella.
4. Apex of capsule.
5. Portion of capsule and peristome seen internally.
6. Sporula.
7. Operculum.
8. Compound hair.
9. Cauline leaf.
10. Perichætial leaf. *It Ass.* 521.

3. *Orthotrichum assamicum*, Gr. Pl. LXXVII. Fig. II.

Caule repente, foliis lanceolato-linearibus subcarinatis ascendentibus siccitate incurvatis contortisque, capsula anguste cylindræa, peristomio simplice, calyptra villosa.

HAB: In arboribus versus Negrogam et in agro "Muttaek" dicto, regionis Assamicæ altæ; atitudine supra mare circiter 600 pedum.

Cæspitosum, ramosum, rami breves ascendentes. Folia rectiuscula, integerrima, marginibus leviter recurvis, prædita vena crastiuscula in apiculum brevem mucroniformem excurrente, inconspicue areolata.

Perichætialia interiora, fere membranæa, subconvoluta, cuspidato-acuminata, solidivenia.

Seta ob innovationes lateralis, vix semuncialis, brunnea, sicca spiraliter torta. Vaginula cylindræa. Paraphyses plurimæ, summæ longissimæ. Pistilla pauca longiuscule pedicellata.

Capsula erecta; juniorem tantum vidi.

Peristomium simplex, e dentibus 16 binatim compositis, obtusis, sæpius emarginatis, punctulato-opacis, notatis linea longitudinali semi-diaphana, lineis transversis ægre distinctis.

Sporula fuscescenti-viridia, irregularia. Operculum e basi convexa recte rostratum capsula triplo brevius.

Calyptra campanulata, pilis luteis compositis ascendenti-adpressis villosa, basi 3-5 fida, fissuris irregularibus, una alterave medium fere attingente.

Præcedenti proximum; capsulaque matura non observata an jure separavi ob folia breviora, ascendentia, siccitate contorta, capsula magna anguste cylindraceam?

1. Capsule and operculum.
2. Ditto and calyptra.
3. Portion of ditto and peristome seen internally.
4. Sporula.
5. Cauline leaf.
6. Peristome.—*It. Ass.* 522.

4. *Orthotrichum squarrosum*. Hook et Grev. Pl. LXXVII.

Fig. I. Loc citat. p. 128 (e Bridelio) *Schlotheimia squarrosa*. Brid. Bryol. Univ. I. 324.

HAB: In terram in sylvis, Myrung.

Bridelio) *Scholtheimia Squarrosa*. Brid. Bryol. Univ. I. 324.

HAB: In terram in sylvis, Myrung.

Planta Khasyana cum descriptione Brideliana bene convenit; differt tantum statura minore, ramis sæpe apice tantum ob innovationes ramosas et peristomio interiore?

Peristomii utriusque descriptionem subjungo.

Peristomium exterius madore connivens, siccitate semi-reflexile, edentibus 16 binatim compositis, subulato-planis, obtusis, emarginatis, rigidis, opacis, solidis, rufobadiis, linea longitudinali subdiaphana transversisque crebris minus conspicuis notatis.

Interius e ciliis totidem alternantibus, ad basin usque fere bipartitis, rarius indivisis, (ciliolis inæqualibus) peristomium ex-

terius longitudine æquantibus vel sæpius brevioribus, opaciusculis, sublentem centies augontem conspicue sed irregulariter striatis, peristomio exteriori præcipue basin versus plus minus cohærentibus.

Structura peristomii interioris affine *O. perichætiali* Hook. et Grev.

1. Capsule and calyptra.
2. Capsule and operculum.
3. Capsule.
4. Portion of the mouth of the capsule.
5. Portion of the mouth capsule with both peristomes seen externally.
- 5a. Ditto, with outer peristome.
- 6, 6. Operculum.
7. Sporula.
- 8, 8. Cauline leaf.
- 8a. Portion of cauline leaf. *It Ass.* 518.

5. *Orthotrichum ? bryoides*, Gr. Pl. LXXVII. Fig. III.

Caule repente ramoso. ramis sterilibus repentibus fertilibus erectis, foliis coriaceis obovatis-subulato apiculatis margine fibrosis, capsula erecta oblongo-elliptica ore coarctato, calyptra villosa.

HAB: In arboribus in locis humidis Surureem.

Cæspitosum. Rami fertiles unciales inferne dense radiculis ferrugineis vestiti.

Folia subconformia, siccatione crispata tortiliaque, madore oblique patenti-ascendentia, interdum recurva,* apices versus ramorum fertilium conferta, obovata, vel obvato-oblonga, repanda, apicibus rotundata, subulato-apiculata, vena crassa subulata in apiculum excurrente vel sæpius infra apicem evanida donata; marginibus fibrosis, integerrimis; areolis pro genere maximis, angulatis, oblongis vel parallelogrammicis, Folia perichætialia pauca, subconformia, basi concava, exteriora majora, interiora multo minor.

* Maxima, longitudine $2\frac{1}{2}$ lineas, latitudine I lineam metientia.

Seta terminalis, viridescens, crassiuscula, sicca tortilis.

Vaginula ovato-oblonga, pistilla plurima præsertim basin versus gerens. Paraphyses plurimæ, summis longissimis, inferne e cellularum seriebus duabus conflatis, pilis paucie compositis immixtis ascendentibus circa setæ basin.

Capsula magna, longitudine fere bilinealis, latitudine semi-linealis, brunnea, sub lentem modice augmentem conspicue celluloso-aeolata, ore lævi valde angustato.

Peristomium utrumque imperfectum tantum vidi. Exterius e dentibus 16? conniventibus, albidis, angustis, binatim compositis, obtusis, infra opacis, supra punctulatis subhyalinis, linea longitudinali indistincta, transversis pluribus distinctioribus notatis, fragilibus, leviter semet cohærentibus.

Interius membrana areolata brevissima p. exteriori 4-plo brevis, apice irregulariter dentata, alba, obsolete plicata.

Operculum (immaturam) conico subulatum obtusiusculum.

Calyptra (immatura) anguste companulata, basi subintegra, pilis compositis longis, ascendentibus patentibusque, flexuosis villosa.

Species perpulchra distinctissima, habitu omnino bryoideo, areolatione marginationeque foliorum in tribum insolita insignis.

Verisimiliter Schlotheimiæ, peristomio interiore perfecto investigato, in posterum adjungendum. Per. exterius p. exteriori Schlotheimiæ sulcatæ simillimum.

1. Young plant.
2. Old plant.
3. Capsule.
4. Apex of capsule with the remains of the peristomes.
5. Very young operculum.
6. Calyptra.
7. Outer perichæatial leaf.
8. Cauline leaf. *It Ass.* 532.

VIII. SCHLOTHEIMIA BRIDEL.

1. *S. sulcata*. Hook. Pl. LXXVIII. Fig. I. Musc. Exot. 2. 14, t. 156.

Macromitrium sulcatum. Bird. Bryol. Unin. 1. 319.

HAB : In rupibus et arboribus Churra Punjee et Moosmai.

Rami hinc apice fere semper innovantes.

Capsula 8-sulcata. Membrana interna adnata. Peristomium exterius e dentibus 16 binatim compositis, minime evolutis, obtusis, fragilibus, fusciscentibus.

P. interius longitudine exterioris, e membrana cellulosa areolata, margine irregulariter denticulata, quamvis conspiciere licet formatum esse videtur e dentibus ciliisve totidem alternantibus, binatim compositis et firme cohærentibus.

Columella inclusa apice truncata.

Sporula in acervulo viridia, lævia, magnitudine valde varia, minima immersa diaphana, majora opaca.

1. Capsule and calyptra.
2. Capsule and operculum.
3. Capsule.
4. Capsule long section of.
5. Portion of the long section of the capsule and outer peristome seen externally.
6. Portion of inner peristome.
- 7, 7. Sporula.
8. Opercula.
9. Cauline leaf. *It Ass.* 520.

IX. WEISSIA HEDW. BRIDEL EXPARTE.

1. *Weissia Templetoni*. Hook. Pl. LXXIII. Fig. II.

HAB : In terram circa Moflong.

Flos masculus cinctus foliis perigonalibus rosaceis patentibus ovato-oblongis. Antheræ plurimæ, cum stipite longo clavatæ, constantes e sacculo simplici subrotundo oblongove, hyalino, transversim dehiscente, stipitem oblique terminante, immixtæ paraphysibus setaceis vel clavatis.

Vaginulæ superficies celluloso-areolata.

Variat statura, foliorum serrulatione et acuminatione, capsula interdum subglobosa et peristomii fugacitate et structura, varietate una peristomio multo magis evoluta minusque fugace gaudente, dentibus simplicibus vel binatim compositis.

Folia magis acuminata et operculum magis planum quam in figura, Hook. et Tayl. Musc. Britt. t. 14.

Planta a *Weissia* proculdubio segreganda.

Habitus omnino *Gymnostomi*, a quo ob peristomii dentes operculo detruso fugacissimos caute distinguendum.

Vix *Eremodon longicollis*, Bird. Bryol. univ. 1. 234. ob venam evanidam.

1. Capsule and operculum.
2. Portion of capsule and peristome seen internally.
3. Portion of peristome much magnified.
- 3a. Tooth of peristome of variety.
4. Operculum.
5. Calytra.
- 6, 6. Anthers.
- 7, 7. Leaves.—*It. Ass.* 514.

2. *Weissia bartramoides*, Griff. Pl. LXXVIII. Fig. III.

Caulis fasciculatim? fastigiatis ramoso, foliis (siccitate rectis) adpressis lanceolatis acuminatissimis solidiveniis perichæti-
bus aristatis, capsulæ erectæ globosæ vel ovato-globosæ ore valide constricto.

НАВ: Rupes arenosæ ad Churra Punjee, Surureem, et Bogapanee. Cæspitosa. Caulis ascendens, apice fastigiatis ramosus, vix semuncialis.

Rami subelavati, extrorsum curvati,

Folia caulis subdistantia, ramorum densissime imbricata acuminatissima, fere pilifera, acuminibus denticulatis, interdum apice diaphanis, percursa vena crassa breviter excurrente, marginibus leviter revolutis, areolis oblongis parallelogramicis.

Flos. hermaphroditus, terminalis, gemmiformis, foliis perichæti-
alibus conformibus in cuspidem piliformem acuminatis, vena longe excurrenti. Antheræ paucæ, pallide lutescentes, oblongæ, breviter stipitatæ, apice dehiscentes, cellulis irregularibus areolatæ. Paraphyses subnullæ. Pistilla antheris numerosiora, longiuscule stipitata.

Seta terminalis, subsemuncialis, fuscescens, sicca tortilis.

Vaginula mediocris.

Capsula siccatione sulcata, brunnea, ore lævi rubro-brunneo.

Membrana interna discreta.

Peristomium, quod imperfectum solum vidimus, fugacius, e dentibus 16 siccatione erectis, humore fere horizontaliter conniventibus, brevibus, latiusculis, binatim compositis (ciliolis interdum facile solubilibus) rarius simplicibus, solidis vel longitudinaliter perforatis, apice emarginatis, aliquand oper paria approximatis diaphanis, pallide fusco-lutescentibus.

Columella cylindracea, inclusa, apiculata.

Sporula fusco-ochroleuca, oblonga, lævia, immersa opaca.

Operculum non visum.

Calyptra dimidiata, per totam fere longitudinem fissa.

Affinis præsertim forma capsulæ, W. pomiformi, Hook. Musc. exot. p. 7 t. 131.

1. Dry capsule.
2. Wet capsule.
3. Long section of capsule.
4. Portion of the peristome.
5. Sporula.
6. Calyptra.
7. Leaves.—*It. Ass.* 563.

3. *Weissia Maclellandii*, Griff. Pl. LXXVIII. Fig. IV.

Caule simplice, foliis siccitate tortilibus e basi lanceolata longilinearibus carinatis sursum argute serrulatis carina apicem versus serrulata, capsula erecta anguste cylindracea.

HAB: In arbore lapsa prope Myrung parcissime invenit D. McClelland.

Caules erecti, vix uncialis. Folia siccitate involuta et tortilia, humore oblique patentia, acuta vel obtusa, percursa vena solida, dorso inferne scabrella superne serrulata, marginibus leviter incrassatis, areolis inconspicuis.

F. Perichætialia conformia longiora.

Capsula fuscescens, ore rubro lucido.

Peristomium e dentibus 16, minutis, simplicibus. infra os capsulæ exsertis, horizontaliter conniventibus, aurantiaceis.

Sporula majuscula, lævia. fusco-viridescencia, immersa opaciuscula.

Columella inclusa, apice truncata.

Operculum. calyptra saltemquoad.

A Calympera Gardneri. saltemquoad iconem Hook. Musc. Exot. t. 146. vix distinguenda, nisi carina foliorum serrulata et peristomio.

Plant magnified.

1. Capsule.
2. Portion of the capsule and peristome seen internally.
3. Sporula.
4. Cauline leaf.—*It. ass.* 575.

X. BARBULA, HEDW. TORTULA, HOOK. ET GREVILLE.

1. *Barbula indica*, Brid. *Bryol. Univ.* 1. 544. *Tortula Indica*, Hook. *Musc. Exot.* p. 7. 135.

HAB. Ripæ prope Jumalpure, Bengalæ inferioris.

Caules simplices. Folia siccitate valde involuta et incurvata vix crispata. marginibus superiorum et præsertim perichætilium involutis. Peristomii capsulam fere æquantis dentium articuli opacitate obscurati.

-
2. *Barbula arenaria*, Gr. Pl. CIII. Fig. I.

Tortula No. 80, Afghan Catalogue.

-
1. Plant natural size.
 2. Do. about ten times magnified.
 3. Leaf seen in front.
 4. Do. laterally.
 5. Do. Transverse section.
 6. Central line of leaf shewing origin etc. of the filamentous bodies.

- 7, 8. The filamentous or confervoid bodies, 550 M.
 9. Apex of capsule and the operculum.
 10. Apex of capsule, operculum removed.
 11. Portion of the peristome magnified about 180 times.
 12. Sporula immature.
 13. Part of the male flower with a perigonal leaf.
- Delt. e sicc. H. B. C. April, 30th 1843.

3 *Barbula longifolia*, Griff. Pl. LXXIX. Fig. II.

Caule simplice brevissimo, foliis erecto-patentibus linearibus concavo-carinatis acutiusculis muticis siccitate incurvatis marginibus valde involutis, capsula cylindracea, operculo subulato obliquo capsula duplo brevior.

HAB. Ad Moflong parce legit D. McClelland.

Caulis vix lineas quatuor metiens.

Folia siccitate etiam subtortilia, humore patentia. inferiora sæpe recurva, integra vel apicem versus minute denticulata. percursa vena subulata in mucronem brevem excurrente.

Perichætialia conformia, majora.

Seta terminalis. subuncialis, gracilis. fere capillacea, flexuosa, rubro tincta. siccitate tortilis.

Vaginula cylindracea, angusta, paraphyses pistillaque paucæ gerens.

Capsula æquilateralis, subfusiformis, os versus gradatim angustata, brunnea, ore incrassato rubro, annulo completo siccitate inflexo cincto.

Membrana interna basi libera. breviter stipitata.

Peristomium capsula triplo-brevius; dentes 32, an semper? basi per paria approximati. capillacei, obliquiusculi, vel ut in var: A semel tortiles, rubri, scabrelli, opaci, apicibus pallidi.

Columella filiformis, apice truncata, inclusa.

Sporula uniformia, lutescentia, lævia, immersa diaphana.

Operculum conico-subulatum. Calyptra dimidiata, apice longe stylifera.

Affinis videtur *Barbulæ recurvatæ*, Hook. Musc. Exot. 7. t. 130.

VAR. A. Peristomio semel torto.

HAB. Ad Bogapancee.

1. Plant magnified.
- 1a. Capsula and operculum.
2. Apex of capsule.
3. Apex of capsule, annulus detached.
4. Portion of capsule and peristome seen externally.
5. The same seen internally.
6. Portion of the annulus.
7. Operculum long section.
8. Calyptra.
9. Cauline leaf.—*It. Ass.* 535.

3. *Barbula arcuata*, Griff. Pl. LXXIX. Fig. I.

Caule simplice longiusculo, foliis lanceolato-acuminatis carinatis vena excurrente breviter apiculatis margine recurvis perichætialibus longissimis canaliculatis, capsula cylindracea arcuata.

HAB. Legimus speciminu 2-3 fructifera in arenosis "Bogapanee."

Caulis erectus, basi denudatus. subsemuncialis. Folia siccatione adpressa, obsolete falcatis secunda, summa apice flexuosa patentia, humore ascendente, rigida, integra, e basi lanceolata valde acuminata, perichætialia margine involuta, acuminibus limbum æquantibus, sursum denticulatis.

Seta terminalis. vix uncialis, capillacea. Vaginula angusta, cylindracea. Paraphyses pistillaque pauca.

Capsula erecta, angusta, brunnea. Peristomii dentes sub-32, obliqui, rigidi, opaci, scabrelli. Columella truncata, inclusa.

Cætera desunt. Peristomium ex parte destructum solum vidimus.

Ex caractere videtur proxima *B. domesticæ*, Brid. Bryol. Univ. An vere differt?

1. Plant magnified.
- 1a. Capsule.
2. Portion of capsule and peristome, seen externally.

3. Cauline leaf.
4. Perichæatial leaf.—*It. Ass.* 537.

XI. GRIMMIA, HEDW.—HOOKER. BRIDEL ex parte.

1. *Grimmia flexuosa*, Griff. LXXIX. Fig. III.

Caule simplice elongato flexuoso, foliis adpressis lanceolatis acuminatis carinatis vena excurrente cuspidatis perichæatialibus longe aristatis, capsula immersa oblongo-ovata operculo bre-
et recte rostrato.

НАВ. Ripæ arenosæ fluminis Soorma prope Chattuc agri Sylhetensis. Ripæ Maamloo collium Khasiyanorum; rivulique Deboro prope Rangagurrah. Nuperius vidimus e collibus Aborensibus allatam.

Caules sæpius simplicissimi, filiformi-clavati, unciam vix excedentes. Folia sursum gradatim majora, integra, e base lanceolata valde acuminata. Perichæatialia majora vena longius excurrente cuspidato-aristata.

Seta terminalis, brevissima.

Capsula brunnea, complete annulata. Peristomi dentes erecti, vel subconniventes, rigidi, plano-subulati, basi diaphani lineisque transversis conspicue notati, cæterum opaco-punctulati, sæpe varie perforati, lutescentes.

Sporula in acervulo ochroleuca, rotundata, lævia, immersa opaca.

Columella brevis, inclusa.

Operculum e base conica subulatum, rostro recto acuto.

Calyptra mitriformis, integra vel fissa.

1. Capsule and vaginula.
2. Portion of capsule and peristome seen externally.
3. Ditto, ditto, seen internally.
4. Portion of the annulus.
5. Sporula.
6. Operculum.
7. Calyptra.
8. Leaves.—*It. Ass.* 515.

2. *Grimmia (Orthotrichum) ovata*, Pl. LXXIX. Fig. IV. *Mohr*. Hook et Taylor Musc.. Brit. 71. t. 13. *Dryopodon ovatus*, Bridel Bryol univ. 1. 202.

HAB. Rupes et monumenta circa Moflong, ubi abundat.

Foliorum margo unus tantum recurvus.

1. Capsule and calyptra.
2. Capsule.
3. Portion of capsule with annulus.
4. Columella with half of the inner membrane and part of the base of the capsule.
5. Spore.
6. Operculum.
- 6a. Long section of operculum.
7. Calyptra.
8. Curious state of an abortive pistillum.
9. Leaf, 9a portion of a leaf.

EFRUCTIFERÆ.

3. *Grimmia*.--

HAB. Rupes roratae ad cataractam Moosmai, ubi dense cæspitosa.

Prostrato-dependens. Caules ramosi; rami sub simplices, clavati.

Folia siccitate adpressa, subsecunda, madida ascendentia, lanceolato-acuminata, carinata, minute denticulata, vena in mucronem brevem excurrente prædita, marginibus subincrassatis opacis, areolis oblongis laxiusculis.

VAR a. Caules filiformes, foliaque minora.

HAB. Ibidem.

XII. TREMATODON, RICH.

1. *Trematodon subulosus*, Griff. Pl. LXXXII. Fig. I.

Caule simplice brevissimo, foliis conniventibus ovato-lanceolatis

acuminatis, capsula subovata nutante apophyse clavata ecerviculata duplo brevior, operculi conico-subulati rostro curvato.

HAB. Ripæ arenosæ fluminis Burrumpootur, tractusque sabulosi huic vicini. Humida cujusque regionis Assamorum editæ, ubi frequentissimus. Fructus Aprili Majoque maturi.

Caulis lineam, vix excedens.

Folia tenera, imbricata, obtusiuscula, concava, prædita vena completa crassa, integerrima. areolis conspicuis, acuminum marginibus basin versus revolutis.

Perichætialia sub 3-plo majora, conformia. Seta sicca flexuosa subtortilisque, gracilis, stramineo-nitens, linealis.

Vaginula arcte, rubra; paraphyses pistillaque pauca.

Capsula conspicue annulata, matura sulcata, sub lente modice augente areolata. Apophysis antice struma minuta instructa.

Membrana interna adnata, sed facile solubilis.

Peristomium connivens, e dentibus 16 binatim compositis, (ciliolis irregularibus) rigidis, medio perforatis, trabeculatis, striatis rubris, apicibus pallide aurantiaceis punctulato-scabrellis.

Columella inclusa.

Sporula in acervulo lutescentia, rotundata, lævia.

Operculum e basi conica curvato-rostratum, capsula paullo brevius. Calyptra dimidiata, lævis.

Quoad characterem affinis *T. brevicolli*. Hornsch. Brid. Bryol.

Univ. I. 385, a quo vix differt nisi statura minore, vena excurrente longitudine que apophysis.

1. Capsule and calyptra.
2. Capsule, annulus detached, dry.
3. Ditto, Ditto, partially reflexed.
4. Portion of peristome.
5. Sporula.
6. Annulus, portion of
7. Operculum.
8. Inner membrane and four teeth.
9. Leaves. *It. Ass.* 469.

2. *Trematodom longicollis*, Rich. Bridel Bryol. Univ,
1. 388.

HAB. Ripæ arenosæ fluminum Noa Dehing et Deboro regionis editæ Assamicæ. Fructus Aprili Maioque maturi.

Caulis simplex, brevis, lineas duas longitudine vix excedens.

Folia sicca flexuosa, etiam tortilia, madida subsecunda, inferiora multo breviora rectiuscula, superiora flexuosa, interdum subcrispata incurvataque, e basi lata longe subulato-acuminata, convoluto-canaliculata, integra, lutescentia, prædita vena completa? plerumque indistincta.

F. Perichætalia maxima, convoluta, acumine limbum vix superante recto vel flexuoso, prædita vena distinctiore; intima minora.

Vaginula rubro-aurantiacea, cylindracea. Paraphyses paucæ, breves. Pistilla subnulla.

Seta longissima, sesquiunciam excedens, capillacea, straminea, sicca flexuosa apiceque parce tortilis.

Capsula immatura cylindraceo-ovata, sicca sulcata, nutans. Apophysis longissima, capsulam 3-plo superans, clavata, apice sub-cerviculata, basi antice strumosa, arcuata. Peristomium (immaturum solum visum) præcedentis.

Operculum conico-subulatum, rostro obliquo, capsula dimidio brevius.

Calyptra dimidiata, lævis, pallide straminea.

XIII. DICRANUM, HEDW.

1. *Dicranum glaucum*, HEDW.

HAB. Sylvæ Churra Punjee et Maamloo collium Khasiyanorum. Regiones Assamorum editæ, ubi ad basin arborum frequens, Fructiferum non vidimus.

VAR. A. Foliis magis deciduis.—Negrogam.

VAR. B. Foliis longioribus, magis acuminatis.

Rupes humidæ, Churra Punjee, ubi Hypni specie mixtum.

—Hypno subbasilari, Hook. proximum.

VAR. C. Foliis brevioribus et latioribus.

Negrogam versus.

VAR. D. *Macrophyllum* ; vix non distinctum.

Churra Punjee, versusque *Negrogam*.

VAR. E. *Marginatum* ; foliis siccatione ascendenti subsecundis, dorso transeverse undulatis, humore falcitim subsecundis, spiraliter dispositis, marginibus hyalinis. latis.

Negrogam versus.

Verisimiliter species distincta.

Dispositio foliorum spiralis in facie ramorum aversa valde conspicua.

2. *Dicranum cuspidatum*, Griff. Pl. XCIV. Fig. IV.

Caule mediocri simplice parceve ramoso, foliis undique patentibus e basi lanceolata acuminatissimis carinatis marginibus acuminis carinaque argute denticulatis baseos incurvis, perichætialibus basi convolutis, capsula erecta clavato-cylindræa basi strumosa,

HAB. Pineta Moflong. Duo solum specimina fructifera vidimus. Cæspitosum ; caules sæpius ramosi radiculoso villosi, ramis ascendentibus, simplicibus.

Folia siccitate falcitim subsecunda, flexuosa, humore undique patentia ; inferiora fere horizontalia, fragilia. seniora sæpius rupta. dense imbricata, amæne viridia.

F. Perichætialia conformia, interiora longissima, convoluta circa setam, abrupte acuminata.

Seta terminalis vel ob innovationes lateralis, crassiuscula, 3-4-linealis, viridescens, siccatione flexuosa.

Vaginula cylindræa, longa, brunnea. ore membranaceo. Paraphyses pistillaque pauca.

Capsula erecta, basi strumosa, sub-cylindræa. e basi sursum gradatim ampliata, (ore incrassato) pallide brunnea.

Membrana interna, discreta, sessilis.

Peristomium siccum madidumve conniven ; dentes rubri, profunde bipartiti, diaphani, raro irregulares, laciniis pallidis, sæpe basin versus materie mucilaginosæ coalitis.

Columella filiformis, capsula paullo brevior, apice truncata.

Sporula lævia, fusco-viridia, difformia.

Operculum calyptra que non visa.

Valde affinis *D. fragili*, Hook. Musc. Exot. 2 p. 10. t. 134.

1. Capsule.
2. Portion of the capsule, annulus and of peristome seen externally.
3. Tooth of peristome.
4. Portion of annulus.
5. Operculum capped with apex of calyptra.
6. Calyptra separated with operculum.
7. Calyptra nearly glabrous.
- 8, 8, 8. Leaves. *It. Ass.* 555.

3. *Dicranum scoparium*, HEDW.? Pl. LXXXII. Fig. III.

HAB. Arenosa torrentis Bogapanee.

Folia innovationum sæpius undique patentia; folia basi planiuscula sursum carinata carinis denticulatis, perichætialia intima mutica, exteriora longe cuspidato-acuminata, acumine canaliculato, apice denticulato, refracto; capsula erecta.

An ita distinctum mediumve inter *D. scoparium*, Hedw. and undulatum, Solrad?

1. Capsule.
2. Capsule long section.
3. Portion of peristome.
4. Cauline leaf.
- 5, 5, 5. Perichætial leaf. *It. Ass.* 544.

4. *Dicranum subulatum*, HEDW.

HAB. Ripæ circa Moflong ubi sequente sæpius mixtum.

Folia sæpe vix falcatis secunda, sub-integerrima, siccitate flexuosa.

Capsula inclinata, subobliqua, oblongo-ovata, vacua demum fere cylindracea erecta et sulcata, annulo completo prædita. Peristomii dentes mediocres, infra medium bipartiti, rubri, lacinis pallidis. Operculum e basi conica longe et oblique rostratum, capsulam æquans. Calyptra non visa.

Sporula immersa opaciuscula, globosa, sublævia, in acervulo fusco-ochroleuca.

Sequenti proximum; vix discrepans seta erecta capsulaque demum cylindracea Affine videtur *D. longisetæ*, Hook. Musc. Exot. 2. 11. t. 139.

5. *Dicranum khasiyanum*, Griff. Pl. XCIV. Fig. II.

Caule simplice brevi, foliis falcatis subsecundis e basi lata longissime subulato-acuminatis acuminibus infra medium obsolete canaliculatis vena crassiuscula, seta flexuosa, capsula inclinata cernuave ovato-elliptica siccatione sulcata, operculo conico subulato, calyptra ventricosa lævi.

HAB. Ripæ Moflong.

Cæspitosum; folia interdum undique patentia, e basi quadrata vel oblongo-quadrata concava axi adpressa subulato-acuminatissima, integra, luteo-viridia, acumine concolori, vena solida latiuscula percursa.

F. Perichæthalia conformia.

Seta terminalis, sæpius solitaria, sicca vix tortilis, seduti madida valde flexuosa, pallida. Paraphyses paucissimæ. Pistilla 2-3. Capsula directione varia, suberecta, inclinata, cernua vel interdum pendula, æqualis siccitate sulcata, brunnea, annulata; membrana interior adhæsens.

Peristomii dentes 16 (vidimus etiam 18,) per paria approximati (an semper?) breves, rigidi, fragiles, profunde bipartiti, basi sub lente ceties argente striati, laciniis punctulato-opaciusculis; lineis transversis conspicuis.

Columella inclusa, filiformi-clavata. Sporula in acervulo ochracea.

Operculum conico-subulatum capsula brevius. rostro obliquo acuto.

Sequenti affine; discrepans præsertim seta madida immutata calyptraque lævi.

VAR. A. majus; foliis saturatius coloratis, seta flexuosa vel suberecta.

HAB. Rupes madidiæ Churra Punjee—*Dicranum Khasiyanum subulato* forsan jungeus.

1. Capsule.
2. Portion of the capsule annulus and peristome seen.
3. Teeth of peristome.
4. Operculum.
5. Calyptra.
6. Leaves. *It Ass.* 513.

6. *Dicranum (Campylopus) pinetorum*, Griff. Pl. XCIV.

Fig. III.

Caule brevissimo simplice, foliis falcatis subsecundis e basi lanceolata longissime subulato acuminatis canaliculatis acuminum apicibus concoloribus scabrellis, seta flexuosa, capsula ovata pendula siccitate to, alscul, opercuca oblique rostrato calyptra fimbriata.

Н.В. Pineta prope Moflong, truncis pinorum adhærens.

Dense cæspitosum, pallide lutescenti-viride. Caules sub-3-lineales simplices vel ob innovationes parce ramosi. Folia inferiora et præcipue caulium sterilium, (qui magis elongati) falcatis subsecunda; superiora et perichætialia ascendentia, e basi lanceolata longissime subulato-acuminata, canaliculata, vel involuto-concava, flexuosula, apicibus minute denticulatis subtriquetris, vena latissima completa.

Perichætialia conformia, majora, convoluta.

Seta vix bilinealis, sicca erecta flexuosa, madida decurva, pallida.

Vaginula mediocris. Paraphyses paucissimæ. Pistilla 2-3

Capsula humore pendula, siccitate erecta, ovata, basi solida, anulata, sicca sub-8-sulcata, palida, parietibus tenuibus.

Membrana interna libera, subsessilis.

Peristomium madore erectiusculum, siccatione inflexile, cum membrana interna facillime separabile, e dentibus 16 æqualiter approximatis ad medium circiter bipartitis, basi rubro-aurantiaceis et sub lente fortiter augente conspicue striatis, laciniis pallidis punctulatis.

Columella inclusa.

Sporula minuta, lævia, uniformia, in acervulo fusco-ochroleuca.

Operculum e basi conica oblique subulatum, theca paullo bre-

vius, sæpe cum calyptra secedens, sed huic netiquam adhærens.

Calyptra, dimidata, per totam fere longitudinem fissa, basi hinc illinc breviter fissa, subinflexa et pilis simlicibus, colore calyptræ, brevibus fimbriata.*

Var. A. Villis calyptræ magis evolutis hyalinis.

Hab. Myrung, in arborum truncis.

A. D. flexuoso, cui proximum videtur, discrepat præcipue capsulis estriatis, operculoque oblique rostrato.

1. Capsula.
2. Portion of capsule and of peristome seen externally.
3. Operculum.
4. Calyptra separated, with operculum.
5. Cauline leaf.
6. Perichæatial leaf.
7. Sporule. *It Ass.* 547

7. *Dicranum (Campylopus) ericoides*, Griff.

Caule subsimplice apice prolifero, foliis rigidiusculis strictis ascendentibus e basi anguste lanceolata subulato-caniculatis acuminatissimis perichæatialibus longe aristatis apicem versus scabris semi-diaphanis, setis aggregatis flexuosis, capsula pendula subobovata basi obsolete strumosa siccitate profunde sulcata, operculi rostro obliquo, calyptra fimbriata.

HAB. Sylvæ Myrung.

Terrestre, cæspitosum, omæne-viridescens.

Caulis primarius terra sepultus, brevis simplex, foliis rigidis-atroviridibus undique patentissimis, summis patienti-ascendentibus obsitus, apice prolifer. Caulis novellus fructifer conformis lineas tres vix excedens.

Folia siccatione adpressa, humore patienti-ascendentia integra, acuminibus flexuosis, apice denticulato-scabris, subdiaphanis.

F. Perichæatialia basi ampliata, membranacea concava, longius

* Bridel makes no mention of an annulus in his *Compylopus flexuosus*, but in his character of the genus, he says, "theca exannulata." C. concolor. *Dicranum concolor* of Dr. Hooker, he however describes as being annulate.

acuminata, et quasi aristata, arista subdiaphana apicem versus scabra.

Setæ aggregatæ, 1-3 sæpius 2, pallidæ vix semunciales, siccæ fere semper geniculatim deflexæ, calyptræ apice nempe foliis perichætialibus ope filamentorum confervoideorum firme adhærente, demum eruptæ erectæ flexuosæ, humore decurvæ.*

Vaginula cylindracea, angusta. Pistilla pauca, stylis longis Paraphyses subnullæ.

Capsula siccitate erecta, inclinata, subæqualis, dorso nempe convexior, lutescens ore rubro, humore lævis, annulata. Membrana interna discreta.

Sporula immersa hyalium, globosa, lævia, in acervulo sordide ochroleuca.

Peristomii dentes 16, ad medium vix bipartiti, pulchre rubri, laciniis albidis.

Operculum fere prioris, cum calyptræ apice arcte cohærens semperque hoc pileatum.

Calyptra profunde dimidiata, basi villis hyalinis pulchre fimbriata, apice semper lacera.

Præcedenti proximum, sed ob foliorum directionem, setas aggregatas, capsulam sub-obliquam que operculum cum calyptra cohærens sat distinctum.

A. D. introflexo distinguitur præsertim foliorum apicibus nunquam hyalinis.

8. *Dicranum (Campylopus) exasperatum*, Griff. Pl. XCIV.

Fig. I. *Campylopus exasperatus*, Brid. Bryol Univ.

l. p. 473.

НАБ. Rupes apicæ Churra Punjee.

Descriptio Bridelii loc. cit, plantæ nostræ apte fere convenit; hujus vers folia perichætialia pilo albo non termina a seta que apicem versus solum tantum scabrella.

* Although the Setæ are aggregate, yet in this as well as in *D. ericoides* no more than the usual number of pistilla can be said to be fecundated, as from each seta being surrounded by a perichætium, it is obvious, that each, belongs to a distinct female flower. The case is different in some other instances of aggregation of setas, in which, as in some Brya, it arises from the development of more than one pistillum of one flower.

Capsula annulata. Membrana interna discreta, breviter stipitata. Peristomium pallide rubrum, e dentibus 16, vel per paria longitudine tota approximatis peristomium que 8-dentatum mentientibus, setaceis, opaciosirius, vel ad medium usque bipartitis, vel, ciliolis plus minus cohærentibus, solidis obsolete vel per foratis,—obliquuscule in spiram dispositis.

Columella inclusa, clavata, apice truncata.

Sporula in acervulo fusco-lutescentia, minuta, uniformia, lævia.

Operculum conico-subulatum, capsula vix triplo brevius, rubro-aurantiacum, rostro obliquo acuto cum apice calyptræ arctissime cohærente semperque hoc pileato.

Calyptra dimidiata, basi fimbriata, sæpe (villis deciduis? subglabra.

Flores fæminei aggregati, terminales, peripherici axillares? cincti foliis perichætialibus arcte convolutis, apicibus patulis.

Paraphyses subnullæ. Pistilla 3-5, stylis longissimis in sinu folii perichætialis intimi convoluti oblecta.*

1. Capsule.
2. Portion of capsule annulus and peristome seen externally.
3. Tooth of Peristome.
4. Portion of annulus.
5. Operculum capped with the apex of the calyptra.
6. Calyptra separated with operculum.
7. Calyptra nearly glabrous.
- 8, 8, 8. Leaves.

DICRANA? EFRUCTIFERA.

9. *Dicranum*, Pl. CVII. Fig. II. *It. Ass.* 546.

HAB. Pini truncus, Nucklow Proximum exasperato, discrepans statura majore folii, distantibus, summis solum arcte imbricatis, magis convultis, acuminum apicibus denticulato-scabris.

Muscus pulcher, dense cæspitosus, læte luteo-nitens.

* In the *Musc. Britt.* of Drs Hooker and Taylor, page 92, it is said, that *Dicranum glaucum* has the nerveless reticulated leaves of a *Sphagnum*. This is not the case in the Indian specimens, so far at least as regards the reticulation, which is, I believe confined to *Sphagnum*.

10. *Dicranum* ? HAB. Rupes humidæ, Churra Punjee, ubi rarum sæpius que aliorum muscorum comes.

Caules elongati, simplices, vel inovationibus parce ramosi. Folia inferiora secunda; brunnea summa vel novella patenti-ascendentia, luteo-nitentia, e basi anguste lanceolata subulato-acuminatissima, convoluto-canaliculata, integra, rigida, stricta, demum fragilia, acuminum opacorum apicibus diaphanis denticulatis vel scabrellis, rectiusculis, vel semel abrupte geniculatis, vena latiuscula indistincta.

An *D. introflexum*, Hedw? sed folia seniora certe secunda Habitu propinquum *D. exasperato* sed præ aliis *D. scopario* et *ericoidi*.

11. *Dicranum* ? HAB. Rupes humidæ, Surureem.

Cæspitosum, luteo-nitens. Caules elongati, apice interdum proliferi, simplices parceve ramosi, unciales vel biunciales, pertotam longitudinem radiculoso-villosi.

Folia distantia, sicca madidave falcatis secunda, e basi lanceolata longissime subulato-acuminata, convoluto-canaliculata, integra, acuminibus sursum quasi aristatis, arista minute scabrella concolore laminam subæquante, vena angusta indistincta.

An *D. concolor*. Hook. Musc. Exot. 2 p. 10 t. 138? sed vena angusta, foliaque valde convoluto-concava.

12. *Dicranum* ? HAB. Rupes torrenti "Burta panee" collium Khasiyanorum vicinæ.

Cæspitosum, amæne virens. Caules subunciales, simplices vel rarius apice innovationibus ramosi, basi decumbentes, nudati, apice decurvati.

Folia semper falcatis secunda, tenera, e basi latiuscule lanceolata acuminatissima, concavo-carinata, integra, marginibus leviter involutis, apicibus acuminum opacissimis teretibus scabrellis denticulatisve, prædita vena angusta, inferne valde striata, infra apicem indistincta.

Aspectu præsertim sicco teneritate structuraque foliorum affine
D. cuspidato. Species præsertim siccæ teneritate structura-
 que foliorum. *D. cuspidato* affines.

XIV. FISSIDENS. HEDW.

1. *Fissidens bryoides*, Hedw. Pl. LXXXI. Fig. VI.

VAR. *A.* Lamellarum margines tantum hyalini.

HAB. In ripis prope Jumalpoore, Bengalæ inferioris.

VAR. *B.* Folia dense imbricata, obtusiuscula rubro-tincta, vena
 sæpius intra apicem evanida, lamellæ obsolete marginatæ,
 capsula inclinata.

HAB. In arbore lapsa ad ripas fluminis, Noa Dihing copiose.

VAR. *C.*, *F. tamarindifolius*. Brid. Bryol. Univ. 2, 684?

Folia læte viridia elongata, lamellarum margines sæpius conspicue
 fibrosis.

Specimina 2, 3, inveni mixta cum muscis aliis e Mumbree.

VAR. *D.*, *arboreus*.

HAB. In arboribus Mofiong: parcissime.

Habitus *D. bryoidis*, minimus, Caules sæpius ramosis. Foliorum
 margines simplices: seta lateralis terminalisve, brevis, folia
 perichætialia caulinis similia paullo excedens.

Capsula erecta urceolato-ovata.

Verisimiliter species distincta. seb ob materies mancas hunc
 adjeci.*

1. Capsule and operculum.
2. Capsule.
3. Capsule long section.
4. Tooth of peristome.
5. Operculum.
6. Calyptra.
7. Cauline leaf.
8. Perichætial leaf vaginula and base of seta. *It. Ass.* 457.

* In referring the above to *F. bryoides*, my European specimens of which
 have a very distinct margin to the leaves, I have been guided by a remark
 of Dr. Hooker, (see Hook et Tayl. Musc. Britt. p. 89,) from which it
 appears that though a general, it is not a universal character,

1. *Fig. V. Var. Seta terminal.* Capsule.
2. Leaf. *It. Ass.* 558.

1. *Fig. VA.* Capsule and operculum.
2. Capsule.
3. Operculum, long section of
4. Cauline leaf of the arboreus variety. *It. Ass.* 555.

2. *Fissidens longisetus*, Griff. Pt LXXXI. Fig. IV.

Caule simplici elongato, foliis lineari-scalpelliformibus integerrimis marginatis perichæatialibus subsimilibus, seta laterali caulem subæquante, capsula inclinata cernuave oblongo-ovata.

HAB. In ripis Mumbree, mixtum cum *F. tamarindifolio*.

Caules semunciales, cum foliis ambitu lineares. Folia valde acuta, amæne viridia, percursa vena medium supra flexuosa in mucronem excurrente.

Seta filiformis pallida, siccatione tortilis, caulem æquans vel excedens. in plantis novellis caule lineali præditis etiam longissima

Capsula interdum urceolato-ovata, basi solida, pallida, ore brunneo. Peristomii dentes ultra medium bipartiti, crebre trabeculati, rubri, laciniis setaceis, pallidis, punctulatis.

Operculum e basi subhemisphærica breviter et oblique rostratum, capsula brevius.

Calyptra breviter fissa.

Proximus *F. bryoide* a quo differt tantum (an satis?) setis lateralibus elongatis. *A. F. adiantoid* statura minore foliis integerrimis, perichæatialibus caulinis subsimilibus, operculique rostro brevi discrepat.

1. Capsule and calyptra.
2. Capsule.
3. Longitudinal section of the operculum.
4. Calyptra with operculum.
5. Calyptra.
6. Cauline leaf. *It. Ass.* 557.

3. *F. Jungermannioides*. Griff. Pl. LXXXI. Fig. III.

Caule repente ramosissimo, foliis insigniter falcatis—secundi

scalpelliformibus marginibus incrassatis subintegerrimis perichætialibus similibus, seta terminali leviter arcuata, capsuli cernua urceolato-ovata, calyptra conico-subulata.

HAB. In rupibus madidis Moosmai.

Dense cæspitosus, luride viridis. Rami semunciales, ascendentes.

Folia præsertim sicca falcatis secunda, acutiuscula, percurta vena crassa in apiculum mucroniformem excurrente, marginibus valde incrassatis, (lamellarum exceptis qui simplices!) areolis subconspicuis rotundatis quadratisve diaphanis.

Flos femineus gemmiformis, paraphysibus fere orbata. Pistilla plura.

Seta suberecta, vel siccitate arcuata, vix bilinealis, pallide fusca.

Vaginula mediocris. Capsula æqualis, pallide fusco-brunnea.

Membrana interna cohærens. Peristomium pulchre coccineo rubrum, dentes medium infra bipartiti, trabeculati, laciniis pallidis punctulato-opacis. Columellæ cylindraceæ, brevis, incluasa.

Operculum e basi conica sub-oblique rostratum, capsula paullo brevius. Calyptra conico sublutata, hinc breviter fissa, basi denticulata, diu persistens.

Distinguitur a *F. bryoide* caule ramosissimo, foliorumque marginibus incrassatis opacis.

1. Capsule and calyptra.
2. Capsule.
3. Operculum.
4. Calyptra.
5. Cauline leaf. *It. Ass.* 554.

4. *Fissidens neckeroides*, Griff. Pl. LXXXIII. Fig. I.

Caule repente ramoso, ramis erectis, foliis lineari-scalpelliformibus subfalcatis marginibus subincrassatis apice denticulatis, perichætialibus convolutis, setis (pluribus) lateralibus foliis brevioribus, capsula ovata erecta, peristomii dentibus per peria approximatis indivisis perforatis.

HAB. In arbore semidestructa inter Moleem et Surureem.

Dense cæspitosus. Caules radiculis villosi, rami ascendentes,

sæpius simplices vix unciales, complanati, apicibus subdeclinati.

Folia leviter falcata, præsertim superiora secunda, obsolete repanda, marginibus irregulariter et præsertim apicem versus denticulatis, vena in mucronem excurrente prædita, inconspicue areolata. F. perichætalia convoluta, ensiformi-cuspidata, evanidivenia.

Setæ axillares, vix bilineales, curvatæ, pallidæ. Vaginula brevis subcylindracea. Paraphyses nullæ. Pistilla plura.

Capsula æqualis, ovata vel oblongo ovata, basi solida, fusco-viridis sub lentem areolis oblongis inconspicue notata.

Peristomium e dentibus 16, madore conniventibus perparia subapproximatis, conspicue trabeculatis, basi pulchre rubris cæterum albidis, ciliolis inæqualibus, sursum hyalinis, per totam longitudinem et præcipuo apices versus mediantibus trabeculis cohærentes, ideoque dentes indivisi et crebre perforati videntur.

Sporula magna, in acervulo fusco-viridia, aliis minutis immixta, ideoque difformia, immersa globosa, opaciuscula, sublævia.

Columella cylindracea, inclusa, apice subcylindriciformis.

Operculum e basi convexâ oblique rostratum, capsula subduplo brevius.

Calyptra dimidiata lævis, apice fusca, basi irregulariter fissa, marginibus leviter inflexis.

Species distinctissima prope *D. adiantoidem* locanda, habitu. Neckeræ peristomioque didymodontis gauden.

1. Plant magnified several times.
2. Leaf.
3. Capsule.
4. Portion of capsule and peristome seen internally.
5. Operculum long section.
6. Calyptra. *It. Ass.* 579.

5. *Fissidens nobilis*, Griff. Pl. LXXXIII. Fig. III.

Caule simplici, foliis lineari-scalpelliformibus basi decurrentibus marginibus incrassatis serrulatis setis lateralibus, folia excedentibus, capsula ovato-oblonga nutante, operculo longe et oblique rostrato.

HAB. In rupibus arenosis sylvarum umbrosarum Mumbree; etiam in ripis Agri Muttock dicti.

Aggregatus. Caules ascendentes, longitudine a semuncia ad uncias duas vel ultra metientes, cum foliis ambitu lineari—spathulatis. Folia maxima, longitudine 3-3½ linealia, latitudine sublineales, ensiformia, acuminata; marginibus conspicue incrassatis opacis denticulatis præsertim apices versus; vena crassa flexuosa in mucronem excurrente percursa; areolis inconspicuis.

Flores fæminei gemmiformes, numero indefiniti, sæpius plures cuique cauli, axillares, his apices caulium versus tantum evolutis (an semper?) in sinibus foliorum fulcientium reconditi, cinct foliis perichætialibus caulinis subsimilibus. Paraphyses nullæ vel paucissime; pistilla plura.

Seta pallida, apice paullo incrassata, subsemuncialis.

Capsula subinæqualis, dorso paullo convexior, ore obliquiusculo dilatato. fusco-brunnea, sicca sæpe erecta. Membrana interna cohærens, stipite crasso insidens.

Peristomii dentes madore apicibus tantum inflexi, rubro-coccinei, pulchre trabeculati, ad medium circiter bipartiti, sub lentem centies augmentem leniter striati, ciliolis inæqualibus apicibus paullo pallidioribus.

Sporula inæqualia, immersa rotundata, lævia, diaphana.

Operculum e basi conico-hemisphærica longe et oblique rostratum, capsulam æquans vel paullo excedens, pallide rubro-brunneum.

Calyptra dimidiata, lævis, integra vel basi aliquoties fissa.

Species perpulchra sequenti valde affinis.

1. Plant magnified.
2. Leaf.
3. Capsule and operculum.
4. Capsule, operculum removed.
5. Teeth of Peristome.
6. Operculum long section.
7. Calyptra.

6. *Fissidens areolatus*, Griff. Pl. LXXXIII. Fig. II.

Caule simplici, foliis ligulato-scalpelliformibus apice rotundatis

marginibus simplicibus integerrimis perichætialibus conformibus, seta laterali curvata, capsula nutante ovato-oblonga, operculo subcampanulato rectiuscule rostrato.

HAB. In ripibus madidis umbrosis Mumbree.

Uncialis, vel sæpe digitalis; caules ascendentes. Folia longitudine sub-bilinealia, latitudine $\frac{1}{2}$ linealia, percursa vena infra mucronulum brevem evanida, diaphana, areolis pro genere maximis rotundatis vel angulatis. Seta plerumque singula cuique cauli. Capsula etc præcedentis sed minor.

Species formosa, præcedenti affinissima, discrepans præsertim foliis apice rotundatis, marginibus simplicibus integerrimis et areolis conspicuis. Operculum etiam paululum forma differt.

1. Plant six times magnified.
2. Leaf.
3. Capsule and operculum.
- 3a. Capsule

7. *Fissidens sylvaticus*, Griff. Pl. LXXXI. Fig. I.

Caule simplici, foliis lineari-scalpelliformibus subintegerrimis marginibus simplicibus perichætialibus intimis subsimilibus, seta basilari caule duplo longiori, capsula cernua vel nutante ovato-oblonga, operculo longe recteque rostrato, calyptra subulata.

HAB. In ripis sylvarum Mumbree.

Caules ascendentes, bi-tri-lineales, basi interdum innovantes, Folia sub-8-juga, acuta, integra, vena in mucronem excurrenti prædita, inconspicue areolata. F. perichætialia, uti in omnibus aliis, setis lateralibus vel basilaribus gaudentibus, diversiformia, exteriora convoluta fere mutica, interiora basi convoluta fere mutica, interiora basi convoluta, cuspidate ensiformi prædita, ideoque foliis caulinis subsimilia.

Seta erecta, solitaria nec ne, pallida, caulem duplo triplove superans, apice incrassata. Vaginula brevis. Paraphyses subnullæ. Pistilla plura.

Capsula paullo inæqualis, dorso convexior, ore lato, collo cons-

trictiusculo. Membrana interna fere omnino libera, breviter stipitata.

Peristomium madore arcte inflexile, rubro-coccineum, dentes profunde bipartiti, ciliolis inæqualibus, asperulis.

Columella brevis inclusa, cylindracea. apice truncata.

Sporula fusco-brunnescentia, minuta, lævia.

Operculum e basi convexa longe recteque subulatum, capsulæ longitudine.

Calyptra subulata, rectiuscula, basi in unico exemplo maturato viso integerrima!

An satis distinctus a *D. taxifolio*. ?

1. Capsula and calyptra.
2. Capsule.
3. Portion of the peristome.
4. Operculum.
- 4a, Long section.
5. Calyptra.
6. Cauline leaf. *It. Ass.* 552.

8. *Fissidens taxifolius*, Pl. LXXXI. Fig. II.

Ad marginem sylvæ Mumbree.

VAR. A. Calyptra longissime subulata, demum breviter submidata, apice curvata, stylo apiculata, seta basilaris.

HAB: In terram Mumbree.

1. Capsule.
2. Operculum.
3. Calyptra.
4. Perichæatial leaf.
5. Cauline. *It. Ass.* 553.

EFRUCTIFERI.

9. *Fissidens*.

HAB: In rupibus rorantibus, Moflong.

Caules repentes ramosi. Rami subunciatis, ascendentes.

Folia leviter falcata, subsecunda, lineari scalpelliformia, obtusa.

omnino mutica, inconspicue areolata, marginibus simplicibus integerrimis, vena infra apicem evanida.

Habitus F. areolati et nobilis, quibus ob ramificationem verisimiliter affinis. Prope F. jungermannioidem locandus. ?

10. *Fissidens*.

HAБ. In arboribus prope speluncas Moosmai.

Caules longissimi, repentes, ramosi. Rami subscendentes, fusco-lutei.

Folia arctissime disticha, seniora brunnescentia plus minus disticha, scalpelliformia, acuta, percursa vena solida sursum flexuosa intra apicem evanida, marginibus simplicibus subintegris apicem evanida, marginibus simplicibus subintegris apicem versus minutissime serrulatis, areolis inconspicuis.

Habitus fere Neckeræ. An affinis F. adiantoidi.

DIDYMODON, HEDW. HOOK.—TRICHOSTOMUM, BRID.; expte.

1. *Didymodon pomiforme*, Griff. Pl. LXXX. Fig. III.

Caule simplice, foliis lanceolato-acuminatis carinatis integris perichætialibus acuminatissim, capsula erecta ovato-globosa, operculo oblique rostrato capsulam æquante.

HAБ. Ripæ. Myrung.

Caules erecti, filiformes, alteri simplices apice discoideo-gemmiformes graciliores, alteri innovationibus ramosi setegeri.

Folia siccatione falcatis subsecunda, humore sæpius ascendunt, anguste lanceolata, prædita intra apicem vena crassa evanida, areolis fusiformi-angustatis majusculatis.

Perichætialia majora, lineari-lanceolata, vena breviter excurrente, sæpe subsecunda.

Vaginula mediocris. Paraphyses paucae, breves. Pistilla pauca. Seta terminalis vel ob innovationes lateralis, viridescens, sicca tortilis.

Capsula erecta, ovato-globosa, saturate brunnea, annulo completo prædita.

Peristomium e dentibus 16? brevibus plano-subulatis, setaceis, irregularibus, basin versus hinc illinc irregulariter nexis et varie perforatis, scabrellis apicibus opacis.

Sporula globosa, in acervulo ochroleuca.

Columella inclusa.

Operculum e basi convexiuscula longe et oblique rostratum, capsulâ sæpe paullo longius.

Calyptra dimidiata, lævis.

Peristomium magis Trichostomi.

Adsunt in axillis foliorum superiorum caulium apice disco-ideorum massæ levissimo tactu separabiles, irregulares, ovatæ vel ovato-fusifformes, celluloso-areolatæ, continentes granulas mobiles difformes.

VAR. A. Caules magis elongati; peristomium fugacius.

HAB. Rupes ripæque Maamloo.

VAR. B. minimus, vix triinealis; capsula suburceolata, castaneo-brunnea, peristomii dentibus per paria approximatis, lutescenti-fuscis, apice hyalinis.

HAB: Myrung.

1. Capsule and operculum.
2. Capsule.
3. Portion of capsule and peristome seen externally.
4. Portion of peristome.
5. Sporula.
6. Part of annulus.
7. Operculum.
8. Calyptra.
9. Body in axil of leaves of discoid stems.
10. Cauline leaf.
11. Perichæatial leaf. *It. Ass.* 510.

1. Fig. III. A. (Var.) Capsule.
2. Bit of capsule and peristome seen internally.
3. Operculum.
4. Cauline leaf. *It. Ass.* 540.

2 *Didymodon squarrosus*, Hook. Pl. LXXX. Fig. II.

Musc. Exot. 16. t. 150. Trichostomum squarrosum,
Brid. Bryol. Univ. 1. 498.

НАБ. Arbores pinetorum Moflong, ubi rarus.

Caules interdum simplices Foliorum margines a medio deorsum recurvi.

Capsula exannulata. Peristomii dentes breviusculi, e ciliolis setaceis, articulatis, vel arete cohærentibus, vel ope substantiæ aspectu gelatinosæ semiopacæ annexis.

Operculum capsula duplo fere brevius.

Figura Hookeriana citata articulationes dentium non ostendit lineaque junctionis nimis regularis videtur.

1. Capsule.
2. Portion of capsule and peristome seen internally.
3. Sporula.
4. Operculum.
5. Perichæatial leaf.
6. Cauline leaf. *It. Ass.* 526.

3. *Didymodon longifolius* Griff. Pl. LXXX. Fig. IV.

Caule simplice flexuoso, foliis patentissimis squarrosis lanceolato-linearibus carinatis subintegerrimis, capsula cylindracea, peristomii dentibus sedecim, operculo longe subulato.

НАБ: Ripæ Surureem.

Caulis vix semuncialis. Folia siccitate marginibus involuta, tortilia, humore patentissima vel patienti-recurva, superiora ascendenti-patentia, raro subsecunda, e basi anguste lanceolata linearia, longa, concavo-carinata, sub lente fortiter augentè minutissime crenulata, percurta vena in apiculo diaphano brevi sub excurrente; areolis minutis quadratis.

F. Perichæatialia conformia, majora, ascendentia.

Seta terminalis, capillacea, angusta. Paraphyses paucæ. Pistilla plura, stylis longis.

Capsula anguste cylindracea, brunnea, sicca irregulariter sulcata; os incrassatum, rubro-coccineum.

Peristomium siccum erectum, madidum, connivens, e dentibus 16, brevibus setaceis subinæqualibus, simplicibus perparia (sæpe obsolete) infra medium ope trabecularum irregulariter marginatis, aurantiaco-rufis compositum.

Sporula rotundata, lævia, in acervulo, fusco-lutescentia, immersa hyalina immixta corpusculis aliquoties majoribus rotundatis opacis.

Columella truncata, filiformis, inclusa. Operculum e basi brevi conica longe recteque subulatum, capsula dimidio brevius.

Calyptra dimidiata, parte fissa semel torta.

D. squarrosa. Hook. propinquius, discrepans caule simplici, foliis angustioribus integris, dentiumque peristomii numero.

1. Plant.

1a. Capsule.

2. Portion of capsule and peristome seen internally.

3. Sporula.

4. Operculum.

5. Calyptra.

6. Cauline leaf. *It. Ass.* 533.

4. *Didymodon perichæticalis*, Griff. Pl. LXXX. Fig. I.

Caule elongato ramoso, patentissimis lanceolato-linearibus carinatis acutis marginibus incrassatis integerrimis, perichæticalibus interioribus circa setam convolutis longissime subulato-acuminatis, capsula inclinata subcylindracea, operculo longe et oblique rostrato.

НAB. Rupes arboresque Myrung et Nunklow.

Caulis repens. Rami ascendentes.

Folia sicciatæ tortilia, margine involuta, humore patentissima vel patenti-recurva, e basi lanceolata longe linearia, percursa venacra in mucronem brevem excurrente, areolis minutissimis opacis punctiformibus.

Perichætalia solidisena, exteriora caulinis consimilia, superiora longissime circa stam convoluta, intima setam sæpe superantia, acuminibus plano-subulatis cirrhosis, sæpe spiraliter tortis, reflexis vel patentibus.

Seta ob innovationes lateralis, vix uncialis, pallida, sicca torta.
Vaginula longissima, anguste cylindracea. Paraphyses plures
breves. Pistilla pauca.

Capsula rarius erecta, inæquilateralis, cylindraceo-ovata utrinque
attenuata, exannulata, fusco-brunnea, sicca sæpearcuata.

Membrana interna libera.

Peristomii dentes per paria obsolete approximati, profunde bipartiti,
(raro tripartiti), laciniis discretis vel hic illi, nexis. vel omnino
cohærentibus, pallide rubri, apicibus albidis opaco-punctulatis,
lineis longitudinalibus indistinctis,

Sporula fusco-ochroleuca, subrotundata, lævia, majuscula, immersa
hyalina.

Columella inclusa, miniata.

Operculum capsula $\frac{1}{3}$ brevius.

Calyptra magna, capsula longior, dimidiata, caduca.

Habitus quodammodo Barbularum ramosarum.

Hæc species, cum *D. squarroso* et longifolio, *Trichostomo* Bridellii
pertinet.

1. Capsule.
 2. Portion of Capsule and Peristome, seen internally.
 3. Sporula.
 4. Operculum.
 5. Calyptra.
 6. Cauline leaf.
 7. Perichætical leaf and bit of seta. *It. Ass.* 526.
5. *Didymodon, Dicranoides* Griff. Pl. LXXXII. Fig. II.

Dic. didymodon Gr. Calc. Jour. Nat. Hist. II. p. 499.

Cuale simplice, foliis persistentibus longissimis subulato-setaceis
falcatis secundis apicibus scabris, seta flexuosa, capsula cylindracea
pendula, peristomii dentibus 32 per paria approximatis, operculo conico
sublato obliquo, calyptra glabra.

HAB. Pineta Moflong, truncis arborum adhærens.

Dense cæspitosum, amœne virens.

Caules vix trilineales, erectiusculi, radiculis villosi, basi nudiusculi.

Folia infima minora, ascendentia, reliqua falcatis secunda, e basi lanceolata subulato-acuminatissima, concavo-canaliculata integra, percursa vena lata excurrente? acuminum apicibus subtriquetis obsolete denticulatis.

Perichætalia conformia. Seta ob innovationes lateralis, pallida. sicca tortilis et flexuosa, raro geniculatim deflexa.

Vaginula cylindracea. Paraphyses pistillaque paucissima.

Capsula paullulum obliqua, utrinque attenuata, exannulata, sicca sæpius erecta.

Peristomii dentes 32, setacoi, per paria approximati et infra medium trabeculis conspicue juncti, ibidem striati, cæterum punctulato-scabrelli, rubri apicibus pallidis, (omnino fere ut *Didymodon* purpuro.)

Sporula lutescentia, globosa, lævia, minuto, immersa hyalina. Columella inclusa, truncata.

Operculum capsula duplo brevius. Calyptra dimidiata.

Omnia *Dicrani*, dentibus peristomii exceptis. Proximum *D. pinetorum*, a quo facile distinguitur calyptra glabra peristomioque.

Proximum videtur *Didymodonti longirostri*, Schwagr:—Brid. *Bryol. Univ.* 1.512, a quo differt foliis persistentibus conspicue secundis non fragilibus, operculoque capsulo duplo brevior.

VAR ? A. Caules elongati, hinc illinc ramosi, ramique apicem versus nudi incrassati, apicibus imis foliosis, partibus denudatis cicatricibus foliorum lapsis semi-annularibus notatis.

Invenimus efructiferum in sylvis Myrung.

1. Capsule and operculum.
 2. Capsule.
 7. Portion of capsule and of peristome seen internally.
 4. Operculum long section.
 5. Calyptra.
 6. Leaf. *It. Ass.* 548.
6. *Didymodon (dicranum?) Paradoxum*, Pl. CVII. Fig. I.

XVI. FUNARIA, HEDW.

1. *Funaria hygrometrica*, Hedwd. Pl. C. Fig. I.

HAB. Colles Khasiyani, ad Maamloo et Moflong.

Statura magnopere variat.

1. Capsule and calyptra.
2. Capsule and operculum.
- 2a. Ditto, Ditto.
3. Apex of capsule (2 teeth omitted.)
4. Long section of capsule and operculum.
5. Portion of both peristomes viewed externally.
6. Operculum and annulus.
7. Portion of annulus.

2. *Funaria leptopoda*, Griff.

Caule simplice; foliis lineari oblongis carinatis incurvis flexuosis integris, vena completa seta, elongata recta, capsula sulcata elongato-pyriformi, operculo convexo.

HAB. Sylvæ, Myrung.

Omnia præcedentis, saltem quoad plantam Khasiyanam, sed folia humore siccitateve incurvata, flexuosa, carinata, longiora, seta longissima, 2-2½ uncialis, recta, peristomii interioris ciliis basi altius connatis, operculoque medio vix depresso.

An vere distincta species? an *F. calvescens*? sed folia nunquam plena?

Funariæ, sp. From Pushut Plates CIX. CX.

(For remarks on the developement of this species and description of the Plates, see General Remarks on Musci. p. p. 360, 361.)

XVII. BARTRAMIA, HEDW.

1. *Bartramia fontana* Suz. var β *marchica*, Hooker et Taylor Musc. Brit. p. 147. t. 23. *Philonotis marchica*, Brid. Bryol. Univ. 2. p. 23.

HAB. Arenosa, Bogapanee.

2. *Bartramia subulosa*, Griff. Pl. CI. Fig. II.

Caule fasciculatim ramoso, ramis cylindraceis, foliis adpressis e basi lanceolata acuminatissimis minute serrulatis vena in subulam longam denticulatam excurrente, capsula subglobosa inclinata sulcata, operculo convexiusculo.

HAB. Ripæ arenosæ rivuli Maamloo agri singfoensis, et Deboro ad Kujoodoo et Rangagurrah.

Caules suberecti. Rami extrorsum curvati, interdum secundi. Folia arcte adpressa, ramulorum novellorum siccitate sæpe ascendentipatentia, interdum subsecunda, perichætialia longius subulata, marginibus recurvis.

Sata subuncialis, vel ultra.

Capsula inæquilateralis, maturata bruunea profunde sulcata, ore obliquo paullo constricto.

Peristomium exterius humore connivens; dentes plano-subulati, trabeculati, plerumque simplices, aliquando vestigia compositionis hic illic ostendentes, rufo-brunnei.

Interioris membrana lutescens, sedecies plicata, solida vel inter plicas minute perforata; cilia profunde bipartita, segmentis interdum apice cohærentibus, interdum divergentibus, sinibus (plicis alternantibus) nudis vel ciliola minuta gerentibus. Sporula sordide lutescentia, reniformia, vel oblonga, sublævia, immersa opaca.

Columella brevis inclusa.

Operculum convexiusculum centro depressum,

VAR. A. Statura multoties minor, folia patienti-ascendentia longiora, sæpe subsecunda.

HAB. In ripis Nunklow. Brid, B. ithyphylæ, fere omnino convenit.

Præcedenti nimis affinis; differt tantum foliis magis planis et adpressis, angustioribus, vena in subulam longe excurrente-operculo convexiusculo (nec conico) peristomiisque magis evolutis.

1. Capsule.
2. Long section of capsule.
3. Portion of capsule and of both peristomes.

4. Tooth of outer peristome.
 5. Portion of inner ditto.
 6. Operculum.
 7. Long section.
 8. Leaf. *It. Ass.* 564.
1. Capsule. Var. B. Fig. III.
 2. Tooth of outer peristome.
 3. Portion of inner peristome.
 - 4, 4. Sporula. *It. Ass.* 564.

Bartramia speciosa, Griff. Pl. CI. Fig. I.

Caule vage et fasciculatim ramoso. foliis patentibus lanceolato, acuminatis minutissime serrulatis vena agicem attingente, seta longiuscula, capsula inclinata ovato-rotundata sulcata.

HAB. In cellibus Aborendibus in ripis arenosis.

Caules dense radiculoso-villosi, steriles sæpe simplices; rami inferiores vagi, superiores dense fasciculati et fastigiati. Folia laxiuscule imbricata, sicca patenti ascendentia striata, madida patentia sublævia, interdum horizontalia, concaviuscula, sub lente modice augente minutissime serrulata, vena tenui completa percursa, marginibus infra medium plus minus recurvis.

Perichætialia subconformia, minora. Vaginula mediocris. Paraphyses paucae. Pistilla plura.

Seta subterminalis, vix uncialis, recta, crassa, rubra.

Capsula madida leviter sulcata, sicca crebre sulcato-striata, fere horizontalis rubro-brunnea.

Membrana interna libera.

Peristomii exterioris dentes lati, brunneo rubri, lineis transversis hic illic lineolis singulis binis vel ternis longitudinaliter connexis crebre et conspicue notati, intus trabeculati.

Interioris membrana lutescens sedecies plicata, ciliis profundibipartitis, segmentis acuminatis sæpius convergentibus, ciliis irregularibus, sæpius binatim compositis liberis vel ciliis adhærentibus interjectis.

Sporula sordide lutescentia, subreniformia, sublente fortiter augente minutissime scabrella, immersa opaca,

Columella inclusa, magna, trigona.

Operculum et calyptra desiderata.

Proxima videtur, *B. tomentosæ*, Hook Musc. Exot. p 25. t. 19.

1. Plant.
2. Cauline leaf.
3. Perichæatial leaf.
4. Capsule (dry).
5. Capsule moistened.
6. Portion of capsule and of both peristomes seen externally.
7. Sporula, moistened (as opaque objects.)

XVII. BRACHYMENIUM, HOOK. BRID. BRYOL. UNIV.

1. *Brachymenium contortum*, Griff. Pl. C. Fig. II.

Caule brevi simplici vel fastigiati ramoso, foliis siccitate contortis, oblongo-lanceolatis marginibus incrassatis apicem versus denticulatis, capsula erecta elongato-obovato-pyriformi.

HAB: Super arbores pinetorum Moflong.

Caulis brevis, vix bilinealis, innovationibus ramosus, et sæpius dichotomus. Rami erecti, simplices, caule oculo longiores.

Folia siccitate valde contorta, leniter tortilia, marginibus valde revolutis humore patenti-ascendentibus, interdum leniter contorta summa subrosaceim patula, interdum obovata, marginibus leniter revolutis (apices versus exceptis fibrosis, sursum attenuatis et apices versus denticulatis, percursa vena in cuspidem subulatam folio aliquoties brevior scabram excurrente-areolis conspicuis.

Flores monoici vel dioici; masculi terminales gemmiformes, cincti foliis caulinis terminalibus et ideo quasi discoidei, foliisque perigonalibus conniventibus multo minoribus, ovato-rotundatis, apiculatis simili modo, concavis.

Paraphyses plures hyalinæ filiformes.

Antheræ plures subsessiles-oblongo, cylindræ, areolatæ apice dehiscentes.

Flores fæminei terminales discoidei.

Paraphyses pistillaque plurima.

F. Perichæetia consimila, interiora minora. Seta terminalis, sæpius e dichotomia uncialis vel sesuncialis, rubra, sicca flexuosa tortilisque, humore paulo flexuosa.

Vaginula longiuscula, subcylindrica, paraphysibus hyalinis filiformibus pistillisque pluribus obsita.

Capsula erecta cum apophysi longa capsula paulo brevior obconica, obovato-pyriformis, brunnea, ore valde constricto, lucido, rubro, annulato. Membrana interna leviter adnata.

Peristomii dentes operculo detruso primo per peria cohærentes, demum erecto discreti, æquidistantes, reflexo-patentes, mediocres, pallidi, apiculus albidus opaciusculi, linea longitudinali notati, trabeculati, capsulæ firmè adhærentes.

Interius e membrana areolata punctulato-opaciuscula, sedecies carinata, carinis dentibus peristomii exterioris alternis paulo prominulis, obtusis, ultra interstitia quæ plerumque bidentato breviter productis; dentes interstitiorum interdum (mora Bartramix) conniventes. Membrana secus carinas facile finditur.

Sporula viridescens, majuscula, lævia, immersa globosa opaciuscula.

Columella truncata, inclusa.

Operculum diu persistens, conicum, obtusum cum columellæ apice secedens.

Calyptra desiderata.

An. B. nepalense, Schwaeg; Brid. Bryol. Univ. 1.602 ?

Habitus illi Leptostomo, R Br. certe affinis.

1. Plant.
2. Cauline leaf.
3. Capsule and operculum.
4. Capsule, operculum removed.
5. Upper part of capsule with peristome (dry).
6. Long section of capsule.
7. Portion of both peristomes.
8. Portion of annulus.
9. Sporula (dry.)
10. Sporula (in water.)
11. Operculum long section. *It. Ass.* 569.

2. *Brachymerium cuspidatum*, Griff. Pl. CII. Fig. I.

Caule brevi ramoso, ramis cylindraceis fastigiatis, foliis lanceolatis acuminatis, integerrimis, vena excurrente cuspidatis, marginibus simplicibus, capsula suberecta obovato-pyriformi.

HAB. In sylvis Myrung.

Caulis primarius brevissimus, innovationibus ramosus. Rami erecti, brevisculi, vix semunciales, sicci filiformes, humore squarrosuli. Folia siccitate adpressa, humore ascendenti-patentia, concava, valde acuminata, vena excurrente in cuspidem brevem subulatam patentem prædita, aerolis fusiformibus.

F. Perichætalia magis acuminata oblongiora, marginibus subincrassatis. Seta terminalis, uncialis vel, ultra, flexuosula, rubescens, sicca tortilis. Vaginula brevis, conico-ovata, obsita paraphysibus hyalinis filiformibus pistillisque numerosis.

Capsula erecta vel paulum inclinata, cum apophysi longe obovato-pyriformis, rufo-brunnea,—fere Br. contorti, sed minor. Peristomium exterius e dentibus 16, erectis, imis apicibus subrecurvis, trabeculatis, linea longitudinati notatis, rubris, apicibus opacis lutescentibus.

Interius e membrana alta, sordide lutescente areolata, sedecis plicata, plicis exeuntibus indentes breves irregulares, (interdum in cilia,) fissis plerumque divaricatis et dentibus p. exterioris opositis, sinibus sæpius nudis.

Sporula minuta, lævia immersa diaphana.

Culumella inclusa, filiformis, truncata.

Operculum conium, obtusum.

Calyptra desiderata.

An. B. bryoides, Schwaeg. Brid. Bryol, Univ. 1. 603. ?

1. Plant.
2. Two young plants, the simple one not fecundated, the fecundated one branched by innovation.
3. Some of the pistilia and paraphyses.
4. Cauline leaf.
5. Capsule.
6. Apex of capsule, annulus almost detached.
7. Mouth of ditto, outer peristome nearly removed.
8. Tooth of outer peristome.

9. Portion of inner ditto.
10. Sporula in water.
11. Operculum long section.

3. *Brachymenium filiforme*, Griff. Pl. CII. Fig. II.

Caule ramisque elongatis filiformibus, foliis arcte adpressis ovatis muticis 1-veniis, capsula cernua vel pendula.

HAB. In ripis Maamloo ; in rupibus inter Surureem et Moleem et ad cotaractam Moosmai.

Cæspitosum, argenteo canescens ; caules basi decumbentes, subclavati, apicem versus innovationibus ramosus, ramique simplices, interdum longissimi. sæpe fastigiati. Folia dense imbricata, sicca madidave arcte adpressa, obtusa vel acutiuscula, integerrima, vel minutissime denticulata, marginibus simplicibus, vena mediocri medium versus evanida donata ; areolis fusiformi-angulatis.

Perichætialia exteriora caulis terminalia sed acutiora, interiora minora.

Seta terminalis, uncialis, vel ultra, rubescens, siccatione etortilis.

Vaginula brevis, conica, paraphysibus pistillisque pluribus obsita. Capsula cum apophysi mediocri obconica (capsula 3-plo breviori) obovata, brunnea, ore constricto rubro annulato.

Membrana interna libera.

Peristomium exterius connivens, e dentibus 16 angustis, plano-subulatis, sordide et pallide rubris, acuminibus setaceis albidis, subhyalinis, linea longitudinali inconspicua sæpius notatis trabeculatis. Interioris membrana alta, solida, areolata, sordide lutescens, sedecies carinata, carinis dentibus p. exterioris more solito alternis, productis in dentes irregulares breves, vel longiusculos, setaceos, rarius perforatos, interdum si breves, fissos, laciniis divaricatis. (ut in *Bartramia*.)

Sporula minuta, lutescenti-viridia, immersa diaphana.

Columella, inclusa punctata.

Operculum conicum, obtusum, rubrum, obliquiusculum.

Calyptra desiderata.

1. Plant.
- 2, 2. Cauline leaves.

3. Capsule.
4. Mouth of capsule, peristome and annulus.
5. Portion of capsule and of both peristomes seen externally.
6. Operculum long section.

XIX. BRYUM, LINN.

1. *Bryum argenteum*, Linn. Hook.
 HAB. Saxa ad Surureem et Nanklow.
2. *Bryum cæspiticium*, Linn. Pl. XCI. Fig. V.
 HAB. Rupes, Churra Punjæ et Surureem. Super arborem delapsam Suddiya.
 1. Capsule and operculum.
 2. Capsule annulus separating.
 3. Portion of capsule and of both peristomes viewed internally.
 - 4, 4. Sporulæ.
 5. Annulus.
 6. Operculum long section.
 7. Leaf.
3. *Bryum coronatum*, Schwaeg: Brid. Bryol. Univ. 1. 650.
 HAB. Colles Khasiyani; locus nobis ignotus,
 Planta Khasiyana descriptioni Bridelii l. c. apte quadrat.
4. *Bryum crudum*, Huds. e Musc. Brit. Pl. XCI. Fig. IV.
 HAB. Colles Terrestræ. Pineta Moflong.
 Variat statura. Caules sæpe innovationibus ramosi, folia sæpe plus minus destructa, vena continua etiam subexcurrente prædita, innovationum latiora brevioraque. Flores hermaproditi.
 1. Capsule.
 2. Portion of capsule and of both peristomes.

3. Sporula.
4. Operculum, section of.
5. Anther.
- 6, 6, 6. Leaves. *It. Ass.* 569.

5. *Bryum coriaceum*, Griff. Pl. XCI. Fig. III.

Caulibus sterilibus repentibus, fertilibus erectis simplicibus, foliis terminalibus rosaceo congestis obovatis emarginatis denticulatis, setis aggregatis, capsula cylindraceo-oblonga cernua, operculo longe et oblique rostrato.

НАБ. Rupes humidi Maamloo, ubi copiosum.

Caulis sterile ramosus, flagelliformis, fertiles sæpius simplices, subunciales, basi denudati, radiculoso-villosi.

Folia caulium fertilium crassa, coriacea, emarginata, sinu mucronigero, marginibus diaphanis lutescentibus e cellularum difformium sub sub-triplice serie conflatis, percursa vena subulata completa vel intra apicem evanida sæpius centro linea fuscescenti notata percursa, areolis majusculis suc-6-gonis sæpe aer continentibus; inferiora magis rotundata, et vix emarginata.

Caulium sterilium folia inferiora aliis conformia, superiora rotundata vel orbicularia, repanda.

Perichætialia exteriora caulina terminalia, interiora minora, intima minima, acuminata, integra.

Flos terminalis, hermaphroditus.

Antheræ plures. Pistilla numero varia.

Paraphyses copiosissimæ, hyalinæ, filiformi-clavatæ.

Seta pallida, raro solitaria, sæpius 2-3, aliquando 6, aggregatæ sescuncialis, sicca parce tortilis.

Capsula cernua vel nutans, sæpius horizontalis, fusco-viridis immatura tantum visa.

Peristomium exterius e dentibus 16, latis, breviusculis, trabeculatis, linea longitudinali obsoleta notatis.

Interioris membrana lutescens; ciliis ample perforatis, ciliolis binis ternisue cohærentibus interjectis.

Operculum e basi convexa longe et oblique rostratum, (rostro sæpius incurvo) capsula dimidio brevius.

Calyptra longe subulata, hinc fissa.

Medium quasi tenet inter *B. punctatum* et affine.

1. Capsule.
2. Calyptra.
3. 3. 3. Leaves *It. Ass.* 573.

6. *Bryum Sollyanum*, Griff. Pl. XCI. Fig. I.

Caule repente, ramis erectis, foliis terminalibus, rosaceo-congestis obovatis acuminato-cuspidatis marginatis, marginibus medium infra revolutis integris supra planis argute serrulatis, vena intra apicem subevanida, capsula oblongo-cylindracea cernua, operculo acute mammillari.

НAB. In sylvis Surureem, et copiose in pinetis Moflong.

Rami erecti, unciales vel ultra, inferne nudiusculi radiculoso-villosi, interdum apice vel infra proliferi.

Folia rosaceo-patentia, confertissima, maxima, semuncialia, vel ultra, latitudine extrema fere 3-linealia, breviter acuminato-cuspidata, cuspidate semi-torta, argute serrulata, dentibus serraturis sæpe biseriatis, percursa vena crassa sursum attenuata intra apicem subevanida, læte viridescencia, areolis anguste hexagonis siccitate flexuosula interdum subtortilia.

Flos. hermaphroditus fæmineusve, terminalis, vix discoideus, cinctus foliis perigonalibus caulinis multo minoribus, erectis, lanceolato-linearibus linearibusve, carinatis, acuminatis, acumine in subulam scabrellam longam exeunte, marginibus subsimplicibus infra medium insigniter revolutis. sursum planis obsolete denticulatis, vena basin acuminis versus evanida.

Antheræ plurimæ, hyalinæ, filiformes, æqualiter septatæ. Pistilla floris hermaphroditi pauca, fæminei copiosa, 2-3 sæpius fecundata.

Seta terminalis, sæpius binæ termæve, $1\frac{1}{2}$ vel 2-uncialis, rubescens.

Vaginula ovato-conica, mediocris.

Capsula raro pendula, sæpius subtransversa, maxima, longitudine trilinealis, oblongo-cylindracea, inæquilateralis, basi solida, demum brunnea, collo parum constricto, ore annulato.

Membrana interna libera.

Peristomium exterius connivens, e dentibus 16, magnis, plano subulatis, utrinque trabeculatis, lineis compositionis albis conspicuis notatis pallide rubris, acuminibus setaceis albidis.

Peristomium interius e membrana lutescente altiuscula, insigniter sedecies plicata, ciliis valde acuminatis, crebre ampleque perforatis punctulatis; ciliolis interjectis hæc subæquantibus tenuissimis, sæpius ternatis conspicue trabeculatis.

Sporula minuta, viridescens, globosa, lævia, immersa opaciuscula. Columella longe apiculata, inclusa; operculum concolor. Calyptra desiderata.

Species præ aliis ampla et pulchra.

B. Umbraculo proximum. Hook. Musc. exot. p. 16. t. 133.

1. Capsule and operculum.
2. Apex of Capsule.
3. Portion of inner Peristome.
4. Operculum long section.
5. Leaf Natural size. *It. Ass.* 570.

7. *Bryum longirostrum*, Griff. Pl. XCI. Fig. II.

Caule sterili repente, fertili erecto, foliis (terminalibus) rosaceo-congestis oblongo-ligulatis obtusis marginatis denticulatis vena in mucronulum excurrente, setis aggregatis, capsula cernua cylindræo oblonga, opercula longe et oblique rostrato.

HAB. In arboribus vel ripis sylvarum, collium Khasiyanorum inter Churra Punjee et Nunklow.

Folia omnia subconformia, siccitate crispata, sæpius recurvata et carinata, oblongo-vel spathulato-ligulata.

Perichætialia intima, minima.

Setæ aggregatæ 2-8, capsulæ sæpius horizontalis, inæquilateralis, annulata.

Peristomium exterius humore connivens, pallide lutescens; dentes plano-subulati, breviusculi, trabeculati.

Interioris membrana solito saturatius lutescens, ciliis acuminatis valde poratis, ciliolis simplicibus binisve interjectis.

Sporula globosa, lævia, immersa opaciuscula.

Columella longiuscule apiculata, inclusa.

Operculum e basi convexa longe et oblique rostratum, capsula $\frac{1}{3}$ brevius, lutescens, margine rubrum.

Calyptra longe subulata, apice uncinata, ad medium usque fere fissa.

Ab. ligulato, vix distinguendum operculo longirostro, et floribus hermaphroditis ?

1. Capsule and operculum.
2. Portion of Capsule and of both Peristomes viewed externally.
3. Calyptra.
4. Leaf. *It. Ass.* 571.

XX PTEROGONIUM, HOOK.

1. *Pterogonium squarrosum*, Griff. Pl. XCVIII. Fig. II.

Caule repente pinnatim ramoso setigero, ramis erectis simplicibus, foliis siccatione adpressis humore patentissimis late ovatis valde concavis breviter apiculatis integris aveniis, capsula erecta oblongo-ovata, operculo conico-subulato.

HAB : Super arbores sylvarum Tingrei vicinitatisque Suddiyæ. Rami siccatione sæpe depressi, apice interdum elongati.

Folia dense et undique imbricata, late ovata, interdum suborbicularia, breviter acuminate, apices versus fusco-tincta, areolis subquadratis.

Perichætialia lanceolato-oblonga, acuminata, acuminibus exteriorum et minorum patentissimis vel recurvis, interiorum rectis.

Seta vix semuncialis, pallida, sicca parce tortilis.

Vaginula subcylindracea pallida. Paraphyses plures, tenues, filiformes. Pistilla puaca.

Capsula exannulata, albida, æquilateralis.

Peristomium e dentibus 16, plano-subulatis, acutis, binatim compositis, linea longitudinali transversisque distinctis, interdum apices versus obsolete perforatis, sub lente centies augente obscure striatis, badio-rufis, apicibus diaphanis ; serius albidum, fragile,

Sporula magna, valde inæqualia, rotundata.

Columella apiculata, inclusa.

Operculum leviter inclinatum, obtusiusculum.

Calyptra profunde dimidiata lævis.

Affine *Pterogonio Myuro*, Hook. Musc. Exot. p. 9, t. 148, a quo præcipue differt caule repente, ramis erectis squarrosis approximatis, foliisque acuminatis.

1. Capsule.
2. Long section of capsule.
3. Portion of peristome.
4. One tooth of peristome.
5. Germinating sporula.
6. Leaves.
7. Perichæatial leaf. *It. Ass.* 576.

2. *Pterogonium aureum*, Hook. Musc. Exot. p. 8. t. 147.
Brid. Bryol. Univ. 2. 180.

HAБ : Super arbores—Mumbree.

Folia plantæ Khasiyyance multo magis patentia quam demonstrat Hookeriana icon.—Capsulas seniores tantum vidi, quarum peristomia decolorata. Præcedenti valde affine, discrepans foliis minus patentibus, membranaceis, lanceolato-acuminatis, marginibusque recurvis.

1. Capsule.
2. Portion of Capsule and of old Peristome seen internally.
3. Leaf. *It. Ass.* 584.

3. *Pterogonium flavescens*, Pl. XCVIII. Fig. IV. Hook.
Musc. Exot. p. 8. t. 155. Bridel. Bryol. Univ 2. p. 193.

HAБ : Super arbores Myrung.

Omnia fere plantæ nepalensis, sed statura major, et ramificatio indistincte pinnata. Variat dentibus peristomii solidis perforatisve.

1. Capsule.
2. Portion of capsule and of peristome viewed internally.

3. Portion of peristome.
4. Operculum.
5. Calyptra.
6. Leaves. *It. Ass.* 583.

4. *Pterogonium neckeroides*, Griff. Pl. XCVIII. Fig. III.

Cuale repente pinnatim ramoso, ramis ascendentibus, foliis ascendenti-patulis lanceolato-acuminatis planiusculis tenuissime semi-venis subintegris, capsula obliqua cylindracea inclinata annulata, operculo conico-subulato brevi.

HAB. Super Buddleæ speciem arboream Mumbree.

Rami depressi, siccatione filiformes. Folia sub-4 fariam imbricata, siccitate adpressa, humore patentia, marginibus medium infra leviter revolutis, areolis angustis, marginalibus baseos majusculis quadratis.

F. Perischætialia avenia, acuminibus patulis.

Seta axillaris, solitaria, vel aggregatæ, sed ad inflorescentias diversas semper pertinentes, pallida, sicca tortilis; vaginula mediocris, cylindracea; paraphyses pistillaque paucissima.

Capsula cylindracea inæquilateralis, utrinque paullo attenuata. brunneo-rufescens

Peristomii dentes 16, subulati, simplices, breviusculi, coriacei, solidi, lutescentes, marginibus valde opacis, utrinque marginati.

Sporula majuscula, vix uniformia, globosa, lævia viridescens, immersa opaca.

Columella filiformis, inclusa, apiculata; operculum obliquiusculum.

Calyptra non visa.

Variat statura.

1. Capsule and operculum.
2. Capsulé.
3. Portion of capsule, annulus and peristome viewed internally.
4. Operculum.
5. Leaf. *It. Ass.* 589.

XXI. NECKERA.

Hedw. ex pte. Bridel. Bryol. Univ. 2. 226, ex pte.

1. *Neckera curvata*, Griff. Pl. LXXXVI. Fig. 1.

Caulē repente pinnatim ramoso, ramis apice attenuatis curvatis, foliis undique imbricatis late ovatis ovatisve-breviter acuminatis minutissimo denticulatis sæpidis aveniis, capsula erectiuscula cylindræca leniter arcuata, operculo conico subulato.

HAB. Rupestris prope torentem Bogapanee collium Khasiyanorum.

Caulis elongatus. Rami siccitate filiformes, madidi subcylindracei. Folia subquadrifariam imbricata, siccitate adpressa, humore ascendente, concaviuscula, sub-lente forti minute denticulata, avenia vel basi brevissime bivenia (potius bistriata,) fusco-tincta, caulinia late-ovata, acuminata, ramena ovata, acuta vel breviter acuminata.

F. Perichætialia exteriora conforma, recurva, interiora majora, oblongo-lanceolata, valde acuminata, recta, subintegra.

Seta lateralis, ancialis vel paullo longior, rubro—sanguinea sicca torta.

Vaginula oblongo—cylindræca pallida. Paraphyses hyalini, filiformes, plures. Pistilla pauca.

Capsula obliquiuscula, leviter arcuata, anguste cylindræca, ferrugineo-brunnea.

Membrana interna libera, stipitata :

Peristomium utrumque cum membrana interna secedens, exterius e dentibus 16, plano-subulatis, binatim compositis, solidis, rigidis, fragilibus, conniventibus, etrabeculatis, infra medium rufis, supra idem lutescentibus. Interius e ciliis totidem alternantibus, brevioribus, setaceis, binatim compositis, solidis, pallide lutescentibus, diaphanis, basi unitis in membranam perbreve.

Columella subcylindræca, apiculo persistente exerto.

Sporula viridescens, globosa, lævia mixta cum massis ovatis, aliquoties majoribus, compositis, in membrana hyalina inclusis.

Operculum conicum, obtusum, capsula fere 4-plo brevius.

Calyptra lævis, demidiata.

Habitus omnino Hypni.

1. Capsule.
2. Apex of capsule.
3. Ditto long section.
4. Portion of os capsulæ.
5. Portion of both peristomes seen internally.
6. Portion of the inner peristome.
7. Columella and base of capsule.
8. Operculum long section.
9. Calyptra.
10. Cauline leaf.
11. Perichætial ditto.

2. *Neckera lurida*, Griff.

Caules repente subpinnatim ramoso, foliis undique imbricatis ovato-lanceolatis brevissime acuminatis cymbiformibus basi obsolete biveniis integerrimis, capsular oblongo cylindræa basi subapophysata operculo conico.

HAB. Rupes Surureem.

Caules elongati repentes, subpinnatim ramosi, sæpe denudati.

Folia undique imbricata, patulo-ascendentia, acuta, cymbiformia, marginibus leviter involutis, basi obsolete biveniis.

Perichætialia fere præcedentis.

Seta præcedente paullo brevior, apice in apophysi obsoletam incrassata.

Capsula inclinata, leviter arcuata, obliquiuscula, rubra incomplete annulata.

Columella, sporulaque præcedentis.

Peristomii exterioris dentes fere ut in præcedente, sed duplo breviores magisque evoluti. et trabeculati.

Interius e ciliis totidem alternantibus, inferne obsolete carinatis, brevioribus vel subæquantibus, lutescentibus diaphanis, basi unitis in membranam brevissimam (vix demonstrandam) dentium peristomii exterioris basibus arcte coherentem.

Calyptra. —

Præcedenti, quamvis habitu sat distincta, proxima.

An species Anomodonti et Hookeri et Taylori.

3. *Neckera pulchella*, Griff. Pl. LXXXVII. Fig. VI.

Caule repente pinnatim ramoso, ramisque subcomplanatis, foliis undique imbricatis lanceolatis acuminatis, concavis, basi bi-striatis apicem versus minute denticulatis, capsula cylindracea leniter arcuata, peristomio interiore tenerrimo, operculo conico-subulato.

HAB. Sylvæ Mumbree.

Species pusilla. Rami præsertim siccitate complanati, depressi.

Folia undique imbricata, lateralia disticha, concava incurva, acuta, basi inconspicue bivenia, areolis angustis, basilaribus utrinque laxis et quadratis, marginibus subincurvis.

Flos. fæmineus axillaris, gemmiformis, cinctus foliis perichætialibus conniventibus acuminibus patulis, interiorum longissimis rectis vel subtortilibus. Pistilla circiter 12. Paraphyses magis numerosæ hyalinæ. longiores.

Seta axillaris, lineas tres vix excedens, rubescens, sicca valde tortilis. Vaginula mediocris, pallida, ore membranaceo.

Capsula suberecta, obliquiuscula, annulata, brunnea.

Peristomium exterius e dentibus 14, humore incurvis, plano-subulatis, breviusculis, vix trabeculatis, transversim crebre lineatis, linea longitudinali inconspicuâ, valde fragilibus, pallide rubo-brunneis, acuminibus hyalinis. Interioris cilia breviora, alba, utrinque repanda, fere moniliformia, tenerrima fragilima, membrana basilari tenuissima dentibus peristomii exterioris cohærente.

Sporula mediocra, rotundata, fusco-viridescencia, immersa semi-opaca.

Columellæ apiculus acutissimus, primo exsertus.

Operculum subulatum, rostro curvato, capsula vix duplo brevius.

Calyptra profunde dimidiata, lævis.

Medium quasi ambigit inter *N. curvatam* et *N. lætam*, præcipue hujus varietatem *A.* e qua tantum differt statura minore, ramis minus complanatis, operculo longiore peristomioque interiore tenerrimo.

Dentis peristomii exterioris fere ut in *Pterogonio*.

1. Capsule and operculum.

2. Portion of capsule and both peristomes viewed internally.
3. Calyptra.
4. Cauline leaf. *It. Ass.* 586.

4. *Neckera læta*, Griff. Pl. LXXXVII. Fig. VII.

Caule repente pinnatim ramoso, ramis complanatis, foliis lanceo-
latis acutis integerrimis basi sæpius bi-tri-striatis, capsula
erecta cylindræa, operculo subulato.

HAB. Super arborem lapsam prope cataractas "Moosmai." Loci
editi Assamici prope Suddiyam et Negrogam.

Folia undique imbricata, antica posticaque adpressa, literalia
disticha, ascendentia, concaviuscula, pallide viridescencia.

Flores masculi axillares, gemmiformes. Fol perigonia exteriora
retundata, interiora oblongo acuminata, acumine patente
ascendente.

Paraphysas paucæ, hyalinæ antherarum longitudine. Antheræ
plures, circiter decem, subsessiles, apicibus deliscentes, in-
conspicue saltem post dehiscenciam areolatæ.

F. Perichætalia acuminata, acuminibus exteriorum recurvis.
interiorum ascendenti-patentibus.

Seta axillaries pallida, subuncialis, sicca tortilis. Vaginula brevis
pallida, ore rubro. Paraphysas hyalinæ, filiformes.

Pistilla pauca, stylis longis.

Capsula anguste cylindræa, basi solida, subæqualis, pallida
sub lente modice augente areolis quadratis reticulata, ore
lævi, rubro, exannulato.

Membrana interna adnata.

Peristomium exterius humore connivens, siccitate erectum,
breve; dentes binatim compositi, subulati, rigidi, fragiles,
vix trabeculati, castaneo brunnei.

Interius e ciliis totidem, subconcoloribus, solidis, brevioribus,
diaphanis, basi in membranam mediocrem sursum concolorem
cum peristomis exteriore leviter cohærentem unitis.

Columella filiformis, apiculo semi-exserto.

Sporula subuniformia, lævia, immersa subdiaphana.

Operculum obliquiusculum, alatum capsula sub 5 plo-brevius.

Calyptra profunde dimidiata, lævis, apice stylifera.

Variat A. Ramis magis complanatis, foliis estriatis, (an semper ?)
Peristomii exterioris dentes siccitate ascendenti-patentes,
longiores perforati.

HAB. Negrogam et Suddya.

An distincta ob dentes p. exterioris perforatos (characterem insolitum) coloremque.

Variat B. Fuscescens.

HAB. Nunklow.

1. Capsule.
2. Portion of capsule and both peristomes viewed internally.
3. Calyptra.
4. Cauline leaf. *It. Ass.* 298.
5. *Neckera brevirostris*, Griff. Pl. LXXXV. Fig. I. I'. I''.

Caule repente, ramis complanatis ascendentibus apice valde attenuatis, foliis ovatis lanceolatisve cuspidato-acuminatis concavis marginibus revolutis subintegerrimis basi sæpius bistriatis, capsula cylindræa inclinata, operculo conico subulato rostro curvato.

HAB. Arbore Surureem.

Rami ascendentes, simplices, ambitu lineari-lanceolati, apicibus valde attenuati, basi sæpius setigeri.

Folia sub 4-fariam laxè imbricata, basi concaviuscula, lanceolata, valde acuteque acuminata, sublente forte minute denticulata, raro prorsus avencia; partis rami attenuati minora, falcatim-incurvata, disticha. In axillis foliorum inferiorum adsunt appendiculæ, longissimæ, tenuissimæ filiformes, septatæ, paucæ, utrinque leviter attenuatæ, articulis vel omnino materia grumosa velpartim materia coagulata repletis.

F. Perichætialia acuminata, acumine denticulato.

Seta lateralis, 7-8-linealis, filiformis, fuscescens, sicca tortilis.

Vaginula elongata, cylindræa. Paraphyses subnullæ. Pistilla pauca.

Capsula inolinata, apte cylindræa, angusta, exannulata, fusco-brunnea.

Membrana interna adnata, ore carnosiore peristomifero.

Peristomium exterius e dentibus 16, angustis, subulatis humore apicibus patulo-reflexis, inconspicue trabeculatis, lineis transversis subconspicuis, longitudinali inconspicua notatis, albidis punctulato-opacis.

Interius; cilia totidem alternantia, breviora, tenuissima. punctulato opaca, basi unita in membranam brevissimam areolatam dentibus peristomii exterioris leviter adnatam.

Columella apiculata, inclusa, cubeylindracea.

Sporula fusco-viridescens, deformia immersa, majora opaciuscula, minora diaphana.

Operculum fuscescens. e basi conica breviter rostratum; rostro obtuso, ut plurimum incurvo.

Variat. A. Ramis erectis, foliisque angustioribus striatis, papeniculis copiosissimis oculo nudo villos ferrugineos mentientibus valde conspicuis, capsula oblongo-cylindracea, operculoque longiore.

HAБ. Pineta Moflong.

Appropinquat sectioni ultimæ.

1. (Fig. I'') Plant magnified about eight times; (seta curved to keep it within the drawing), perichætum represented too large.
1. (Fig. I') Capsule and operculum.
2. Apex of capsule.
3. Portion of capsule and both peristomes seen internally.
4. Sporula.
5. Cauline leaf. *It. Ass.* 585.
1. (Fig. I. Variat. A.) Capsule.
2. Portion of both peristomes seen internally.
3. Operculum.
4. The same long section.
5. Cauline leaf. *It. Ass.* 582.
6. *Neckera rostrata*, Griff. Pl. LXXXVII. Fig. I.

Caule repente subpinnatim ramoso, ramis ascendentibus brevibus, foliis undique imbricatis lanceolatis valde acuminatis concavis, sub integerrimis aveniis, capsula inclinata cylindracea, operculo conico-subulato inclinato capsulam fere æquante,

HAB. Sylvæ Myrung, ubi muscis aliis mixta viget Super pinum
vicinitate Myrung frequentissima.

Arborea, cæspitosa. Folia, etiam sicca, patenti-ascendentia.
plurifariam imbricata, marginibus subrevolutis.

Perichætialia interiora recta, acuminatissima.

Seta lateralis, rubescens, vix uncialis.

Vaginula arcte. Paraphyses pistillaque pauca.

Capsula inclinata, æqualis, cylindræa, utrinque paullo at-
tenuata, brunnea. exannulata.

Membrana interna adnata.

Peristomium exterius siccitate apice inflexile, e dentibus 16,
binatim compositis, linea longitudinali notatis, trabeculatis,
subulato-setaceis, longis, apicibus opaciusculis.

Interius. Cilia totidem alternantia, conniventi-erecta, angustis-
sima, opaciuscula illis paullo breviora: membrana basilaris
brevis basi peristomii exterioris cohærens.

Columella inclusa, apiculata.

Sporula inæqualia, rotundata, lævia, immersa diaphana.

Operculum e basi conica longe et oblique subulatum.

Calyptra dimidiata, lævia.

1. Capsule and operculum.
2. Capsule.
3. Portion of both peristomes seen internally.
4. Calyptra.
5. Operculum.
6. Cauline leaf.
7. Perichætial leaf. *It. Ass.* 524.

7. *Neckera capillacea*, Griff. Pl. LXXXIX. Fig. III.

Caule repente, ramis subascendentibus brevibus, folius undique
imbricatis lanceolato-acuminatis aveniis apicem versus minute
denticulatis, seta longissima capillæa, capsula erecta urceo-
lato-ovata, operculo conico subulato obliquo brevi.

HAB. Super arbores sylvarum Surureem rara.

Folia ascendenti-potentia, concava; perichætialia oblongo lan-
ceolata, acuminibus denticulatis.

Seta $1\frac{1}{2}$ uncialis, pallida, flexuosa.

Capsula erecta, æqualis, fusco-brunnea, exannulata.

Peristomium utrumque album; exterioris dentes siccatione undulati, plano subulati, obtusi, conniventes, lineis compositivis inconspicuis, opaco-punctulatis, basi unitis, in membranam brevem areolatam solidam sedecies plicatam.

Sporula sordide virida, lævia, immersa opaciuscula.

Columella inclusa.

Operculum conico-subulatum, obliquum, capsula triplo brevis.

Calyptra non visa.

Species distincta, Leskiæ approximans.

1 Capsule.

2 Portion of capsule and of both peristomes viewed internally.

3. Long section of operculum.

4. Cauline leaf.

5. Perichæatial leaf. *It. Ass.* 384.

8. *Neckera comes*,* Griff. Pl. LXXXVI. Fig. II.

Cuale repente subpinnatim ramoso apice attenuato pendulo. foliis laxè imbricatis lanceolato-acuminatis aveniis acumine minutim denticuloso, seta brevi, capsula inclinata ovato-oblonga, operculo conico-subulato obliquo.

HAB. Colles Khasiyani, inter Churra Punjee et Nunklow. Prope Mumbree frequentissima, semper que sodalis.

Caulis apicibus sæpius valde attenuati gracillimique, spithamæi, vel paullo ultra, muscis sociis arcte implicati.

Folia patentissima, margine uno involuto, concaviuscula, prorsus avenia, acuminatissima, partium elongatarum disticha et sæpe aristata.

Perichæatialia externa rotundata, mutica; interiora cualinis subconformia, acumine ascendente; intima longissime acuminata, rectiuscula.

Seta pallida, curvatula, subbilinealis; vaginula subcylindracea; paraphyses plures, hyalin, filiformes. Pistilla numerosa.

Capsula exserta, æqualis, exannulata, pallide brunnea.

Membrana interna inferne libera.

* *Comes*—because it always occurs mixed with other mosses.

Peristomium utrumque album, fere hyalinum, humore connivens, ori capsulæ arcte cohærens.

Exterioris dentes 16, subulato-setacei, linea longitudinali subinconspicua transversisque crebris conspicuis exsculpti.

Interioris cilia alternantia, breviora submoniliformia, carinata, interdum obsolete perforata, basi unita in membranam brevem, hyalinam, reticulatam.

Columella apiculata, inclusa.

Operculum e basi convexiuscula oblique subulatum, capsula paullo brevius

Calyptra dimidiata, lævis.

Affinis videtur *N. acuminatæ*, Hook. Musc. Exot. 2. 15. t. 151.

1. Plant magnified.
2. Cauline leaf.
- 2a. Lateral leaf.
3. Perichætium seta and capsule.
4. Portion of capsule and both peristomes seen internally.
5. Sporula.
6. Operculum.
7. Operculum, long section of.
8. Calyptra separated, with operculum.

9. *Neckera aurea*, Griff. Pl. LXXXVII. Fig. 11.

Caule repente, sæpius longissime pendulo pinnatim ramoso, foliis undique imbricatis e basi lanceolata acuminatissimis serrulatis mediatenus-venis, seta brevissima, capsula subexserta oblongo-urceolata, operculo conico-subulato recto, calyptra mitræformi glabra.

HAB. Pineta Maamloo et Moflong. Margines sylvæ Mumbre, ubi frequentissima aliorumque Muscorum Jungermanniarumque socia.

Fusco-aurea, squarrosa. Caules longitudinis variæ, paullo elongati copiose fructiferi, vel longissimi, pedales quin fere sesquipedales, sæpiusque steriles. Rami plerumque simplices, unciamque vix excedentes, Folia sicca subdisticha, madida patentissima, oblique torta, margine uno basin versus involuto, plus minus undulata, areolis angustissimis, partium attenuata-

rum disticha apice fere pilifera. Variant angustatione, marginibus subinvolutis, venaque ultra medium evanida.

Flores monœci; masculi axillares, gemmiformes, cincti foliis perigonalibus concavis, ovato-lanceolatis, lanceolatisve acuminatis, integris, aveniis, interioribus minoribus. Paraphyses paucissimæ, 2-3, filiformi-clavatæ hyalinæ.

Antheræ paucæ, subquinæ, breviter stipitatæ, apicè dehiscentes, ore membranaceo irregulari, cellulis sine ordine dispositis, areolatæ.

Folia perichæetialia caulinis subconformia, subintegra vel acumine denticulata; interiora majora, capsulam subæquantia.

Seta brevissima, vix linealis, crassiuscula, vaginula ovata, ore brunneo, seta subduplo-brevior, paraphysibus fere expers.

Pistilla pauca.

Capsula suberecta, æqualis, exanulata, setam paullo excedens, fusco-brunea.

Membrana interna adnata.

Peristomium exterius albidum; dentes plano-subulati, longe acuminati, acuminibus flexuosis, longitudinaliter obsolete transversim magis conspicue notati, vix trabeculati, opaci humore reflexo-erecti. Interius e ciliis totidem ejusdem longitudinis tenuissimis, capillaceis, binatim compositis, solidis, puntulato-opaciusculis, basi carinatis et unitis in membranam brevem obsolete sedecies plicatam.

Columella cylindræcea, apiculata, inclusa.

Sporula rotundata, immersa opaciuscula.

Operculum lutescens, capsula vix duplo brevius.

Calyptra mitræformis, glabra, basi aliquoties fissa leviterque inflexa, fissura una profundiore.

Habitu præcedenti valde affinis. Variat statura et gracilitate, capsulaque interdum exserta.

1. Capsule.
2. Portion of capsule, with both peristomes seen internally.
3. Operculum.
4. Calyptra.
5. Anther.
6. Cauline leaf. *It. Ass.* 580. *Var.* 581.

10. *Neckera crispatula*. Hook, Pl. LXXXIX. Fig. III.
Musc. Exot. 2. 15. t. 151.—Brid. Bryol. Univ. 2. 236.

HAB Colles Khasiyani, inter Churra et Nunklow, super rupes arboresque.

Fructiferum non vidimus.

Muscus hujus sectionis præcæteris speciosus. Caules elongati sæpe penduli. Folia siccatione adpressa, tri-striata fere tri-carinata, leviter flexuosa.

Flos, masculus axillaris, gemmiformis, ovatus. Folia perigonia concava, avenia; exteriora rotundata, mutica; interiora ovata acuminata, acuminibus ascendentibus vel subpatentibus.

Paraphyses filiformes, hyalinæ, rectæ.

Atheræ ciriter decem, subsessiles areolatæ, saturate brunneæ.

It. Ass. 488.

11. *Neckera fuscescens*, Hook. Pl. LXXXVII. Fig. IV.
Musc. Exot. 2. p. 14. t. 157. *Polytrichum fuscescens*,
Brid. Bryol. Univ. 6-224.

HAB. Socia N. aureæ, comitis filamentosæque. Nuperius collibus Naga, Børhath vicinis, legimus.

Folia quam iconis Hookeranæ, I. c. magis concava.

Flores monæci? axillares; masculi gemmiformes, ovati, cincti foliis perigonalibus concavis, ovato-rotundatis vel ovatis, breviter acuminatis, acuminibus rectis vel patulis. Paraphyses plures, hyalinæ, filiformes. Antheræ subsessiles plures. cylindræo fusiformes, areolatæ-brunneæ. Flores fæminei subcylindræi, gemmiformes; folia perichætalia inferiora minima, rotundata ovatave, acuta, avenia; interiora longissima, alba lineari-lanceolata, acuminata, subintegra, vel apices versus minute denticulata, citra medium 1-venia.

Paraphyses paucæ, interdum subnullæ.

Pistilla puaca.—Florem fæmineum, quoad tegumenta, musculo pate similem semel solum vidimus.

Seta brevissima, Vaginula cylindræa, ore brunneo-rubro, paraphysisibusque nonnullis longissimis flexuosis rectisve varidque longitudinis stipata.

Capsula immersa, foliis perichætialibus interioribus longe superata.

Membrana interna adanata.

Peristomia infra marginem oris capsulæ subincrassatam exserta.

Exterius humore connivens, castaneo-brunneum, apice pallidum; dentes plano-subulati, diaphani, lineis compositionis conspicuis notati, leviter trabeculati; interius e ciliis totidem alternantibus, subæquantibus, a medio infra circiter binatim compositis, setaceis, articulis incrassatis basi in membranam brevissimam concolorem liberam unitis, p. exterioris dentibus præteris similibus.

Sporula valde inæqualia, rotundata vel angulatâ, lævia, immersa, diaphana, in acervulo fusco-viridia.

Columella crassa sub cylindræa, apiculo gracillimo incluso.

Calyptra basi aliquoties fissa, fissura una profundiore, villis flexuosis numerosis ascendentibus simplicibus (paraphysibus) paucissimisque compositis eadem directione (foliis abortientibus) obsita. Pistilla etiam gerit.

Variat foliis magis concavis, integris; apiculo productiore tortilli; peristomii exterioris dentibus irregularibus linea longitudinali obsolete notatis; interioris ciliis minus evolutis quin interdum simplicibus. Varietas rara, forma foliorum sequenti accedens.

1. Perichætium.
2. Capsule.
3. Portion of capsule and of both peristomes viewed internally.
4. Portion of inner peristome.
5. Calyptra.
6. Cauline leaf. *It. Ass.* 592.

Fig. III. Variet efructif. *It. Ass.* 310.

12. *Neckera filamentosa*, Hook, *Musc. Exot.* 2. p. 14. t. 158. *Polytrichum filamentosum*, Brid. *Broyl. Univ.* 2. 264.

HAB. Colles Khasiyani, super arbores: muscorum, præsertim

vers *N. fuscescentis* socia. Collibus "Naga," altitudinis circiter 1000-petalis nuperius legimus, fructifera vers nobis ignota. Inter Churra Punjee et Nunklow.

Flos masculus axillaris, gemmiformis, cinctus foliis perigonialibus conniventibus, valde concavis; exterioribus ovato-rotundatis, muticis vel breviter apiculatis; interioribus majoribus, acuminatis, rectiusculis. Paraphyses copiosæ, breviusculæ, antheras longitudine paullo excedentes, hyalinæ, filiformes. Antheræ breviter stipitatæ, majusculæ, 12-25, oblongo-cylindraceæ, areolis subquadratis reticulatæ, apice dehiscentes.

VAR. A. Statura multo minore, vena longiore, infra apicem evanida.

Flores fæminei gemmiformes, axillares. Folia perichætialia foliis perigonialibus supra descriptis subsimilia, acuminibus scabris sæpius rectis: interioribus minoribus lanceolatis, acuminibus denticulatis; intimis minimis, setiformibus scabris.

Paraphyses paucissimæ, hyalinæ, filiformes, articulis sæpe alternatim compressis. Pistilla pauca 8-10, stipitata.

An ita distincta a planta Hookeriana cujus folia perichætialia "obtusa, emarginata, atque pilo longo sub-flexuoso terminata, nerve obscuro; intra hæc folia paraphyses numerosæ.

HAB. Loci Assamorum editi, Negrogam vicini.

13. *Neckera dentata*, Gr. Pl. LXXXVIII. Fig. II.

1. Capsule and perichætium.
2. Portion of ditto and of outer peristome.
3. Portion of inner peristome.
4. Operculum.
5. Calyptra.
6. Cauline leaf. *It. Ass.* 492

14. *Neckera spectabilis*, Pl. LXXXVIII. Fig. III.

1. Capsule.
2. Portion of capsule and of both peristomes viewed internally.
3. Cauline leaf.
4. Perichætial leaf. *It. Ass.* 587.

15. *Neckera Hookeriana*, Gr. Pl. LXXXIV. Figs. II. II,A.
1. (Fig. II.) Plant magnified about ten times.
 2. Part of stem with a lateral and posticous leaf, the lateral reflexed shewing its equal insertion, and the oblique insertion of the other.
 1. (Fig. II,A.) Portion of stem.
 2. Lateral leaf.
 3. Posticous ditto.
 4. Appendages.
 5. Appendages detached.
 6. Capsule.
 7. Portion of Capsule with both peristomes. *It. Ass.* 577.
16. *Neckera adiantum*, Gr. Pl. LXXXV. Figs. II. II'
1. (Fig. II.) Upper portion of plant magnified ten times.
 2. Perichæatial leaf.
 3. Pistilla.
 1. (Fig. II.?) Portion of stem with female flowers.
 2. Appendage.
17. *Neckera elegantula*, Pl. LXXXIII. Fig. V.
1. Capsule and perichætium.
 2. Capsule and operculum.
 3. Portion of do. and of the peristomes viewed internally.
 4. Calyptra.
 5. Cauline leaf. *It. Ass.* 294.
18. *Neckera crinita*, Gr. LXXXIV. Figs. I. 1,A.
N. undulata Hedw.
1. (Fig. I.) Plant magnified.
 2. Capsule and perichætium.
 3. An outer perichæatial leaf.
 4. Series of inner ditto representing the various stages of transformation.

1. (Fig. I, A. Capsule and operculum.
 2. Ditto. operculum removed.
 3. Portion of both peristomes viewed internally.
 4. Calyptra.
 5. Metamorphosed leaf of perichætium.
 - 6, 6. Perichætial leaves.
 7. Cauline leaf.
 8. Anther. *It. Ass.* 588.
19. *Neckera efructifer* Pl. LXXXVII. Fig. III. *It. Ass.* 590.

XXII. *Daltonia Hook et Tayl. Musc. Britt.* 138 *partim.*
Bridel Bryol. Univ. 2. 255.

I. *Daltonia marginata*, Griff. Pl. LXXXVIII. Fig. I.

Foliis oblongo-anceolatis marginibus fibrosis, seta apicem versus scabrella, capsula cum apophyse obovata inclinata.

HAB. In arboribus in Pinetis Moflong.

Musceus pusillus, elegans, Caules subsimplices apice innovantes, ascendentes, vix trilineates.

Folia ratione plantæ magna, siccatione tortilia, humore patentia vel ascendente, acuminata, plicato-carinata, integerrima, marginibus fibrosis diaphanis incrassatis, vena crassiuscula infra apicem evanida donata; areolæ parvæ rotundatæ oblongæve.

F. perichætialia pauca, subquina, minima, evenia, integra, concava vel convoluto-concava. exteriora lanceolato-ovata, acuminata, marginata, interiora subrotunda, brevissime apiculata, obsolete marginata.

Seta axillaris, crassiuscula, subbilinealis, rubro brunnea, apicem versus scabra et in apophysin brevem incrassata. cæterum pertotam longitudinem sublente fortiter augente minutissime scabrella.

Vaginula subcylindræa, arcte, rubro brunnea.

Paraphyses paucissimæ. Pistilla pauca longiuscule stipitata. Antheræ quas semel solum vidi pluris 5-7 ovatæ, mediocriter stipitatæ, cellulosa-areolatæ, brunneæ.

Capsula cum apophyse sicca ovata, madida obovata vel obovato, pyriformis, situ fere horizontalis, æqualis, exannulata, saturate rubro-brunnea, sublente modice augente areolis oblongis quadratisve reticulata.

Membrana interna leviter adnata, subsessilis.

Peristomium exterius lutescenti-albidum, capsulam ipsam subæquans, humore demum arcte reflexile, e dentibus 16, subulato setaceis, late trabeculatis, linea longitudinalina obsolete notatis, punctulato-opacis scabrellisque.

Interius e ciliis totidem alternantibus paullo brevioribus, suberectis, binatim compositis, punctulato-opacis, scabrellis, basin versus sæpe obsolete et minutissime perforatis, et imâ basi unitis in membranam brevissimam dentium peristomii exterioris basibus arcte cohærentem.

Columella inclusa, breviter apiculata. Sporula in acervulo viridia, immersa globosa lævia, diaphana.

Operculum conico-subulatum, rostro acuto recto, capsulam cum apophyse sub-æquans, brunnescenti-aureum.

Calyptra mitræformis campanulato-conica, basi (demum) fissa, pilis simplicibus longis acutis pallide stramineis hyalinis fimbriata, obsolete (madida saltem) reticulata, basi lutescens rostro sanguineo brunneo vel atrato.

Character generis in Muscol. Britt. loc. cit erroneus, præsertim quoad *D. heteromallam*, quæcus species neckeræ cujus peristomii interioris membrana basilaris, quamvis brevis, facile demonstratur. Dubitare igitur licet de genere *Anomodon* ejusdem libelli.

Plant magnified.

1. Cauline leaf, 1*a*. margin of cauline leaf magnified.
2. Perichæatial leaf.
3. Capsule and calyptra.
4. Capsule and operculum.
5. Capsule moistened.
6. Portion of the capsule and both peristomes viewed internally.
- 3*a*. Cilium of inner peristome with the bases of the teeth of the outer.
8. Columella and portion of the inner membrane.
9. Sporula. *It. Ass.* 525.

XXIII. PLEUROPUS, GRIFF.

Seta lateralis. Per: ext: e dentibus 16. Interius e membrana alta divisa in cilia totidem alternantia irregularia, obsolete carinata. Calptra dimidiata.

Musci arbosei repentes. Folia undique imbricata, acuminata, venatione varia. Flores monoici (an in omnibus) Capsula in species unica inæquilateralis.

Genus medium inter Neckeram et Leskiam, a priori apicem membrana basilari alta, a posteriori ciliis irregularibus obsolete carinatis distinguendum.

1. *Pleuropus densus*, Griff. Pl. LXXXIX. Fig. I. Pl. XC. Fig. II. Cal. Journ. Nat. Hist. Vol. III. t. xvii.

Foliis lanceolatis acuminatissimis concavis integerrimis aveniis, capsula ovata, operculo brevirostro curvato.

HAB. In Pinetis Moflong.

Cæspilosus, luteo-nitens. Caules repentes, ramosissimi, ramis ascendentibus, sæpe fasciculatis, apicem versus pinnatim dispositis.

Folia siccatione adpressa, humore patentia dense imbricata, basi utrinque conspicue areolata cellulis magnis quadratis, areolis reliquis angustis. Flores monoici; masculi laterales sæpius setæ basi approximatae, gemmiformes. Fol. perigonialia cordato-acuminata, integra, avena. Paraphyses nullæ. Antheræ plures breviter stipitate oblongo-ovatae apice coarctatae (an semper) areolatae.

F. Perichætialia ovato-oblonga, acuminatissima, recta avenea medum supra minute denticulata, bases versus laxè areolata.

Seta lateralis, rubro-sanguinea, fere uncialis, sicca tortilis flexuosaque.

Vaginula oblongo-conica, paraphysibus subexpers. Pistilla plura.

Capsula erecta, æqualis, rubro-brunnea, exannulata exapophy sata.

Peristomium exterius humore connivens; dentes 16 primo perparia cohærentes, cito discreti, plano subulati, solidi, cre-

berrime trabeculati lineâ longitudinale inconspicuâ, rigidi, opaiciusculi, lutescentes.

Interius e membruna breviuscula areolata, solida, sedecies plicata, dentibus peristomii. Exterioris alternantibus exeuntibus in dentes totidem plicatocarinatos, irregulares, breves, solidos, obtusos, sinubus nudi vel denticulum gerentibus.

Columella cylindraceo-clavata, apiculata, inclusa.

Sporula majuscula, lævia, fusco brunnea immersa opaciuscula.

Operculum e basi conica, breviter curviateque rostratum.

Calyptra dimidiata lævis, apice atrata.

1. (Pl. LXXXIX. Fig. I.) Plant magnified.
2. Male flowers.
3. Male flower, perigonal leaves removed.
4. Anther.
1. (Pl. XC. Fig. II.) Capsule and operculum.
2. Capsule, operculum removed.
3. Portion of capsule and of both peristomes, viewed internally.
4. Tooth of outer peristome.
5. Portion of inner peristome.
6. Columella and base of capsule.
7. Sporula.
8. Operculum.
9. Calyptra.
10. Cauline leaf.
11. Perichæatial leaf. *It Ass.* 536.

2. *Pleuropus fenestratus*, Griff. Pl. XC. Fig. I. Calc. Journ. Nat. Hist. Vol. III. t. xviii.

Foliis e basi cordato-lanceolata acuminissimis planis serrulatis mediatenus 1 veniis, capsula cylindraceo-ovata, peristomii interioris membrana fenestrata pertusa, operculo longirostro.

НЛВ. In arboribus Mumbree et Myrung.—Cæspitosus. Caules repentes, ramosi, ramis ascendentibus simplicibus sæpissime pluries ramosis, apicibus (saltem siccitate) incurvis. Folia undique imbricata, ascendenti-patentia, marginibus simplici-

bus basi subrecurvis, acumine semitorto magis serrulato, prædita vena tenui medium paulo supra evanida. Arcolæ oblongæ, angustissimæ conformes.

F. Perichætialia lanceolato-oblonga, concava, longe cuspidato-acuminata, acumine patenti recurvate denticulato, evenia vel interiora interdum obsolete 1 venia.

Seta axillaris, rubro-nitens, vix uncialis, sicca valde tortiesu, Vaginula, mediocris.

Paraphyses plures filiformes, hyalinæ interdum copiosissimæ. Pistilla plura.

Capsula erecta, æqualis, basi obsolete apophysata, annulata, rubro-brunnea.

Membrana interna distincta, sessilis.

Peristomium exterius e dentibus 16, plano-subulatis, mediocribus fragilibus, rigidis linea longitudinali inconspicua notatis, trabeculis, conventibus humore, siccitate patentissimis.

Interius e membrana areolata altiuscula, membrana species precedentis duplo longiore, sedicies plicata, punctulata, irregulariter-perforata, plicis exeuntibus in ciliis setacea, fragillima, longitudine fere dentium p. exterioris, subcarinatis opacis, ciliolis brevibus interdum dentiformibus, persistentioribus, solitarius binisve intersectis.

Sporula globosa, lævia, immersa opaciuscula.

Columella cylindracea, apiculata, inclusa operculum e basi conicâ longe et oblique rostratum, capsulam subæquans.

Calyptra dimidiata, lævis, cum operculo decedens.

Cilia p. interioris fugacia, sunt, cave ne cum his ciliola persistentiora confundas. An separandus ob membranam p. interioris perforatam, characterem insolitum, et cilia longa magis evoluta.

1. Plant magnified.
2. Cauline leaf.
3. Perichætial leaf.
4. 3. Capsule.
5. 6. Inner membrane, and inner peristome separated.
6. Tooth of outer peristome.
7. 8. Portion of inner peristome.
8. 4. Operculum.

9. The same, cut longitudinally.
 5. Calyptra and operculum. *It. Ass.* 574.
 2. *Pleuropus pterogonioides*, Griff. Pl. LXXXIX. Fig.
 IV. Calc. Journ. Nat. Hist. Vol. III. p. 272 t. xx.

Foliis ovatis valde concavis acuminatis intergerrimis avenies.
 capsula cylindræa inclinata, peristomiorum dentibus cohæ,
 rentibus.

HAB. In arboribus in Pinetis Moflong.

Caspiotus, aureo-nitens. Caulis repens, vage ramosus. Rami
 sæpius divisi, ascendentis apicibus prasertim siccitate incurvi.
 Folia undique dense imbricata, patentia valde concava acumina-
 ta in apiculum breviusculum interdum semitortum, avenia,
 interdum basi obsolete bistriata marginibus subrecurvis inte-
 gerrimis, Areolæ angustissimæ, basilares imæ utrinque laxæ
 quadratæ.

F. Perichætialia exteriora lanceolata, acuminata, interiora multo
 majora, acuminatissima, apicibus imis scabrellis diaphanis.

Seta unciam excedens, gracilis, apice incrassata, fusco-aurea,
 siccitate leviter tortilis. Vaginula elongata cylindræa.

Paraphyses copiosæ, filiformes, hyalinæ. Pistilla pauca.

Capsula cylindræa, sæpius inæqualis, grisea, inconspicue areo-
 lata.

Peristomium exterius e dentibus 16, subulatis, siccitate inflexi-
 libus, humore erectiusculis albidis obtusis crebre trabeculatis,
 marginibus, diaphanis conspicuis, linea longitudinali incon-
 spicua notatis.

Interius e membrana areolata, breviuscula, tenuissima, fragilli-
 ma, cellulis componentibus facillime solubilibus albida sede-
 cies plicata, plicis exeuntibus in dentes carinatas solidos cum
 dentibus peristomii exterioris arcte cohærentibus subæ quan-
 titibus, marginibus irregularibus, vel repandis vel grosse den-
 tatis,

Collumella inclusa, apice truncata, valde dilatata.

Sporula.

Operculum calyptraque desiderata.

Habitus Pterogonii aurei, an affinis Neckeræ tenui Hooker Pte-
 rogonium Schwaegæ?.

1. Plant magnified.
2. Cauline leaf.
3. Perichæatial leaf.
4. Capsule.
5. Portion of capsule and of both peristomes.

XXIV. ANHYMENIUM, GRIFF.

Rhegmatodon Brid. Plerogonium sw.

Seta lateralis. Peristomium duplex, exterius e dentibus 16, (brevibus) interius e ciliis todiem alternantibus (maximis) carinato convolutis, basi angustatis; membrana basilari brevissima. Capsula subæqualis. Calyptra dimidiata.

Muscus Leskioideus, pusillus, dense cæspitosus. Flores monoici.

1. *Anhymenium polycarpon*, Griff. Pl. XCVII. Fig. I. Calc. Journ. Nat. Hist. Vol. III. p. 275. t. xvi.

HAБ. In Buddleæ specie arboreâ ad marginem sylvæ. Mumbree copiose legi.

Caules repentes, ramossimi, ramis ascendentibus, siccis clavato-cylindraceis, ramosis, rarius simplicibus.

Folia dense undique imbricata, siccitate adpressa, madida patentia, ovata, breviter acuminata, integerrima, percursa vena ultra medium paullo evanida, marginibus leviter recurvis areolis subconspicuis oblongis angulatis; inferiora adpressa brunneo tincta.

Flores masculi laterates, gemmiformes, setæ basi approximati, ovati.

F. Perigonialia rotundata ovatave, avenia concava, interiora majora, Paraphyses copiosæ, longitudine variæ, filiformes vel subclavata, hyalinæ. Antheræ oblongæ, obliquæ, apice dehiscentes, areola.

Perichæatialia interiora subconformia, majora acuminibus subpatulis, vena obsoleta apicem infra evanida.

Seta lateralis e babi ramorum plerumque excerta, horum fere longitudine et subtri-linealis, apicem versus curvata, rubra. Vaginula oblongo-cylindræa, paraphysibus hyalinis filiformibus pluribus pistillisque paucis obsita.

Capsula inclinata, subobliqua, ovato-cylindræa, inconspicue areolata rufobrunnea, ore integerrimo exannulato.

Membrana interna libera.

Peristomium exterius e dentibus 16, profunde intra os thecæ exsertis, inflexilibus, brevibus, latis, plano-subulatis, obtusiusculis, crebre trabeculatis, marginatisque, linea longitudinali tenui exaratis, pallide lutescentibus.

Interiorius e ciliis totidem maximis dentes p. exterioris triplo excedentibus, plicato-convolutis, ideoque dorso non carinatis, acutis, basi angustatis, (ambitu ideo fusiformibus) dorso (apicibus exceptis) fissis foratisque, luteo-flavescentibus, punctulato opaciusculis, basi unitis in membranam brevissimam, lutescentem, dense areolatam, sinibus nudis.

Sporula rotundato-angulata, in acervulo viridia, immersa globosa opaciuscula.

Columella subcylindræa, apiculata inclusa.

Operculum conicum, obtusum, minute mammellatum.

Calyptra dimidiata, lævis, per totam fere longitudinem fissa,

1. Plant magnified.
2. Male flower.
3. Perigonial leaf.
4. Male flower, perigonial leaves removed.
5. Anther.

2. *Anhyemenium polysetum* Griff. Pl. XCVII. Fig. II.

1. Plant.
2. Cauline leaf.
3. Portion of cauline leaf.
4. Capsule.
5. Capsule laid open and the inner peristome removed
6. Inner membrane and peristome separated.
7. Tooth of outer peristome.

8. Portion of inner peristome.
9. Columella.
10. Sporula.
- 10a. Sporula in water.
11. Operculum.
12. Calyptra. *It. Ass.* 497.

XXXV. HOOKERIA, SMITH.

1. *Hookeria Grevilleana*, Griff. Pl. XCIX. Fig. IV.

Caulē decumbente simplici vel ramoso, foliis lanceolatis acuminatis acutis aveniis, capsula cylindraceo-ovata nutante, operculo e basi convexa recte subulato, calyptra integra glabra.

HAB. In ripis et rupibus madidis.

Surureem et Mumbree.

Caulis sæpe simplex, $1\frac{1}{2}$ -2 uncialis ramique (si adsunt) complanati.

Folia subquadrifariam imbricata, antica posticaque cauli subparallela, lateralia disticha paullo obliqua, integerrima, grandia longitudine bilinealia, latitudine extrema unilinalia, marginibus simplicibus, textura quam maxime cellulosa areolis magnis fusiformi-hexagonis.

Flores monoici: masculi axillares, gemmiformes, cincti foliis perigonialibus paucis, minutis, rotundatis, aveniis, breviter acuminatis. Paraphyses paucae breves filiformes, hyalinæ. Antheræ 2-5.

Folia perichætialia pauca, caulinis plures minora, lanceolata, acuminata, concava avenia.

Seta axillaris, basi subgeniculata, subuncialis, crassa rubra sicca etortilis.

Vaginula brevis. Paraphyses paucae, hyalinæ, filiformes. Pistilla pauca.

Capsula inclinata, nutans, æqualis, conspicuiscule areolata, castaneo-rubra. Membrana interna libera, stipitata.

Peristomii exterioris dentes humore inflexiles, basi connati, plano-subulati, acuminatissimi, crebre trabeculati, linea longi-

tudinali inconspicue notati, rubri apicibus capillaceis scabrellis hyalinis.

Interioris cum membrana interna fascillime solubile; cilia con-niventia, plicato-carinata solida, apicibus capillaceis punctu-latis scabrellisque, membrana basilaris, altiuscula pallide straminea, conspicue areolata; ciliola nulla.

Sporula minutissima, in acervulo viridia, globosa, lævia, immersa semi-diaphana.

Columella apice truncata, inclusa operculum e basi convexa longe recteque subulatum, capsula sæpius $\frac{1}{2}$ aliquando demidio brevius.

Calyptra mitræformis, conico-subulata, celluloso-areolata.

Valde affinis *H. lucenti*, equâ præsertim distinguitur foliis majoribus, lanceolatis, acuminatis, semperque acutis et capsula minus ovata.

1. Capsule.
2. Tooth of outer peristome.
3. Operculum.
4. Calyptra.
5. Cauline leaf.
6. Perichæatial leaf. *It. Ass.* 509.

2. *Hookeria obovata*, Griff. Pl. XCIX. Fig. I.

Caule ascendente, ramoso, foliis densissime imbricatis spatulato-obovatis apice rotundatis obtusissimis ultra medium univeniis, marginibus fibrosis integerrimis, floribus hermaproditis. seta scabra, basi fimbriata.

HAB. Inveni specimen unicum fructiferum inter muscos alios o Maamloo allatos.

Caulis vage ramosus, ramique ascendentes, apicibus latiores, leviter decurvati, complanatis. Folia adpresso ascendentia, vena unica infra apicem desinente prædita, cellulis maximis sub-hexagonis areolata, marginibus integerrimis e fibris fusiformibus sub-biseriatis conflatis.

Flores hermaphroditi axillares, gemmiformes.

Folia perichæatialia caulinis aliquoties minora, ovata vel lanceolata acuta vel acuminata, avenia, concava, marginibus simpli-

cia. Paraphyses nullæ. Antheræ 2-6, fuscescentes, areolatae, cylindraceo-oblongæ. Pistilla plura centralia.

Seta semuncialis, curvata, atro-rubra, pertotam longitudinem (apice vaginula inclusa excepta) papillis simplicibus, dentiformibus albis exasperata.

Vaginula mediocris, atro-brunnea.

Capsula æqualis, basi solida, sub lente modice augente areolis quadratis hexagonisve reticulata.

Membrana interna omnino fere libera, stipitata.

Peristomii exterioris dentes subulati, acutissimi, peristomium interius paulo excedentes incurvi, utrinque trabeculati, centro linea longitudinali lutescentiata notati, pallide lutea, apicibus punctulatis.

Interioris cilia solida, acuminatissima; membranam basilarem sedecies plicatam duplo vel paulo ultra superantia.

Sporula viridia globosa.

Columella inclusa, obovata.

Calyptra (perjunior tantum visa) mitræformis conico-subulata, papillis (setæ papillis simplicibus) exasperata, basi pilis longis simplicibus fimbriata.

Operculum desideratum.

Hujus speciei perpulchræ capsulam uam tantum vidi. Flores in exemplaribus duobus examinationi subjectis hermaphroditum quamvis vaginula exemplaris setigeri, pistilla tantum gessit.

1. Plant.
2. Male flower.
3. Male flower with part of a perigonial leaf.
4. Anther.
5. Capsule.
6. Capsule laid open, shewing the inner peristome and membrane turned to one side.
7. Part of outer peristome.
8. Calyptra.
9. Perichætil leaf.
10. Cauline leaf.
11. Ditto, portion of cauline leaf.
12. Portion of mass. *It. Ass.* 507.

3. *Hookeria pulchella*, Griff. Pl. XCIX. Fig. III.

Caule ascendente ramoso; foliis obovato lanceolatis mucronato-acutis vena ultra media marginibus fibrosis integris repandis, capsula nutanti obovato-pyriformi, calyptra integra, basi fimbriata.

HAB. In rupibus madidis sylvaticis, Sururoem Mumbree et Myrung.

Caulis semuncialis, raro uncialis, interdum simplex, ramique complanati.

Folia subquadrifariam imbricata, lateralia disticha, siccitate flexuosa, marginibus recurvis; areolatio densiuscula cellulis sub 6-gonis vel rotundatis.

F. Perichætalia pauca minora, lanceolata, valde acuminata, recta.

Seta axillaris, vix semuncialis, rubra, sicca tortilis.

Vaginulla brevis cylindracea, rubro-brunnea, paraphyses subnullæ, pistilla perpauca.

Capsula inclinata, nutans, vel pendula, basi solida et obsolete apophyseta, obovata pyriformis vel obovata.

Membrana interna adnata.

Peristomii exterioris dentes breviusculi, acuti, crebre trabeculati, linea longitudinali conspicua, lutescentes, apicibus hyalinis.

Interioris cilia acuta, dentes peristomii exterioris longitudine paullo superantia, solida, hyalina, membrana basilari mediocri, ciliolis interjectis nullis.

Sporula minutissima, globosa, lævia, in acervulo viridia, immersa hyalina.

Columella inclusa.

Operculum conico-subulatum, rostro mediocri rectiusculo, interdum perbrevis.

Calyptra mitræformis, conico-subulata, basi fimbriata.

Variat statura, caulibus longioribus foliis plus minus oblongis, operculo brevi-rostro, et calyptra basi, villis quasi soluta.

1. Capsule.
2. Lateral view of the tooth of the peristome.
3. Operculum.

4. Calyptra.
5. Perichæatial leaf.
6. Cauline leaf. *It. Ass.* 508.

4. *Hookeria secunda*, Griff. Pl. XCIX. Fig. II.

Caule decumbenti, ramis ascendentibus, foliis oblong-lanceolatis, acutis vel breviter acuminatis argute dentatis mediatanus biveniis (lateralibus falcato-secundis, capsula cylindraceo-ovata, pendula, peristomii interioris, ciliolis nullis.

HAB. Mumbree in ripis.

Rami complanati sæpius ut videtur simplices. Folia laxiuscule subquadrifariam imbricata, antica et postica adpressa, lateralia disticha obliqua, marginibus simplicibus basin versus integris, cæterm argute dentatis prædita veniis 2 sursum divergentibus medium infra vel paullo supra evanidis; areolis angustis angulatis, parietibus crassis.

Perichæatialia acuminato-cuspidata, (cuspidate patula denticulata) per totam vaginulam inserta, avenia, interdum obsolete bi-striata.

Vaginula foliis perichæatialibus nuncupata cæterum nuda.

Seta lateralis, rubra, flexuosa, unciam paullo excedens.

Capsula æqualis vel subobliqua brunnea, inconspicue areolata.

Peristomium exterius humore connivens, e dentibus 16, plano-subulatis, creberrime trabeculatis, linea longitudinali semi-pellucida notatis, opacis, rubris apicibus albidis.

Interioris membrana breviuscula; cilia acuta, solida, punctulata, ciliola interjecta nulla.

Sporula. non visa.

Operculum calyptraque desiderata.

Proxima *H. falcata*, Hook. Musc. Exot. t. 54. p. 17. a qua præsertim distinguitur foliis breviter acuminatis, capsula pendula, peristomioque interiori, quod Leskioidium.

1. Plant.
- 1a. Leaves of ditto, the oblique one is a lateral leaf.
2. Female flowers.
3. Some of the pistilla separated with one of the innermost perichæatial leaves.

4. Two Perichæatial leaves and apex of vaginula.
5. Capsule.
6. Tooth of outer peristome.
7. Portion of inner peristome.

XXVI. LESKIA.

1. *Leskia incompleta*, Gr. Pl. CII. Fig. III.
 1. Capsule.
 2. Portion of both peristomes viewed internally.
 3. Tooth of outer peristome.
 4. Sporula.
 5. Cauline leaf.
 6. Perichæatiale. *It. Ass.* 481.
2. *Leskiæ*. sp.—Pl. CVII. Figs. VII. VIII. *It. Ass.* 358, 500.
3. *Leskiæ*. sp.—Pl. CVII. Fig. IX. *It. Ass.* 345.

Leskia—Pl. CVII. Fig. V. *It. Ass.* 352.

Leskia.—Pl. CVII. Fig. III. *It. Ass.* 338.

Leskia.—Pl. CVII. Fig. IV. *It. Ass.* 308.

Leskia.—Pl. CVII. Figs. II. VI. *It. Ass.* 346.

Leskia.—Pl. CVII. Fig. X. *It. Ass.* 357.

XXVI. HYPNUM.

1. *Hypnum rotulatum*, Hedw. Pl. XCVIII. Fig. I. Hooker.—Vix. Hyp.

HAB. In rupibus calcareis prope speluncam Moosmai et in rupibus areonosis Mumbree.

Folia marginata lateralialia obliqua sursum irregulariter et sæpe argute denticulata, vena ultra medium evanida accessoria lateralius alternis tantum adjecta, æquilateralialia subintegra vena excurrente prædita.

Perichætialia minora avenia concava integerrima.

Seta apice incrassata.

Capsula cylindraceo ovata nutans aspectu cellulosa. Per Hypni.

Cilia peristomii interioris minute perforata; ciliola interjecta irregularia.

Operculum e basi conica longe recteque subulatum capsulam excedens.

Calyptra dimidiata lævis.

Huic referri ob verba cel. Hookeri in *Musc: Exot. sub Hypno laricino*, t. 35. Vix Hypo-ptygium rotulatum. *Brid. Bryol. Univ.* 2. 713.

1. Capsule.
2. Portion of capsule and of either peristome, viewed internally.
3. Operculum.
4. Calyptra.
5. Portion of a branch.
6. Lateral cauline leaf.
7. Perichætial leaf. *It. Ass.* 531.

2. *Hypnum mnioides*, Hook. *Musc. Exot.* p. 200 t. 77 ?

HAB. In rupibus umbrosis, Churra Punjee in regione Assamica alta versus. Negrogam. Fructiferam reperi in sylva Theiferam Gubroo Purbut.

Verosimiliter species distincta ambigens inter *H. mnioides* et *spininervium*, huic caule simplicii foliis angustis setaque basilaribus, illi foliis marginatis et carina denticulata accendens.

Habitus quodammodo *Polytrichoides*.

Color sæpius fuscescens folia siccatione incurva, interdum obsolete tortilia.

1. *Hypnum*.—Pl. CVI. Fig. XI. *It. Ass.* 337.
1. *Hypnum*.—Pl. CIV. Fig. V. *It. Ass.* 342.
1. *Hypnum*.—Pl. CV. Fig. XIII. *It. Ass.* 351.
1. *Hypnum*.—Pl. CVI. Fig. I. *It. Ass.* 383.
1. *Hypnum*.—Pl. CVI. Fig. XIII. *It. Ass.* 504.

2. *Hypnum*.—Pl. CV. Fig. I. *It. Ass.* 361.
2. *Hypnum*.—Pl. CV. Fig. IX. *It. Ass.* 392.
3. *Hypnum*.—Pl. CVI. Fig. IX. *It. Ass.* 339.
3. *Hypnum*.—Pl. CV. Fig. II. *It. Ass.* 367.
3. *Hypnum*.—Pl. CIV. Fig. VII. *It. Ass.* 376.
3. *Hypnum*.—Pl. CVI. Figs. II. V. *It. Ass.* 490, 495.
4. *Hypnum*.—Pl. CV. Fig. VII. *It. Ass.* 347.
4. *Hypnum*.—Pl. CV. Fig. III. *It. Ass.* 368.
4. *Hypnum*.—Pl. CIV. Fig. X. *It. Ass.* 378.
4. *Hypnum*.—Pl. CIV. Fig. IV. *It. Ass.* 482.
5. *Hypnum*.—Pl. CVI. Fig. X. *It. Ass.* 340.
5. *Hypnum*.—Pl. CV. Fig. VIII. *It.* 348.
5. *Hypnum*.—Pl. CV. Fig. VI. *It. Ass.* 369.
5. *Hypnum*.—Pl. CIV. Fig. I. *It. Ass.* 483.
5. *Hypnum*.—Pl. CVI. Fig. III. *It. Ass.* 493.
5. *Hypnum*.—Pl. CVI. Fig. IV. *It. Ass.* 503.
6. *Hypnum*.—Pl. CV. Fig. IX. *It. Ass.* 349.
6. *Hypnum*.—Pl. CV. Fig. IV. *It. Ass.* 370
6. *Hypnum*.—Pl. CV. Fig. XII. *It. Ass.* 381.
6. *Hypnum*.—Pl. CIV. Fig. II. *It. Ass.* 484.
7. *Hypnum*.—Pl. CIV. Fig. III. *It. Ass.* 486.
7. *Hypnum*.—Pl. CVI. Fig. V. *It. Ass.* 495.
7. *Hypnum*.—Pl. CVI. Fig. VIII. *It. Ass.* 554.
8. *Hypnum*.—Pl. CV. Fig. VI. *It. Ass.* 372.
8. *Hypnum*.—Pl. CIV. Fig. VIII. *It. Ass.* 487.
9. *Hypnum*.—Pl. CV. Fig. V. *It. Ass.* 371.
10. *Hypnum*.—Pl. CVI. Fig. VI. *It. Ass.* 494.
11. *Hypnum*.—Pl. CVI. Fig. VII. *It. Ass.* 489.
- Hypnum*.—Pl. CIV. Fig. VI. *It. Ass.* 373.
- Hypnum*. sp.—Pl. CVI Fig. XII. *It. Ass.* 341.
- Hypnum Confertum*. { Pl. CIV. Fig. XI. *It. Ass.* 501.
 { Pl. CIV. Fig. IX. *It. Ass.* 350.
- Hypnum*.—Pl. CIV. Fig. V. *It. Ass.* 342.

GENERAL NOTES ON MUSCI.

Dicranum latifolia.—Hook. Rather a Didymodon, the teeth are not disposed in pairs, are binarily compound, and generally entirely coherent, they are hispidate and semiopaque, occasionally they are ternarily composed, the third part being rudimentary. Bridel's generic figure of Cynodon must be wrong; whenever teeth are perforated, it is owing to the adhesion of the component parts not being perfect, nothing appears to be more difficult than to distinguish Dicranum, Didymodon, and Trichostomum. Hooker represents the teeth of this species as bifid, they evidently spring from the inner membrane, the columella is slightly contracted and apiculate. It can scarcely be Bridel's plant, he says the capsule is cernuous and the opercule obtuse papillate. The margins of the leaves are subincrassata.

Did. capillaceus.—A true Didymodon, teeth rather obscurely approximated in pairs, from the inner peristome, sometimes united throughout their length, generally partially united below the middle. Bridel says they are not perforate! his figure in the supplement is bad, he says highly magnified, if so, it is not at all like the reality.

Didymodon inclinatus.—The teeth of the peristome are often ternarily composed, in this case they have of course two longitudinal lines, the perforations arise from the cohesion only taking place here and there, they are distinctly approximate in pairs, and I think that generally the tendency to ternary composition only affects one tooth of each pair. I am satisfied there is no limit between Didymodon and Trichostomum.

Dicranum sollianum.—A true Dicranum. Teeth binarily composed, but the longitudinal as well as the transverse lines, at least in the joined portion, are very faint. These latter are not to be mistaken for the rather conspicuous trabeculæ. The composing cells are striate.

Grimmia ovata.—Is certainly a Grimia, and not a Dicranum, or Campylopus. Teeth as in other Grimmiæ so opaque, that the line of composition is scarcely discernible.

In this, the peristome evidently originates from the inner membrane of the theca, which adheres to the outer only towards the mouth of the capsule. The teeth of the peristome are binarily connate: they are whitish and at least when dried punctulate: perforated here and there, or entirely connate obtuse with emarginate apices, they cohere mutually towards their bases. Sporules opaque unequal. I think it is doubtful whether Weissia should not be restricted to those species in which the teeth

of the peristome are certainly simple. The perforation of teeth is by no means of generia value.

Tayloria splachnoides.—In this genus the teeth are at the base, at least, binarily compound, Hooker's representations fig. 6. 7 are therefore deficient. From the imperfection of the specimens I have, I cannot say whether the teeth are binarily composed to the summit. The line indicating their composition is excessively faint: indeed scarcely discernible with my 1-20. I am likewise inclined to believe that the pairs of teeth are compound as those of the inner peristome of *Bartramia* and *Funaria*: if so, this will be a singular case. In the outer peristome, the teeth arise very evidently from the inner capsule. The columella has a remarkably long apiculus.

The almost universal contraction of the columella is singular; hence *Lyellia* is not so remarkable for this property, as for that of extensibility.

Cinclindotus fontinaloides, e siccis.—The teeth here likewise spring from the inner theca, but the union of this, with the outer towards the mouth of this is very intimate. The teeth are semispirally twisted at first, but they appear subsequently to lose this, and to become straight. They are binarily composed, but the composition does not appear to extend far up, as a 1-20 lens does not demonstrate a longitudinal line.

It has some points in common with *Grimmia*, but more with *Trichostomum*: it must likewise be considered as approaching *Tortula*. The anastomosis that takes place at the base appears to take place chiefly between the pairs of teeth. *Suddya* July, 7th. 1836.

Diphyscium.—Of this genus I have examined a single theca; this examination leads me to believe that *Diphyscium* is scarcely generically distinct. The outer peristome is not at all analogous to the peristome of other mosses, and is a direct continuation of the cellular tissue of the outer theca, and is hence perhaps analogous to an annulus. From this continuation the cuticle of the theca is distinct. The inner peristome likewise appears different from almost all others in not originating from the inner theca, it is certainly distinct by its structure: which is entirely that of *Diphyscium*; still it may be assumed to be binarily composed: the narrower lines occupying the bottom of each fold, being the lines indicating composition: the broader and prominent ones indicating the union between the teeth. The greater part of that which is called the outer peristome separated with the operculum. In *Diphyscium* there is certainly a tendency toward the formation of a similar outer peristome. The operculum

carries away with it, the apex of the columella. In that examined, the part where it separated resembled a membranous cup, terminating the inner membrane.

Fontinalis capillacea of *N. America e siccis*.—This of which I have only examined one imperfect peristome is obviously allied to *Neckera*, from which it differs so far as its peristome is concerned, in the ciliæ of the inner one being mutually connected by transverse bars, arising I think from the articulation of the ciliæ. These are binarily composed, and appear to have small teeth interposed. The outer teeth are likewise binarily composed, occasionally split along the central line, they are remarkable for being carinate, which though a common character in the inner peristome, appears to be very rare in the outer.

Tortula muralis.—The teeth are connected by a membrane of considerable size, opaque, and imperforate; the teeth are mutually connected towards the base, but to a short extent: the cohesion however extends in some cases between pairs to a considerable height. The teeth are opaque; obsoletely articulate transversely, and scabrelous. They occasionally appear as if binarily composed, but this seems to be owing to the development of the peculiar tissue, to the existence of which the trabeculæ of other mosses is attributable.

Tortula subulata.—*Syntrichia* differs certainly in degree from *Tortula*, but so does *Buxbaumia* from *Diphygium*. Yet this latter is adopted by Hooker, but not *Syntrichia*. In addition the teeth of *Syntrichia* are binarily composed, an important difference.

Pterogonium hirtillum.—Teeth arise from inner membrane which is excessively fine. They are binarily composed, and opaque, especially below the middle. They are distinctly trabeculate.

This genus I should be inclined to place next those *Weissia* with binary teeth, owing to the great similarity of these organs, and the theca in general. It will be at once distinguished by its lateral fructification. It comes near *Leucodon*, but as I have no opportunity of examining good specimens of this, I am unable to state whether it agrees with it in the structure of the teeth of the peristome.

The leaves in Drummond's specimens are scarcely fimbriolate, except the perichaetial ones. Bridel says *folia prostrata enervia*; in the above specimens, they are *mediatenus l. venia*.

Didymodon purpureus e siccis.—Perhaps Bridel's *Ceratodon* is a tolerably good genus.

The teeth of the peristome arise very evidently from the inner theca,

which is shortly stipulate, and free throughout its extent. They are beautiful, perhaps as elegant as any I know, distinctly trabeculate, and connivent when moist. The annulus is firmly united to the opercle, with which it separates, the sporules are when immersed transparent, the teeth are minutely punctuate.

What is the nature of the margin seen on the outside of each tooth, and ceasing about the middle. It is evidently similar to that which exists in all ? trabeculate teeth, which is generally uncoloured, and often fills up what are called fissures and perforations. I take it to be a kind of sheath, complete or not, perhaps according to the length of the real part of the tooth. See my *Anhyemenium* and *Bridel's Macrothecum*, in which it is at its maximam.

Splachnum sphaericum, *S. minioides*. *S. vasculosum* and *Fræticlianum*.—The four species I have from Drummonds N. Amer. mosses the teeth are 32 in number, they all are continuous with the inner theca which in all is free, except towards the mouth of the capsule, where the cohesion is in some, remarkably intimate, particularly *Splachnum sphaericum*. In *S. Fræticlianum* and *S. sphaericum*, the teeth are mostly distinct and the cohesion if any, takes place by their apices. In *S. minioides* the cohesion is nearly uniform, but is still on the plan of the above. In *S. vasculosum*, all the teeth cohere intimately throughout, nearly their inferior $\frac{1}{3}$, while they are free towards their apices. In this moss too, there is a decided tendency to quaternary composition of each tooth, but this is only visible in the cohering inferior $\frac{1}{3}$, the free portions being as in the other, binarily composed. In *S. minioides* the inner theca terminates in a stout pedicel nearly equalling the theca in length. *Suddya* 21 July, 1836.

Sphagnum acutifolia.—From the examination of one capsule of this species I am not at all certain that the genus is evaginulate, I rather consider that the apex of the stalk is much dilated, and adherent when mature, to the dilated apex of the Perichæatial axis. The elongation of this axis beyond the perichæatial leaves is so far as I know singular, as is likewise perhaps the irregular rupture of the calyptra above its base. The inner membrane of the capsule appears to have the lower portion alone persistent.

Buxbaumia.—The leaves form a confervoid mass, surrounding the whole axis, which is excessively short, including the vaginula. They are pinnatifid from the elongation of the marginal cells. The upper portion of the capsule which forms the chief portion of the obliquity is of much thinner structure than the remainder, the seta is scabrous. I see nothing like *Bridel's* outer or intermediate peristome at least as he describes it. *Bryol. Univ.* 1. 330.

Certainly allied the Polytrichoidæ, to the peristome of which the outer of this genus is certainly analogous. Is the inner a modification of the Epiphragma, so conspicuous in Polytrichum?

Encalyptra vulgaris.—Orthotrichoid in the structure of the calyptra, habit and areolation of the leaves.

Trichostomum aciculare, *Trichostomum lanuginosum*, *Trichostomum fasciculare*.—These three species agree exactly in the structure of the teeth, which in all have a tendency to cohesion, and often to mutual adhesion. Their formation is irregular, and in their opacity they approach those of Grimmiæ. Of the figures given of many species by Hooker, I can only say, that a priori speaking, the teeth appear to me to be very singular, at the same time the augmentation is sufficiently great for the demonstration of their real structure. The same is applicable to the drawings of Leucodon, and to Bridel's figures of *Racomitria* and *Trichostomum*.

Bridel says that *T. aciculare* has a continuous nerve as well as *T. fasciculare*, but this is not I think correct, either of one or of the other.

The genus is remarkable for the universal occurrence of lateral innovations, the sporules are semi opaque, and burst in water.

Delin. e siccis, Drumm. N. America Mosses, *Suddyañ*, July, 1836.

LYCODEACEÆ.

PSILOTUM.

Pl. CXVIII. A.

1. In the first I have examined, the future capsule is a small round body, concealed by the bilobed suffulting leaf, a hyaline edge being traceable round; at this period it appears to be like a membranous bag containing grume and rudimentary cells.
2. In the second, it is still more short than the leaf to which it belongs, which has considerably increased in size. It now has an obscure cellular aspect, but contains nothing separable, but grumous mucilaginous tissue passes out on pressure.
3. The base of the young capsule is now apparently narrowed: its upper part broadened and presenting three furrows, corresponding to the septa. In the grumous mucilage now separating under pressure are rudimentary cells of some diameter, each with its nucleus.
4. Capsule now distinctly 3 locular, its proper walls are cellular; each cell is at this time filled with a grumous mucilaginous mass, for the most part composed of large cells, containing many, though indefinite nuclei: towards the circumference, the nuclei or something like them, appear to occur without any common or proper cell.

Nitric acid in many instances causes the appearance of separate, somewhat angular granules, each with a nucleus. It also renders the nuclei in the *compound* cells more clear, and as if contracted.

At this period large cells will be found attached to the parietes of the cells of the fruit, the walls of which, as well as the septa are of a lax-looking formative character, and greenish tint.

The changes occur from the circumference to the centre, in which the appearance of no. 3. viz. cells with solitary nuclei or rather solitary nuclei, will be found, the membrane not being distinct.

Otherwise the cells containing many granular nuclei are very evident, particularly towards the circumference.

- 4½. The changes affect chiefly the circumference, in which there is an evident tendency to the separation of the compound cells into as many cells, with nuclei, as there were nuclei. And towards the centre, there is likewise a tendency to the appearance of the compound cells.

There does not appear any change in the parietal cells.

Among the cells occur granules of smaller size, with a very defined edge, and without proper membrane. These correspond in appearance with the nuclei of the parietal cells, at least after the action of nitric acid.

5. The next stage consists in the enlargement and distinctness of the cells entering into the formation of the compound ones, they still however adhere, but generally the original common membrane is not distinguishable.

These cells have a grumous appearance with a nucleus; and nitric acid dissolving or contracting the glume into the nucleus, shews them to be nucleary, with a beautiful hyaline membrane.

- 5½. Appearances not uniform, adhering or incrustated cells, all having been enlarged, or only so in part, but the grouping of the cells still continues; otherwise all sorts are seen, simple and large, with a large inner cavity to which granules adhering give a crystalline or incrustated appearance to compound cells, with several adhering cells as in the preceding. The defined membraneless granular nuclei still found.

6. Appearances not uniform, nor reconcilable with the preceding. Parietal cells not evident. Compound cells visible, containing several other cells, each with its own

nucleus How the deuce does his common membrane appear.?

The component parts are also frequently detached and present all appearances from that of a simple nucleus to a nucellar nucleus, or to a nucleus shewing tracings out of the future sporula. The principal want of correspondence between this and the preceding, regards the primary parent cell, which in the former (the most conformable to analogy) appeared, to consist of as many parts as there were nuclei. In this, it is simple, each nucleus being provided with its own membrane, particularly as shewn by iodine.

Also large cells (escaped probably) with incrustated appearance, and also the defined mere granular nuclei, probably abortive cells.

- 6½. Enlargement of the secondary parent cells, which are either found distinct, or in common cells. The somewhat larger *incrusted*-looking cells also visible, but not frequent. All degrees of developement occur, from simple nuclei to nucellar nuclei, from these to nuclei less defined, presenting traces of the subsequent sporules. These are most distinct in the larger incrustated-looking cells, appearing first to be two, then as far as can be judged from one distinct instance, each of these is marked by a groove down its back, as if preparatory to the appearance of 4.
7. Cells now appear filled with large bags, each containing many bodies, each with its distinct membrane containing grume even while in the bags, (lines of loculicidal dehiscence present), traces of arrangement of the grume of each partial cell into the subsequent spores. Smaller defined membraneless nuclei present. Many of the cells are not contained in a common bag, perhaps from cutting etc., these appearances of division of the grumous nuclei present considerable differences from simplicity to traces of quaternary division.

8. Enlargement of the secondary parent cells, which appear immersed in grume or amorphous tissue. Primary parent cells obsolete, disappeared? Sporula in all marked out, in some, quite distinct, and without adhering grume. So far advanced as to present traces of the outer hyaline membrane.

Many nucleary discoid oblong bodies, these are the young sporules which have escaped (in the section) from the secondary parent cells.

I have not seen a corresponding division of the secondary parent cell, but as it suffers a slight indentation between each spore, from the analogy of Isoetes it is assumable that it does not become divided prior to disappearance.

9. Cells filled with the young spores, which though the secondary parent is not observable even in iodine or nitric acid, remain grouped quaternarily, offering all sorts of appearance from ovate to oblong reniform, etc., according to their direction when seen. They have now their perfect form: contain slight grume, and generally a nucleus. Smaller granules (not those visible before, but amylaceous,) occur with the ordinary green mobile granules.
10. Cells filled with the young spores in innumerable quantities, and although often quaternarily grouped, no evidence of parent secondary cells occurs, the sporules appear to be loosely immersed in grumous matter.
They have the mature form, the centre occupied by *light* grume, either semi-transparent, and ending by a coniform cell, or hyaline cavity.
11. Membranes all formed, central cavity has an incrustated appearance, from producing on its surface young cells. A nucellus visible.
12. Perfect sporules, uniform oblong reniform, convex outwardly, and triangular inwardly, of 3 membranes, the outer hyaline, distinguishable only with very high powers,

and along the convexity, being stretched as it were from point to the other. Cavity containing globose cellular one looking bodies which, judging from pressure escape, as they are mucilaginous or oily.

Note.—The following is copied from pencil writing on the margin of the sketches of *Psilotum triquetrum*, Pl. CXVIII, A. and as it continues the analyses from fig. XII. to the end, as noted down by the author at the time of observation, it is given entire. *Ed.*

[*PSILOTUM TRIQUETRUM*. Pl. CXVIII, A.]

I. In this stage which is the earliest, the female is a brownish membranous bag, containing grume and rudimentary cells or oval bodies 1, 2, the edges hyaline entire. The young suffulting body consists of two primary points, so it cannot therefore be a simple organ.

II. No opaque lines are seen in the marginal cells, which when they are viewed as an opaque object, appear hyaline and membranous.

Although the 3 valves are marked out externally, the whole appears a mere cellular body, containing grume, and ovate, or oblong interspersed rudiments of cells.

III. Suffulting bodies now convex internally. Deep bilobed calyx cellular. Cells prominent, in the centre of the inner face is the globular young fruit. (1.)

The young fruit appears to be cellular outside, or it presents markings of cells.

The male is composed of cells each crowded with molecular matter.

The female contains grume or grannules, after this has escaped I have not seen cells in it. This last is invariably the precursor of the formation of cellular tissue. A mucilaginous fluid in which minute often moveable granules are, as it were suspended. (*a*, female inner view, *b*, back.)

IV. At this stage the capsule is evidently trilocular, the walls thick cellular, opaque by granules, the cells are filled each with a detachable grumous cellular mass, the outer portions of which are, I think, most separable. The mass about this time is composed of a number of large cells, in each of which are many nuclei.

Pressure shows large cells in the centre, with indistinct parietes, and several nuclei; but towards the circumference the nucleus is detached, no membrane is visible, or agregation. There is little if any difference in size between the nuclei and the distinct granules. All are immersed in grume, the very outermost do not seem to separate within the mass, but will be found in the cavities of the cells.

V. This is a little more advanced; the whole of the cells are now filled with a cellular mass, all cells equal, adhering together, less grume.

These cells under $\frac{1}{2}$ present the appearance of an inner cavity, the walls of which are studded with granules, and probably besides filled with grumous matter.

VI. The next stage the capsule is hardened, perfectly walled out with furrows, indicating the incomplete valvation.

The cells appear now filled with large bags, each with many globular nuclei, within each is a distinct membrane.

Each of these becomes afterwards divisible into farinaceous grains by division.

There are also many smaller grumous bodies without any distinct membrane. All sorts of stages are seen, the smaller grumous bodies are perhaps the young grains, although their shape is different.

VII. The next stage, sporules have their mature form. They are shaped like a narrow grain of wheat, looking very different according to the aspect. No membrane visible under 1-10, although the sporules preserve their grouping in a marked manner, no membrane visible in iodine; amylaceous (violetted) granules plenty, invisible in the field, mixed with the usual molecules, many are about this period loose: (*a*, side view, *b*, back.)

VIII. Cells occupied by irregular groups of hispid looking cells, all sorts of cells are seen, from simple large ones, with adhering granules, to compound with nuclei as the simple small nucellar, without obvious membranes; in the large earlier simple ones, a remarkable aggregation of the granules occurs.

Young sporules are evidently contained in parent cells, while those near the walls of the capsule present the appearance of aggregate opposite, without any distinct membrane. The appearances at this stage are otherwise uniform.

IX. Tolerably uniform, irregular masses of cells without any common membrane, with a cavity, or one forming; in some with a distinct nucleus in the cavity. This may be considered next to IV.

Nitric acid shews these to be of a distinct nucleus, with a beautiful hyaline membrane.

X. Mature sporules subreniform, apex filled with globules containing grume. Appearances of teguments, probably three, the outer teguments, quite hyaline, only seen along the concave edge, and by the aid of pressure.

XI. Slight traces under 1-16 (in the perfectly distinct one) of a proper integument, also of nucleus on a transverse section, many nucleary disks with nucelli will be seen also, these from examination, I take to be escaped young sporules.

These often burst, discharging a grume in the parent cell, exactly as in Isoetes.

I have not seen a division of the parent cell before separation of the

young sporule, but as there is an indentation in it between the sporules, probably it is the same as in *Isoetes*, many of the parent cells are imbedded in grume, the debris of the original compound cells.

XII. In the next stage, a transverse section of the walls of cells present the same transparent appearance, the cells are perhaps large, but preserve the same appearance? The nuclei of the moveable grumous mass vary much, some being very large, others free, smaller and more defined, and these appear to be circumferential, the free ones are similar to those contained in the parent cells. The component parts of central moveable mass, now presents the appearance when loose, of irregular plurilocular cells, each cell with grume, or a tendency in this to become nucleary.

The loose granules mentioned above also, will be found adhering to the circumference of the mass, and are enveloped in amorphous nucleary tissue, or in cells like the parietal ones. It is not improbable that they are the outermost of the mass, which is certainly more disposed to assume the appearance of cells containing nuclei, the star appears in the centre when no membrane is discernible, nitric acid shews that each of the divided large cells is in reality an aggregation of cells, each with its own nucleus; component parts are not all on the same plan. Nitric acid only shews the cellular nucleus to have its membrane on the circumference (*a, a*, in nitric acid.)

XIII. Adhering to the walls of the cells, and apparently originating from the large cells containing ovine grume, otherwise each cell is filled with grume in which rudiments of other cells are visible, giving the mass where seen in bulk, a blistered appearance. Outer part of capsule cells just defined, inner lining from which large cells and septa originate, of light green colour, but opaque. These two appear almost, if not quite distinct, at least the nucleary grumous rudimentary cellular mass is inseparable; appearances as if the grumous mass would be devisable into large cells with several nuclei. Nitric acid in many instances causes the separation into distinct angular granules, each with its own nucleus. In the others it only makes the nuclei in the large cells and the outlines of these more clear.

The parietal cells certainly are not separable, they are less distinct after nitric acid, (*b, c*, green with whitish molecular.)

The next stage shews little if any appearances of the parietal cells. The whole mass if such it can be called, consists of roundish cells either distinct or variously aggregated, some of these with the incrustated appearance are much larger, among them are well defined small granular nucleary bodies.

The next stage shews the enlargement of the compound cellular bodies, some of which are papilose or incrustated, and the granules of the defined nucleary aspect have now their tegument.

These bodies which when compound, I take to be the enlarged state of the preceding, when distinct, present almost always a hyaline membrane, always a nucleus, occasionally a nucellus, and rarely traces of subsequent sporula.

The want of the membrane is to be explained by the escape of the nucleus before the separation of the cells composing the masses.

But what are the granules, which are of all sizes. They generally though not always appear outside the compound sacs.

Iodine shews that the nuclei which is contained in the compound cells have their own hyaline membrane. According to the condensation of the nucleus, is the development or distinctness of the hyaline envelope. Thus in those in which the central body consist of a grumous disc, enveloping a nucleus, it is some times scarcely, or not all distinguishable, as if the envelope were formed from circumferential grume.

Also, in the larger bodies which have separated from the component cells, the marking-out of the spores is evident, even while they appear confined in the compound cells; the young sporula also becoming developed, in large cellular bodies, in which there is no condensed nucleus. Only two nuclei in one instance appeared grooved out at the back, but these are rare, the bulk consists of cells escaped, or contained in compound cells.

XIV. In this (*a*, 1-16) the secondary parent cells evidently escaped, but it is difficult to be seen although *b*, *b*, obviously must have a particular disposition, but from seeing through so many, it is lost.

XV. Intermediate stage of sporule when the central cavity presents papillose incrustations on the formation of young cells, 1-10, in this stage the cavity of each cell is filled with a mass of grume, in which the young sporula are in an infinite number imbedded. Neither original compound cells, or the parent cells are now evident, the sporules are closely connected together by grume, they are transparent and indistinct, containing no grume, but as to outline, nearly perfectly formed; almost always both ends appear to contain a cell, the grume forming a sort of belt across the middle.

XVI. The young fruit is distinctly trilocular, and the outer coat is marked out: either it is very small, or not much larger than the suffulgent one.

The parietal cells are well developed, contain some grume, centre occupied by a mucilage, presenting a grumous separable blistered mass; the blisters not unlike the parietal cells, but much more grummy and less defined.

XVII. Very early or immediately antecedent to the foregoing distinct parietal cells, the whole solid, the large cells of the centre being

the only hyaline part ill defined ; many of the nucleary granules, of the outer wall of capsule marked out : cells *b.* not separable.

XVIIa. Development from the circumference of the mass towards the centre, presents every degree of compound cells, in none do I see a common membrane. Evolution of the cells is probably centripetal.

Nitric acid reduced all these to one appearance, viz. a large nucleus and beautiful hyaline membrane.

XVIII. I would almost think that there are two kinds of bodies formed during the intermediate period, for I find that numerous large compound cells certainly do exist, chiefly round the parietes of the cell ; containing globular incrustated nucleary cells, each distinct, while the rest consists of the original compound cells, now all detached and distinct, but of a different aspect, very grumous, with a nucleus.

The primary parents do not exist at first, at least in the trilocular fruits, however nucleary the appearance of cells may be in the centre of the mass, from the grume in which they are imbedded.

Afterwards these large incrustated globules contained indistinct cells, they are very abundant, some are of large diameter, several times bigger than the separated ones, and always at this period presenting a distinct aspect ; some seem to be attached to the parent.

They certainly appear to increase in number, while the distinct ones seem to diminish, and however these may appear to assume the appearance of division, the spores are really, I think, formed entirely from the cells enclosed.

Before the compound including cells make their appearance, the cells are not uniform. They are grouped as before ; the groups either consisting of grumous cells with a nucleus, or some of the outer ones have assumed the incrustated appearance : nucleus without an enlargement of size, is characteristic of those afterwards found contained in a membranous bag. But even granting that these are the same, where does the membrane originate.

XIX. These represent what I take to be the passage of formation. If the enlarged cells of the compound cells subsequently become enclosed in bags, how are the abortive ones excluded, or are they vivified by becoming enclosed ?

1. Certainly there is no common membrane to any of these cells.

2. Appear in many to be contained in cells, as if the enveloping grume was being developed into a membrane. The contained grains are similar to those outside.

2a. It is remarkable, that the enlargement of the cell is always accompanied by the appearance of a hyaline membrane and distinct appearances of the nucleus. 3a. all cells detached, 3c. changed, 3b. unchanged cell in nitric acid.]

The numbers of stages refer to those attached to the figures.

The chief difference between this and *Isoetes quoad* spores, consists in the sporula not being formed in the primary parent cell, but in cells, developed with definite number in those; there are therefore two sets of formative cells, the first I call the primary parent; the second, the secondary parent cells.

There is a tendency to *Isoetes* in non-uniformity, succeeded by marked uniformity, though not to such a degree. Also, in the remarkable omission of the gummy contents of the young spores while enclosed in the second parent cell.

This is a remarkable instance of the fact, that in Acotyledonous Plants with high foliaceous or axine organs, no analogous sexes occur: nothing like fecundation—nothing like a Pistillum exists.

Musci Hepaticæ.—Pistilliform, evident sexes, ovulum generally removed to a distance during development of fruit (*Riccia*, and other evaginulate ones perhaps developed into the membrane, enclosing the sporules), forming the apex of the seta. Reproductive organs formed at the opposite end long after the changes sequent on fecundation, generally very complex.

Often radiating dichotomous, often analogous in the female receptacles to those of Fungi. *Jungermanniæ* are analogous to Mosses.

Azolla.—Pistilliferous, evident traces of fecundation, though the males are not ascertained. Products of the pistilla very different, in only one produced by division, and consequently analogous to sporules. Capsules analogous to those of certain Ferns. Habit peculiar, but something like that of *Jungermannia*.

Anthoceros.—No pistillum. Traces of fecundation mediately followed by development of capsule within the frond, which as it protrudes, carries with it the tissue of

frond between its apex and that of the cuticle, this is called a calyptra. The development of the sporules in the capsule is gradatim, at the apex it is perfect, at the base it is rudimentary. Male organs much developed and evidently dehiscing.

Habit of Marchantiaceæ. Frondose, estomatose.

Ferns.—No Pistilla. Rudimentary male organs. No trace of fecundation, which if any, is mediate. Capsule in the more perfect, with an annulus.

Distinct axis, often arboreous. Habit. Peculiar veneration gyrate. Reproductive organs on the dorsum or under surface of the leaves. Scales (Ramenta) much developed, perhaps the true leaves.

Isoetes.—Male organ non-analogous, no traces of fecundation, the reproductive organs by separation and enlargement of parts of the inner tissue of the young female, subsequently by division from the enlarged parts or cells, Sporula in earlier stages non uniform, in adult uniform.

Herbaceous, Rhizomatus, Cyperaceous—Immersed or partly stomatose.

Psilotum.—No male organs, no pistillum, sporules developed by a two-fold system of the ordinary division, sub non-uniform at first, afterwards uniform.

Lycopodineous.—Frutescent, dichotomous, axis stomatose, leaves estomatose, rudimentary. A distinct representation of a Phænogamous loculicidal trilocular capsule, (stylo lapso.)

After repeated examinations, I am unable to reconcile the appearances in a satisfactory manner.

Though these are uniform at first, consisting of the separation of the inner tissue of each cell, into compound cells, each with its nucleus, and again the separation of these, yet nothing can be clearer than that the cells in which the sporula are produced are subse-

quently contained in a membrane, within which, even the peculiar aggregation of the granular matter by which the spores are first traced out may be seen.

With these compound cells or bags are mixed original cells, as is evident from their appearance which is peculiar, being grumous with a marked nucleus, sometimes with an evident hyaline membrane, always after acid or iodine. I have seen also decided appearances in these original cells while in groups, affecting the whole group or part of it, which exactly put on the look of the globular cells subsequently contained in the bags, viz. an incrustated appearance, manifest enlargement, hyaline disc, and a nucleus scarcely observable except after acid.

But then in what manner do these, (which from their abundance may be supposed to be metamorphosed from nearly the whole original tissue,) become enclosed in bags? Can the grume around each mass become membrane.?

There can be no doubt moreover, that the original cells, i. e. the grumous nucleary ones, become less and less frequent as the developement proceeds, although some remain at least in the segregated state to a late period.

When the bags are seen, there seems to be considerable variety in the size and number of the enclosed cells, but as the time for the marking out of the sporula approaches, they become uniform.

Of the parietal cells I know nothing. Some of the general circumstances agree with Isoetes, such as the first stage where the tissue of each cell in the centre is transparent, lax and large the extension of this outwards, the returned uniformity of appearance, the compound cells, becoming subsequently divided into as many component parts as nuclei, and the enlargement of some part of these, or the whole.

The enclosure of these enlarged incrustated cells in bags, appear to me anomalous.

MARSILEACEÆ.

I. PILULARIA.

The stem of *Pilularia* is creeping: it consists as it were of two cylinders, at least when mature: The outer system is chiefly cellular, the cells towards the circumference being divided into air cells, which are disposed in a radiating manner: the septa are composed of a single series of cells: next to these occurs a thin layer of fine fibrous tissue.

The inner system is easily separable, it consists externally of tubes of some diameter arranged in perhaps two series, the central part, consists of ducts (not many) and fine fibres, the central portion becomes subsequently discoloured, no spiral vessels occur; but the young parts should be carefully examined, as unrollable ducts occur in the petioles.

The petioles have the same external cellular tissue with similar air cells, the central part consists of tubes, and unrollable ducts, but these are few in number.

Granules are abundant, especially about the tubular tissue of the pedicells.

Small stomata occur on both sides of the leaves, on the petioles?, and stem?, venation dichotomous, the venules irregularly connected: terminations simple.

Hairs articulate.

The cells of the cutis, especially those of the under surface sinuose, the petioles are of a callous nature! protected by strong hairs, buds subterminal, or obliquely situated with regard to the axil of each frond, the fructification which is generally fasciculate intervening.

The radicles, pierce through the outer cellular portion, but are not calyptrate, the branches communicate directly with the centres; not as in *Azolla* where they are formed by an elongation of the cells of the circumference, young roots covered near the base by a vaginiform sheath.

It is a much more developed plant than *Salvinia* or *Azolla*, the most remarkable difference it presents from Ferns, are the partial vernation, the termination of the veins, and pseudo male organs, ovaria of authors, also the separation and situation of the sori, the quaternation of the fronds, and anatomy in general.

II. MARSILEA.

General Remarks.

Nothing like sexes in *Marsilea*.

Reproductive organs always extra axillary.

Each capsule represents a carpellary leaf.

The first appearance of the organs is uniform, in rows, at right angles with the midrib, unchanged spaces being left between them, in which spaces appearances occur as if there would be vessels.

Of these bodies which are entirely cellular and opaque, as if from contained air, some are larger than others, and the larger are confined to the central line of each set. The two kinds, though subsequently so different are not distinguishable at such periods, both being cellular and grumous, but some are larger and sessile by a broad base, these may afterwards become the sessile reproductives.

At the earliest period, the capsule is mucilagino-cellular, with a flat front face, along the centre of which is a depression indicating the line of folding?. At this period they are solid. The tissue along this central depression, appears if I may so say, thrown off subsequently, the margins of inflection, (so far at least as the cavities containing the reproductives are concerned,) being formed on either side of it. Can it be analogous to the male of *Isoetes*, which would have a somewhat similar disposition if the leaf were folded on itself.

The usually supposed male organs are subovate, or subobovate in form, they consist, when mature of an outer cellular lax coat, an inner ditto, which when immersed, expands and

becomes mucilaginous, and a central shortly stipitate coriaceous opaque coat, which encloses grumous fluid and many irregular granules of an amylaceous appearance. The colour of this coriaceous coat is whitish, its stalk being tawny: its opacity is caused by the presence of innumerable granules: no traces of cells are demonstrable by the ordinary means.

Most of these organs abort, the abortion being confined to the inner envelopes and their contents. The female organs are more numerous, and much less liable to abortion. They are generally of a clavate or obovate form. They consist of one coat similar in structure to the outer coat of the male organ. This coat is laxly cellular and unprovided with any apparatus for promoting dehiscence. Within this sac are contained an independent number of sporules: The sac is whitish, and the cells from which it is formed as in the male, contains greenish granular matter; the sac subsequently on immersion becomes nearly mucilaginous. It is more or less stalked, whereas the male is as invariably sessile, it is about $\frac{1}{2}$ as small-again as this. Neither of these appear to be dehiscent.

The sporula, at the most mature stage, I have examined them, are of very various sizes; they are whitish; the larger being opaque when viewed through transmitted light, they are of a tawny brown colour, the larger appear to be situated next the parietes of the sac, they are round, of considerable size, and consist of two coats, which are not, however separable, the inner containing small granules of a subamylaceous appearance, and is less coloured than the outer. The remainder vary much in form, being either opaqueish and convexo-concave or globular, presenting the appearance of two coats, and towards the centre of ternary, or rarely quaternary division; these latter I imagine to be always in the centre of each theca, all of these are surrounded by a mucilaginous pellicle when immersed, this pellicle when dry assuming the appearance of an envelope, often with a small stalk.

The development of these organs is as follows.

The males ? from the earliest period are the largest : they consist when young of suborbicular subsessile cellular sacs, containing granular matter in which are to be seen, though indistinctly, the rudiments of distinct cells. At a somewhat later period they have increased in size, and the inner cellules are most distinct. For sometime no material change occurs, when traces of an inner sac surrounded by an obscure envelope are traceable.

These however are not separable, the contents remain the same. At a later period the innermost envelope is separable, it has assumed its opaque appearance, and somewhat of its subsequently coriaceous texture, it is surrounded by thin muciliginous pellicle, it contains no granules, at this period there is an obvious cavity in its interior, which is demonstrable by pressure. As the development proceeds, the *nucleus* becomes more coriaceous, more easily separable, its proper tunic always adhering, becomes thicker, and a cavity is demonstrable in its interior, running in the direction of the largest diameter, it still remains empty. The next step consist in the development of its stalk, (which always remains very short,) and in the maturation of the three envelopes. When fully formed, the coriaceous coat will be found to contain grumous granular matter, and amylaceous granules. The development of the female is as follows, it has no correspondence with that of the males.

At an early period the contents as well as the structure of these is similar to that of the males, but their form is different, being orbicular, and they are moreover, stipitate.

Within the grumous mass by which they are filled and rendered turgid at an early period, cells are distinctly seen to be imbedded, and these cells present towards their centre, traces of an almost always ternary division, they consist at this period of one tunic ? These cells are all of equal size. At a rather later period, these bodies present a more decided appearance of subdivision, and are surrounded by a hyaline envelope, they are colourless.

The next step consists in both tunics becoming tawny: they are still all of the same size, and the appearances of division are not increased.

At a later period they become surrounded by a mucilaginous envelope, which is at first faint, and they are unequal in size. At this period, they fill entirely the cavity of the capsule. At a subsequent period they are still more unequal in size, of the same colour, and surrounded with a distinct mucilaginous envelope.

They undergo no further change, beyond maturation.

The additional or mucilaginous envelope obviously originates in the grumous mass in which the sporules are formed, its different stages of development and separation, being distinct enough.

The inequality of the sporule is attributable to the very different periods at which the portions marked out by the dividing lines become separate. This process appears to commence in the sporula of the circumference; when it takes place, each mass carries with it a tunic from the mucilaginous coat. So soon as it has been perfected, the convexo-concave sporule adopts a tendency to become globular, and at the same time granules, or very small cellules are developed in its interior. The innermost compound sporula at a late period preserve the same appearance that they had on first becoming coloured, with the exception of the addition of the mucilaginous envelope.

The fact of the different periods of separation, accounts satisfactorily for the various appearances presented by the sporula at a late period of development. We have on the circumference rather large and perfect sporula, in the centre small transparent compound sporula, and between these every gradation of size, but all more or less convexo-concave, those towards the centre being the most so; contiguous to the innermost unseparated compound sporula, we have some undergoing separation, but still enclosed in a common mucilaginous tunic.

The developement of these bodies corresponds to that of similar bodies of the higher Cryptogamic orders with two exceptions, viz the corresponding developement and separation of the tunic formed from the formative mass, which in other cases subsequently disappears, and the commencement of the separation of the parent cell in the centre, and not in the circumference. Inversions of two ordinary phenomena thus occur. These bodies are, reasoning from their developement, beyond all doubt the proper reproductive organs.

To the formation of the male I know of no analogy, not having yet (1837) examined *Azolla* and *Salvinia* with the usual form of anther as this organ occurs in *Cryptogamia*. Taking into consideration the reproductive organ of *Chara*, I imagine them not to be male organs, but more analogous to gemmæ, and hence in one point of view, reproductive organs. And the idea that they are a merely casual mode of reproduction similar to gemmæ is strengthened, I think, by the fact of their very frequent abortion. Their structure I am unable to explain, but I conjecture from partial appearances, that one cell in the mass they contain, assumes a preponderating growth, and that this cell produces subsequently in its interior, amylaceous granules. Of the origin of the second envelope I cannot give any explanation.

It must not be forgotten that botanists appear to have been mistaken in imagining the necessity for impregnation in all Cryptogamic classes. In all of these in which a style is formed—in which there is a stigmatic communication obviously analogous to that of other Phanerogamous plants—in which there is a pre-existent cell, which has to be operated upon, that it may receive the necessary influence—I believe that impregnation does exist, and in all these we have obvious anthers. The grand difference is, that in these, impregnation is limited to the production of the organs from which the sporules are subsequently formed. This idea is suggested by the special provision made in *Anthoceros*.

If this view be sound. Filices, Marsileaceæ, and Salviniaceæ have no male organs. Musci and Hepaticæ, on the contrary have them, as every one knows. And thus, these latter orders are, except in the organs of vegetation much more developed than the rest. The fact that in these, impregnation is effected to produce the organs which again produce the sporula, is quite sufficient to shew that impregnation is not absolutely necessary in all.

I see nothing like attachment by fours, or any other number.

From the analogous instance of Chara, if the body be reproductive it will produce only one plant.

MARSILEA, Pl. CXIV.

Fig. *a*. Represents three parent cells imbedded in the formative mass, which has commenced being divided into cells, these cells form at a more advanced period, the mucilaginous hyaline tunics.

9. 1. Capsule.

2. Sporula, mucilaginous tunic dissolved. At this period all the parent cells have become divided, although the component parts remain approximated in some.

3. Sporula with mucilaginous tunics.

4. Sporula burst by pressure; mature.

a'. Represents a theca.

b'. Male body.

y. Young state of theca, mucilaginous or rather grumous formative mass, with some parent cells, with indications of ternary division.

c. Female organs.

d. Young theca.

e. Section of involucre through its small diameter.

f. Portion of septum.

g. Long section of involucre.

h. Nearly mature involucre.

- i. Long section of young involucre.
- j. Portion of theca.

MARSILEA, Pl. CXV. (*continued.*)

B. Male ? body, shewing the nucleus with its mucilaginous coats separated, and granular matter with cells imbedded, this is situated between the middle and outer envelopes.

1. Body.
 2. The same under pressure.
 3. Portion of paries of nucleus. 4. Portion of its contents. Corresponds to 1, 2, 3, 4, Pl. CXIV.
 5. Below 9. Sporule burst. 6. Ditto to shew the inner sac. 7. Below 6. Sporula, compound, not separated.
 - 7'. Male body less developed. 1'. Nucleus and middle coat separated. 2. 2. Male body under pressure. The nucleus is in its earlier periods of developement.
 11. Young involucre, *a.* portion of a sorus; *b.* Male and young theca.
 12. Portion of a sorus; *a.* young theca, with a portion of its contents, parent cell already divided; *b.* male body, and portion of contents.
 13. Do. more advanced; *a.* theca and contents; *b.* male body and contents.
 14. *a.* Theca, and contents; *b.* male body; *c.* ditto under pressure; *d.* portion of contents.
 15. Male body, nucleus scarcely separable.
 16. Young fronds.
 17. *a.* Male body, corresponds to 15; *b.* sporula not separated.
 18. *a.* Male body; *b.* theca; *c.* sporula not yet separated.
- In Marsilea the general theca is obviously a modification of the frond; it is formed from one ? conduplicate leaf, the margins of which are united.
- The structure of this is coriaceous outside, internally of green fleshy cellular tissue, this being the only part provided with vessels; this tissue is perhaps at first solid: but by the

subsequent developement of the organs of reproduction within, it becomes subdivided irregularly into cells.

The reproductive organs are fixed to the inner parietes of the capsule, at right angles with its longest diameter. They are subdivided into rather lengthy groups by the cellular partitions above mentioned, they are attached to the vessels.

They are of two kinds, one which is, so to say, monosporous, and the other, polysporous.

The former are the least numerous, but of earlier development, and appear generally to occupy the middle of each sorus, or mass of capsulets. The structure of both is the same: the contents of that now under consideration, consisting at an early period of a few simple cellules, always imbedded in a minutely grannular mass, and at a later period of a single coriaceous subwaxy mass, enveloped in an indistinctly cellular envelope, and surrounded? by minute granular matter, containing some diaphanous cellules, the waxy mass being perhaps a developement in excess of one of these.

The structure of the partial thecæ is in both the same, but that of the true sporules is always smallest and stipitate; the others being nearly sessile. They are cellular, unprovided with any organ of dehiscence, and contain many masslets of irregular outline, consisting of greenish grannular matter, the cells are lax, and entirely simple.

The true reproductive sporules are in their developement similar to the acknowledged sporules of other Cryptogamous plants. They are formed by the subdivision, always ternary, of a single cell, which cell is lodged in a granular mass, without adhesion to the interior of the theca. When nearly developed, they are of very variable size, all being surrounded by a mucilaginous looking fluid. The largest contain many granules, and are hence opaque, globular. The smaller are nearly transparent and empty, and are concavo-convex: the result of their original situation, and aggregation in threes.

The grumous granular mass in which they are originally

enveloped, does not present appearances of being cellular, although each sporule after its separation is confined in a cellular-looking areola.

The distribution of the veins, and their relation to the sorus deserves to be examined.

Do the pseudo, reproductive organs become less numerous as the maturity of the spore increases? if so, those that remain may be merely accidental.

Has the ripe sporule a tunic?

Is there any certain order in the situation of either?

Is the capsule originally solid?

Are any of the cells surrounding the pseudo reproductive organ ternarily divided?

Note the conformity, if any between the fronds and capsules.—*Bamo.* 1837.

From these observations it would appear, that Marsilea has two organs, dissimilar in development; one only presenting the usual ternary, or quaternary division: the other presenting no analogy to the usual males, and appearing to be that which authors have ascertained to be the real reproductive organ.

These observations do not agree with those of M. Fabre, as given by Dunal, *Annales des. Sc. Nat.*, N. S. Tom. VII., in which paper nothing is given on the development. However, the mature parts do not agree, for M. Fabre has described the female as terminated by a mamelon; and has described the anthers as simple sacs, containing molecules and granules.

It is not improbable that Mars. Fabri may be very distinct from ordinary Marsileæ, in which I see no disengagement of the sorus from its original connections, which are a good deal like those of Ferns.

Pending the want of observations on the development of M. Fabri, is it assumable to conjecture, that in it, the development reverts to the Phænogamic form, in which the pollen alone is derived from division. It is observable, that in my sketches, the mamelon would appear to belong to the at-

tachment of the nucleus, rather than to any stigmatic apparatus.

M. Fabre says nothing of sphaclation of the stigma, which it ought to present, if really stigmatic.

III. AZOLLA.

AZOLLA PINNATA, Pl. CXIX.

- Fig. I.,—1. Confervoid filaments attached to the axis near the reproductive organs. I only saw these appearances in one instance. 1-16.
2. Represents the contents of the nucleus dissected out (but disturbed), it shews however, that there are more membranes developed round the condensed points than the subsequent number of lobes (9) for here on one face there are 7. The grumous mass below the yellow sac, is there from misplacement.
3. One of the ovate oblong bodies: parts seen in situ, a few grains still remain. In this also there are more membranes than subsequent lobes. The yellow sac is of this form from pressure.
4. Very young state of the reproductive organs, young involucre pushed back: confervoid filaments pass from the *receptacle*, but not with positive relations to the *ovula* in young reproductive organs.
5. Young state of the pedicellate globose body, shewing the division of the cells imbedded in its grume, parts in situ.

Fig. II.—Represents a very young involucre: evidently open at top, from which protruded two confervoid filaments; it contained one very young pistillum, the nucleus of which was beginning to be enclosed in the tegument.

Fig. IIa.—Involucrum very young.

Fig. III.—In this instance, one only presented clearly the communication and the sac, apparently filled with granules, or itself granular, the other presented neither distinctly, but from this protruded?

many filaments, some of which under pressure (before which they did not appear) seemed to pass down the canal. $\frac{1}{4}$

Fig. IV.—A pair of pistilla, after slight pressure, in the left hand one, the sac is distinct, but quite enclosed: from the open mouth, grume confervoid granules, and filaments protrude; and it appears that the filaments afterwards observed really are composed of the granules above the apex of the sac. $\frac{1}{4}$.

In the right hand one they are less distinct; only grume being visible; from the umbilicate apex, this appears to be more developed than the other; $\frac{1}{16}$ shewed that the filaments were filamentous portions of the protruded mass, i. e. that they are protruded from it, and are composed from it. $\frac{1}{4}$.

Fig. IVa.—This represents a *single* pistil, contained singly in an involucre, which appeared quite closed. It is not distinguishable from the young states of many ovula! No filaments were observed, and only a very few of the capitate cells. $\frac{1}{4}$.

Fig. V.—Very young involucre, $\frac{1}{4}$; it appeared as tho' formed of three parts, but possibly the posterior part may belong to the leaf, it contained two antitropous bodies, one rather more advanced than the other; the right hand figure represents them under pressure under 1-16: each cell contains a green nucleus, and looks as if studded with nails.

Fig. VI.—In this there were two pistilla, one less advanced, without confervoid filaments, but with a bit of grume projecting: the other with protruding filaments, burst accidentally, the lower filament I think is continuous with the apical protruding ones. $\frac{1}{16}$

Fig. VII.—This represents the pedicellate bodies of *Azolla pinnata* after their natural escape from the *body* (Ovulum). They were several; and were found mixed with the oblong amorphous bodies, but such dehiscence appears unusual, for I find both bodies generally mucilaginous-looking, the one containing pedicellate bodies, the other appearing to be an intricate mass of laminae, not unlike that of the cutis of the plant. In the pedicellate body, or theca represented, there were two frondiform sporules. On which it is to be remarked, that the root-like prolongations were not found to be so pronounced, as in those which appeared to be undergoing the natural process: viz. those contained in the dissolving *ovulum*, mixed with remains of the thecae themselves.

The curved bodies at the base of the stalks, are I imagine, what I have elsewhere called antheriform bodies. $\frac{1}{4}$.

Fig. VIIa.—Represents a sporule after separation from the plant, lying in the *body*, either involucre or ovulum, at the bottom of a goblet. It is of a pale whitish green tint.

AZOLLA PINNATA, Pl. CXX. (*continued*.)

Fig. III.—1. Represents parts of the contents of a pedicellate body, (Capsule) 1-16, shewing the yellow sacs contained in parent cells; the membrane of which is scarcely formed.

2. Represents the contents of a more advanced pedicellate body, (Capsule). The appearance is now a good deal changed, instead of as many cells, as groups of yellow sacs, or instead of the yellow sacs being 3-4 in each cell, they are several; this is one of the great anomalies, several of the yellow sacs are evidently abortive.

3. Represents a pair of bodies, very young, under pressure; one accidentally ruptured, granules have past out. This shews well the condensing grume in the nucleus, and the early existence of the cellular protuberances round the base of the nucleus.

Fig. II.—a, Very young involucre 1-10.

b, Two pistilliform bodies, $\frac{1}{4}$ C. Lens, measured. Apex of the smaller one distinctly hyaline, umbilicate, disclosing confervoid filaments passing out; then the uninverted funnel shaped part; then the nucleus or grumous cell which appeared erect, attached by a broad base. The base of the pistillum opaque, but the rest penetrable; the passage out of the filaments *most distinct*.

The larger one of the pair, with a mucilaginous dissolved looking, browned, more obtuse apex, not distinctly umbilicate, and with no evidence of perforation, or of a tube, the larger confervoid filament *appeared* to pass into its apex obliquely. The nucleus the same. Each cell of the superficies of both, parallelogrammic, and in all except perhaps the cells of the apex; a, nucleus of greenish colour; c. represents the confervoid filamentous structure at different foci, d. d. are the most correct. 1-16 M.

Figs. I.—In this instance although the filaments were only in

adhesion with one, both were to produce pedicellate bodies, both were exactly similar, though one was a little larger than the other. The nucleus chiefly cellular grume and granules adhering to the walls of the cells; its centre opaque.

The future pedicellate bodies, sessile or on one cell looked hollow in the disc, which was $\frac{1}{2}$ opaque with grume, the margin rim-like, cells beginning to be marked out, looking as if the transparent part were formed by expansion of a nucellus.

Fig. IV.—*a*, Represents a young mass of capsules dissected out from a body: the original nucleus appears unchanged: not even diminished, (see above), but it cells are more distinct, and it is less opaque, the development is from above downwards! !

All the future thecæ, young and old, have a grumous disc, rendered more evident by iodine; this is largest and most opaque; and also the most advanced. In the uppermost also, more transparent nuclei may be traced, as if extending in size until they occupy the greater portion of the cavity once opaque; this looks then incrustated with grume; see 1. 2. 3. which give the ratio of development.

What are the cellular bodies attached to the base of the foot stalks of the advanced ones.

According to development, is the distinctness of the superficial cells: these are traceable in 1, whereas in 4. the parietal or *double* margins are distinct,

a, $\frac{1}{4}$ C. L. M.

1, 2, 3, 4, $\frac{1}{16}$. M.

Fig. V.—A pair of bodies of ovula of 1 involucrum, in both the remains of filaments are seen adhering to the apex, one only apparently entering, in both the granular communication is distinct, especially in the right, or more advanced one.

In this the original nucleus is larger, broader at the base; it appears especially along the sides to be cellular. There are only small projections round its base; from the upper part hangs a yellow sac by means of grumous matter, beginning to exhibit the frondose lobation, vessels are seen very evidently, expanding round the base of the nucleus.

In the other, the yellow sac is more globular, but still presents a short neck or mouth, between it and the apex of the nucleus, is a

crenate shaped grumous mass, not lobed. In this the projections round the base were more evident than I have seen. The granular communication is distinct above, towards the apex of the nucleus becoming dissolved. The inner wall of the nucleus is likewise cellular in this.

In both, prolonged maceration caused the base of the nucleus to become narrowed, and then in one the basilar projections became more evident.

AZOLLA PINNATA, Pl. CXXI. (*continued*)

Fig. I.—Bodies anisochromous: in the left one, distinct sphacelation, distinct granular communication. Body occupied by enlarged nucleus, towards the middle of which is a yellow sac; above, it is distinctly grumous having angular nuclei, in a subspirial direction. The yellow sac is separable on pressure, elastic, empty; grumous angular nuclei floating on grume, escaping with it on pressure.

The right hand body, is much less advanced, filaments adhering. sphacelation slight, and not throughout the cells of the apex, but rather about the centre, nucleus grumous, with obsolete nuclei towards the centre, no vessels prolonged into this.

In the larger, few if any of the cells of the superficies exhibited nuclei, in the smaller many green ones did.

The circumference of the yellow sac is more opaque than the rest, probably from condensing grume. $\frac{1}{4}$

Fig. II.—In this, both are distinctly umbilicate: in one are distinctly protruding confervoid filaments; of this also the communication, funnel, and sac, are very distinct. In the other there was sphacelation near the apex, and the body was opaque, nothing could be more distinct than the right hand, one. 1-16 $\frac{1}{4}$ M.

Fig. III.—Represents the two bodies of one involucrem, the lowest (in the drawing) less advanced.

It shews well the general condensation of grume within the nucleus, prior to the appearance of the yellow sac.

Both, especially the upper, shew that the cellular protuberances exist around the base of both nuclei. $\frac{1}{4}$ M.

Fig. IV.—Superficies parallelogramic cellular, cells above the base of nucleus or bag, gorged with pink fluid, below whitish, with a distinct pinkish nucleus, often dark pink, and often very lax. Cells of

the apex brown : umbilicus distinct, and in the smaller or narrower, an evident line of communication with the apex of funnel. This in both appeared crammed with granules of a brownish red, its upper end most distinctly defined in the narrower pistil.

In the nucleus is a diffused grumous disk. Dark *aërating?* lines from base of the pistil, extending irregularly upwards, *male??*; the cells have granular fovillar contents, especially the terminal one.

Confervoid filaments not passing into the umbilicus, but adhering to the apex apparently. Apex of larger with none.

The structure of the apex appears to be composed of four sets of cells, so perhaps herein there is something like Chara.

Acid causes grumous nuclei in each cell of the surface, and the disappearance of the funnel. Pressure after it shews the bag, as if it were extending to the base of the pistil.

In the drawing, the centre is seen through the surface, so that the surface cells are not represented. Measured $\frac{1}{4}$ Achromatic.

Fig. V.—These two are scarcely distinguishable at first sight, but in the upper one the sac is larger, the grumous nucleus and its transparent part both more developed; after maceration in water it assumes more of its mature form, i. e. the grumous nucleus appears erect, as if incasing a transparent bag.

In the smaller, the grumous nucleus is smaller, less distinct, and so is the transparent part, which disappears after maceration in water.

The upper one would afterwards have the yellow sac, and its frondose stuff at top. In both, vessels are plain enough:

In the smaller or under, small cells exist round the base of the nucleus, or origin of the sac.

Confervoid filaments *outside*, adhering to the upper pistil, and antheriform bodies at the base.

Fig. VI.—A pair of ovula, $\frac{1}{4}$ M.

The lowest will be the frondiferous, the uppermost sporuligerous.

In the former the development of new parts takes place within the nucleus, in the other without.

Confervoid filaments only to the upper one, the development of the angular granules of the lower appears coeul with that of the yellow sac.

Fig. VII.—*Similar*, no confervoid filaments observed at the apex, although the granular communication exists, the size of the original

sac continues the same, vessels in both extending into the base of the pistil. There is some difference as regards the yellow sac, which in the left hand one is twice as big as in the other, and crowned with brown grume. In the right, the grume appears in massules, *prior to condensation*? In both, there are cells projecting about the base of the original sac between it and the walls of the pistil cavity.

The small yellow sac alone is separable, as also the grume; with a tendency to lobing, so that it is the most advanced.

AZOLLA, Pl. CXXII. (*continued.*)

- Fig. I.—1. Circumscissed seeds or bodies of *Azolla pinnata*.
 2. Contents separated with the apex of the seed.
 3. Apex of the seed, (analogy to *Lemna*.)
 4. Same as 2, circumscissed apex of seed removed.
 5. Same, the frondose lobes slightly separated.
 6. Lower brown free end of the same, shews the upper surface of the yellow sac.
 7. Another view of the same as an opaque object, the trifacial lines distinctly seen.
 8. Part of the crustaceous coat $\frac{1}{4}$ M.
 9. Yellow sac burst, to shew its contents.
 10. Do. entire.
 11. Frondose lobe.
 12. One of the fibres, 1-16.

Fig. II —Two pistilla dissimilar producing.

In both, the apex is distinctly umbilicate, and browned, with something like traces of confervoid filaments on the larger, but *uncertain*. Then the granular origin of the funnel-shaped mass, is distinct in both, but in larger only presenting in the centre the *communicating line*. In the smaller, the original sac is not enlarged, it is distant from the granular funnel, which is truncate, and also from the sides of the cavity, between which and the sac, as well as all round its base, are many cellular bodies, these afterwards are the pedicellate 3, 4, ternary bodies.

In the larger, the sac is much enlarged, occupying the whole cavity, except round its immediate base, where *one or two cellular minute projections* occur, touching the granular funnel. This body contains a

yellow netted sac, to the upper end of which a grumous obsolete lobed mass is attached, in this confervoid mass, loose filaments are seen. The yellow sac in the drawing, is under pressure and shrivelled, it is loose, and may be dissected away when it separates with the grumous mass, each lobe of which becomes a frond, looking centrally to the punctate body.

The original sac in both seems erect, that is, its lower margin is not so definable as the upper.

a. Cellular body. *b.* Grumous lobed body. *c.* Space empty.

Fig. III.—In this the sphacelation of the apex is commencing and spreading irregularly, the structure of the apex evidently of 4 teeth as before closely connivent, the line of communication formed with the funnel and granular mass, which is also very distinct, very plain. The only difference, and it is a minor one, is in the left hand, or larger body, the sac of which is larger and presents a diffused granular grumous mass in the centre. To this, one filament adheres, but it is not seen to penetrate. In the other the nucleus of the sac is more defined and smaller, in the cells of the apices of both, a few red nuclei are visible, confervoid filaments among male cells.

Fig. IV.—Represents two bodies of one involucre under pressure, (the left hand and larger one entire, contains no green granules) forming what I have elsewhere called the granular communication, for these which filled the space between the foramen and apex of the nucleus at first, have passed out, as is partly represented, the other is split, and shews the internal structure well. I think in this case both would have been yellow sacular; the larger certainly would have been so; I have also represented a part of a confervoid filament (17) found about the base of the bodies to be compared with those squeezed out (18 and 19) of these, some are twice as long as others: some look as though intending to coalesce into a mass. It is to be remarked that in the filaments themselves the joints vary in length, though perhaps none are so long as the largest of those squeezed out.

Great analogies with *Cycas*. !!

Fig. V.—This represents a rare case, in which both pistilla appear to produce the pedicellate bodies, in which alone the ordinary ternary

and quaternary division takes place. The right hand one is rather more advanced than the other $\frac{1}{4}$.

AZOLLA, Pl. CXXIII. (*continued.*)

- Fig. I.—1. *Azolla pinnata*, portion, of the plant magnified.
 2. Root, the apex enclosed in its sheaths.
 3. Ditto the sheaths removed.
 4. Transverse section of the root.
 5. Apex of the root as it appears enclosed in its sheath.
 6. Outer sheath.
 7. Inner do. open at the end.

AZOLLA, Pl. CXXVII. (*continued.*)

- Fig. I.—1. Very young capsule, a mere cellular body, of two cells, the terminal one with a nucleus of grume.
 2. More advanced, the cells increased, terminal, itself cellular (see margins) contains a cavity in which is grume—nucleus.
 3a. More advanced iodined.
 3. More advanced, grumous mass of considerable size, superficial granules now *commencing*.
 4. More advanced burst by pressure, contents partly escaped as 4a, 4b. one of the young spores. 1-16.
 5. More advanced. Iodined, nucleus grume contracted, exhibits yellow sacs.
 6. About the same period—probably would have been abortive.
 7. Capsule now contains several bags, membrane not definable, of these the central one is in focus, and contains several yellow sacs.
 8. Yellow sacs separated, 1-16.—evidently the mature sporal form. See *Isoetes* etc.
 9. Now the capsule only contains three of the same indefinable membranous sacs, yellow sacs often in 3 and 4 and 2.
 10. More advanced, the three bags are now cellular, solid though not so firm as they afterwards become, the yellow sacs are imbedded in the cellular mass.
 11. One of the bodies in a mature capsule, the yellow sacs grouped in 4, at least those that are visible, they contain granules

12. One of the bodies intermixed with young capsules.

All but 4b. and 8. $\frac{1}{4}$ C. L. M.

9a. Represents one of the future three bodies, the membrane is scarcely definable, and I never saw it with a double edge, it is just what one would imagine to arise from gaseous matter contained in minute grume and mucilage; it presents a grumous nucleus of irregular shape.

III. SALVINIA.

SALVINIA VERTICILLATA, Pl. CXXIII.

Fig. II.—Ovulum, terminating the axis, most of the hairs removed. I observed one (not represented) like the confervoid filaments of the roots. Grume plainly adhering to the foramen, and also I think filling the space (or at least adhering to the walls) between the nucleus, or rather sporangia, and the mouth.

This would have been a capsule containing the few oblong bodies, so the change on which one part depends takes place very early. It is only cognisable by the greater or less size.

Fig. IV.—8. Young capsule, and a nascent secondary one, $\frac{1}{4}$.
Hairs all removed.

9. Nascent ditto, as seen under pressure, $\frac{1}{4}$, the terminal cell larger than the next to it.
10. One of the cellular bodies (future capsules) of the larger young capsule, of which they occupy the whole fundus, being exceedingly numerous.
11. The same shewing the usual preparatory steps to the forming of cellularity.

Fig. V.—1. One of the spherical more numerous capsules I-16, whole cavity occupied by grume, in which are imbedded trifacial cells, with anylaceous green granules in irregular groups of cells within the parietes of spherical capsule.

Fig. III.— One of the oblong larger spherical capsules, the space between the central large body, and wall is occupied by fluid grume, which escapes on very slight pressure, in it a few trifacial cells occur. 1-10.

- b. Is the contained body; there is a small attaching? process to the centre of the three apical teeth.
- c. Vertical view of its apex, shewing the trilineal mark, and its situation with regard to the teeth. At this time the incrusting is all minutely granular, or at most a few seeming cells in it.
- d, d. The same body more advanced, the granular incrustation is now pseudo-cellular, owing to the cavities containing oil?

SALVINIA VERTICILLATA, Pl. CXXIV. (*Continued.*)

Fig. I.—1. Mature oblong capsule.

- 2. Long section.
- 3. Secondary capsules (group of) removed.
- 4. Long section of contents of one of the secondary capsules.
- 5. Transverse do.
- 6. Part of the contents of yellow sac. $\frac{1}{4}$

Fig. II.— α . Represents an ovulum very young $\frac{1}{4}$ M.

- 1, 2. Represent two stages of the same young capsule. 1-16.

In the upper (least developed) grume at first homogeneous; after slight maceration in water, it appeared as if an angular grumous nucleus was forming in the centre, and after this as if there was a large parent cell 4 lobed in the centre. This however disappeared after it had been in dilute tincture of iodine sometime.

The other shews the mode of formation of the trifacial and central cells, it does not shew the parent cells, they being excessively faint, but existing between the periphery, and the (abortive spores) central, nearly detached cells.

Fig. III.—1. Oblong reproductive bodies of *Salvinia verticillata* $\frac{1}{4}$ M. A few trifacial cells still to be found in the grume which is fluid: this perhaps represents the formation of the three teeth ending the incrustation. This presents an analogy with capping process of *Azolla*. Middle in focus.

- 2. Yellow sac of the same capsule detached, common, but of a less advanced body, trifacial line in focus. $\frac{1}{4}$.
- 3. The same, middle in focus, shewing the cellular appearance.

Fig. IV.—1. Mature capsule.

- 2. The same naturally open.

3. Some of the secondary capsules.
4. Secondary capsule, viewed as an opaque object $\frac{1}{4}$.
5. The same as a transparent object. $\frac{1}{4}$.
6. Part of paries, shewing the tendency of component cells to separate.
7. Contents.
8. The same under pressure: it is scarcely cellular, is grumous-looking, very opaque, contains imbedded in it, larger cells? or cavities perhaps, and trifacial cells of which one has escaped. They are to be recognised *when contained*, by their colour and more defined outline.

SALVINIA VERTICILLATA, Pl. CXXV. (*Continued.*)

- Fig. I.,—1. Represents the youngest of a set of the oblong bodies. The yellow sac of the largest was complete, though still young, and only yellowish. It shews no central sac, no trifacial cells, but a continuous mass of grume, shewing a tendency above to develop cells. In this grume nothing was seen except numerous irregular angular nuclei, without a membrane. $\frac{1}{4}$.
2. Grume and nuclei. 1-16.
 3. Represents the very young state of the spheroidal pedicellate bodies: shewing I fancy, the commencement of the cavity in which grume is subsequently deposited. Generally in proportion as the cellular membrane is more distinct, the nuclei are less so.
 4. Grumous nuclei from an abortive oblong body, all of the same had aborted, only in one instance were there one or two trifacial cells? The abortion has occurred at a period the same as No. 1,—1-16.
 5. Nuclei of a more advanced stage, and developing, trifacial cells existed towards the circumference, though not many, and the central cell existed. The first change after enlargement is the appearance of a cavity in the centre.
 6. Two ovula, $\frac{1}{4}$,—the grume is not resolvible under 1-16, the two cells represented are probably accidental, the large one at the base is of the foramen.
 7. Smaller ovulum, under pressure, grumous matter filling the space between the annulus and base of the nucleus.

Fig. II.—1, 1, 1. From the same young capsule. Sphærical secondary capsules, the uppermost represents an abortive one, 1-16, at least as regards the contents.

2. Apex of a fructiferous axis $\frac{1}{4}$: this would have been a sphærical body, bearing secondary capsules. $\frac{1}{4}$.
3. Superficial view of a secondary sphærical capsule, the grume in which the trifacials are imbedded is more thick and opaque. $\frac{1}{4}$.
4. Central focus of the same. $\frac{1}{4}$.
5. Contents of the same, the grume appears to have condensed into a solid mass.

Fig. III.—I was unable to dissect out the nucleus of this, which apparently is reduced to great tenuity. The yellow sac was easily dissected, separating in one instance with its grumous cap. In the other this was torn away, and in this the yellow bag looked as though contained in a very fine hyaline membrane. The grumous cap contains more transparent places, in one of which is an angular brown nucleus.

The sac itself has a stout rim, under some aspects it is thick in texture, almost waxy, not cellular and contains granules and many *oily? globules*.

The pollen is unchanged in some: most of the granules however have become more or less rounded, the edge of the green part is now a dark line, the envelope remains; iodine slightly fuses it. Iodine renders the yellow sac dark brown.

How is it that similar fecundation should produce such dissimilar results? 3

The angular nucleus becomes the punctum! the surrounding hyaline part the frondose lobe. *The sac freed is a perfect sphere.*

SALVINIA VERTICILLATA, Pl. CXXVI. (*continued.*)

Fig. 1. *a*. Plant natural size.—

1. Young capsule (this was a solitary one) 1 inch M. most of the hairs removed.
2. Long section of the same.
3. One of the bodies of this, they were 16 in number.
- 3*a*. The same under $\frac{1}{4}$ (M.) shews the peripheral cells, chiefly towards apex or upper half at least, the large nucleus, and the central cell.

4. The same, superficies in focus : even in this way, the smaller cells are visible adhering to the inner surface.
5. Another of the same capsule : rather too large. This shews that the grumous nucleus has some connections with the periphery, probably by parts not converted into cells and unabsorbed.
6. Another of the same, in a rather younger state, the small nucelli in the grumous nucleus are the rudiments of cells :
7. Another more advanced, the only change is the encroachment of the central cell or the grume by its enlargement.
8. Central cell detached, shews its trifacial attaching face.
9. Portion of the grumous contents escaped from pressure, shew the cells in various states the 3, 4, facial are the mature form of the sporules, the 4 nucellar one was only seen once ; no lines of division were seen.

The greenish nucelli are very common, generally with a faint indication of a cell, round them (*very obscure.*)

10. Confervoid filaments attached to the out side of the capsule.

Fig. II.—1. Long section through the centre of the young capsule, hairs removed entirely, 1 inch F. D., magnified about 45 times.

2. One of the young secondary capsules $\frac{1}{4}$.
- 2a. 2b. Two ditto 1-16, the lower one shews the development to be the same as in the other body, excepting the absence of the central cell in the grumous nucleus.
3. The same in diluted spiritous solution of iodine.
4. Represents a less advanced state. $\frac{1}{4}$.
5. The same 1-16.
6. The same (iodine.)

So that it is apparent that the differences consist *first* in the greater number of secondary capsules developed, *secondly* in the absence of the central cell in the grume, on which all the rest of the changes seem to depend.

Mem. Chara is another form of the same kind, more disguised : but similar changes take place in the female, and probably in the male ; *i. e.* as regards abortive sporula. I have seen the trifacial cells in the young females !

Fig. III.—1. Represents a long section of the capsule of *Salvinia verticellata* 1 inch focus 45 times mag.

2a, 2b, 2c, 2d. Sporangia or secondary capsules 1-16, all about the same period of development: the outlines of the cells of 2d., in the grumous nucleus very faint and scarcely to be relied on.

2c. Represents a single instance, the usual form is angular or irregular, nucleus generally more or less isolated.

3a, 3b. Secondary capsules from the same body, but more towards the periphery of these, 3a is the more developed; they are parent cells, because they are larger than the subsequently trifacial ones; in one of the parent cells? an obscure marking of division occurs, but not in the largest one, and only thought to have been seen once.

3. Next 2d no granular angular coagulations, but obvious *gonflement* of the granular mass, as if cells were forming.

4. More advanced peripheral 1-16, in this the grume presents a number of trifacial cells, imbedded in it.

5. Some of these detached. Varying much in size, the upper one being the medium.

These appearances are clear enough, but the parent cells are not clear: indeed, they have been so obscure, that arguing from the ease with which they are found in higher Acotyledons generally. I sometime supposed the trifacial cells to be the parents themselves, which is not the case.

Can the abortion of the other two cells account for their not presenting the usual relations, even when imbedded in grume which should hinder them from totally losing their original relations.

What are the angular nuclei, which appear to be usual, here is a marked allusion to the ovate body of *Azolla* as regards development. Their aggreation is apparent, 2c. however was only observed once.

SALVINIA Pl. CXXVII. (*continued.*)

Fig. II.—1, 2, 3, Represent stages of yellow sacs of the same common capsule, 3 being the middle focus of 2 which is superfluous in focus, 1, 3, shew the mammilla and its apparently having something to do with the cellularity, which is *not organic*.

4. Oblong reproductions 1 inch (45 times) opaque.

5. One in water.

6. Long section of the same.
- 7, 7. Central nucleus in yellow sac and its incrustation separated, the three teeth of this shewn, sometimes these are irregular, incrustated, *not organic*.
8. Upper end of incrustation removed to shew the upper surface of the yellow sac, which becomes depressed when dry, the trifacial line hardly seen.

Fig. III.—1. Represents an imbedding mass viewed superficially $\frac{1}{4}$.

2. Represents part of the same under pressure, shewing that it is not organic cellular 1-16, it also shews the contents *now* of the trifacials.
- 3, 3. Younger secondary capsules, illustrating the formation of the imbedding masses from parietal growths or deposits, each protuberance either enclosing several cells or one only. They subsequently meet in the centre and coalesce.

They are not organic cells, presenting no membrane, and being sometimes elastic under pressure, just as mucilagino-granular fluid may be. In the early semifluid state it is very deeply browned by Iodine.

SALVINIA, Pl. CXXVIII. (*continued.*)

- Fig 1—1. One of the oblong bodies, surface view. $\frac{1}{4}$.
2. The same centre in focus, the chief change is in the great size of the central cell, the diminution of the grumous nucleus, peripheral cells are still visible. $\frac{1}{4}$.
 3. Attaching trifacial face of sac central. $\frac{1}{4}$.
 4. The same, centre in focus. $\frac{1}{4}$.
 5. Grume escaping on puncture or pressure. This shews what I take to be an instance of the spores just separating (seen only once.) 1-16.
 6. Another part of grumous contents: one of the green nuclei, so common in earlier stages, now rare is seen. The spores are frequent but not very many, generally occurring as it were imbedded isolatedly. 1-16.
 7. Portion of a grume, do. $\frac{1}{4}$, shews three cells, membrane not well defined, without nuclei, or lines of division. $\frac{1}{4}$.

Fig. II.—Germinating body, $\frac{1}{4}$ M.

In this the original radiating lines are not destroyed : the yellow sac presents an obscure grumous coating, it has more evident relations above with grume than elsewhere. A few of the abortive sporules remain, two above in apical grume, one to the left, the yellow sac surface is not spheroidal above, but seems flatish : it also has some relation or another with the grumous mass, and opposite it present a mammilla projecting inside, which appears to pass off into a thin lining, whether complete or not, not ascertained.

Yellow sac detached, it is elastic to a certain extent, viewed centrally presents undulated inner edge perhaps from oily globules? ? rim then also thick, trifacial line small but distinct, appearing as if the thick yellow coat was there interrupted or at any rate, thinner and whiter. Membrane thick tough waxy, contents though turged, not ascertainable by the naked eye.

Fig. III.—Rather more advanced, abortive sporules seen in both. In the larger one, a conspicuous grumous envelope of irregular thickness round it, and no rim, possibly the development of the incrustation.

The left hand figure is the more usual, traces of the radiating lines visible.

Fig. IV.—Represents unequal development subcentripetal of oblong, or yellow sac bodies.

1. One of the less developed $\frac{1}{2}$, M., the central is abortive, looks like an angular granular nucleus, like those of the same organ in *Azolla*.
3. Represents parent cells from the grume surrounding the central cell or its abortion, the outlines of the young spores very faint, rather cognisable from different light than by its defined membrane; in one case more distinct, as also was the cell of the parent itself seen.
2. Monstrosity of one of the more developed, an irregular grume adhering to the apex of the upper sac, both sacs surrounded with proper grumous envelopes. I have seen the same development of more than one large central sac at an early period.
4. Another less developed than 1, shews the trifacial central cell clearly, (no other cell or nucleus near it.)
5. A larger body of the same, the grume appears to originate from the unaltered part.

Azolla and Salvinia, General Remarks.

The first stage of the two organs (*ovula*) observed in *Azolla*, has presented them enclosed in an involucre of a very cucullate form, the point turned inwards so as to touch the axis. They are sessile cellular bodies of a concave or cup-shaped form, the cup (the young *tegument*) being occupied by a protruding cellular body (the *nucleus*); one is rather more advanced than the other. Pl. CXIX. Fig. 1., 4.

The second stage presented them of a more oblong form, the protruding cellular body being more surrounded by the cup, (Pl. CXIX. Fig. II. V.) by which in the third it is completely enclosed. Pl. CXIX. fig. IVa.

The fourth stage presented them as still more oblong, with a tendency to an urceolar form. The once protruding nucleus is now completely concealed, the cup having become extended beyond its apex into a short mammilla having a narrow orifice (the *foramen*). Minute examination at this stage discloses a tendency, at least in appearance, in the aforesaid mammilla to be lobed, as though it had been produced, not by one, but by about four component parts. The same stage has generally presented moniliform filaments in opposition with the apex of one or both organs. (Pl. CXIX. Fig. IV.) These moniliform filaments are found within the involucre from the earliest period examined, but were not observed to have any positive relations with the organs before this period. They now plainly pass into the organs, and have therein sooner or later appeared to be resolved into their component joints, which occupy the cavity existing between the once protruding body and the foramen. (Pl. CXX. Fig. II., Pl. CXXI. Fig. II., Pl. CXIX. Fig. II.) And this is so constant, that even in cases where the moniliform filaments are not seen in application with the foramen, or passing through it, the space just particularised will found filled with their component parts. Pl. CXX. Fig. III., Pl. CXXI. Fig. IV.

Up to this time both the organs have presented a cellular

surface of the usual colour ; each cell of the surface containing a nucleus, likewise of the ordinary herbaceous colour.

The fifth stage presents the base of the nucleus surrounded by small cellular protuberances. (Pl. CXX Fig. III., Pl. CXXI. Fig. VI.) The moniliform filaments are the same. The cells of the surface of each organ are more developed, and have begun to assume a rosy tint. The nuclei of these cells also are not only more distinctly defined, but are in most cases of a pink tint, in some deep pink.

Throughout these stages small cellular protuberances have been developing from the axis outside the base of either organ. These at the stage under consideration are simple, jointed, more or less capitate filaments, the head representing the protuberance as it existed originally. Pl. CXXI. Fig., IIa. IV., V., Pl. CXXII. Fig. IV., Pl. CXX. Fig. III.

The sixth stage presents both organs of a decided pink tint, except the base or often the lower half, the cells of which do not contain a coloured fluid. The apex of both appears distinctly browned, and generally exhibits short moniliform filaments adhering to it. The space between the nucleus and the foramen, is occupied by the joints of the moniliform filaments. Thus far both organs present common appearances.

But at this stage remarkable dissimilarities begin to be exhibited, and what is equally remarkable these affect either both organs indifferently, or one only of each pair, in which case alone there can be said to be any thing definite in the position of the two. In this case in one organ the developments take place within the nucleus, in the other in the small cellular protuberances round its base. The former becomes the male of Botanists, the latter the female ; or the former becomes the ovate organ presenting the so-called calyptra containing the large yellow sac, surmounted by the curious lobed body ; the latter becomes the globular organ containing the numerous, smaller, pedicellate bodies. Of the first, the first change ascertained was the appearance of a

grumous condensation in the original nucleus; (Pl. CXX. Fig. III., Pl. CXXI. Fig. III.) of the latter, the development of grumous matter in each of the small protuberances round the base of the nucleus, which are developed in a centrifugal order

In the first which I now propose to follow, this condensation, for so it apparently is, increases until a tolerably well defined opaque grumous disc is seen in the nucleus: this disc subsequently appears under a certain focus transparent in the centre, opaque round the edges (Pl. CXXII. Fig. IV. 15; Pl. CXXI. Fig. V.); an appearance due, I believe, to the development of a membranous sac inside. In the meantime, the pink colour of the cells of the surface of the organ has increased, so has the browning of the apex, which still often presents traces of adhering moniliform filaments. Both organs also exhibit distinct vessels prolonged from the vessels of the axis into their bases. (Pl. CXX. Fig. III., Pl. CXXI. Fig. III.)

The next stage presents nothing particular in the appearance of the organ or the enclosed moniliform filaments. The nucleus however, presents about its centre, in lieu of the grumous disc transparent in the centre, a well defined small yellow sac, and between it and the apex of the nucleus, a grumous mass is seen presenting what appear to be several small points of condensation. (Pl. CXXI. Fig. I.) Somewhat later the organ having increased a little in size, the yellow sac is found to be as it were capped by the grumous mass, (Pl. CXXI. Fig. VII. Pl. XX. Fig. V.c.) which presents shortly after indications of division (lobes) on its surface. Pl. CXIX. Fig. 1., 2, 3.

The space between the apex of the nucleus, and the now very brown apex of the organ, still presents the dislocated joints, which now form a column of communication between the foramen and the nucleus (Pl. CXXI. Fig. VI.); parts of the moniliform filaments may often also be found adhering to the foramen itself.

The lobes mentioned as appearing in the capping grume continuing to be developed, encroach upwards on the nucleus (Pl. CXIX. Fig. 1., 3.); and the yellow sac, which, as the

lobes increase in consistency, appears more and more distinctly pendulous from their mass, becomes gradually covered with an incrustation. The joints of the moniliform bodies which previously could be easily squeezed out through the foramen, disappear about this period.

When fully developed the organ presents scarcely if any change of form: most of the cells of the surface are gorged with pink fluid; the apex is distinctly brown. The cavity of the organ is occupied by a complex body, consisting of two dissimilar parts; the upper, which forms rather more than the half, consisting of nine lobes (Pl. CXXII. Fig I., 4, and 5.) (the three uppermost of which are the largest,) mutually united by a remarkable tissue, which on pulling them from their places separates with them in the form of fibrous radicular prolongations (Pl. CXXII, Fig. I., 11.) This part (the upper locus of Brown) is up to a certain period perfectly homogeneous, and even when the nine lobes are evidently cellular, the axis or common attaching portion is grumous and homogeneous. It is by this tissue that the whole mass hangs from the apex of the capsule which separates with it in the shape of a conical calyptra, (Pl. CXXII. Fig. I., 2, 3.) presenting in the centre a brown mammilla (the original *foramen*.) The mass is in apposition below with the upper surface of the yellow sac; the part of this (i. e. the vertex) so in apposition not being covered by the incrustation (Pl. CXXII. Fig. I., 6, 7. The yellow sac is filled with oleaginous particles; it presents on the centre of its upper face a trilinear mark (Pl. CXXII. Fig. I., 7.) it is separable from the incrustation, which presents an areolate cellular-looking surface (Pl. CXXII. Fig. I., 2, 4, 6); its membrane is thick, of a waxy texture, and without markings or any other indications of composition. (Pl. CXXII. Fig. I., 10.)

The changes in the other organ, appear only to affect the protuberances round the base of the nucleus, which body may be detected unchanged, as I have ascertained by meas-

urements in the mature organ. All the protuberances undergo the same changes, those next the base of the nucleus, (or those first developed, or the uppermost,) being the most precocious. A nearly mature capsule will present a complete series of the developments.

First they appear as small sessile protuberances with slight indications of cellularity and a central cavity (Pl. CXXVII. Fig. I., 1.) In the second stage one or two cells will be found to have been developed under the original protuberance, which is now therefore more or less pedicellate. The cellularity of the head or terminal part is more evident, it is evidently hollow, and the cavity contains grumous matter (Pl. CXXVII. Fig. I., 2.) As it goes on enlarging the head assumes a spherical form, the pedicel becomes more developed, the grumous mass larger (Pl. CXX. Fig. IV. 1, 2, 3.)

Then in the cells of the heads, which are the young secondary capsules, amylaceous granules (for they are violetted by indigo) appear. And at this period, if the grumous mass be closely examined, very minute cells will be seen in it, each cell containing 3 or 4 nuclei, Pl. CXXVII. Fig. I., 4, 4a, 4b. (or perhaps three or four cells, each containing a nucleus) convex exteriorly, trifacial interiorly.*

The enlargement continuing, the next stage presents the formerly grumous mass as cellular, the membrane of the cells (*the parent cells*) not well developed, with grume along their contiguous faces. (Pl. CXX. Fig. III, 1 $\frac{1}{16}$, Pl. CXXVII. Fig. I., 9a.) In each of these cells are 3 or 4 yellow nuclei presenting more or less of their original connection, or quite distinct. Examined separately each of these presents a convex surface and a trifacial one, the last being the surface of their former contiguity. The parent cells soon cease to be evident, and then the cavity of the s. capsule appears filled more or less with trifacial yellow cells. Pl. CXXVII. Fig. I., 6.

* Trifacial if three are developed as is most usual, quadrifacial, if four.

At a later period each head (or s. capsule) presents the appearance of being subdivided into several cellular-looking compartments, each of which encloses several of the yellow sacs (Pl. CXXVII. Fig. I., 7.) The yellow sacs, when separated, present no particular change. appearing generally quite empty (Pl. CXXVII. Fig. I., 8.)

Still later each s. capsule presents generally three or sometimes two subdivisions of increased size (Pl. CXXVII. Fig. I., 9, 10.) And this is nearly the mature form, for the further changes only regard the appearance of cellularity in the subdivisions, and the imbedding of the yellow sacs in the apparently cellular masses hence resulting.

When quite formed, each secondary capsule presents a long simple stalk, a spherical head, formed of one layer of sinuous cells, containing green granules adhering to the walls of each cell (CXIX. Fig. VII., *b.*). Each contains two or three, sometimes four, cellular bodies, convex on the outer surface or that next the wall of the cavity, irregular on the inner surface, or that of mutual apposition. This surface presents prolongations having appearances of cellularity, but not of organic cellularity (Pl. CXIX. Fig. VII., *c. a.*) The mass is solid and apparently cellular; within it may be seen the once free trifacial yellow sacs.

It will be hence seen that in *Azolla* the difformity of the mature organs is extreme, indeed but for the foramen, and the trilineal mark of the vertex of the yellow sac, the two could scarcely be considered as having any thing in common.

The young state of the *Salvinia* is too much like that of *Azolla* to need any detailed remark. But the nucleus presents from an extremely early period a papillar appearance, the first developments of the future secondary capsules taking place at an exceedingly early period. (Pl. CXXV. Fig. I., 6, 7. Fig. II., 2., Pl. CXXIV. Fig. II., *a.*)

The first discrepancy remarked in the organs of this plant consists in the number of the papillæ (future secondary cap-

sules) developed. This also occurs at a very early period, when the two subsequently difform organs are recognisable, the one by the smallness and great number of the papillæ, the other by their larger size and smaller number.

The second discrepancy arises from the greater development of a particular cell in the secondary capsules resulting from the development of the papillæ. Otherwise, at least up to the period of the enclosure of the trifacial cells (or spores) of the smaller spherical secondary capsules, the developments are so much the same that they may be advantageously considered together.

In both, the first steps consist in the development of the cells of the superficies of the secondary capsules. (Pl. CXXV Fig. III., 2*b*, *c*, *d*, *e*.) Shortly after, a cavity begins to appear in the secondary capsule, and this cavity then becomes filled with the usual formative grumous matter. (Pl. CXXV. Fig. I., *a*, *b*., Pl. CXXVI. Fig. II., 5.) It is in this grume that all the subsequent changes of importance take place.

The first of these exhibits a variable number of irregular granular nuclei (or coagula or condensations) in the grume, which same coagula soon exhibit (except in cases of abortion) traces of being surrounded by a membrane. Pl. CXXVI. Fig. III., 2*a*, 2*b*, 3, 3*a*. etc.

A little later each secondary capsule will be found to present a central mass of grume apparently connected with the inner surface of the secondary capsule by radiating grumous lines (Pl. CXXVI. Fig. II., 2*b*.) the intertices of which are very generally occupied at least partly by distinct cellular bodies with one surface trifacial. On slightly pressing the secondary capsules the grume escapes, and then presents, if attentively examined, a few nuclei or coagula as before said, and a considerable number of faintly defined cells, in most of which traces are to be seen of ternary or quaternary division, and as many nuclei; also a few small trifacial cells, as above-mentioned.

The grumous mass of the secondary capsules resulting

from the larger papillæ exhibits, however, in the centre, a cell containing granules, completely surrounded by grume, and apparently quite isolated (Pl. CXXVI. Fig. I., 3*a.*); with this exception and the difference in size, its contents may, I think, be considered as identical with those of the others. But this includes the curious difference of trifacial cells being developed both in the centre and the circumference.

Following the development of each from this period separately, it will be found that the grumous mass of the smaller secondary capsules gradually becomes smaller, while the number of the trifacial cells becomes visibly increased; until the whole or greater part of each secondary capsule is filled with them and with grume (Pl. CXXVI. Fig. III., 4.); and latterly by trifacial cells alone. After this however, the cavity of these secondary capsules become again filled with grumous matter developed from the inner paries of each from several points, each including a variable number of the adjacent trifacial cells (Pl. CXXVII, Fig. III., 3, 3, 3.) These at length meet in the centre and form a solid mass, imbedded in which, without any appreciable order,* will be found all the trifacial cells of the capsule (Pl. CXXIV. Fig. IV., 8.)

In the perfect state these secondary capsules are exceedingly numerous, attached by capillary simple pedicels to branches of a central receptacle (Pl. CXXIV. Fig. IV., 3.) They are of a brownish colour, the cells composing them are in one layer, and are separable from each other (Pl. CXXIV. Fig. IV., 6.) Each contains a sub-globular whitish opaque body, with an unequal surface presenting prominent and depressed parts (Pl. CXXIV. Fig. IV., 7.) It can scarcely be considered as organically cellular, although its surface to a greater or less extent appears cellular under the microscope, for pressure destroys this appearance, and it then appears as uniform grume in which are imbedded the trifacial cells. These are of unequal size; some of them can be seen with-

* These lines are presumably unabsorbed or unaltered portions of the original continuous grume.

out using pressure ; they are of unequal size, and of a yellowish brown tinge. Though previously empty they now contain grumous coagula cohering to the sides ; the larger present in addition granules.

The trifacial cells often appear grouped. No oil escapes on pressure, or I should have attributed the superficial cellular appearance (it is altogether like nascent cellular tissue, and its precursion by grume is like this too) to the same cause as the apparent cellularity of the incrustation. In some, abortive trifacials may be seen.

The changes that take place in the larger capsules from the same period, chiefly affect the central sac, which, when detached, will be found to present a similar, but relatively smaller trifacial surface (Pl. CXXVI. Fig. I.,c.) ; at this period this sac is about equal in size to the trifacial cells, visible in the circumference of the grume. But it never has presented to me their empty appearance. Pl. CXXVI. Fig. II.,3, Pl. CXXVI. Fig. I., 5, I., 6.

The next period presented this central sac a good deal enlarged, still apparently isolated ; it is surrounded by a much thinner mass of grume, which from the frequent absence of the radiating* lines, often appears free of attachments. The space between this grume and the inner wall of the secondary capsule is more or less occupied by free trifacial cells (Pl. CXXVI. Fig. I., 3a, 5, 7.) The grume itself on escaping from the capsule will be found to present the trifacial cells, and larger cells, (*parent cells*) exhibiting indications of division. Pl. CXXVI. Fig. I., 9.

The central sac continues to increase : the grume surrounding it to diminish, until it is reduced to a thin coating. Generally about this period the sac has appeared to be attached to the apex of the cavity of the secondary capsule by

* But I have remarked that while the trifacial cells are being imbedded, the trifacial surface is turned to the peryphery. Can this have any reference to germination ?

means of grume ; occasionally traces of radiating lines have been visible. The trilineal mark has mostly appeared to correspond with the attaching mass of grume.

The sac continuing to increase soon occupies the greater part of the cavity of the secondary capsule ; it assumes a yellowish colour ; generally it appears to be freely pendulous, but sometimes traces of radiating lines remain to a latish period.

About the same period I have pretty constantly observed a mammiform process in the cavity of the sac, corresponding to the trifacial line (Pl. CXXVIII. Fig. II., 17.) ; it has a mucilaginous appearance and gradually passes off into a thin layer apparently applied over the whole surface of the cavity of the sac. About this period also, the outer surface of this sac will be found studded with granules, by the increasing deposit of which it becomes at length enclosed in an incrustation. This increases in thickness, presents subsequently three lobes at the apex, in the centre of which is an attaching ? process of the sac (Pl CXXIII Fig 11I., *d, b.*) Its next and last change is to assume a cellular appearance and harder consistency. The cavity of the sac also generally presents appearances of cellularity, the cells seeming to be very irregular in size, and I believe having some connection, at least at first, with the mammilla above-mentioned (Pl. CXXVII. Fig. II., 3. The contents of the sac, however though seemingly so cellular, are scarcely appreciable ; grume only of excessive tenuity escaping under pressure. Soon after this, the yellow sac which has increased in yellowness and thickness, presents a viscid granular matter, not in my opinion organised.

The mature secondary capsule, which is attached to a free central receptacle by means of a short, stout, compound stalk (Pl. CXXIII. Fig. III., *c.*)* presents a cellular papillose surface of a brown colour, becoming hyaline in water ; the component

* The assumption that the more numerous pedicelled capsules are derived from the development of every cell of the surface of the nucleus, while the fewer oblong ones are derived from the development of several cells of the same surface, will explain the difference of their stalks.

cells are separable; it contains a large, single, whitish body of a chalky embossed aspect, without any obvious attachment; this is of an oblong shape, and has a rugose or irregular surface, (Pl. CXXIII. Fig. III.,c.) The upper end, which is rather the smallest, presents three connivent valvular lobes. This white body is the incrustation, it is of a thick, apparently not organic, crustaceous substance. Its lower two-thirds are occupied by the yellow sac (Pl. CXXII. Fig. III. c, b, d.) which is with difficulty separable entire; its upper surface, which on drying becomes concave, presents the trifacial line. This sac is filled with a viscid matter, innumerable granules, and irregular globules of oily fluid. A section in the dry state appears solid (Pl. CXXIV. Fig. I.,3.) A few trifacial cells may still often be found between it and the wall of the secondary capsule.

The mature capsules of both kinds which are almost similar in appearance, appear to become irregularly ruptured (Pl. CXXIV. Fig. IV.,2.) ; they are covered externally with brown rigid hairs, and present at the top a brown striated mark (the original *foramen*;) (Pl. CXXIV. Fig. I.,2.) they consist of two layers, an outer, from which the hairs arise, composed of irregular angular cells of a brown colour, and an inner, thinner, colourless one, united to the outer only along certain lines: this is composed of oblong cells, in which a few greenish mobile granules exist.

Those containing the fewer oblong bodies are the most numerous, and more oblong, they are solitary and always next the axis; therefore if only one capsule is developed it will be of this kind, if more than one, it will be the lowest one.

It will be hence seen that the differences of *Salvinia* from *Azolla* consist in the situation of the organs; in the absence of an indusium or involucrem; in the nucleus being in all developed into secondary capsules, in the early appearance of the papillæ indicating the future secondary capsules, their unequal size and number, (on which so much depends,) and their being all subsequently developed indiscriminately: in

the greater degree of incrustation of the yellow sac, and its three-lobed upper end; and in the absence of the cellular lobes. The development of the smaller, more numerous, secondary capsules of the two may be said to be absolutely the same, the fact of their presenting in *Salvinia* simple pedicels, and a single mass being, at least so far as origin is concerned, of minor importance.

Many points of this communication are nearly untouched, but I have not lately been able to procure either of the two genera in fructification. I have not yet observed any thing in connection with germination; after three months immersion in water neither kind of organ has undergone any change.

There are some points of the above observations which seem to me to call for remark, before passing to the more general ones, which it is the aim of this to establish.

A curious discrepancy to reduce, appears to me presented by the body and its lobes surmounting the yellow sac in *Azolla*.

Analogy perhaps suggests its being of the nature of the masses enclosing the trifacial cells in the other kind of secondary capsules. For not to mention the similarity in appearance between the rather numerous condensed points, visible in the grume surmounting the sac in *Azolla*, with those, in the grumous nucleus of both kinds of secondary capsules in *Salvinia*,* I have seen appearances of their being surrounded by membrane. And it has appeared to me certain that at least more such membranes have been observed than the subsequent number of lobes, although I have seen more than one point of condensation enclosed in one membrane. So that their origin from confluence of several distinct parts, and the enclosure of one at least of the original points in the mass so resulting seems, though perhaps obscurely, to parallel the formation of the masses properly so

* Which would perhaps justify the hypothesis of their being the rudiments of so many parent cells.

called, with which in external appearance and hypothetical capabilities of forming new plants they have something in common.

On the remarkable difference of the yellow sac. etc, in *Azolla* being developed within the nucleus, to the exclusion of the growths round its base, while in *Salvinia* each corresponding sac is developed within a growth or protuberance from the surface of the nucleus, I have nothing to offer. Neither have I any thing to say in explanation of the pedicelled, mass-containing secondary capsules of *Azolla* being developments of the basilar protuberances, to the exclusion of the nucleus itself. It is a remarkable fact, however, that in *Musci* and the vaginulated *Hepaticæ*, the ovulum undergoes no change except in situation, for it forms the extreme tip or point of the mature seta. In *Azolla* something of the same kind occurs, but in a limited manner, an opposite direction and without change of situation; for the nucleus, the part first formed, may be found unchanged in the mature capsule. And we are not in want of instances in which that part of a phanerogamous ovulum, which is first formed and which is a direct extension of the surface from which it grows, remains equally unchanged during the development of the seed.

The first general remark I have to make regards the similarity of the organs in their younger stages to that form of the ovulum of phanerogamous plants, in which the original direction of development is preserved, and which are now generally known by the term antitropous, or more correctly atropous.* And though this simpler form of ovulum is not always peculiar to particular families and not invariably even

* Although the difference between the development of the vegetable carpel leaf and vegetable ovulum is in general sufficiently apparent, an exception has appeared to me to be presented by *Naias*, in which the future pistillum seems to be derived from an annular growth round a central body, which subsequently becomes the ovulum!!

to particular genera among Angiospermous plants,* yet I believe it is characteristic of those plants called Gymnospermous, in which the ordinarily convolute carpel leaf is expanded or in which the ovulum is supposed to be a direct continuation of the axis.

The similarity contended for will scarcely be denied at least to *Azolla*, in which it is extended even to the relations of the vascular fascicles with the base of the nucleus. In both, as in all ovula, the nucleus is first formed, and is afterwards gradually enclosed by the growth of an integument, at one period a mere annulus round its base.†

I do not conceive the very early papillose state of the nucleus in *Salvinia* to weaken the similarity. For in the first place this indication of division is scarcely aboriginal, and I do not consider a nucleus with a similar surface unlikely to

* *Nepenthes*.

† The other instances in which a similar structure might exist among the higher Acotyledones are *Chara*, such forms of Ferns as *Deparia*, some *Cyathæ* and especially ? *Hymenophyllum* and *Trichomanes*.

In *Chara*, in which there is also a similar but more constant disposition of the two difform organs, the first objection presented is that the integument, within which the nucleus becomes included, is not a continuous development from round its base, but from as many points as there are subsequently spiral tubes. The growths of distinct cells from the apices of these form what has been considered by some the stigma. But I have not observed any thing like the usual subsequent development; nucleus itself appearing to become the germinating body, that is the membrane enclosing the amylaceous granules. In this genus the degree in which both organs represent the axis of the plant itself, is carried perhaps to a greater extent than in any other.

So far as I have yet seen there is nothing in common between the supposed male of *Chara*, and the supposed males of these plants. But there is an analogy between the twisted filaments it contains and the assumed male organs of *Azolla*, and of many other of the higher Acotyledonous plants.

The structure of the germinating organs, and of the growing points of the stem and its branches appears to me to shew that *Chara* cannot be generically separated from *Nitella*, of which it is merely a more developed form.

be found in a phænogamous ovulum, in connection with a plurality of embryo sacs, in which case the similarity will be mainly increased.

If the comparison is drawn between the organs of *Azolla* and the ovula of certain Gymnospermous plants at a later particular period, we find the resemblance to be increased by the occupation of that part of the interior of the ovulum, or body, between the foramen and the apex of the nucleus, by a number of grains derived from without.* This circumstance in Gymnospermous plants is explainable by the external relations of the ovula being so much more direct than in Angiospermous plants. And the same may be said of *Azolla* (and *Salvinia*) if they are compared with pistilligerous Acotyledones.

I have here set aside the nature of the grains found in the ovulum of *Azolla* for the sake of exactness, but there are presumptive evidences that the analogy may be extended to the functions of the grains themselves.

The evidences in favour of fecundation are, I think, as strong as they are in Musci and Hepaticæ, in which I derive them from the breaking up of the tissue terminating and closing the style (subsequently to the application of a particular matter,) whereby the style becomes a canal opening exteriorly; from the browning observable in the orifice of this canal extending downwards until it reaches the cavity of the ovarium, and from the corresponding enlargement of the cell (*ovulum*) existing in that cavity.† In *Salvinia* the appearances as closely resemble the above as is compatible with the difference in the organs themselves. The supposed fecundating matter has appeared, at least after it has come in contact with the female organ, to be much the same.

* For instance *Cycas*; I have drawings illustrating this, made in 1835.

† Such are the appearances that have been presented to me by examination of *Phascum* and *Funaria*; by Mr. Valentine however neither the opening of the apex of the style or the browning is supposed to be in any way connected with fecundation.—Linn. Trans. xvii. p. 466-67.

In *Azolla* the evidence consists in the derivation of the grains from without, on the browning of the foramen after the appearance of the grains within the ovulum, and on the subsequent new growths presumably excited into action thereby, and their direction, which proceeded from the point next the point of application of the supposed fecundating influence.*

I am not willing to omit an analogy with Phanerogamic fecundation derived from the apparent inaptitude of the means to the end. It has always appeared to me remarkable by what means a tube of such tenuity, of such flexibility, and with such an obtuse point as a pollen tube can not only get at the nucleus, but overcome the resistance presented by its solid tissue so far as to penetrate it to a certain, and often

* Assuming fecundation to take place in *Azolla* and *salvinia*, there will be, I think, three modifications at least of this phenomenon among the higher acotyledonous plants. In one the male influence is applied to the apex of the pistillum, in the second to the nucleus without the intervention of a pistillary apparatus. In the third the male influence is exerted on the frond itself, and is followed by the development of the young capsule from a point in the substance of the frond corresponding to and sometimes distant from the place to which the male influence has been applied.

This is founded on observations made on *Anthoceros* in 1836, from which it would appear that the place of exertion of the future capsules is pointed out by a slight protuberance, over the apex of which a flaker of matter like the male matter of *Musci* and *Salvinia* is spread, sending down to some distance within the frond and tube-like process which causes the dislocation of the cells of the tissue with which it comes into contact.

The future capsule is stated in my notes not to be appreciably pre-existent, and its situation, which is exactly under the line of direction of the descending process, above mentioned, is only pointed out by a bulbiform condensation of the tissue of the frond. The young capsule during its development ascends along the same line, and pushes before it a corresponding cylindrical body of the tissue of the frond, the calyptra of authors.

I have never since had an opportunity of verifying these observations which, if correct, may I think prove of some importance.

not inconsiderable a distance. Of this apparent insufficiency Azolla has a considerable a distance. Of this apparent insufficiency Azolla has a considerable share; yet the access of the grains to the inside of the ovulum appears certain.

Difficulties however are at present offered by both genera. In *Salvinia* there are three kinds of bodies, which might be assumed to be the male organs: one found on the stalk of the ovula, the second on the capsules, the third on the roots.

Of these the second kind (Pl. CXIX. Fig. I.,3.) appeared precisely like the moniliform filaments of *Azolla*, but was only observed once, and on a somewhat advanced capsule. The second kind was observed constantly and in plenty. They vary somewhat, some the male organs of Hedwig. (*Theoy. Gen. et fruct. Plant. Crypt.* Pl. 105. t. 8. f. 2, 3.) having rather long joints containing granules; others nearest the ovulum (Pl. CXIX. f. VI.) having shorter joints, each containing a nucleus immersed in a brownish fluid. Those on the roots, are also constant and in plenty: they resemble those on the stalk of the ovulum, figured by Hedwig. The granular contents are first developed in the terminal cell, and thence downwards; each joint becoming at length quite crammed with granules, some of which are often of a large size. They then lose more or less of their previously very active motion. These radicular filaments have the same reference to those containing granules found on the stalk of the ovulum, that the radicles themselves have to the brown hairs of the same part and the capsule.

But it is from the assumed action of those containing a nucleus and brown matter, that the appearance of the matter found adhering to the previously clean foramen, (and which looks like the fecundating matter of *Musci* and *Hepaticæ*) will be perhaps best explained.

I should not however, omit remarking that in such submerged parts of a plant, as these of *Salvinia*, deceptions might arise from the adhesion of foreign matter to a greater degree than would be likely to occur in many *Musci* and *Hepaticæ*.

In *Azolla* the *chief* difficulty I think is presented by the absence of such a developed form of anther as might be expected to accompany so developed a form of pollen grain.* So much so, that each joint of the moniliform filaments, or each grain as found in the ovulum, is not distinguishable from the simplest forms of pollen grains, which I take to be those in which no outer integument is developed, as in *Naias*, *Zanichellia*, etc. and which are consequently simple membranous bags or sacs. The chief† discrepancy is that the grains of *Azolla* do not undergo any elongation in the performance of their supposed functions as appears to be universally the case in phænogamous plants, even in those in which the pollen grain is bodily received into the nucleus:‡ and contrariwise no growth, beyond mere extension, has

* In order to reduce the usual acotyledonous form of anther to the type of the same organ among phanerogams, I have often speculated on the probability of each anther being a pollen grain. But they have an organic connection with the plants to which they belong, their structure is different, and they generally dechisce. These are all strong objections particularly when it is considered that if these anthers be pollen grains they represent the inner membrane of ordinary pollen.

But the difference is not unadjustable in my opinion, if the anther of Mosses is compared with the very young phænogamous anther, at that period when the grume, from which the mass in which the parent cells are developed originates, is so fluid that pressure causes an escape of minute fovillar matter not unlike the contents of the anthers of Musci.

† I do not mention their organic connection with the plant, because that may be the consequence of their not being provided with a proper protecting organ. It is besides at the most only very partial, and it is not greater than that occurring in many forms of supposed anther among these kinds of plants; i. e. where the anther consists of a cell terminating a stalk of a single row of cellules, to which type the male organ of *Azolla* and *Chara* are easily reducible. For any difficulty that might be objected to the attributing fecundating powers to each component cell (not exclusively to the terminal one) becomes lessened by the remarkable form of the male organs of *Drepanophyllum* and certain *Neckeræ* and *Syrhopodon*.

‡ e. g. *Cycas*.

been observed in phænogamous pollen exterior to the ovulum.*

It is scarcely, however, to be expected that analogies, producible through every stage of any particular process in plants very much differing in general organization, should be found ; so I do not lay stress upon the possibility of the elongation, just referred to being reduced to such an almost inappreciable amount as might perhaps occur in a Gymnospermous ovulum with exerted embryo sacs.

A difficulty may also be considered to be presented by the existence of the hairs round the base of the ovula. For these in their structure resemble what I suppose to be the male organs of Fern, and also the anthers of certain Mosses and Hepaticæ ; although the terminal cell presents less granular matter than usual.

In the respect of the supposed males, *Azolla* presents greater analogies with phanerogamous plants, than either *Musci* or *Hepaticæ*, in which nothing analogous to pollen grains has been, I believe, yet observed in the anther ; which again can scarcely in all cases be considered a grain of pollen, the view suggested by the contents. Still even with the objections before mentioned the analogies are as tenable I think as those existing between the pistilla of Mosses and of phanerogamous plants ? those organs in the former being originally closed, in the latter, theoretically at least, originally open.

General objections may be raised from the fact of monili-

* A remarkable circumstance was observed once or twice in some of the joints of the moniliform filaments, while attached to the axis. Some of them were a good deal enlarged, of a yellow green tint, with a nucleus towards either end, or with only one near the base when the enlarged joint happened to be the terminal one. Others near the terminal ones had become divided into two by a line cross the middle, the two cells thus resulting being broader and more beadlike than before. In some others again close to either end was a small nucellus, which corresponded with the contiguous nucelli of the neighbouring joints : and near each nucleus was observed the shadowing out of a large cell.

form filaments similar to those of *Azolla* having been found on the capsule of *Salvinia*, unconnected apparently with fecundation, and on the dissimilarity of the supposed fecundating process in the two genera.

These observations, although they appear to me to indicate the existence of sexes in *Azolla* and (*Salvinia*) as strongly as in *Musci* and *Hepaticæ*, (in which they are admitted by the best botanists), do not bear out in any way the ideas hitherto entertained by botanists regarding the sexual organs of the two genera in question. For independently of the organs being the same in structure up to a comparatively late period, they are both submitted to the action of the same agent determining their subsequent development; that development is continued contemporaneously; they separate contemporaneously, and without either having undergone any particular change. So that if they be male and female, the action of the one on the other does not take place while they are attached to the axis.

There appears to me absolutely nothing in the structure of the supposed male to suggest its performing the functions of that sex. I believe that in cases of the known male organs of vegetables the (active) contents are homogeneous, the functions ephemeral. Dr. Martius (*op cit p. 127*) is of opinion that the lobed bodies have nothing of the characters of antlers, and that the whole contents form the rudiment of a young plant, grounding this opinion on the similarity of the sac or visicle with the nucula of *chara* and *Marsileaceæ*. But it is remarkable that he considers the masses of the other secondary capsules, which are solid bodies, to have the closest analogy with pollen grains, and therefore he alludes to his having observed them adhering firmly to the calyptrate capsule.

An argument in favour of their being male organs is derivable from the development, which appears to be that of the pollen of phænogamous plants. But this holds good to a greater degree in the development of the contents of the sup-

posed female, as well as in that of the acknowledged spores of some other acotyledonous families, in which nevertheless the evidence in favour of sexes is acknowledged to be the most complete. The same argument, so extended as to include both kinds of bodies, may be advanced. In this case they will enter the hypothesis of Mr. Valentine,* which must, however, to be consistent with analogy suppose the absence of sexes in all Acotyledonous plants. This I think difficult to do, and while I fully agree in the remarkable similarity between pollen and spores, it is to be borne in mind, that whereas pollen is the result of a simple separation constituting a primary and independent process; in Musci, Hepaticæ, Salvinidæ, the spores, otherwise so similar to pollen, are the result of a secondary process, dependent on a primary one which appears to be remarkably analogous* to phanerogamic fecundation.

Among the peculiarities of the development of the spores I may mention the comparative obscurity of the parent cells, which in all other similar plants examined by me have been obvious enough especially in Isoetes and Marsilea, the spores being visible enough in the parent cells, within which their outer coat even becomes developed. In these plants however it is so obscure, and the separation takes place at such

* Linn. Trans. xvii. p. 489, 481; xvii. p. 502.

† The identity of the spores of Acotyledonous and the pollen of Cotyledonous plants is perhaps strengthened by the curious resemblance of the fructification of Equisetum to the male apparatus of Cycadææ; in which also the pistillary apparatus, in this view to be looked on as a sort of nidus, is of great simplicity.

Mr. Valentine's account was read before the Linn. Socy. in 1833, and appeared in 1837. M. Schleiden's was extracted in the Lond. Edin. Phil. Mag. from Weigmann's Archiv. für Zoologie, pt. iv. 1837 The similarity between the observations of the two is remarkable, and gives the hypothesis great importance. M. Schleiden has however an advantage in my opinion from considering the embryo to be a growth of the ends of the pollen-tubes, and from acknowledging the difficulties presented by Musci, Hepaticæ and Rhizocarpeæ.

early period, and apparently so rapidly, that for some time I was almost reduced to consider the trifacial cells, as parent cells, each containing 3 spores in a state of extreme contiguity. In no instance did I observe the parent cell of the central sac, (subsequently the yellow sac,) or its companions. And although I have examined many instances, yet in none did I find the usual relations continued, that might have been expected as long as the trifacial cells remained imbedded in grume. So much so, that for a second time I was almost reduced to look on them as parent cells.

The great development of a particular spore of a particular capsule, and the corresponding abortion of all the rest, is a second peculiarity. This, which has not been observed in Musci, Hepaticæ, or Filices, occurs in a marked degree in Marsilea* and Pilularia;† and there is also a tendency to it,

* A second examination of marsilea has not presented to me any thing corroborative of M. Fabre's statement. So far as the development of the two difform bodies (*capsules*) themselves is concerned, there is manifest agreement with Pilularia, Salvinia, and Azolla. The germinating body is equally derived from the excessive development of a single spore of one capsule, and the abortion of the rest. The other capsules contain spores in a state of uniform development, forming the supposed pollen of some Botanists,

Marsilea evidently appears to connect Salvinidæ with Filices; its important difference from Salvinidæ consist in the capsules, which correspond to the secondary capsules of that family, being developed within the substance of a modified leaf, in their occurring mixed with each other, and in the spores of the pedicellate capsules not becoming imbedded in apparently cellular masses. I have not observed anything indicating fecundation.

† Mr. Valentine, (Linn. Trans. loc. cit.) appears to have no doubt of this in Pilularia. M. Endlicher* think it may be so in Salvinia, and makes it part of his generic character of Pilularia and Marsilea, (op. cit. p. 68,) at least so far as the term sporangia abortiva may be considered to indicate abortive spores.

But I think their great comparative number, at least the equal development of their capsules in Salvinia and Azolla, their appearance, and

* Gen. P. p. 67, in annot, in Salvinia.

though not confined to different capsules, in *Isoetes* and *Psilotum*. And this, to which the dissimilarity of the mature reproductive organs is mainly attributable, thus becomes so general, that it obviously relates to something important, and will probably be found to exist in particular portions of the families just mentioned as exceptions.

Mr. Valentine,* was so far as I know, the first who distinctly attributed this want of uniformity to abortion, an opinion which appears to be correct to some degree at least.

The anomaly observable in the numerous spherical pedicelled secondary capsules, through the previously free spores become enclosed in cells, which subsequently partly or entirely coalescing form solid masses, in which the spores are then imbedded, is, I think, very remarkable.

The appearance, however of these cells, which exist in both genera, and which seem to be developed from the inner surface of the secondary capsules, either corresponding to and enclosing several spores, or at least as in *Salvinia* occasionally arising opposite single ones, is not organic: it is that of the mammilla of the yellow sac. The young masses indeed are like it elastic, and it is evident that there is neither a common nor a partial membrane.

It is difficult to believe that these masses are abortive developments, particularly when the appearance of grume or molecules in the imbedded spores, and the obvious hypothetical capability of growth of the masses is considered. Direct observation on this head is required and if it be found that they do produce young plants, and that the growths take place from more than one of the imbedded spores, an analogy may become presented to pluri-embryonate Gymnospermous plants.

their subsequently containing granular matter, objections to this, though none of them can be considered conclusive. Still it is not to be denied, that if compared with the mature spores of *Filices*, *Musci*, *Hepaticæ*, in all which the spores have hitherto been found uniform, they exhibit an apparently imperfect state of development.

* Valent, Linn, Trans. 49I, 497, t. 35, f. 34, 35, 36.

I know of no parallel instances to the lobes surmounting the yellow sac in *Azolla*, and especially the tissue, which on being pulled separates in the form of radicels. There are reason, as I have stated, for supposing the lobes themselves to be modifications of the spores, and comparing the early number of nuclei or points of condensation with the mature number of the lobes, the opinion becomes suggested, that these receive their developments at the expense of others. However this may be, their analogy with the solid masses of the spherical pedicellate secondary capsules appears sufficiently obvious. They are not in any way to be referred to the incrustation, which does not, I think, become organised; and which moreover, appears somehow or other connected in every instance with the difformity of the organs.

In conclusion it appears to me sufficiently plain, that in the higher Acotyledonous plants, in which I include Filices, Lycopodineæ, Isoeteæ, Equisetæ, Marsileaceæ, Salvinidæ, Musci, Hepaticæ, Characeæ, there are at least two modifications of the female organ representing the modifications of the same organ of Cotyledonous plants.

The term *Pistillum* has been applied to the female organ of Mosses by some first-rate Botanists, though not without violent opposition from others. Since the examination of *Balanophora*, its application is, if possible, still more legitimate. In my opinion it is not to be doubted, that not only have Musci and Hepaticæ a pistillum, but that this contains an ovulum.*

The analogies presented by the plants which form the subject of this communication, to those Cotyledonous plants in which the ovulum is entirely naked, either, as is supposed to be the case in some, without a carpel leaf, or with that organ in an expanded not a convolute state, are I think equally striking,

* See also Mr. Valentine, Linn. Trans, xvii, p. 466, 67, t. 23, f. 1 2, 6; where it is stated, that the development of the capsule depends on the presence of the cell (or ovulum) in the pistillum.

It may be worthy also of remark, that in proportion as Acotyledonous plants become, so to speak, less pistilligerous, their vegetative organs appear to be more developed. This is evident if a Fern be compared with a Moss. And it seems to be so closely followed up, that *Salvinia* which has less, perhaps, of the atropous phænogamous ovulum than *Azolla*, has its organs of vegetation considerably more developed.

FAMILIA.—SALVINIDÆ, *Bartl.*

Pars Rhizospermarum. Roth. D. C. Rhizocarpearum.

Batsch. Marsileacearum, Br.

Plantæ natentes, ramosæ. *Rodices* plumosæ. *Folia* opposita,* pagina supera papillosa. *Organa mascula*; pili articulati pedicelli ovuligeri? vel filamenta moniliformia partium novelarum. *Organa feminea*; Ovula atropa, (submersa), solitaria vel per paria. *Capsulæ*† submersæ, apice micropyle notatæ, *aliæ*‡ (infima cujusque paris vel racemi) includentes saccum§ luteum, vel plures, (et tunc singuli in capsula secundaria reconditi,) materie granuloso-viscosa, oleaginoso farctum et incrustatione e maxima parte tectum. *Aliæ* (superiores cujusque paris vel racemi) continent capsulas secundarias|| OO, globosas, pedicellos simplices terminantes, singulis includentibus *massam*¶ (vel *massas* 2-3) aspectu cellulosam, in qua *sporæ* immersæ.

* The leaves are not quite opposite in *Azolla*: this combined with the obvious conduplicate veneration of these organs in *Salvinia*, inclined me to believe, that they were bilobed in *Azolla*; a conduplicative veneration would then explain their situation. But their development is opposed to this, as also their opposition in *Salvinia*.

† Calyx. Schreber. Indusium. Willd. Mart. Fl. masculi et fæmtnæ. R. Br. Receptacula. Sprengel. Organa propagatoria. Mart. Endlicher.

‡ Flos. fæmineus. Schreb. Fl. Masc. R. Br. Meyen. Organ. masc? et fæminea. Mart. Endl. Indusium. Calyptra. Mart. Endlich.

§ *Gongylus*. Mart. Vesicula basilaris. Endl.

|| Fl. Masc. Antheræ. Schreb. Fl. Fæm. Meyen. R. Br. Capsulæ partiales, R. Br. Mart. Organ. fæm: masc. Sporangia. Mart. Endl. Indusia Mart. Meyen. Globuli. Endl.

¶ Semina Br. Grana. Endl. Granula Mart.

SUB-FAMILIA.—SALVININÆ.

Radices verticillato-fasciculatæ, nudæ. *Folia* opposita, integra petiolata, pilis articulatis superne vestita, veneratione induplicato. *Organa mascula* ? pili* simpliciter articulati siti in pedicellum ovuli. *Ovula* terminalia, nuda, solitaria. *Nucleus* celluloso-papillosus. *Capsulæ*¹ aliquando solitariæ, sæpius in racemum terminalem dispositæ; *infima*² cujusque racemi, (vel terminalis si una tantum evolvitur) continens capsulas secundarias³ 6-18 oblongas, insidentes in receptaculum centrale. *Saccus*⁴ incrustatione apice triloba omnino inclusus. *Capsulæ alie superiores* capsulas secundarias⁵ 00, globosas, n receptaculum centrale⁶ ope pedicellorum capillaceorum⁷ affixas recondentes. *Massæ*⁸ solitaria.

SALVINIA.

Mich. Nov. Gen. p. 107. t. 58. Aublet. Pl. Guian. p. 969. t. 367. Linn. Gen. Pl. ed. Schreb. p. 753. No. 1617. Juss. Gen. Pl. p. 16. Lam. Enc. Meth. t. 863. Flore Francaise. D.C. et Lam. 2. p. 579. Mart. Pl. Crypt. Bras. p. 128. t. 76. 75. II. Endl. Gen. Pl. p. 67. No. 689.

CHAR: GEN:—Character Sub-familiæ.

Superficies infera et immersa pilis brunneis subulatis vestita. Radices sessiles in cauli vel circa apicem rami ovuligeri. Capsulæ subrotundæ, irregulariter dehiscentes, parietibus bilamellosis, lamella interna exteriori secus lineas longitudinales paucas tantum adnata. Crusta sacci cretaceo-albida.

* These curious filaments have in some respects a centrifugal development: the cells of the base, or next the axis, being the least developed as regards number of granules. These, which are very irregular in size, are exceedingly mobile. The action appears to cease at last from want of room, for the cells become literally crammed with the granules.

- 1 Receptacula. Spr. Fructus. Mich. Fœm: flores, Germinia, Aubl. Indusium, Mart.
- 2 Flos fœmineus. Schreb. Indusium, Mart.
- 3 Germinia, semina. Schreb. Sporangia. Mart. Endl.
- 4 Gongylus, Mart. Spora, Endl.
- 5 Flores masculi. Indusium, Mart. Anthere. Schreb. Sporangia. Mart. Fl. masc. ? Globuli. Endl.
- 6 Columella. Schreb.
- 7 Filamenta, Schreb.
- 8 Granulum, Mart, Materies mucilaginosa. Endl.

HABITUS *Lemnaceo-Pistoideus*.

Characteres specierum forma foliorum, dispositione et numero papillarum, situ radicum, et numero et dispositione capsularum deducendi.

S. verticillata, foliis parallelo grammico-oblongis subpan-duriformibus canaliculatis, pilis ternis vel quaternis papillas (conicas) superficiei terminantibus,

S. verticillata, *Rozb. Crypt. Pl. Cal. Jour. Nat. Hist.* IV. p. 469.

HAB.—Stagnant waters. Bengal.

DESCR.—Floating, sparingly branched. *Stem, stalks* and *undersurface* of leaves thickly covered with stout subulate brown hairs, the terminal cell of which is suddenly attenuated. *Leaves* parallelogrammic-oblong, constricted about the centre so as to be sub-pan-duriform. channelled down the middle. *Hairs* in threes or fours arising from conical papillæ of the surface: terminal cells brownish, withered-looking.

Roots terminating, short descending stalks, generally about 12, disposed in two series around the lower reproductive organ, which occupies the centre. Mixed with the radicles, especially in the young parts, are articulated colourless filaments, the component parts of which contain unequal granules.

Male organs? articulated hairs on the stalks of the ovula; each joint containing a nucleus and a brownish fluid.

Ovula nearly sessile concealed by the roots, and partly covered with hairs. *Tegument* open at the top.

Mature reproductive organs solitary, or in racemes of 3-5, about the size of a pea, covered with brown rigid hairs. The upper ones of each raceme, (or lowest as regards general situation,) contain innumerable spherical bodies, of a brownish colour, and reticulated cellular surface, terminating capillary simple filaments. These again contain a solid whitish opaque body.

The other, which occupies the lowest part of the raceme. and which is the first and often the only one developed, is more oblong, containing 6-18 larger, oblong-ovate bodies on short stout compound stalks: colour brown, surface also reticulated. Each contains a large, embossed, opaque, ovate, free body, of a chalky aspect: it

is three-lobed, at the apex, and contains below this a cavity lined by a yellowish membrane, filled with granular and viscid matter and oily globules.

S. cucullata, foliis subreniformibus in cucullum conduplicatis, pilis solitariis e superficie ipsa exorientibus.

S. cucullata. Roxb. *Crypt. Pl. Cal. jour. Nat. Hist.* IV. p. 470.

HAB.—Stagnant waters. Bengal. Tenasserim Coast.

DESCR.—Much branched. Under-surface covered with brown hairs. longer and with a less suddenly attenuated terminal cell. Joints of the stem short, so that the leaves are all close together. Roots springing directly from the stem, about 15. leaves on short stalks, subreniform in outline, so folded together that the margins of the base are in contact. Hairs of the surface solitary, springing immediately from the surface; terminal cells with the same curious withered appearance. *Fructification* not observed.

Obs.—This species I take to be comparatively less developed than the preceding, founding my supposition chiefly on the fact, that the leaves partly represent the immature state of the same organs of *S. verticillata*.

Sub-FAMILIÆ.—AZOLLINÆ.

Radices solitariæ, basi vaginatæ, apice calyptratæ.* *Folia* imbricantia, inferum immersum membranaceum. *Organa mascula*; filamenta moniliformia in partibus novellis caulibus et ramorum. *Ovula* per paria cauli affixa, in *invulcro* e foliis

* The calyptra of the roots of *Azolla* has probably been considered to be the torn-up end of the sheath surrounding the base of each root, which can scarcely have escaped observation. But it is quite a distinct organ; the sheath at the base is perforated at its apex by the young root, while the calyptra appears to be a separation of its cutis, due to the development of a radicle from each cell of the subjacent tissue.

In this respect it has another curious analogy with *Lemna*, of the sheath and calyptra of which I was aware in 1836, long before I saw M. Schleiden's paper on *Lemnaceæ*.

contigui lobo membranaceo derivato abscondita. *Capsulæ* ¹ involucri inclusæ, sessilibus; paris difformis inferior,² oblonga, demum circumscissa continens *Saccu* ³ (luteu) e maxima parte incrustatione inclusum, vertice coronatum *corpore* ⁴ centro cavo, apice explanato cum *capsulæ* apice cohærente, divulso radiculoso fibroso, superficie divisæ in *lobos* 3 vel 9 ⁵, quorum 2 superiores (majores), 6 inferiores; corpus totum in membranam nuclearem (*capsulam* secundariam) inclusum. *Capsulæ* alterius ⁶ *capsulæ* secundariæ *massas* ⁷ 2—3 faciebus contiguis radiculigeras continent.

AZOLLA.

Lam. Enc. Meth. 1. p. 343. t. 363. *R. Br. Prod. Fl. Nov. Holl. edn.* p. 2. 22. *App. Flinders. Terra Austr.* 2. p. 611. t. 10. *Mart. Pl. Crypt. Bras.* p. 123. t. 74. 75. *I. Meyen. Nov. Act.* 18. p. 523. t. 38. *Endl. Gen. Pl.* p. 67. No. 688.

Salvinia, *Juss. Gen. Pl.* p. 16.

Rhizosperma. *Meyen. op. cit. loc. cit.*

CHAR. GEN.—Character Sub-familiæ.

If the foregoing supposition be correct, those species of *Azolla* alone, that have radicles either plumose throughout, or to a greater or less distance from the apex, will present *this* calyptra. *M. Meyen* does not notice any such calyptra in his account.

1. *Organa propagatoria* *Mart. Endl. Meyen.*
2. *Fl. Masc.* *Meyen. Endl. ? R. Br. Calyptra. Eart Endl. Indusium. Meyen.*
3. *Dimidium inferius. Loculus inferior. R. Br. Nescula. Mart. V. basilaris. Endl. Vesicula spherica Meyen.*
4. *Dimidium superius. Loculus superior. R. Br. Axis tricurris. Mart. Columella tricurris: Endl. Axis triangularis. Meyen.*
5. *Antheræ. R. Br. Meyen. Corpuscula. R. Br. Mart. Corp. antheriformia. Endl.*
6. *Involucrum interius. R. Br. Indusium. Mart. Indusium exterius. Meyen. Capsulæ. Capsulæ partiales R. Br. Sporangia. Mart. Endl. Sporangia. Indusium interius. Seed-holder. Meyen.*
- 7 *Seminia R. Br. Granna. Mart Endl. Granula Meyen.*

* *Americanæ. Radices* simplices. *Lobi corporis* (capsulæ calyptratim dehiscentis) 3, pyriformes. *Massæ* (capsulæ secundariæ pedicellatæ) 6.9, globosæ, subcompressæ, margine pilis* glochidiatis instructæ.

** *Asiaticæ. (Rhizosperma. Meyen. op. cit. p. 523) Radices* partim vel omnino plumosæ. *Lobi corporis* (capsulæ calyptratim dehiscentis) 9, angulati, (3 superiores majores, 6 inferiores.) *Massæ* (capsulæ secundariæ pedicellatæ) 2-3, extus convexæ, intus concavæ et processibus radicelliformibus 3-4 instructæ.

Superficies *infera immersa glabra. Ovula basi processibus paraphysiformibus stipata. Capsulæ rubro plus minus tincta, parietibus simplicibus; inferior (paris difformis) oblongo-ovata, superior subglobosa, superficie rugosa. Sacci lutei tegumentum nigro-sanguineum.*

HABITUS *Jungermannia*.

Affinitates incertæ. Analogiæ cum Gymnospermis phanerogamicis et Lemnaceis.

A. pinnata, circumscriptione triangulari-pinnata, foliis superioribus papulosis, radicibus longitudinaliter plumosis.†

A. pinnata, R. Br. Prod. p. 23.

Salvinia imbricata, Roxb. Crypt. Pl. Cal. Jour. Nat. Hist. IV. p. 470.

A minute floating plant with the habit of *Jungermannia*. *Stem* so branched, that the general outline of the whole plant becomes triangular. *Roots* solitary, arising from the stem at the origin of each branch, plumose throughout their whole length, tipped by a *calyptra*, and surrounded at the base by a short *sheath*, which may be mistaken for one of the circumscribed capsules.

* The situation and structure of these hairs require I think further examination. As regards the first it appears to me, that whether scattered over the whole surface, or only along the margin, they would be visible while contained in the secondary capsule, yet neither Martius nor Meyen represent them as being so. And as regards the second, the hairs of *Azolla pinnata* do not appear to me organically cellular.

† Char. ex. immort. Prodr.

Leaves opposite, so close together as to become imbricated, especially the lower membranous ones, entire, obliquely ascending thick, fleshy, outer surface covered with stout whitish papillæ of a single somewhat conical cell, the oldest ones rather the smallest, upper ones more or less trapeziform. *Under* ones quite membranous, hyaline, larger, nearly reniform, with a tendency, especially in the young ones, to have the points incurved; these are composed of a single layer of cellular tissue.

The growing points especially, present a number of minute confervoid filaments, the assumed *male organs*, which at certain periods may be seen passing into the foramen, the ovula becoming resolved into their component cells within the cavity of that body.

Organs of reproduction in pairs, attached to the stem and branches, one above the other, concealed in a membranous involucreum. *Ovula* atropous, oblong-ovate, with a conspicuous foramen and nucleus, around the base of which are cellular protuberances.

Capsules of each pair either difform—in which case the lowest one is oblong-ovate, the upper globose—or both of either kind, generally perhaps the globose, presenting at the apex the brown remains of the *foramen*,* and still enclosed in the *involucrum*. Upper half generally tinged with red.

The oblong-ovate capsule opens by circumcission; with the apex separate the contents, which consist of a large yellow sac contained in a fine membrane, the remains of the nucleus (or the secondary capsule.) The sac is filled with oleaginous granular fluid, and surmounted by a mass of fibrous-tissue, by which it adheres slightly to the calyptra; on the surface of the fibrous tissue are 9 cellular lobes (the three upper the largest), which when pulled away, separate with some of the fibrous tissue, and so appear provided with radicles.

* See also Martius, t. 74, f. 10, and Meyen f. 23, for the apex of the round capsule containing the pedicelled secondaries.

M. Meyen indeed says, his figure is a representation of the base of this organ, his common indusium; but this is probably a mistake. For the mere punctum in the centre is too small an indication of a rather large hilum, and the disposition of the cells and whole appearance is that of the apex.

The globose capsule has a rugose surface from the pressure of the secondary capsules within; these are many in number, spherical, attached by long capilliform pedicels to a central much branched receptacle; each contains two or three cellular masses, presenting on their contiguous faces two or three rediciform prolongations. In their substance may be seen inbedded numerous yellow grains, the spores.

The genus *Azolla* was founded by M. Lamark,* on specimens without fructification brought from Magellan by M. Commerson. M. Jussieu,† as I have stated, considered it a congener of *Salvinia*.

Willdenow‡ who quotes Lamark, describes the fructification as “capsula unilocularis radicalis globosa polysperma?”

It was first accurately defined by Mr. Brown in his *Prod. Fl. Nov. Holl.* ed. 2, p. 22, and subsequently in the Appendix to Flinders' Voyage to Terra Australis, vol. 2, p. 611, t. 10, in which it is worthily illustrated by that great observer, Ferdinand Bauer. M. Meyen observes of these illustrations, that they are so wonderfully complete, that repeated examinations since have made scarcely the least addition to what is therein represented. To this I may add, that M. Bauer has even delineated the trilineal mark on the yellow sac, which in itself is quite sufficient to shew the real origin and nature of that body.

It was again described and figured by Martius,|| from American specimens.

It has been observed in an original manner by M. Meyen,¶ and also by M. Rafinesque, but I have no access to his account.

The character framed by Mr. Brown, leaves as usual, little or nothing to be desired. He considers the capsule con-

* Enc. Meth. 2, p. 343, t. 863, and Suppt. 5, p. 567.

† Gen. Pl. 5, p. 17.

‡ Sp. Pl. 5, p. 541.

|| Pl. Crypt. Bras. p. 123, t. 74, 75, f. 1.

¶ Nov. Act. Acad. 18, p. 507, t. 38.

taining the yellow sac, etc., to be the male: the other capsule, *i. e.* that containing the pedicelled spherical secondary capsules, the female. Of the two cited characters, if I may presume to judge, I prefer that of the *Prodromus*. That of the Appendix to Flinders presents some modifications, the most important of which appears to be the substitution of "*Involucrum interius*" for "*Capsula communis*," which latter term is, I think, very happy. Another regards the substitution of "*corpuscula*" for "*Antheræ*?" unaccompanied however by any increased doubt of their being the male organs. For this alteration may perhaps be taken as indicating, that though sexes may be present, yet the male must not necessarily be an antheriform body, which some writers would seem to have insisted on.*

By Martius the pedicellate spherical secondary capsules are called "*sporangia*," their contents "*grana*," and the capsules themselves "*indusia*."† these he considers doubtfully the females. The others which he considers with equal doubt to be the males, he describes to consist of a "*calyptra*," subsequently circumcised, containing a "*vesicula*," on which is placed a three-legged axis bearing semi-immersed "*corpuscula*," and adhering to the apex of the calyptra. The "*grana*" or contents of the spherical secondary capsules are stated to be furnished with hairs,‡ but this appears only to apply to the American species.

The principal aim of M. Meyen's account is to establish a generic difference between the American and Asiatic species, but the genus *Rhizosperma*, intended to contain the Asiatic species, has not been adopted. The principal points to be noticed in regard to the fructification are his considering (with Mr. Brown,) the calyptrate capsule to be the male organ, and the globular capsule containing the pedicelled se-

* Lindl. *Introd. Nat. Ord.* p. 407, extr. *Mem. Wern. Soc.*

† His synonym "*involucrum, R. Br.*" should have been "*involucrum interius*;" it has no application to the character in the *Prodromus*.

‡ See t. 75, f. 14, 18, 19.

condary capsules to be the female; his not having been able to ascertain the presence of the yellow sacs, each containing four bodies, figured by Martius in the contained masses, (his seeds); and his stating that the root-like prolongations are confined to their flattened edges, and not, as represented by Martius, scattered over the whole surface. M. Meyen's inner calyptra of the male is the nucleary membrane? M. Meyen mentions the original nucleus of the capsules containing the pedicellate secondaries, as a pestle-shaped body, terminating the column to which they (his partial indusia,) are attached.

The later descriptions of Sprengel and Endlicher are compilations.

Sprengel* calls the capsules receptacles, and states them to be axillary! Some of these are described as transversely bilocular, the upper-cell containing triangular bodies attached to a common axis, the under-cell containing a mucus latex or subsequently a powdery mass. The others which are said to be covered by a double membrane! contain pedicelled globules, each divided into three triangular corpuscles furnished with radicles.

The best part of this curious character appears to be taken from the character in Flinders' Appendix, and as regards the contents of the pedicelled secondary capsules, from figure 17 of M. Bauer.

It is, I think, instructive to observe, that with the exception of the term receptacula, this character presents no analogy with those of the other genera with which it is classed: even the similarity of the pedicelled spherical secondary capsules with those of *Salvinia*, the genus immediately preceding it, is not noticed.

M. Endlicher's† character is obviously derived from that of Martius; one difference being his applying the term colu-

* Gen. Pl. 2, p. 716, No. 3604.

† Gen. Pl. p. 67, No. 688.

mella, (the columnula of the organum calyptratum of Martius,) to the three-legged axis of this botanist; another his stating the lobes attached to it to be antheriform.*

The genus *Salvinia* is said to have been first established by Micheli.† He considered the papilliform hairs on the

* In Mr. Hervey's *Genera of S. African plants*, I find a character of this genus taken from Kaulfuss, but it would be impossible to identify the genus without the synonymy.

The terms used in most of the characters, except those of Mr. Brown, are in several instances unintelligible, as generally is the case when a name is made to pass for an explanation, or when the application of a name is founded on mistaken ideas of the nature or analogies of certain parts. In the late work on *Genera* by M. Endlicher, I find the terms *indusium*, *calyptra*, and *columella*, all in use. And in a note, other general analogies are so extended as to refer one of the organs to the type of a "*flos monadelphus ovario infero*."

Now of the terms above cited, there appears to me only one, (*calyptra*,) capable of legitimate application, but only as far as regards mechanical function. The difference otherwise is very great; for in *Azolla* the *calyptra* is nothing more than what is presented by every *dehiscencia circumscissa* of a fruit, and is limited to one only of the capsules; while in Mosses and all *calyptrate Hepaticæ*, it is the *pistillum* displaced from its base at a remarkably early period. A more real analogy of this part in *Azolla* is to be found, perhaps, in the seed of *Lemnaceæ* during germination.

The term *indusium* is applied to the capsule itself, whereas, correctly speaking, it is only applicable to a covering of capsules of a partial or general nature derived from the surface of the foliaceous body or frond, on which the capsules are situated. This term *indusium*, which should be distinguished from *involucrum*, is at most only applicable to *Azolla*.

A *columella* is the remains of an originally continuous, solid, cellular tissue, unaffected during the development of the spores; it is a continuation either of a partial or a special axis. It may, I believe, be justly considered analogous to the connectivum of a bilocular anther, or the cellular tissue between the cavities of a plurilocular anther. In *Azolla* it does not appear to be even solid.

It may be seen also, that the same character gives an *indusium* to one, a *calyptra* to the other body, while the application of the term *calyptra* ceases to be even mechanically correct from being applied to the whole capsule.

† *Nov. Gen.* p. 107, t. 58.

surface of the leaves to be apetalous flowers; a curious idea, since the hairs themselves, which he calls filaments, are expressly stated to be without anthers, "scilicet filamento apice destituito." The spiral nature attributed to them is due to a mistaken view of their articulations.

Linnæus* referred it to Marsilea; the generic description of which is derived as regards his male-flowers from *Salvinia*, and as regards his female-flower, from *Marsilea* itself. But his views of the parts of the male-flower do not quite coincide with those of Micheli, as he describes with greater consistency, but not accuracy, filaments as anthers, and the papilla from which they arise as filament (or receptacle).

Aublet's† description of the filaments is much the same as that of Micheli, but he expresses doubt of their being the male organs. The capsules are described by him as germina. He appears to have only noticed the smaller indefinite secondary capsules,‡ which he describes as seeds. The species is represented as having emerged erect fructification, and the capsules as being bivalved.

Jussieu|| in adopting *Salvinia* of Micheli refers to the *Marsilea* of Linnæus and *Azolla* of Lamark. His character is derived almost entirely from Micheli. The flowers are stated to be monoicous; the view taken of the males is much the same as that of Micheli, but the specification of the analogous parts is avoided. It is suggested that the males will rather be found to have some connection with the capsule than the leaves.

In Schreber's¶ character. (probably owing to Guettard whose account I have not been able to consult,) a considerable step is made in advance, the difformity of the organs being recognised. The capsules constitute his calyx; those

* *Genera Plantarum*, ed. 6 Holmiæ, 1764, p. 560, No. 1182.

† *Hist. des Pl. de la Guine*, p. 969, t. 367.

‡ See *Pl.* 367, f. 5, 6. || *Gen. Pl.* p. 16. ¶ *Gen. Pl.* ed. 8, p. 969. No. 1617.

containing the indefinite mass-containing secondary capsules being his male flowers. Their pedicels are the filaments; the capsules themselves his anthers. The other capsules are the females; their secondary capsules are his germina, and the analogy is carried so far as to suppose, though with some doubt, the existence of a stigma. The germina become the seeds, though the pericarpium is stated to be present!

It is stated in a note, that the above males and females are distinguishable even in the dried plants by the size of the grains they contain. The male-flowers are described as glomerated round a central solitary female.

Willdenow* after quoting Schreber, describes the capsules as composed of imbricated connate indusia. The difformity of their contents is passed over entirely. The capsules are described for seed!

Lamarck† appears to have entertained still another view, for in his generic character, (o. c. p. 484,) the stamina are stated to be situated on the capsules, which are said to be in pairs. In his description of *S. natans* no mention is made of any difformity in the contents of the capsules, nor is it to be gathered from his remarks on any of the other species in the supplement, that he was aware of it. The figures C. D., however, of the Illustrations obviously represent the two forms of the mature organs.

In the Flore Française of Lamarck and Decandolle,‡ the same views are entertained as in the Encyclopédie.

In the Dictionnaire des Sciences Naturelles,§ the same opinions are adhered to, and it is to be gathered from it, that the hairs on the capsules are the stamina of Lamarck.

Sprengel,|| describes the capsules as receptacles, the secondary capsules as sporangia. He is also silent regarding the important point of their dissimilarity.

* Sp. Pl. 5, pt. 2. p. 536, No. 1985. † Enc. Meth. Illustr. Pl. 863.

‡ 2, p. 579. § 47, p. 149.

|| Gen Pl. p. 716, No. 3603.

Martius* calls the capsules *indusia*, the indefinite mass containing secondary capsules he doubtfully considers *sporangia*; the others he calls *sporangia*, their contents a germinating *gongylus*. (This *gongylus* Martius states to be the seed of Schreber, which I have rather considered to be the secondary capsule. This appears to me indicated by the statement, of the pericarpium being absent.) The part to which the secondary capsules are attached he calls *columnula*. He notices the articulated granule-containing filaments found among the radicles, which he described as *spongioliform*.

Endlicher's† character is much the same as that of Martius, but without as much reservation regarding the nature of the organs. The contents of the larger sac containing secondary capsules, which he considers the females, is stated to be a solid spore; of the others, (doubtful males,) a mucilaginous matter. In a note he inclines to regard these as abortive *sporangia*.

These are all the accounts which I have been able to consult. It appears to me singular, that the dissimilarity of the organs so specially noticed by Schreber, should have been overlooked by subsequent authors, prior to the appearance of Martius's beautiful works. It is, moreover, adverted to by Mr. Brown,‡ who also notices the analogy between the seeds of Guettard and Schreber, (the sac-containing secondary capsules,) and the supposed male organs of *Azolla*. This analogy is reversed by Martius and Endlicher.

The germination of these sac-containing secondary capsules has been observed by M. Vaucher§ and from Endlicher's|| remarks it would appear to have been also observed by

* Pl. Crypt Bras. p. 128, t. 76, 75. f. 2.

† Gen. Pl. p. 67, No. 689.

‡ Prodr. Fl. Nov. Holl. ed. 2. p. 23 in. obs.

§ Ann. Mus. Hist. Nat. 18, d. 404, t. 21, No. 1.

|| Gen. Pl. loc. cit.

others. M. Vaucher, seems to have been unaware of the existence of any other organs: although the indefinite mass-containing secondary capsules appear to be represented by the right hand figure of f. 3. The circumstance that fixes the germination to have been observed in these particular secondary capsules, (otherwise it would be an open question,) is the explanation of fig. 5, and this figure itself. For the teeth there mentioned and depicted only exist in these particular secondary capsules. But there is nothing to fix the exact nature of the three teeth, which may either be those of the incrustation as is most probable, or the interlinear spaces of the vertex of the yellow sac.

The accompanying table will shew the opinions regarding the locus naturalis of the family composed of these two genera. I consider the association of these plants in a tribe with Isoetæ and Lycopodineæ to be untenable.* The classification of Reichenbach is remarkable.

1804,	Lamark.	Naiades.	
1810, } 1814, }	Brown.	Marsileacæ, (Rhizospermæ, Roth, D. C.) (ord. nat.)	Pilularia, Marsilea, Salvinia, Azolla.
1828,	Reichenbach.	Musci. Gongylobrya, (Formatio.)	Ricciæ, Salviniacæ.
1830,	Bartling.	Rhizocarpæ, Batsch, (class)	Salviniacæ, Marsileacæ, Isoetæ.
1831,	Sprengel.	Rhizospermæ, D. C.	Marsilea, Pilularia, Salvinia, Azolla, Isoetes.
1836,	Lindley.	Lycopodales. (alliance.)	Lycopodineæ (including Isoetes), Marsileacæ, Salviniacæ.
1836,	Endlicher.	Hydropterides (class.)	Salviniacæ, Marsileacæ.

* De candolle does not include Isoetæ in his Rhizospermæ. See Fl. France. 2, p. 577-579.

Aublet places Salvinia in the Linnean Cryptogamia Algæ

EXPLANATION OF THE PLATES.

AZOLLA PINNATA.

(Male Organs and development and fecundation of the female Organs,
(Ovula.)

- Pl. CXIX. f. I., 4. Pair of organs (ovula,) with the involucrem somewhat reflexed.
- „ f. V. Another pair rather more advanced; involucrem removed.
- „ f. III. One of these magnified, about 400 times.
- „ f. IV. Ovulum considerably more advanced, 250 times.
- „ f. IV. A pair of the same more advanced: under slight pressure.
- „ f. VI. Fully developed ovulum, in this instance no filaments were found connected with it, but grume is represented projecting from the foramen.
- „ f. VI. Fellow ovulum, burst accidentally; about 300 times. The filaments passing out through the rupture were noted to be apparently continuous with some of those projection from the foramen.
- Pl. CXX. f. II. Another ovulum. the filaments are seen plainly passing into the cavity, which was partly filled with their disconnected joints, 300 times.
- Pl, CXIX. f. I., 1. Confervoid filaments: undergoing certain changes while attached to the axis. 550 times.
- Pl. CXXI. f. 11. a. Pair of fully developed ovula.
Right hand one of the same pair, more magnified the space inside is filled with the disjointed component parts of the protruding filaments.
- Pl. CXX. f. III. Pair of rather more developed ovula, the left hand one burst accidentally; both seen under pressure. The protuberances round the

base of the nucleus distinctly seen, also the paraphysiform bodies, the vascular supplies of the ovula, and in the right hand one the disposition of the component cells of the previously continuous filaments. Both shew the first change the occurs in the nucleus, and both would have been calyptrate capsules; 200 times.

- Pl. CXXI. f. III. Upper is another a little more advanced, burst and under pressure.
- Pl. CXXII. f. IV. Another of the same, the grains, (disconnected joints of the filaments,) have all passed out by pressure, and the space between the nucleus and the foramen is consequently empty. In both the early development of the future yellow sac is attempted to be shewn.
- „ f. IV. 17. Part of a confervoid filament found about the base of this pair, 550 times.
- „ 18. 19. Grains contained in the same: in 19 these appear as if inclined to coalesce; 550 times.
- „ f. IV. 15. Fellow of the same, as usual a little more advanced: in this the yellow sac was sufficiently distinct, and the condensed points, the first step in this development of the lobes, had also made their appearances; 200 times.

(Development and mature state of the sac-containing capsule.)

- Pl. CXXI. f. VI. Pair of young capsules, filaments still protruding from the foramen of one; this belongs to the second kind of formation. The lower one represents the development of the yellow sac, and the appearance of the condensed points within the nucleus above the (yellow) sac.
- „ f. IV. Another pair of about the same period, with some paraphysiform bodies round the base,

- Pl. CXXI. f. V. A pair rather more advanced : the membrane of the (yellow) sac is now being developed : to the right hand one confervoid filaments are seen adhering.
- „ f. VII. Do. do. still more advanced : this is intended to represent that step of the development when the (yellow) sac is crowned with a cap of grume, presenting numerous condensed points, or nuclei.
- Pl. CXX. f. V. Another pair still more advanced, under slight pressure : the grains (disconnected joints of the filaments) have almost disappeared, a membrane is developed round the condensed points, (or nuclei :) the yellow) sac is collapsed accidentally.
- Pl. CXIX. f. III. 2. Represents the (yellow) sac and its crowning mass detached, parts displaced : (yellow) sac collapsed. Intended to shew that there are more membranes developed in the crowning grume than there are subsequent lobes, there being in this, on one surface, no less than 7.
- Pl. CXX. f. V.,c. (Yellow) sac and capping grume with its condensed points, at a stage intermediate between fig. 6 and 7.
- „ f. V.,a. (Yellow) sac alone.
- „ f. V.,f. The same, burst on the trilineal-marked surface.
- Pl. CXXII. f. I.,1. Lower persistent parts of a pair of calyptrate capsules.
- „ f. I.,2. Contents of one of the same, as they separate with the calyptra.
- „ f. I.,3. Calyptra detached.
- „ f. I.,4. Contents without the calyptra, to which they adhere by the cup-shaped mass of radicle-fibrous tissue at the apex : nucleary membrane (or secondary capsule) removed.
- „ f. I.,5. Contents without the calyptra, and without

the nucleary membrane: lobes somewhat displaced.

- Pl. CXXII. f. I.,6, 7. (Yellow) sac, and its incrustation removed, shewing the trilineal mark on its vertex.
- „ f. I.,8. Part of the incrustation.
- „ f. I.,9. The same burst, and emptied of most of its contents.
- „ f. I.,10. (Yellow) sac.
- „ f. I.,11. One of the lobes, pulled off.
- „ f. I.,12. One of the radicular fibres, 550 times.

(Development of the other kind of capsules and their contents.)

- Pl. CXX. f. I. Young capsule.
- „ f. I.,2. Nucleus and basilar protuberances detached.
- „ f. I.,3. The same magnified, about 300 times.
- „ f. IV.,a. Nucleus and basilar protuberances of another more developed young capsule.
- Pl. CXXVII. f. I.,1. One of the lowest or least developed protuberances, (very young secondary capsule.)
- „ f. I.,2. Another more advanced.
- Pl. CXX. f. IV.,1. Ditto still more advanced.
- „ f. IV.,2. Ditto ditto.
- „ f. IV.,3. Ditto ditto in connection with curious, jointed, often very irregular bodies, the history of which was not traced.
- Pl. CXXVII, f. I.,4. Young secondary capsule more advanced: burst by pressure. 4a. Young trifacial cells shewn in the escaped grume.
- „ f. I., 4b. One of these trifacial cells, about 500 times.
- Pl. CXX. f. III, 1,2. Portion of the contents of one of these secondary capsules, shewing the parent cells, and enclosed (trifacial cells) or spores: only observed once; 300 times.
- Pl. CXXVII, f. I.,6. Young secondary capsule, for the most part filled with grume and (yellow) trifacial cells.
- „ f. I.,7. Ditto more advanced: the primary masses) are being developed.

- Pl. CXXVII.f. I.,8. Trifacial cells (spores) detached from the same.
- „ f. I.,9, 10. Fully developed secondary capsule: containing 3 masses in which the spores are imbedded.
- Pl. CXIX. f. VII.,b. Secondary capsules, surface view.
- „ f. VII.,c. Masses of the same.
- „ f. VII.,a. A mass detached.

SALVINIA VERTICILLATA.

(Development of the Organs, (Ovula,) and of the indefinite mass-containing secondary capsules and their contents, trifacial cells, (or spores.)

- Pl. CXXV. f. II.,2. Apex of a reproductive-organ-bearing axis with one somewhat developed ovulum, and one in a much earlier state, *i. e.* before the appearance even of the tegument. Both, from their situation, would have contained the spherical mass-containing secondary capsules.
- „ f. I.,7. A young organ (ovulum) under pressure, it is the small one of. Pl. CXXV. Fig. 1.,6.
- Pl. CXXIV. f. II.,a. Another rather more advanced.
- Pl. CXXV. f. I.,6. An organ (ovulum) in its perfect state, with a much younger one (CXXV. f. I.,7,) at its base. The supposed fecundating matter shewn in application to the foramen.
- Pl. CXXIII. f. IV.,9. 11. An organ much less advanced: 9 is a longitudinal section.
- „ f. II.,5. Another in its perfect state: the jointed obtuse filaments are what I take to be the male organs. The supposed fecundating matter shewn in contact with the foramen. It was also noted to have appeared to fill the space in the organ between the nucleus and the foramen.
- Pl. CXXV. f. III.,2. Young capsule under pressure to shew the nucleus, now a mass of young secondary capsules.

- 2, *a*. Nucleus (or mass of young secondary capsules) of the same.
- Pl. CXXV. f. III., 2*b, c, d, e*. Represent the first developments of these secondary capsules.
- „ f. I., *c, a*, 3*b*. Continuation of the developments, ending in the presence of a larger cavity filled with grume in the secondary capsule.
- Pl. CXXVI. f. II., 1. Long section of a capsule more advanced.
- „ f. II., 5. One of its secondary capsules at that stage when the cavity is occupied by uniform grume,
- Pl. CXXVI. f. II., 2*a*. Another intended to exhibit the next step *i. e.* the appearance of points of condensation (or nuclei.)
- „ f. II., 2*b*. Another more advanced: the parts of the circumference of the grume between the radiating lines, have a tendency, (shewn by iodine,) to the production of membrane (parent-cells?)
- „ f. III., 2*a*. Represents a young secondary, with its cavity only partly filled with grume, in which two condensed points (nuclei) are visible.
- „ f. III., 3*a*. Another about the same period, a considerable number of membranous sacs (parent cells?) visible in the grume.
- „ f. III., 3. Another about the same period.
- „ f. III., 3*b*. Ditto more advanced, the membranes, (parent cells?) more developed.
- „ f. III., 4. Another still more advanced; at this stage the cavity is filled partly or entirely with grume, in which are imbedded a number of distinct trifacial cells, the young spores.

(*The development of the sac-containing secondary capsules.*)

Pl CXXVI. f. I., 1. Capsule.

Pl. CXXVI. f. I., 3*a* One of its secondary capsules, the cell in the centre of the grume is the young (subsequently yellow) sac; those between the

- central grume, and the inner surface of the capsule are young trifacials, (abortive spores.)
- Pl. CXXVI. f. I.,4. Another secondary of the same capsule rather more advanced.
- „ f. I.,7. Another, still more advanced.
- „ f. I.,c. The central cell, young (subsequently yellow,) sac detached; trilineally marked surface.
- „ f. I.,9. Portion of the grumous contents of f. I.,7. shewing parent cells developing, and fully formed, and two young spores.
- „ f. I.,10. Confervoid filaments attached to the outside of the capsule of CXXVI, I.,7.; about 500 times.
- Pl. CXXVIII.f. IV.,1. A young secondary still more advanced, but with the central cell abortive, appearing in its original state of a grumous condensation or nucleus.
- „ f. IV.,3, 3. Parent cells squeezed out of the grume of the same secondary capsule.
- „ f. I.,2. Another secondary capsule still more developed: central cell (subsequently yellow)-sac much more developed; the surrounding grume much diminished.
- „ f. I.,5,6, Part of the more fluid grumous contents of the same: 6 represents what appears to be trifacials just separating: this was only observed once.
- Pl. XXVIII. f. I.,3. Central sac of f. I.,2.
- Pl. CXXVIII. f. IV.,5. Another secondary capsule rather more advanced, the central sac now commences to assume a yellowish tint.
- Pl. CXXVIII. f. II., 17 Another more advanced, shews the mammilla in the vertex of the central (yellowish) sac, appearing to pass off into a thin grumous lining of the cavity of the sac.
- Pl. CXXVIII. f. II.,18. Sac of the same; trilineally marked face.
- Pl. CXXIV. f. III.,1. Another more advanced: perhaps represents the development of the three lobes sub-

sequently crowning the (yellow) sac. *Analogy with Azolla?*

Pl. CXXIV. f. III. 2. Vertex of the (yellow) sac of the same.

Pl. CXXVII.f. II. 3. Another surface of the same, intended to represent the cellular appearance.

(Salvinia verticillata and cucullata, the completion of the development of the spherical mass-containing secondaries, and the perfect state of the (yellow) sac containing secondary capsules of the first species.)

Pl. CXXVII. f. III. 3. 3. Spherical mass-containing secondaries at the time when the trifacials become contained in grumous projections from the inner surface of the secondary capsules, which projections subsequently coalesce into a mass.

Pl. CXXIV. f. IV.,1. Capsule containing the indefinite, simply pedicellate, spherical, mass-containing secondaries.

„ f. IV.,2. The same opened naturally.

„ f. IV.,3. Some of the secondary capsules and part of the receptacle.

„ f. IV.,4. Superficial view of one of the secondaries.

„ f. IV.,5. Another view of the same; centre in focus.

„ f. IV.,6. Portion of the secondary capsule, shewing the separation of the component cells.

„ f. IV.,7. A mass.

„ f. IV.,8. The same under pressure, to shew the imbedded trifacial cells or spores.

Pl. CXXIII.f. III.,c. A nearly mature sac-containing secondary capsule.

„ f. III.,d.d. Contents of the same.

„ f. III.,b. Another view, shews the central attaching (?) process between the lobes of the vertex.

„ f. III.,e. Same, (vertex in view,) lobes somewhat displaced to shew the trilineal mark.

Pl. CXXIV. f. I.,1. Mature capsule.

„ f. I.,2. Same, long section.

„ f. I.,3. Contents of the same.

- Pl. CXXIV. f. I., 4. Contents of one of its secondaries.
 „ f. I., 5. Cross section of the same.
 Pl. CXXVI. f. 1., a. *Salvinia cucullata*, natural size.

All the figures, (with a few exceptions mentioned,) more or less magnified: reduced for the most part from (measured) sketches made under $\frac{1}{4}$, 1-16th objectives of an achromatic microscope, by Rees.

ISOETES.

Isoetes capsularis.

Pl. CXVI, CXVII, CXVIII.

Planta spithamæa pedalisve axi brevissime inferne radicans. cæterum covered, foliis rectis imbricatis, exterioribus oblique ascendent, interioribus erectis, pagina anterior plana, dorso convexissimo, ideoque quasi trigona, angulo postico rotundato, intus dividuntur septis transversis crebris et cavitatibus aeriis 4 longitudinalibus, margines basin versus in membrane producuntur.

Basis intus concava dilatata, fructigera. Fructus fere omnino immersa dorso basi excepta, folio secus centrum adnato, faciei interna libera, (or a level with the surface of the leaf,) quasi deliquescens demum folio lapsa, liberofacto: parietes antice tenui, cæterum crassiusculi, cavitata septis longitudinalibus divisa.

[On examining *Isoetes capsularis* of Roxborough, which appears to be plentiful about Serampore I find, that botanist appears to have adopted curiously incorrect ideas regarding the structure of the genus.

The functions of the male which I conjecture to be the cordiform, oblong fleshy lamina about the female, from which it is divided by an expansion of the leaf, probably analogous to an indusium, appears to have been entirely over-looked.

It is of constant occurrence, and is evidently produced from the leaf, with the vessels of which it has the same relations as the female, it is persistent, and appears subsequently to become fimbriately lacerate.

The receptacle of the females is at first solid, but it is divided partially, and irregularly, by those parts of the cellular tissue which remain comparatively unchanged. The separation of the tissue forming the parent cells, takes place in a somewhat linear series, appearing on a transverse section to occupy the centre of each cell. These cells are much larger than the surrounding ones, which up to a late period, preserve the original fuscous colour, different from the opaque appearance of the partitions. The parent cells at the earliest period in which I have seen them, adhere to the surrounding ones, and are filled with grumous matter; they are very easily ruptured.

They then become forced from their connections, the hyaline edge becomes more apparent, shewing the envelope to be more decidedly formed, and at the same time small nucelli 3-4, may be seen in the grumous molecular looking contents.

The next change consists in the separation of the grumous matter into 3 or 4 masses, each of which has generally its nucellus.

The hyaline membrane continues to be more manifest; complete separation of the nucleary, the future spores take place; they become completely formed or shaped out, and the parent cell itself divides into a corresponding number of intimate contiguous cells which subsequently disappear.

All the contents of the female have the same origin, and development; but generally some suddenly (?) take on a greater development, answering to those considered as the males, the others remain as spores; transitions of form between these occur, and they subsequently become spores, some being larger than the others.

Those called males contain in their first stages a fluid with which they are turged, but subsequently they, like the others, enclose a membranous bag, filled with amylaceous granules.

The spores are highly developed, analogous to those of some *Khasya Hepaticæ*. They appear to have 3 spores, and closely resemble pollen. It is remarkable that in some, in their earlier stages before the division of the parent cell, I have observed emission of the contents of the young spore, but not of the parent spores.

The glandular cordate mass is the male, notwithstanding its permanence, and the quick withering of the suffulting part of the leaf.

I want observations on its stages, and on its origin. It will be curious if the lamina suffulting it, which is not lunate, be an indusium.

One thing is certain, that in this species the contents of the female are one and the same, notwithstanding the temporary difference which only affects the size and sphericity and contents, the internal organization of the coats being the same.

The striæ are the result (?) of the ternary or quaternary approximation.

Lastly the leaves have stomata on their inner flat face. Endlicher says they have none but let him consult De Candolle's plate, etc. in the *Organographie*, as regards *I. lacustris*.]

The cells contain a few globular bodies of considerable size consisting of a spherical hyaline sac containing 3 young spores nearly perfectly formed, the spiculæ of the angles being visible.

It is remarkable that immersion in water causes the more or less partial emission of the granular nucleus from the pores so that the number exceeds 3, and is often upwards of 6.

In this extensible nucleus, a nucellar is generally observable, this is seen sometimes in the protruded part; sometimes in the spore, mostly the lax cells of the surface of the septa have disappeared but the lining is still fuscous; under 1-500 the mass looks commencing to be cellular, it has also plenty of granules, iodine does not act on the cell, but colours fuscous both spore and extensible stuff.]

[The protrusion of the contents of the sporiform nuclei appears constant.

The spores often totally escape, are membranous hyaline, with triangular inner face, and a tendency to evolution on the dorsum; after making their escape, they assume entirely a spherical form, precisely like, but much less in size than the original parent cell, before the tendency to division, less solid looking. In the spores there are still some remains of grumous granules, or they are quite empty.

The nucelli, green spots are the first to appear, then the triangular subdivisions.

Very early the cells are solid, septa opaque from air, the rest lax, more especially towards centre, with a brownish pointed disk; parent cells even more decidedly brownish. One or two are visible only in each, on a thin transverse section; it is along the outer that these are developed from below upwards; for while it is divided below by septa, it is below a subsigmoid shaped mass of dense brown reproductive tissue, in the septous part however the parent cells are already distinct.

The septa are most developed along the mesial line, and are developed from back to front.

There is little distinction of cuticle.

The parent cells are not free now; they are attached to the surrounding cellular tissue. Pressure occasions them to discharge a grumous granular matter, occasionally they have the appearance of internal sub-division.

All sorts of formation may be seen, in one instance, five-form spores may be distinguished, as well as quaternary, while in some there will be no septa.

The next stage is the formation of the partitions between the nuclei, or rather; the contraction of the grume until the hyaline cell is left alone on the circumference.]

Pl. CXVI. (*Upper division.*)

1. Sporula different faces, considerably advanced
2. Quaternary state one younger.
3. Ripe fruit, natural size.
- 3a. Transverse section of the same.

4. Ripe sporule, like sugar plums in colour.
5. Transverse section of do.
6. Innermost membranous coat enclosing the starch granules.
7. Very young leaf and female organ.
8. Do. more advanced.
- 8a. Part of the same.
9. One of the large cells separated, they appear to have no decided attachment.
10. Very small ditto from the same cells, imbedded in the brown soft reproductive ? tissue.
11. 1-500 No. 9.
12. Two young sporula belonging to section 1. Pl. CXVI. (Lower division.)
13. Part of leaf and female more advanced.
14. Brown reproductive tissue, each of the lax cells is faintly nuclear, the most lax are not to be found when the fruit is advanced.

Pl. CXVI. (*Lower division.*)

1. Transverse section of female reproductive organ, to this belongs sporula 12. Pl. CXVI. (Upper division.)
2. Do. more advanced.
3. Sporula of the same.
4. Sporula not entirely separated, such as is often the case.
5. Represents two sporula less advanced, enclosed in the entire parent cell, and emitting the nucleary matter, inside !!
6. One ditto burst spontaneously, the bursting does not take place at the points or angles, but in the face, and is generally, though not always confined to one; the quite free one of fig. 6, has burst at 3 places.
7. Another do. spontaneously burst; 7a., nucleus, escaped from a spore, and has assumed a spherical form.
8. Spore do. burst a little nucleary matter 250 remains.
- 8a. Ditto at a fissure of bursting 550.

9. Ditto acted on by iodine.
10. A spore in *emission* 1-560, the nucellus has also escaped.
11. Transverse section very early, shows one of the cells partly, the spores are at this time nearly or quite free.
12. One spore (parent) and the tissue lining the septa.
13. A parent spore, not divided yet, or yet nuclear.
14. A parent spore, 3 green nuclei commencing.
15. Do. do. nuclei not shewn, but the division has commenced.

Pl. CXVII. (*Upper division.*)

1. Portion of female transversely, in this there are many of the spores which have taken on themselves great powers of growth, these are spherical and turgid, obviously of the same structure as the smaller ones, even to the echinulate dorsum: they contain a subtle invisible fluid? the others do not burst on pressure; and have now their mature form, although the amylaceous granules do not yet exist.
2. A group of these larger spores, the males of authors.
3. A transition form, both in size and turgidity.
4. A smaller one, or real spore?
5. Do. under iodine, causing the outer, or *parental* part to be thrown off, this shews the difference in size between these and the males of authors. Fig. at 2.
- 6, 6. Very much enlarged.
- 7, 7. Perfect spores of both kinds, measured, 1 inch object glass.
- 7a, 7a. Their sections.
8. Very young parents, nucelli just commencing.
9. Very young part of female, seen transversely, loculi now solid, parent immersed in the brown cellular tissue, not separable, containing a grumous fluid, it bursts on slight pressure.
10. Part of reproductive tissue? and the parent spores.

Pl. CXVII. (*Lower division.*)

1. Young female, transverse.
2. Male, immersed part.

3. Portion of female 250, septa now incomplete : receptacle solid, central tissue fucescent along the middle of the brown parent cells.
4. Parent cell represented detached, but they now adhere to the surrounding tissue, and easily burst.
5. Parents developing ; 1st. earlier, 2nd. division commencing.
6. Ditto later, the future spores are separating.
7. One in iodine, 7a, 550. shews that the nuclei or spores have an outer proper tegument.
8. More advanced, shews that the parent cell becomes divided, also it forms the mucilagino-hyaline coat of the spore, or the mucilaginous opaque fuscous one of the ripe one.
9. Long section of male and female 1-10, but light fuscouscent.
10. Transverse of male near its immersed part. 250.
11. Transverse ditto above 250.
12. Portion of fascial lamina shewing it to be deliquescent. 550.
13. Part of female, 250, the central tissue more discolored.
14. Male and female more advanced.

Pl. CXVIII. (*Left side.*)

1. Front view of base of leaf, and male and female scale represented as mostly removed.
2. Long section of the same.
3. Part of lamina of male shewing the grumous turgid cells towards the centre.
4. Parent cells just developing.
5. Base of leaf more advanced, scale in situ.
6. Ditto obliquely, scale reflexed, the male is seen to have deliquesced nearly to the base.
7. Another similar view but earlier, in this case, there was a lamina, but this is the appearance under $\frac{1}{4}$ inch lens.
8. Long section of 5.
9. Parent cells, 1-250, 10 Ditto 550.

Pl. CXVIII. (*Right Side.*)

1. Long double section of male and female, the development of the parent cells commenced, the cells of male contain granules or nuclei which are of a lustrous appearance.
2. Parent cells and surrounding tissue.
3. One parent cell developing.
4. Monstrosity of spore, from this it would appear that there is a confluence of the outer membranes of the young spores; in this only one spore is developed, but the membrane appears marked out for two more.
5. spore, with the tegument derived from the parent.
6. Do. under iodine.
7. Do. parental cell separated spontaneously.

The upper body is of constant occurrence, and presents curious similarities to the earliest states of the female, its cellularity however, is more early developed, and at a time when the female is a mass of mucilaginous looking, obscurely cellular tissue, its cells are tolerably distinct, and contain granules see Pl. CXVII. (Lower division); it is suffused by a membranous oblong cordate lamina, probably analogous to the indusium: for it is assumable that this substance is in its earliest stages actually immersed in the leaf, the female in transmitted light is the more fuscous of the two.

Above, the male? consists of oblong distinct cells containing granules, outermost cells of both dorsum and face look as if they were melting away.

The immersed part of the male has larger and more rounded cells, the lamina has both cells containing granules and often nucleary cells? surfaces deliquescent (vide Lower division of Pl. CXVII.) it is much more advanced in cellularity than the female, apex also truncate, it is deliquescent and fuscous. In the very young state when the apex of the leaf is barely longer than the dilated base, the male is a large tongue-shaped fusco-grumous mass, spread as it were over the surface of the upper part of the leaf.

In the centre of this tongue which has a tendency to be folded, are two short rows of large cells gorged with fuscous grume.

Along the centre line of this, about equi-distant between the base and apex, the cells are more grumous, and the lamina from being folded about, here presents a special appearance; pressure shews that they belong to the lamina.

The scale disappears first, for the male is evident even when the leaves are 4 inches long.

FILICES.

General Remarks on Fern's.

Essential points of the Filical structure. Axis very distinct, when branched, dichotomous

Primary roots endorhizal, secondary (?) ultimate (?) confer-void.

Leaves generally densely imbricated, scarious with no aërat-ing organs, with plane equal attachments. *Ramenta.*

Fronde highly foliaceous, stomata generally on the under surface, during vernation spirally coiled upwards (almost in-variably) veins bifurcate with clavate ends.

Male flowers, (obviously reduced transformations from the leaves, squamæ etc. of authers,) reduced to their simplest forms (their representatives exist in the abortive male flowers of Mosses or Epiphyses), sac of the anther but little de-veloped, dehiscence obscure.

Female flowers, appearing subsequently to the application of the fertilising matter to the under surface of the young fronds ; consequently they have neither style or stigma.

Calyptra none. Capsule simple, for the most part bursting by means of an annulus.

I have long since had reason to believe, that the fruc-tification of the frond of a Fern, is a circumstance to be deter-mined only at a very early period, and if not determined at that stage of development, never appears likely to be determined subsequently ; or in other words, that a frond which is sterile when young, is sterile ever afterwards. My attention was hence led more strongly if possible than it otherwise would have been, to exmine these curious produc-tions at the earliest possible period.

The first Fern I met with, was a species, if *Adiantum*, of ordinary form, and I was at once struck with the similarity,

that the less developed of the peculiar scaliform bodies called ramenta, and which are to be found towards the first subdivisions of the frond, bear to certain organs occurring in some of the lower orders.

Keeping in view this apparent similarity, I examined young fronds at a still earlier date, and found that the resemblance was not only more striking, but that the bodies near the 1st ramification of the frond, presented some resemblance to those organs assumed to be the female of Mosses and Jungermannæ; and that further, there was a sort of disposition detectable in these bodies, which warranted me to limit my examinations to them, at least for the present.

With this view I have examined the only species of Filices amounting to 4, to be procured about this place—and so far as I have been able to judge, throughout the extensive portions of Khorasan, I have hitherto visited. They consist of one *Adiantum*, a *Cryptogramma*, a *Grammitis*, or *Ceterach*, and an indetermined form, in venation nearly allied to *Cryptogramma*.

I have found the same occurrences in each, in some more evident, in others more obscure, presenting among the above small number, such gradations as I think allow me to assume that in certain forms, more especially those that border as it were on *Marchantiacæ*, the resemblances will be so striking as to set the question at rest, so far at least as regards the identity in function between these ramenta, and the assumed male organs of Mosses and *Hepaticæ*.

At the early stage I allude to, the ramenta at the termination of the new development, present the appearance of articulate cellular bodies, consisting either entirely of a simple superposition of cells, or being more compound at their base; but the last cell is invariably simple, turgid with a minutely granular fluid, and in *Ceterach* and *Cryptogramma* distinctly capitate, and in the former, tinged with a yellowish colour—the ordinary tint of moss anthers. The nearest approach to the structure of these, are to be found in the newly developed

ramenta at the points of elongation of the axis, there is still however a peculiarity in those connected with the fronds.

I believe that in some instances, these bodies assume after their functions have been performed, the size of ordinary ramenta. The external characters of the ordinary form of ramenta are too well known to require any remarks, those to which I would beg to direct attention are obvious modifications, the only difference perhaps being in the greater size of the terminal cell. In *Adiantum*, those I have described represent rather closely the ramenta of the axis in their earlier stages, they however present sufficient peculiarities to entitle us to consider them as organs possessing different functions.

I have before alluded to a certain disposition visible in these organs, this I have traced in 3 out of 4 of the instances, particularly in *Ceterach* and *Cryptogramma*, in which it consists in an inflexion of these bodies, so that their heads or terminal cells are brought into juxta position with the surface of the young frond, and as it would appear towards its margin.

In *Adiantum* (the only species of the 4 with glabrous fronds,) they appear to be so directed as to be placed in communication with the centre of the axis of gyration.

But of these obscure appearances, the most evident are those which occur in these bodies afterwards, and which, from analogies fresh in my memory, I incline to believe indicate that they have performed their functions.

I allude not so much to the colouring of brown, because this appears universal among ramenta, which can have had nothing to do with the important functions of fertilisation, but to a certain appearance of aggregation of grumous matter, in, but especially about the septa of the cells, especially conspicuous in *Ceterach* and *Cryptogramma*, in both which the terminal cells have been seen apparently open: and in one or two instances these openings have appeared in connection with an eruption of the very minutely granular grumous matter. This appearance has been met with only

a few times, and is no argument against its general character, because it is obvious that in a spherical or capitate cell, openings may escape notice when viewed by a microscope of small penetration.

In *Ceterach* another circumstance occurs, on which I am disposed to attach considerable weight; which is, that however evidently the ramenta formed on the axis, and between it and the fronds, resemble those which I suppose to be the fertilising organs, yet those formed subsequently to the capitate ones, are formed so much on a different plan that no terminal cells whatever are formed. The distinction alluded to, will at once, be evident by comparing a ramentum of the stipes, with the vast majority of scales on the frond, and it is equally obvious on very young fronds in which the peculiar ramenta are attached beneath the lower half.

On a single lobe of a very young frond both in *Cryptogramma* and *Ceterach*, all stages of these bodies are to be traced with sufficient exactness: those at the base appearing just to have discharged their functions, those toward the centre present the appearance of perfection; those beyond, every stage from the first appearance of the terminal leaf cell to its pedicellation, decided capitation, and engorgement with grumous granular matter.

It then became a question to ascertain whether any peculiarities were to be found among these organs in barren fronds, but none have been detected by me.

From examination of the youngest plants of *Adiantum* I could meet with, I believe that the ramenta make their appearance with the 3rd or 4th frond; near the base of the first circinate one of these young plants, they are in some plentiful.

The rarity of barren fronds may be in some measure attributable to the abundance of male organs, at any rate no proof is to be deduced from their casual occurrence. It then became a matter of interest to examine, when the ramenta make their first appearance.

The means I possess are far too humble, to enable me to

prosecute any examination as to the *modus operandi* of these organs; such an examination will be always difficult, and will absolutely require the aid of excellent achromatic compound microscopes.

From such very imperfect materials, imperfect in extent, and imperfect in means of observation, it may be unreasonable to draw any conclusions, but I cannot refrain from hinting my suspicions that, the bodies I have mentioned, which are simple forms of ramenta, found on, or about the frond or its lobes, perform the same offices, that there are reasons for assigning to the supposed male organs of *Musci* and *Hepaticæ*.

My reasons for the suspicion, are founded on the distinct resemblance of the capitate forms to the anthers of certain *Jungermanniaceæ*, on their peculiar disposition at a particular time, on the changes in appearance that they subsequently undergo, and on the fact alluded to as occurring in *Ceterach*.

I omit the appearance of their occasional dehiscence, because it was *occasional*, and because dehiscence appears to me, by no means essential to the performance of the functions I am disposed to assign to them.

However numerous the objections to this suspicion may be, and however absurd it may appear to those who view subjects in a partial light, to attribute such important functions to what they call mere scales, or hairs, I believe the objections will disappear, and the absurdity also, on a more extended investigation into these bodies.

The chief objections appear to be, first, the difficulty in attributing the fertilisation of all the lobes of a frond, to the few bodies situate about the lowest lobes in *Adiantum*, secondly, the fact of those ramenta which cannot be allowed to have exerted any fertilising influence, presenting much the same appearance, and occasionally undergoing the same peculiar changes as those in immediate contiguity with the future seat of the fructification; thirdly, the apparent uniformity in situation, and want of any relation between the situation of the supposed male organs; lastly the great variety in the situation

of the organs, supposed to have been called into existence by their agency.

The striking resemblance that these organs have in certain cases, to the cellular processes formed round the pistillum in many Mosses, may suggest a partial objection. But the question reverts to this, of what nature are these cellular processes. As they are obviously not reduceable to the type of formation of the pistillum, as is more over testified by the frequent presence of undeveloped pistilla, near, or among them. I incline for the present to consider them as abortive anthers.

We should expect from theoretical reasoning, that if imperfect anthers are found among Mosses, they would assume the form of the perfect ones in those Families, in which the sexual organs are doubtless in a far lower stage of development, probably the lowest known.

To this hypothesis, Anthoceros is at present an objection, for with some analogies in its female organ with that of Ferns, it has perhaps the most perfect Cryptogamous anthers.

The fact is, that in this, as in every other question, the objections will be numerous in proportion to the limited manner in which the subject is viewed. Ferns form a tribe of beings not to be understood if viewed as an isolated division of vegetables; but comprehensible, if viewed in connection with the neighbouring tribes. The interpreters of their obscure passages are, I think, to be found among Hepaticæ and Musci; and I therefore pass at once to a short review of the reproductive functions of these beings.

It is, I think evident, that Ferns do not present any obvious point (punctum) to which the male influence is to be applied, and which point, whenever it is obvious to our senses, assumes the stigmatic form, as in all pericarpial plants.

In this point of view, they are inferior to Mosses and Hepaticæ: the inferiority in this may be fairly assumed as indicating a corresponding lowness of organisation in the males. The intermediate degree of organisation of generative organs, is to be found in Anthoceros, which is a plant *sui ordinis*,

which presents a considerable development of the male organs, but no evidence of a pre-existing punctum for the application of their influence, with a high degree of organisation of the products, or reproductive organs. This latter part of their structure may explain perhaps the apparent contradiction in what I just stated of Ferns, that the degree of inferiority of the males, was in accordance with their want of a pistillum. It will be a curious confirmation of this, if the Ferns which have most complicated reproductive organs, (setting aside any greater degree of relationship to *Anthoceros* etc.) have the most highly developed stamina.

In Mosses, in which the pistillum is so evidently organised on the general plan of that of Phænogamous plants, the steps are obvious. They include a distinct sphacelation of the style, and stigma, with even a tendency to the disorganisation of this, followed by the enlargement of the body of the pistillum, either consequent upon the growth of a pre-existing cell, or upon the formation of a cavity, to allow of the growth of this cell, which is unquestionably the first thing formed, and which same cell forms subsequently the termination of the seta. What is important to bear in mind is, that the essential reproductive organs, the sporules, are of such late appearance that they would almost seem unconnected with the obvious processes attending the pistillum. Not only are they very remote with regard to the first appearance of sphacelation, but what is more to the point, they are considerably remote from the time when the bulging out of the incipient theca interrupts the close communication which its apex has hitherto had with the apex of the cavity of the pistillum, or as it may be, calyptra: to which apex the sphacelation is in the cases examined by me, obviously extended.

I must however observe that this question of remoteness may only be remoteness of effect, we know nothing of the time required.

For the first changes involve the formation of a cavity in the young capsule, then the appearance or fashioning out of

a central body. And perhaps the first evidences of the sporula, are presented with the appearance of the membrane, which is to be the inner membrane.

In *Anthoceros*, we have obvious dehiscence of the male organs, the remarkable appearance of a conducting tissue penetrating the fronds, apparently at any indeterminate point, and this is followed by the appearance of the capsule, then its protrusion through the upper surface of the frond, with a comparatively late evolution of the sporula.

There is another point worthy of notice in these frondose *Hepaticæ* and *Anthoceri*, which is, that the sexual organs are evidently in connection with the inferior tissue of the frond, and that while the males invariably protrude through the upper surface, the females assume an opposite direction whenever physical obstacles are not presented. This explains at once the universal dorsal nature of Ferns.

The fact is in accordance with what takes place in Ferns, the direction of the males is an apparent exception. For in many instances they obviously arise from the under surface. Great stress is to be laid on this remote operation, if I may so express it, of the male organs, because Ferns are perhaps an excessive case in point, and because it may be asked, why attribute fertilizing properties to these organs, when there is no evident connection sufficiently immediate, between their actions, and the appearance even of the capsule.

The analogy these organs bear to certain supposed anthers, such as those of many *Jungermanniæ*, bear upon a curious anomaly in some Mosses, the only instances with which I am acquainted occur in that heterogeneous assemblage, *Neckera*. I allude to the curious confervoid filaments which give a barbate appearance to the attenuated portion of the branch on which they occur; so far as I dare trust to my memory, their appearances, and the coagulation of their contents, are much the same. Have these particular Mosses anthers of the usual form, or are these their anthers? If they are, it amounts to something like proof positive in favour of my suspicion.

It is needless to enlarge upon the grounds on which I have based my suspicions, their value will depend entirely on the extent to which they are found to occur, and on the nature of the cause disturbing these resemblances.

The same remarks apply to the objections ; in which I have not included the obvious resemblances they bear to organs supposed to be of very minor importance—scales and hair : because in reality it amounts to no objection. But as it will be made, I would beg to recommend the examination of *Adenophorus*, which may throw some additional light upon the question. But after all, many will be inclined to observe, well, we grant you the similarity, and the analogies you require, but what proof have you to urge that the supposed male organs of Mosses etc. are male organs ; we deny the possibility in toto. That this remark may be made, is evident, when we consider that Dr. Greville and Arnott deny that the pistillum of Mosses is a pistillum : and if that which is so evident is so flatly denied, what degree of denial may we not expect in regard to these organs, which even in Mosses have some obscuring circumstances connected with them. On this point, I must confess that the majority of botanists appear to me wholly unreasonable, I am sure that no other class of scientific observers would deny claims founded on so many obvious analogies. Is sexuality so anomalous that its advocates are exposed to such strenuous and unmeaning opposition, or has any one instance of reproduction without the agency of sexes been proved throughout a single natural family.

Independently of this, why so unreasonably insist on what with our means, may be impossibilities. If they require absolute demonstration of all the steps of a function, they must deny that the appearance of the embryo is due to the action of the boyau.

The objectors to the assumed sexual organs of Hedwig, Brown, and Brongniart, seem to assert that they are gemmæ ; but what analogy has a sac containing grumous molecular matter, deficient in green colouring matter with a gemma,

which is vascular, or a vascular congeries of cells, and which invariably contains green parenchyma. Besides, in what instance is a plant known to be multiplied by reproductive organs, and two sorts of gemmæ: such an instance as *Marchantia* ought to satisfy the most sceptical.

The objections of Sprengel, who with deference is not a high authority on points of minute structure, amounts to nothing more than that the disk is capable of growth, a fact which has indeed never been doubted; they are only worthy of notice as having been perpetuated in Lindley's *Introd.*, 2nd. ed., But even if proved occasionally to grow, they may not the less generally perform the office of male organs.

In phænogams, we have certain species endowed with three sets of organs, conducive to their perpetuity.

These organs are very dissimilar, we know that some of them, perform the function of the male, the second of female, the third of a gemma. In Mosses etc. we have organs of 3 different kinds, and very dissimilar, one of these is allowed by all to be gemmaceous, another reproductive; analogy asks, is not the second the male?.

No one would attempt to prove that the anthers of *Sempervivum* are female organs because occasionally they bear ovula: we have besides evidence to prove that the essential part of a grain of pollen, to which the anthers of some *Jungermanniaceæ*, and of Ferns are analogous, has remarkable powers of growth.

To prove that the anthers are gemmæ, we require to have proved that they generally grow, and this after dehiscence.

What is an anther in its widest acceptation but a case containing fertilizing fecundating matter; we are not to look invariably for highly organised grains of pollen, but we are to look for fecundating matter in the lower orders, in the form of the first appearance of the pollen to the higher orders: we shall then have a case containing grumous molecular matter: the precise description of organ we have in Mosses etc.

The only really strong objection is, that the molecular matter has been seen to grow, but this I doubt.

The same question may be asked of the Pistillum, and be similarly answered: but this organ whenever it exists, is too palpable to be mistaken; as it is not an essential organ we may expect its complete disappearance in certain divisions of Acrogens, and perhaps Ferns etc. in which it is a subsequent formation, and in which it is not furnished with stigma, its invariable adjunct when the male influence is directly applied to it.

And it is a very curious fact, perhaps tending to assert the greater permanence of the male organs, that in these tubes in which, so far as we know, the fertilizing matter is not submitted to those changes which it undergoes in Phænogams, the changes undergone by the sporula are precisely the same as the changes undergone by the perfect forms of pollen.

To those who require the proof of the existence of the complex male organs of Phænogams, or of a male organ of that form with which they are alone familiar, I do not address these remarks, but to those who expect to meet with a lower degree of organisation in the lower tribes of vegetables, in which there is a tendency to reduction to the essential elements, and who bear in mind the comparative structure of similar organs in adjoining groups, I beg leave to suggest the intimate study of the ramenta of Ferns.

One very obvious consideration results from these enquiries, which is, that the Frond of a Fern is a decided frond, analogous strictly to the involucre etc. of Marchantia; our attention is therefore directed at once to the Ramenta as leaves, hence a reason for their universality, and a striking proof is afforded that simple as these leaves are, the male organs are as simple a modification of them.

What additional affinities does this view disclose. What curious argument for compensation; no plant with axillary organs has fronds: in Mosses therefore are well developed leaves and no fronds, in Ferns etc. developed leaves, and largely de-

veloped fronds; in both, stomata are confined to the receptacle of the organs of reproduction.

Ophioglossum has not gyrate venation; query, have the primordial fronds of any Ferns this gyration. The structure of the fructiferous frond of Ophioglossum, would lead me to suppose that this genus has only the first, or most simple primordial frond, and the fructiferous one; if a barren one be found, it will be at least once pinnate, *Oph. pendulum* has nothing to do with general Ophioglossa.

Connected with the above suspicions, are the questions, what is the foliaceous part of the Fern, which is so invariably connected with its reproductive organs. Common parlance makes them to be fronds; and such I take them really to be, founding my opinion on their intimate association with the reproductive organs, and the situation of these, which in all genuine frondose plants, would appear to be invariably in connection with the lower stratum of tissue.

It appears to be a curious fact, that while in *genuine Acrogenous* frondose plants, the male organs always protrude through the upper surface, the female generally, or always takes a contrary direction, except when physical obstacles are opposed to this. Their chief analogy with true leaves, consists in their being the chief, perhaps sole organs of aeration. The venation is more consonant with what we know to be the mode of division in genuine frondose plants, than of true leaves.

If these foliaceous organs are frondose, and merely accessory to reproduction, (in short analogous to the cap of *Marchantia*) the ramenta must be the true leaves reduced to zero as to function, agreeing intimately in structure with the acknowledged leaves of Mosses and *Jungermannia*; this may be the reason of their universality. If these views are correct, we have a beautiful instance of the male organs being a simple modification of the leaves.

If the ramenta are leaves. Ferns are allied to *Lycopodiaceæ*; from which otherwise they are too much isolated.

Have they any definite arrangement; and, are the fronds axillary to them in any way?

If rammenta are leaves, Ferns become beautifully intermediate between strictly foliaceous, and the strictly frondose vegetables, two structures otherwise *too* much isolated unless some of the apparently foliaceous forms, such as those of certain *Jungermannias*, are really frondose.

If I succeed in directing attention to the early and minute study of Ferns in association with that of other Acrogens, we may soon expect to become acquainted with their primary, but at present hidden types of formation, of which we as yet know definitely, only two. What has been done within the last few years in isolated cases, is an earnest of what may be expected in comprehensive cases. At present the whole class may be termed without presumption a reproach to Botanists, more especially as many have limited themselves to its particular study. A few years ago, and the essential parts of the sexual organs of the more perfect vegetables, in all their stages of development, were sealed books.

No body noticed them, or if they did do so, noticed them only in their perfect and most tangible form. Similar studies, prosecuted similarly to those that have now placed our knowledge of corresponding points in *Phænogams*, in so forward a position, will I am sure be attended with the desired effect in these divisions.

It appears to me that hitherto the only properly conducted investigations into these vegetables, are those of Mosses by Mr. Valentine, and of *Merchantia* by Mirbel—both of these are however in a certain degree isolated.

Affganisthan Filices.—The number contained in the collection is 17.

But of this number, no less than 12, are from Otipore and the forests of Bharowul, and are to be considered as belong-

ing rather to the Himalaya, than the Affghan Flora. Of the remaining 5, three only were met with in the Eastern Affghanian. So that the proportion of Ferns to Western and Northern Affghanian, which are both more characteristic than Eastern, is reduced to three—a proportion of 1-670, to the general vegetation.

The only species that appears to me worthy of remark is the Grammitis, which is from one technical character equally referable to Gymnogramma. It is remarkable for its minute size, and the appearance it presents at first sight, of having two forms of fronds, both being soriferous.

Some of the sketches of this submitted, represent what I suspect to be the male organs of Ferns, the appearance of which is pretty uniform in the few Polypodeaceæ I have examined.

These bodies appear to me important on account of their universal presence, and their structure, which is essentially that of the anthers of *Jungermanniæ* or *Musci*, the curious changes they undergo, are especially remarkable, particularly the coagulation of the contents. I have also seen appearances, indicating the application of the glandular head to the frond, though this may obviously arise from mere mechanical causes, consequent on the direction of the young fronds. They require to be observed at an early period, in connection with which I may remark, that the fructification of the family has appeared to me to be determined at an early period.

It also appears worthy of notice, that a muscoid form of anthers as in *Syrhropodiæ* probably occurs in *Platyrium biforme*, and that this form, excepting as regards the canal of dehiscence, is easily reducible to a form which occurs, and in which the rament are divided, each division ending in an anther.

The curious structure of the bodies, among which occur the capsules of *Platyrium biforme*, was first pointed out to me by Mr. Grant. The occurrence of muscoid anther in a Fern, which I take to represent *Algæ*, appears to me to indicate the

importance of examining such forms as *Kaulfussia* and its allies, *Trichomanes* etc. And as these bodies in *Platyserium*, appear to pass into mere stellate hairs, it may be of importance to examine those genera such as *Nephobolus*, in which stellate hairs are largely developed.

It would also be desirable to examine accurately the nature of the venation in *Tænitis*, if it is not strictly continuous, my idea of *Blechnum* being a dislocated *Pteris*, is corroborated. There is a tendency to greater perfection of sori towards the circumference; of this, one of the *Achrosticha*, figured by Hooker, and *Lindsæa* Pallens, Wall, (which is not, I think a *Lindsæa*,) are conspicuous examples.

What is the value of an indusium? to determine this its origin must be sought out.

The following genera have been examined in the course of these observations.

Hemionitis.
Antrophyum.
Vittaria.
Hymenophyllum.
Trichomanes.
Cheilanthes.
Allosurus.
Cryptogramma.
Pteris chrysocarpa.
Pteris. sp.
Chrysis.
Adiantum.
Dicksonia.
Onoclea.
Blechnum.
Woodwardia.
Doodia.
Schizotoma.

Lindsæa.	Asplenium.
Davallia.	Allantodia.
Nephrodium.	Diplagium.
Aspidium.	Scolopendrium.
Cyathea.	Didymochlæna.
Alsophila.	
Sphæropteris.	
Woodsia.	
Trichopteris.	
Polypodium etc.	

In *Ophioglosseæ* Pl. CXXXI. Fig. II*a*. the venation is somewhat less perfect, there being scarcely any central vein, and the appearance of lateral veins towards the base of the leaf arising more from an elongation of the reticulations, than from the actual presence of a distinct order of veins.

The petiole is decurrent, or perhaps the axis of the spike adheres to it, at any rate the disposition is curious, and singular.

The spike itself obviously represents an involute leaf, on the outer side it is marked with the dorsal vein, on the inner a line exists pointing out the margins of inflexion, both surfaces are stomatose.' Pl. CXVXI. Fig. II.,*a*.

There are some grounds for supposing, that were more leaves developed in this genus, they would be pinnate; since this is the structure of the spike, consisting of linear alternating involute leaflets, carrying the sori on the margins. Pl. CXXXI. Fig, II.,*b*.

In this the development is inverse, shewing the composition?

The sporula occupy the whole of the walls of each cell, which are compound, half and half, they are not striate; nor is the distinction of the two membranes evident, the outer is membranous, they burst readily by the action of water, they are reinform.

In its frond, which is estomatose, it approaches to algæ;

does it also in the articulate spike evince an approach to articulation in some Polypodia.

Ophioglossum.—No Fern perhaps assumes so much the form and particular appearance of Fuci as does *Ophioglossum pendulum*: This hangs from trees, and the fronds have an undulated or twisted appearance. It is not common here, and I have only met with it once growing on another Fucoid Fern, the *Acrostichum fuciforme*.

In habit, it is widely different from the terrestrial *Ophioglossa*, in which the leaf bears the usual proportion to the axis, and the inflorescence has the appearance of terminating an one leaved stem. In this plant however the most natural description, would relate to a long frond of linear shape: from the middle of which at a variable distance from the base, but always below the middle, the pedunculated spike originates.

The fronds have stomata on both sides, which is nothing remarkable. They are similar on both sides, the base is roundish, whitish cellular, with a circular series of vascular bundles, not in very regular relation with the curve described by the circumference; the substance of the frond above the inflorescence is homogeneous, composed of large rounded cells, much green matter in those of the superficies, several vascular fascicles; ducts in the centre and fibres outside.

Below the *Peduncle* the frond is much thickened in the middle, a transverse section shews a linear series of distinct vascular fascicles, and towards the greater angle or protuberance another smaller one. This is for the supply of the *Peduncle*, the angle becoming more and more protuberant towards its base.

The formation of the two series is due to a disruption of the original irregular circle into 2, the larger side going on to the leaf, the smaller to the peduncle, it commences where the angle of the peduncle first makes its appearance. The *Pe-*

duncle is cellular with but little green matter with a (transverse) series of simple fascicles.

Spike evidently of a frond, midrib unchanged, cells containing sporules between it and margin, the diaphragms of frond, and supplied by vessels proceeding from the outside, and rather distended fascicle of the centre, and as it were, in a series of arches.

The youngest state that I have observed the frond, has been when it was $\frac{1}{2}$ an inch long, the apex consisted of two fleshy bodies or lamina: bent down almost on the round straight part, but not in any way gyrate, the upper of these is the larger, concealing the under, which is the future inflorescence.

Thus the difference between the frond and the spike, is merely a *difference in size*, and there is nothing to corroborate the idea that, the spike literally belongs to the frond.

This genus, *Ophioglossum verum*, (for I have long known the two be distinct in the structure of the spike, or rather the *capsular cells*.) *Hemionitis*, and *Antrophyum* all agree in being more or less Fucoidal, and in having a reticulate, uniform, or subuniform venation.

This species, *Oph. pendulum* has little in common with *Polypodiaceous Ferns*.

The fronds are not invariably spicigerous.

Allosurus crispus, (Pl. CXXXVIII. Fig. II. 3.) This exhibits a close approach to *Cryptogramma*, and also to *Pteris aurea*, but which differs in having an intramarginal vein, and continuous sori.

In all these the involucrel edges meet over the midrib, *Cheilanthes*, *Allosurus*, *Gymnogramma*, *Lomaria*. *Pteris aurea*. Pl. CXXXVIII. Fig. II., 1. It is doubtful to me whether this is really a *Pteris*, although Hooker and Gevillé say it is.

Cryptogramma Pl. CXXXVIII. Fig. II. 2. scarcely differs from *Allosurus*, the sori are linear, and the veins are always forked and the involucre more involute.

There is certainly some difference between the plants referred to *Lomaria*. Thus I have one from the *H. B. Kewensis*, in which the sori are really continuous, occupying a thick intramarginal vein (Pl. CXXXVIII. Fig. II. 4, *h*, *costa*) the veins are very indistinct, and judging from the back of the frond, very oblique.

Between this and *Stegania lanceolata* of Brown, there is no generic difference. Pl. CXXXVIII. Fig. II. 6. *a* outer, *b* inner vein, *c* costa.

Strutheopteris; in this, the inner involution is carried to such an extent that the scarious margin is carried under the sori, and there attached (Pl. CXXXVIII. Fig. II. 7.) *b. c.* outer costa an inner ditto a line of involution. In other words both involucre are confluent, the veins are stout, and carried beyond the sori (Pl. CXXXVIII. Fig. II. 8, *g* costa; *e* outer; *f* inner) which are situated on the ramifications of, and continuation of the secondary veins.

I am not certain whether the involucre are continuous. It is hence nearly approximated to *Blechnum*.

Onoclea. Shews that the involucre are not continuous.

The outer is involute, and the sections of the frond adhere: the inner are as membranous as those of *Strutheopteris*, are arched over the very large sori, and open externally.

The veins are prolonged beyond, and are solitary with respect to the *should be* lobes of the fertile pinnula.

There are receptacles, the sori are among the largest. *Onoclea*, and *Strutheopteris*, ought not to be disjoined, unless the general involucre of the former adheres to the partial one.

Blechnum—The general involucre is referrable to the inflexed margin of the frond as in *Pteris*, in some species of which, the frond is actually produced beyond the inflection; we may hence look for any amount of dislocation from the costa, forming a very natural passage into *Pteris*.

In no case does an involucre not having this origin, open internally.

It follows hence as a matter of course, that the intromarginal vein is far within the margin.

Thus a section will be formed, characterised by the prolongation of the margin of the frond beyond *the vein* to which will belong.

Blechnum.

Doodia.

Woodwardia.

What can be the reason that in *Doodia* and *Woodwardia* the sori are not continuous, they are enclosed in *Woodwardia* in cells, the sides of which are formed by the secondary veins, which is due to the bifurcation of these. As bifurcations very rarely bear sori, especially in the the congeners, it is due probably to it.

The venation of *Woodwardia* is remarkable, we have a short secondary, with a bifurcation which runs in the direction of the costa, giving off branches also on its outer edge. Pl. CXXXVIII. f. II. 9. these branches again are generally forked and anastomose freely from the junctions to the ultimate veins.

The fork is equally free in *Doodia*, in which other sori are occasionally added between the forks, (which appear to be rare,) of the tertiary veins; so that double *Blechna*, and double *Woodwardia* may occur: it is curious that as the fork is so constant in *Woodwardia*, they do not occur on it, for it certainly has two parallel intromarginal continuous veins.

In *Adiantum* the veins of the inflected portion which are capsuliferous, are obvious continuations of those of the frond;

although they are less distinct than these. It is a very well marked genus, and admirably characterised by Mr. Brown, its nearest affinity to fructification would appear to be in *Cryptogramma*, which differs chiefly in having the margins involute, not abruptly inflexed, and in habit. In *Lomaria* too, there is a similar arrangement: the sori occupying the upper part of the secondary veins Pl. CXXXVIII. Fig. II., 3. presenting a tendency towards occupying their whole length. Hence two modifications of form occur, in which all the veins are in soriferous:

1st. veins distinct.

2nd. veins running into an intro-marginal one, to this belongs *Pteris*.

Distinction may likewise be made between those with actually continuous sori, and those which have them only continuous by approximation.

Hemionitis cordata. The venation of this species is curious, it is reticulate, but that of the margins is incomplete, and it is only towards this that clavate-ended veins occur.

As in *Ophioglossum*, it is decidedly of a less perfect nature than the generality of the order.

As in that plant, the central vein is imperfect, and not to be distinguished in the upper part of the frond.

The fructifying frond is smaller than the rest, but its stalk is much longer.

Upper surface stomatose, under surface with largish, stomata, the mouth projecting beyond the surface.

The whole of the under surface corresponding to the veins, produces capsules, and what is curious, these in one and the same place, are of various ages.

It may subsequently be found that more natural divisions will be indicated by the venation than by any other single character.

Diplazium. In this I find that the midrib, or rather primary vein of the frond, as well as of the minor divisions, are smooth,

the outer surface of the lobes of the young pinnæ are covered with scales, which have or have not glandular terminations or appendages.

Under these occur nearly simple elongated hairs, with glandular terminations. I think but am not sure, that these are confined to the surface of the lobes, and do not arise from the costæ. The inner surface however, is that which presents these bodies of the largest size, they are about 4 times as large as the longer ones on the outside, and are more filled with the grumous matter, the granules of which are not definable by my $\frac{1}{2}$ inch simple lens, an incurvation of the longer ones, is generally apparent.

The outer squamiform ones are much like the ramenta so called, they are like these, toothed on the margins, the teeth being bifid, *i. e.* the two component cells are more or less divaricate at the apex, the union of the cells especially of these often present an appearance of a marked intercellular passage.

The ramenta assume the usual black brown colour; in those of the frond high up, the coloration is often confined to the marginal series of cells, and is due to exposure to the air; at first the colour begins at the first parts exposed.

This Fern therefore presents no greater peculiarity than the limiting of the most capitate hairs, to the inner face of the coil.

The perfection of the foviliform contents, is in proportion to the size of the cell; in the earlier stages it is much less opaque, nor is the cell so turgid.

Does this correspond with the development of glandular hairs?

The ramenta in this are confined to all parts of the stipes except the inner surface, this is covered with minute, white fluff consisting of irregular ramentiform uncoloured scales, and simple glandular headed hairs, which have not undergone much change, even when the stipes is a foot in height, and they are taken near its base.

In order to give greater semblance to my theory, it will be necessary to shew that there is a general tendency in these male organs to spring from the surface of the frond, opposite to that which bears the fructification.

Because in most *frondose* plants, it is so; the males protruding from the upper, the females from the under surfaces. It cannot be expected always to hold good in Ferns, because the male organs are superficial, while the females are often immersed, this is opposed to what takes place in most *Marchantiaceæ* etc. in which, except in *Anthoceros* and *Riccia*, the males are always superficial, but protected by a covering derived from the frond.

An objection will arise if these bodies do not generally appear to dehisce: but this only in reference to *Musci* and *Hepaticæ*, and particularly *Anthoceros*. For the relation that these bodies have to the male organs of *Phænogans*, is that of *Anthers* reduced to a single grain of pollen, and this single grain reduced to a single coat.

Are the anthers of the *Musci* and *Hepaticæ* composed of a single cell, or are they cellular, if they are cellular they are analogous to ordinary antheræ at an early period of development; if not, they are simple sacs analogous to single grains of pollen.

Is there any relation between the perfection of the male and the perfection of the female. (For in *Anthoceros* in which no female exists, the anthers are highly developed. A similar proportion exists in *Balanophora*, it is visible also in *Coniferæ* in which the anthers and pollen grains are all maximum of development.) If there is, it may be an arguments against my hypothesis.

The stipes of this Fern is chiefly composed of cellular tissue, which, towards the circumference is much more compact, passing into fibrous tissue suddenly enough. There are likewise two other systems, arranged parallel to the shorter diameter of the stipes, that towards the inner face of the stipes prolonged into obliquely transverse lobes, the outer part of each of these,

which are identical in form, consists of fibrous tissue precisely like that of the circumference, the inside is vascular.

The inner plates become separate afterwards, and appear to consist entirely of vascular tissue in the centre, much crowded, and of fibrous tissue on the circumference. The tissue of the circumferential fibres is not continuous, but forms two plates interrupted along towards the end of the outer lobes of the inner vascular fibrous system; the line of interruption has externally the appearance of a white cord running up along both sides of the stipes, near its inner angle, and suffering no interruption from the exertion of the pinnæ.

The white colour of these two is singular, because they are composed of the same greenish tissue, of which the bulk of the stipes consists; it does not appear to have stomata.

The inner general plates may become confluent by the innerlobes of their outer faces; It is from these that the vascular fibrous system of the pinnæ is derived.

The pinnæ have precisely the same organization, the same basis of cellular tissue, the same intro-marginal interrupted plate, the same inner confluent central one.

I believe that the white lines do have stomata, although I have not seen them, for they have precisely the same appearance as to under surface of the divisions of the frond.

In the primary veins of the pinnules the circumferential plate is *obsolete*, if it exists, it is only partial.

The axis has the same organization? its bulk is composed of dense white cellular tissue, surrounded by a pellucid mucilaginous looking margin, I believe of a sort of fibrous tissue, it contains more, or fewer plates according to its size.

Its growth is endogenous, as every growth must be, if a simple axis be assumed.

To investigate the reproductive organs in this family, it is in the first place necessary to submit the same individuals to examination, marking each young frond examined, so that it may be recognised in its adult state. Otherwise we shall have no direct proof as to what the changes are, that

may take place in the supposed male organs, supposed to have acted upon the females.

I have but little doubt; that these organs may assist us in limiting the genera.

How is it that the veins differ *so* in the points by which they give attachment to the sori.

Why, in this genus for instance, are the sori limited in the upper veins to their inner side, while in the lower, they spring from both sides; why are the compound supercurrent veins free from sori, except at the base.

What is the anatomy of the veins, what is it in the soriferous, what in the other portions?

Helminthostachy. This belongs to a very different type, its venation is precisely that of many other Ferns, and in this, as well as margination, it approaches to *Pteris*. The leaves are sub-terminal, an unusual disposition. The spike is densely crowded, with groups of capsules which almost in every respect closely resemble the carpella of phænogamous plants. What is more, the margin representing the involution is always internal, and we have besides somewhat of an attempt at the formation of a stigma, if not in function at least in analogy.

It is difficult to reconcile its structure with that of others nor has it much to do with *Ophioglossum*, and *Botrychium*.

The fructification cannot be considered as an altered frond, because it is too irregular, and because the capsules have no order. The lowest of those of each group are globular, and have no styloid process. These being confined to the upper.

Botrychii. sp. Pl. CXXXV. Fig. II.

Radices horizontales, carnosæ, caulis pedalis apice 1 foliosus, hincque et quasi folio opposit. sed infra et forsan ternatim, pinnæ fructifer pinnatifidæ. Fol. supra decomposit.

oblonga, dentata, tenera, subintegra oblongeque linearia, acuminata.

Thecæ, utrinque racheos l seriatæ globosæ transversisulcatæ, spicatum dispositæ, spicæ simplices saltem mediæ, inferiores compositæ, multithecatæ, vel pauci thecatæ.

Thecæ viridescentes, cellulosæ, transversim bivalves.

Sporulæ minutissimæ, albidæ in acervulum subrotundæ, angula læve.

In sylva, cum Thea. Kujoodoo versus, Tingree Feb. 1836.

The metamorphosis of the fronds is very evident in the composite axis of the fructification: the nature of the thecæ is very distinct, almost enough to warrant the total separation of the tribe from Filices? *It. Ass.* 405.

Platyserium biforme. Pl. CXXXVI. Fig. I.

Anthers? of *Platyserium biforme*.

Magnified 1-250 times.

(Stalk shortened.)

Antrophyi sp. CXXXV. Fig. I.

Epiphytica in arboribus, surculis brevissimis dense paleaceis, frondibus simplicibus lanceolato ensiformibus, integris, acuminatis carnosis, tactu mollibus, in stipitem complanato ancipito-attenuatis.

Venatio. Vena primaria frondis basin versus tantum subdistincta, cæterum frons occupata est, venulis anastomosantibus reticulas irregulares oblongas formantibus.

Sori lineares continui vel interrupti his impositi, rarius venulas connectentis occupantes, depresso parenchymate frondis nempe utrinque venarum soriferarum elevato.

In arboribus Cheikwar, Feb. 8, 1836.

The venation of this genus may in one view be compared to that of *Vittaria*, that is as consisting of a central vein, and many secondary ones running very obliquely, these being connected by branches, running either transversely, or downwards.

The most obvious difference is, that they do not coalesce, at least regularly with the margin. The stomata are somewhat peculiar, occupying a roundish areola to the upper margin of which they are attached, the two component cells are filled with greenish opaquish matter, and the line indicating their approximation is continued like a small bridge over the orifice.

The capsules are mixed up with a number cellular simple processes of a more red colour than the rings of the capsules themselves. The stomata must be examined again with better lenses than I have with me. *Il. Ass.* 394.

Dicksonia assamica Pl. CXXXVI. Fig. II.

Filix, surculo obsolete nec exserto, elegans, stipite supra planiuscule, lævi brunneo, sublucido. Fronde gigantea, 10, 12 pedali apicem versus nutanta, 3 pinnata, rachibus pinnarum junioribus furfuraceis, dorso planiusculo velutino. Pinnis (outline of) oblongo-lanceolatis, pinnulis linearibus acuminatis supra saturate viridibus glabris, subtus glaucis, secus nervum medium, et secus nervum medium laciniarum arachnoideis, arachna venulis tertiariis informa punctularum parce superjecta, laciniis oblongo ovatis, acutis, directione quoad nervum pinnæ medium paulo obliquis, crenato-serratis, basi confluentibus, acumine pinnæ tantum grosse dentato læviusculo.

Venatio vel secundaria primariave cujus lacinia ad apicem rect. secus axis ejus currit, ibidemque desinit, cursu tertiarias quæ sæpius, simplices aliquando bifurcatæ, emittens, hæ ad apicem cujusque serraturæ curvatim currunt ibidemque desinunt. Sinus serraturarum semper *diaphanus*! ut etiam sinus laciniarum.

Sori his impositi vel par singulum, binumve basim laciniarum versus occupantes, marginales obliqui, transversim oblongi, linea curvata extrorsum notati.

Indusium bivalve, transverse secus lineam curvata, dehiscentis, valvuli externi quasi foliacei, et quasi e margine frondis incurva format. magis magisque convexa interior minus con-

vexa, oblonga; venulæ apice originem ducens, exterius dehiscens.

Sori, summi pinnæ cujusque ut etiam pinnulæ cujusque, 1 seriati vel adpar unicum redacti. Indusium *exterius*, interiorius dehiscens obreflexionem in internum equitans.

Thecæ stipitatæ; venulæ apice insidentes; gyratæ in sporula argutata.

Indusii cellulæ sinuosæ; interioris, quid etiam tenuius, cellulæ ob ejus elongationem longiores, venula sorifera semper simplex.

Legi in ripas rivuli Manmoo, January 20, 1836, occurrence videtur inter Theam. Prope Nigrigam, Feb. 21, 1836.

D. assamica, Griff. Frondibus supra decompositis, foliaceis nutantibus; stipite rachibusque supra pubescento hirtis, subtus arachnoideis, laciniis oblongis crenato-serratis, subtus glaucis, subtus soris 2 vel 1 seriatis, involucris glabris, valvula exteriori minori. *H. Ass.* 319

1. Portion of a frond, shewing the sori in situ.
2. Ditto, ditto, back of the sori are generally much less evident on the margin next the axis, than the contrary.
3. Sorus just dehisced.
4. Ditto, in an advanced stage.
5. Young sorus bent over on its upper face to shew the origin or attachment of the inner indusium to the apex of the vein.
6. Transverse section of a sorus.
7. Vein; inner indusium and thecæ in situ.
8. Portion of outer indusium.
9. Ditto, of inner.
10. Thecæ, annulus represented too complete.
11. Sporules.
12. Arachna.

Plate. CXXIX. Fig. I.

This Fern was given to me by Dr. Voigt, and was gathered at Churrapunjee by Mrs. Voigt. It has much of the habit of

the genuine species of *Gymnogramma*, but differs from all these, as well as from every other ? Fern except *Cyathea* in the situation of the sori.

Sori rotundi in venularum furcæ insidentes (Indusium nullum) receptaculo communa elevato.

Ceterach. Pl. CXXXIV. Fig. I.

1. Pinna very young, viewed on its inner face quoad vernation, shews the difference in the ramenta, and the real scales; some of each removed where the green is represented visible.
2. Another Pinna, opposite face, or that which is afterwards the upper surface; the inflexion of the anthers most marked, as well as their change of direction after the functions are performed, scales not represented.
3. Young anther.
4. 5, 6, 7, 8, 9, 10. Anthers or ramenta, in various stages 6, 7. seemed open: 10 is meant to contrast with the ends of the real scales. 13, 14.
- 11, 12. Young scales, their difference in structure so far as concerns terminal cells, most marked. *It. notes* p. 326 no. 10.

Grammitis Adiantoides. Pl. CXXXIV. Fig II.

1. Plant natural size.
2. Base of axis; *a*, base of stalk of reniform frond; *b*, base of pinnate do.; *c*, male organs; *d*, young fronds; *e*, radicles.
3. Radicle portion of surface, shewing the confervoid nature of the finer radicells.
4. Young frond, surrounded by the male organs.
- 4.*a*, male organ ? detached.
5. Reniform frond, occasionally sterile.
6. Pinna of other frond.
- 6.*a*, $\frac{1}{2}$ ditto enlarged.
7. Capsule. 7*a* sporule.

Habitus et antheræ Adianti, a quo differt margine frondis non introflexo, et (capsules in furcas tam venas ultimas insidentibus. Elegans, pallide viridis, repens. In umbrossissimis humidis subtus rupes Otpore. *Itinerary Notes* p. 352. No. 123.

Adiantum. Pl. CXXXIII. f. II.

1. Young plant, the ramenta, appear about the 3rd. or 4th. leaf or frondule, mostly surrounding the base of the new shoot, their appearances and stages are represented above the young plants.
2. Young plant, 3 fronds detached, base of the 4th with a few ramenta, many of these are seen about the new shoot; 2, 2, 2, etc. represent their various stages, 2a. is one in which the functional changes appear to have occurred, a rare instance.
- 3, 3. Young ramenta; from the apex of axis, of new growth, which has a peculiar structure; c, old ramenta; a, apex of new growth, bidentate, b, vein.
- 4, 4. Functional ramenta from circinate frond, near the lower divisions; it is curious that the more simply constituted the ramenta are, the more functional do they appear to be.
5. New frond, young stage not emerged entirely from the ramenta of the axis; the direction of the anthers? shewn to correspond with the other instances, that is, they are in evident communication with the lobes of the frond, they are slightly yellow, in terminal cell, or colorless, but turgid with fluid, they are represented separately most are curved as in other instances.

STENOCHLAMYS *Nov. Gen.?*

Stenochlamys Edgeworthii Gr. Pl. CXXXVIII. Fig. I.

Fronde pedalis vel spithamæa, rachi glabra, lamina supra decomposita, potius bipinnata, apice 1-pinnata, pinnulis

pinnatifido-lobatis, venulis ultimis simplicibus, omnibus intra loborum apices imos terminantibus.

Sori, rotundati vel oblongi, medium circiter venularum ultimarum insidentes (rarius in furcis,) approximati.

Indusium membranaceum, fornicatim, forma varium, vel linguiforme, vel transverse oblongum, vel semicyathiforme, semper si in venula unica insidet basi *centricum* si in furcam basi obliquum.

Receptaculum inconspicuum.

Thecæ plurimæ (ratione indusii) stipitatæ. Sporula angulat. oblonga, scabriuscula.

Habitus Aspleniorum quorundam, aspectus fructificationis primo Aspleniaceus. Genus an novum; Asplenium et Aspidium inter medium? Ab Asplenio indusio centrico, et non laterali discrepans.

Mana, supra Budrinath, alt. 12000 in scopulos.

1. Pinnule magnified.
2. Division of a pinnule cut away.
3. Do. of a young frond; query does any change ever happen in increased development at a latish stage.
4. Lobe of a pinnule, capsule removed and indusium reflexed.
5. Sorus from underneath.
6. Plan of a sorus, and indusium.
7. Sorus from underneath.
8. Portion of a pinnule, indusia reflexed.
9. Represents a rare? case of a sorus infurcam insidens, indusio insertione obliqua.
10. Sorus from the front. indusium reflexed.
11. Capsule. 12. Sporules.

This Fern exists in the Herbarium of Mr. Edgeworth, B. C. S. It appears to me unlike any other India Fern. The apparent unilaterality of the indusia is curious, when contrasted with their usually central attachment.

The relation of the capsules to the indusium requires further examination. Do the capsules arise from an equilateral thickening of the vein, or from a more or less lateral one. If this is the case they would be Aspleniaceous, with a partial indusium.

In Mr. Edgeworth's herbarium other instructive forms occur, such as *Nephrodium Aspidioides*, having the lower sori those of a *Nephrodium*, the upper, those of a *Aspidium*.

There is in the same collection another species *apparently* of *Stenochlamys*.

Meniscium.—Frondebis bipedalibus l pinnatis, stipilibus supra sulcatis, velutinis pinnis suboppositis subsessilibus, lineari-oblongis acuminatis fere caudatis, crenatis, vena primaria utrinque pubescente, venatio *unita*; venæ secundariæ obliquæ intra marginem, arcuatim connectuntur, arcu venulas ultimas brevissimas clavatas, intra marginem desinentes, emittit. Tertiariæ cum secundaria angulum sectum formant et medio interstitio mutuo anastomosant.

Harum par infimum arcuatur externe et vero Menisciforme, reliquæ fere sectæ sunt. Hæ tertiariæ soriferæ sunt, angulo junctionis parum *soriferarum*, venula ultima oritur quæ inter spatium, et ejus medium circiter clavatim desinet. At hæ ultimæ peripheram versus magis evolutæ sunt, ita ut venula infima Menisciformi omnino desit. Sori oblongis venulis transversis tertiariis insidentes verno compositi, aspectu similes omnino nudi.

In sylvis densis humidis circa Kujoo Jan. 23, 1836. *It. Ass.* 323.

The above description of the veins refers alone to the soriferous frond, and this only when held up to the light, the ultimate veins originating from the angles, are when the frond is viewed as an opaque object, at least those towards the margin evidently coalesce into the composite vein. In the sterile frond the composite vein is complete from the greater

curve or the centre of the Menisciform vein to the centre of the intro-marginal arch.

Meniscium triphyllum, Pl. CXXXV. Fig. IV.

Filix præcedent. aliquoties minor cæspitosa. Frondibus, 3-phyllis, pedalibus, vel soriferis sesquipedalibus, stipitibus pubescentibus, supra canaliculatis. Pinnis oblongo-lanceolatis, caudato-acuminatis terminali majore, lateralibus alternantibus, nec oppositis, ideoque frons potius pinnata, 1-juga cum impari; sterilibus irregulariter repandis ut etiam fertiles.

Frondibus fertilibus duplo triplove minorib. quoad saltem pinnarum magnitudinem, venatio et situs ut etiam forma sororum omnino ut in præcedente venulæ venæque secundariæ ut in præcedente in pagina frondis supera prominulæ, et ut in eo venula infima quæ in soriferis Menisciformis in sterilibus, angulata, ita ut 3 angulus oriatur cujus parietes sunt, venæ primariæ, ut hæ venulæ, vena composita etiam quam maxime exidens est.

Cum præcedente hinc illinc copiose occurrit.

1. The fronds, or at least the pinnæ of this genus are, I think simple, the compound vein shews no signs of originating partly from confluent margins of pinnæ, which in some Polypodia it certainly does. Bearing this supposition out, is the fact that the sinuses of the lacinie are frequently diaphanous, as are likewise those of the serratures etc. when such happen to be present.
2. This genus is an arbitrary one, it is nothing but a Polypodium of which the sori are, quoad each vena secundaria, utrinque seriata, and which are confluent.
3. *Meniscium delligerum*, is a *Meniscium*, *Hemionitis*, and *Polypodium* in one and the same pinna.
4. From *Grammitis* it differs only in the sori not being "venulæ unicæ insidentes."
5. Species nuperius descripta, præcedento quam maxime

affinis, differt tantum numero pinnarum: An planta tantum junior. *It. Ass. 324.*

Meniscium.—Stipite supra canaliculato profunde: subpaleaceo, fronde 3 4 pedali pennato pennis oblongi linearibus: acuminatis caudatis breviter stipitatis basi cuneatis subobliquisque, infra subglaucescent.

Venatio: (on the principle of) *unita*, ast venulæ e confluentia tertiarum obliquarum ortæ, non completæ, et nec confluentis, sed clavatim desinunt interstitiorum media supra.

Sori oblongi sæpissime confluentes, raro discreti tertiariis impositi nudi.

Cum Polypod. 442, sed fructiferum rarum omnino intermedium inter Polypodium et Meniscium nullo modo distinguendum. *It. Ass. 333.*

Lindsæa, Pl. CXXXV. Fig. V

Caulē paleaceo scandente in arboribus et radicante. frondibus ambitu linearibus sesquipedalibus pinnatis, rachi tetragona subglabra, Pinnis alternantibus acinaciformibus, breviter stipitatis, margine inferiore interiorique rectiusculo, integerrimo, supero (sorifero) irregulariter dentato, quam maxime obliquis.

Venatio obliquissima, secundaria secus marginem inferiorem et prope eum currens, hinc venulas nec emittens. Tertiariæ cito bifurcæ, hæque vel simplices vel apices versus internem furcatæ sunt, (præsertim venulæ inferiores cujusque pinnæ) et intra marginem desinunt.

Sori his compositi intro-marginales oblongi magnitudine variantes relate ad venulas, si venulam unicam terminant parvi, si duas oblongi distincti vel præsertim basilares confluentes. Indusium e venulis, vel si e 2 e venulis interstitusque

ortu, membranaceum extus dehiscens, ast introrsum flexum. Venulæ quoad distantiam e vena formaria directione variæ his proximis vena ascendens, et cum ea parallelis, illis distantioribus magis magisque obliquis.

In arboribus in sylvis inter Kujoo, et Soorall January, 24, 1836. *It. Ass.* 325.

Genus certe Proximum Davalliæ, certe species Lindsææ confr. Br. char, Pr. 1. 12.

Davallia differs so much in habit that it probably contains some new genera, as it certainly does, subgenera. It appears to me that those species which have an involucre attached by the sides, will form one natural subdivision; of this I have one or two species, and the following of Hookers Icones will also belong to it.

D. contigua, 2. t. 141.

„ *flagellifera*. 2. 183?

„ *emersoni*. 1. 105.

Davallia parvula, 2-t—138. is very probably not a *Davallia*, although it has the habit of some, for according to the authors, it can only be a *Davallia* provided the lobes of the pinnulæ are veinless, in which case the sori may terminate the primary vein, although this would be opposed to all analogy.

The passing over the veins by the authors, depends upon the thickness of the divisions of the fronds, which appear to be almost cylindrical.

D. lobulosa of the same work is probably a mistake: for the venation of the barren and fertile fronds is so unlike, as far as can be judged from the drawing, while the habit of these is quite opposed to *Davallioid* structure.

My species is very distinct, there is a tendency in it, to have the involucre confluent with the margin of the frond, but none to have this inflexed, it approaches to *Dicksonia*, differing only in this last particular.

Both veins terminate in sori.

This is not uncommon in *Davallia*, and is the first tendency

to a passage into *Lindsæa*, *Adiantum*, and *Pteris*. It is curious that in such cases the habits approach also to these, while in others which have the usual venation the habit is that of *Aspidium* etc.

Davalliæ sp.—Fronde decomposita, 4. 5. pedali, stipito pubescente, Pinnulis, profunde pinnatifidis obliquis laciniis oblongis truncatis lateri superiore, inferiori minoribus rotundatisque subirlegis.

Venatio.—venæ secundariæ cuique laciniæ venulam tertiam oblique dant, hæ quartariæ margines versus currentes emittunt, sæpius infra medium bifurcæ, rarius simplices, omnibus intra marginem clavatim desinentibus.

Sori paucissimi utrinque pinnula biseriatu venulam quartariam si simplex est vel ejus ramulum internum quoad secundariam, (primariamve laciniæ,) insidentes rotundato intro-marginales.

Indusium ex apice venulæ unicæ semper oritur membranaceum, nec deflexum, lateribus centro alius insertis, adeo ut cum fronde cupuli modum format.

In sylvis inter Kujoo Soorallque. January, 24, 1836. No sori are ever developed inside with regard to the *rachis*, two are occasionally developed along the outside. *It. Ass.* 326.

Davalltæ sp.—Stipitibus sub 4 gonis superne sulcatis, hispidis præsertim bases versus, fronde sub 3 pedali, 1 pinnata. Pinnis alternantibus brevissime petiolatis, cuneato-linearibus, basi supraque sub auriculatis, acuminatis, crenatis serratisque utrinque secus venas parce pubescentibus.

Venatio, primaria cujusque pinnæ ad apicem flexiuscula currit, introque cum clavata desinet, cursu emittens venas tertiarias quoad stipitem, harum omnes duabus basilaribus tantum exceptis, medium versus furcatæ sunt, furcis intra marginem clavate desinentibus ramo interno tantum vel duobus soriferis. Basilares simpliciter ramosæ, sunt soros tantum in partem externam quoad stipitem gerentes.

Sori intromarginales rotundato distincti, venula unica insidentes. Indusium ex ejus apice ortum directione paginæ frondis, minime revolutum capsula sistens cum fronde, extrorsum dehiscens.

Cum præcedente Jan. 24, 1836.

Species præ aliis distincta, habitus Pteridis cujusdam. *It. Ass.* 327.

Pl. CXXXII. *a.* Lobula of a *Davallia* in Mr. Edgeworth's herbarium, very much like a *Hymenostomum*. Frons membranaceo, indusio texturo consimile annulato verticula.

Vittariæ sp. Pl. CXXXV. Fig. III.

Epiphytica in arborib. frondibus longiuscule tereteque stipitatis $1\frac{1}{2}$, 2 pedalibus linearibus, subcoriaceis nec carnosis, acuminatis, undulatis, saturate viridibus simplicissimis.

Venatio. V. secundariæ obliquissimæ margines versus currunt. introque confluunt. vel simplices, vel rarius bifurcæ sunt, vel apicibus exceptis omnino discretæ, vel ramuli anastomosante, rarissime nexæ.

Sori marginales continui lineares vena intromarginale *composita* insidentes.

Involucrum duplex, consistentia frondis, externum, crassius, minime progessere involutum! internum minus foliaceum rectum.

In arboribus inter Kujoo et Soorall. January 24, 1836. *It. Ass.* 328.

Species distinctissima, primo aspectu *Antrophyum* omnino referens, huic affine ob venationem progessere? quasi compositam.

Vittariæ fronde longe stipitato lineari undulato, venis interdum furcatis, et anastomosantibus.

Asplenium.—F. Cæspitosa bi-tri-pedalis, stipite glabrato lævi tereti usculo supra canaliculato fronde pinnato, pinnulis

alternis sub quinis, an semper, lanceolato, oblongis, acuminatis coriaceis (dull green,) denticulate vel apices versus serratis.

Venatio. V. secundariæ cujusque pinnæ distantes alternæ, a basi etiam vel axilla supra ramum simplicem emittit qui marginem versus currit et intro cum curvatim et clavatum desinit. Ramus alter e latere inferiore emittit, cujus cursus terminatioque idem, denuo vena ipsa continuatur et medium circiter bifurcantur. Incisæ eodem modo dispositæ sunt. Terminatio venarum omnium diaphana. Interdum ramulus inferus *obliteratur*, interdum tertiariam additionalem e latere superiore secundariæ emittitur.

Sori continui lineares tertiariis hoc modo impositi, nempe *utrinque* venulæ ex axilla secundariæ emissæ ideoque sori duplices. Simples sunt in vena secunda infima: ut etiam tertiariam additionalem cum adsit!

Indusium lineare membranaceum, interne cum simplicia dehiscens. hæc dimidio ut etiam sori breviora sunt.

Venulæ secundariæ apices versus tantum bifurcæ tuncque sorus germinatus et ramo supero insidens, acuminis simplices sunt tuncque sori semper? simplices.

Pinnæ infra albidæ sunt.

Cum præcedentibus. Jan. 24, 1836. *It. Ass.* 329.

Stirps quam maxime instructiva ob geminationem sororum et eorum simplicitatum acumina si *Diplazii* species, generis arbitrarii et vix tenendi cives sunt.

Asplenium.—Stipitibus basi paleaceis atro viridibus sub 4 gonis supra profunde lateque canaliculatis, fronde, 2, 2½ pedali, pinnis alternis sub oppositisve, sessilibus, *basi cuneatis* pluribus, lineari oblongis, acuminatis lobulatis? lobulis crenatis, acumine serrato coriaceis, supra atro viridibus subtus pallide. *Venatio* fere omnino ut in præcedente sed ramuli omnes, furcæ ultimæ exceptis soriferis; axillaris superique sori geminati sunt reliquorum simplices apices, quando venulæ bi-

furcæ geminato sunt in ramulum superum, si vena ut in acumine simplex, sorus etiam simplex.

Cum præcedente, Jan. 24, 1836. *It. Ass.* 330.

F. stipite basi paleaceo, fronde pinnata, pinnis pluribus, sessilibus basi cuneatis.

F. stipite basi paleaceo, fronde pinnata pinnis subquinis in petiolulatis, basi ovatis.

Asplenii sp.—Fronde bipinnae 4 5 pedalis, stipite supra late canaliculato, pinnis alternis breviter stipitatis, profunde pinnatifidis acuminatis, laciniis oblongis, dentatis, acumine etiam dentato, supra saturato viridibus infra albidis. *Venatio.* Vena primaria cujusque pinnæ paulo oblique secundarias laciniarum emittit cursu tertiarias, quæ basin pinnulæ versus furcatæ, cæterum sæpissime simplices emittit, omnes intro-marginem clavate desinunt.

Sori his impositi, sæpius basim versus simplices apicem versus geminati: si venula furcata ejus ramulum superum occupant depressi! Indusium lineare continuum membranaceum, quando *singulum* intus quoad venam primariam pinnulæ dehiscens.

In sylvis cum præcedentibus. Jan. 24, 1836. *It. Ass.* 331.

A little below the apex of the frond, the sori situated on the upper vein of each secondary one, are generally geminate. In these the pinnæ are dentate, not deeply pinnatifid. There appears to be no correspondence between the gemination of the sori, and the composition of the veins,

Asplenii sp. Pl. CXXXII.

Filix habitu *Asplenii*, 1 ½ pedali, rachi alba glabra. Frons ambitu oblongo-lanceolat. bipinnat. pinnis alternant. Pinnulis pinnatifidis; divisione oblongis, summis exceptis, apice

bilobatis, consistentu foliaceo ; venis (pinnulum) secundariis in venulas abeuntibus, simplicibus ; venulis ad lobulorum apicés current.

Sori oblongi in venulas oblique insidentes, in lobulis solitarii.

Indusium membraneum oblongum fornicatum basi obliqua insertum, introrsum liberum.

Receptaculum nullum, conspicuum, capsulæ stipitatæ.

1. Pinnule of a young frond ?
2. Do. Do. of a frond covered with sori.
3. Portion of no. 1.
4. Portion of no. 2.
5. Portions of nos. capsules removed, and the indusium bent back.
6. Same represented, one or two capsules remaining.
7. Shews lateral insertion of indusium and its attachment to an ultimate venule.
8. Capsules. 9. Sporula.
10. Represents a nephrodioid sorus, seen vertically and obliquely.

The venation of the divisions of the pinnulæ is simple ramose ; one branch supplies each lobe, and on it on one side (never on the common vein) is situated the indusium.

In one instance a distinctly Nephrodeoid sorus was seen.

When the sori are limited in number : they always exist on the lowermost and uppermost of the venules of the division.

Varies a good deal in habit : the divisions of the frond being occasionally ? crowded with sori and constricted : the midrib of each pinna especially of the lowermost, caudately elongated, and the pinnulæ reduced to simple falcate Dareoid lobes.

The upper surface of the *main* vein of each pinnulæ, has on either side, an elevated ridge, from which, opposite to the base of the lobes arises, a stout subulate fleshy process.

The same occurs, but of smaller size, on the midrib of each of the lower lobes.

Pl. CXXXIII. Fig. I.

I have just had an opportunity of examining a species of *Asplenium*. Precisely the same circumstances occur, the same capitate antheriform cell, terminating the hairs, followed by the same loss of turgidity; the same coagulation, but perhaps the same incurvation to a more remarkable degree, for in many cases the centre of the body is occupied by what appears to be a dark brown tube. It is curious how invariably this change of colour takes place along the lines of union of the cells; thus the tube when the cells are binarily superimposed, often appears toothed. The lowermost bodies may perhaps become subsequently ramenta, but most, if not all of those on or about the lobes remain unchanged, except in becoming charged with brown colour, and fragile.

Tendency to peltation at the base of the ramenta, each division ending in an antheriform cell, is this an exception against my idea; it shews great tendency to confervoid growth.

The anthers are very numerous, and are not confined to the dorsal surface, although they appear to be more common there than elsewhere. I must keep this in mind; can it be connected with the indusium: one thing is obvious, that the first changes in indusiate and ex-indusiate Ferns, are precisely the same.

Judging from this I should say that the first appearance of fructification takes place at a later period in indusiate, than in other Ferns: *Adiantum* is not truly indusiate.

The anthers are often as abundant on the sterile, as on the fertile fronds; how is this to be explained? it shews tendency perhaps to revert to the usual ——— which is to have dioicous organs.

1. Pinna of a very young frond.
2. Supposed anthers, before fecundation.
3. „ „ after fecundation.
4. „ „ at a still later period.
5. „ „ do.
6. Tendency to peltation at the base, and antheriform nature of divisions of an anther, passing into a ramentum.

7. Male organ from an adult fertile frond, shewing that they are not subsequently submitted to change of form.

The curious coloration, which invariably follows the inter-cellular lines, is inexplicable, it generally is developed from above downwards, where it becomes ramified as it were among the cells, whenever the base is broad. In this plant it is not complete in the uppermost cells for a *long time*? but passes off towards these, gradually into a lightish yellowish brown coagulum. *Otipore April 13th. 1840.*

Polypodii sp.—Stipite infra glabro, superne canaliculato, supra velulino. Fronde 1 pinnata, 3 pedali, pinnis alternantibus subsessilibus, oblongis longe caudatis basi rotundatis serratis, repandisque? utrinque secus venas primarias pinnarum pubescens, venatio unita omnino ut in Meniscuis nuper discriptis in venularum summarum apicibus cum margine cartilagineo coalescentibus.

Sori rotundati, quoad interstitia venarum secundariarum biseriati, medium versus venularum tertiarum impositi his venarum infimarum sæpe confluentibus.

Cum præcedentibus, in January 24, 1836. *It. Ass. 332.*

Aspidii sp.—Stipite sub 4 gono, intro pinnas pubescente et subflexuoso fronde 3-3 $\frac{1}{2}$ pedali pinnata. Pinnis subsessilibus linearibus acuminatis, profunde dentatis, consistentia foliacea.

Venatio unita: ideoque tertiariæ simplices in partibus, liberis frondis sori lobulis clavatim intromarginem desinunt, cæterum confluunt vere compositi brev.

Sori his tertiariis medium versus impositi rotundati.

Indusium generis?

Cum Meniscium 333, in Jan. 24, 1836. *It. Ass. 334.*

The compound vein with the exception of that part arising from the union of the lowermost tertiary veins is irregular,

and perhaps most diaphanous. It results I think as much from the union of the margins of the lobes as from the mere union of the veins.

The *lower* pair seems to be always naked.

Allantodiæ sp. Pl. CXXX. Fig. III. and IV. parts marked *a*.

* Stipite flexuoso, supra canaliculato, frondibus 3 pedalibus, bipinnatis, pinnulis alternis, oblongis, fere pedalibus, pinnulis alternis sub oppositisve, breviter petiolatis profunde pinnatifidis, laciniis oblongis, linearie acuminatis, serratis, subtus subglaucescentibus.

Venatio, V. secundariæ, cujusque pinnulæ, primariæ cujusque laciniæ rectiusculæ, a basi tertiarias breves brevisimis præsertim infimas emittit alternantium. Hæ plerumque cito bifurcantur, quartariis ad marginem currentibus, cum eo in dentitum axes sub clavatim confluentibus. Tertiariæ laciniarum infimarum apices versus simplices: laciniarum summarum omnes simplices sunt, interdum sed raro simplices sunt etiam basi laciniarum infimarum, venula additoria aliquando ramulo infero bifurcationis additur.

Sori vel tertiariis si brevibus, vel tertiariis et quartariæ superæ basi si tertiariæ brevissimæ impositi, oblongi convexi.

Indusium fornicatum e venulæ margine supero oritum, insuper venulam deflexum demum ascendens in thecarum acervulam, celluloso reticulatum, margine fimbriato, lacerum intus dehiscens. Thecæ annulatæ verticaliter, stipitatæ.

In collibus Naga dictis, altitudine 1000 pedum circiter. March 12, 1836.

Vix dubito quin sit species Allantodiæ genus ab Asplenio divisum structura indusii et quoad hanc speciem situ composito tororum. Habitus hujus aspleniaceus. *It. Ass.* 427.

Alsophilæ sp. Pl. CXXX. Fig. III. and IV. parts
marked c.

Axis solida conica cellulosa, stratis ligneis vasculosisque sinuosis brunneis peripheriam versus intersectis.

Caudex arborescens, 20, 30 pedalis, apice attenuata basin versus radiculis fibrosis, lignosis brunneis inextricabili (interlaced) hinc densioribus valde ampliata, cæterum scabra, læviscula cicatricibus petiolorum lapsorum notata. Cicatrices medium versus elongatæ, apice versus abbreviatæ, (diamond shaped) intermediis obovatis, interstitia hinc subnulla, illinc ob elongationem axeos evoluta.

Frondes 6-7 pedales, supra bipinnatæ, stipites glabriati, convexi, superne bi-canaliculati subglauci, novelli ramentis pilisque cellulosis ferrugineis vestiti.

Pinnæ a frondis medio excerptæ bipedales pinnulis alternantibus plurimis, sessilibus ambitu sub linearibus, profunde pinnatifidis, laciniis sub acinaciformibus nempe interne curvatis linearibus obtusissimis subintegris, supra læte viridibus, sublucidisque infra glaucis glabris.

Vena primaria rectiuscula, infra convexa prominula. Secundaria (primariæ cujusque laciniæ) axiles utrinque sed præsertim subtus prominulæ. Hæ paleis brunneis minimis paucis que stipantur. Tertiariæ supra paullo depressæ alternantes oblique: cito basi supra bifurcatæ in quartariis, quæ admarginem currunt et cum eo confluunt, summæ cujusque laciniæ simplices sunt, sinus laciniarum cartilagineo hyalinæ. Sori subglobosi, utrinque V. primariæ cujusque laciniæ 1 seriata, et approximata imo contiguæ, sessiles in apice venularum secundarium!

Indusium? inferum, saltem sororum maturatorum fimbriato lacinum tenuissimum.

Receptaculum subglobosum.

Thecæ sessiles, annulo incompleto.

Sporuli brunnescentii, subtriangulares vel hinc convexi, hinc angulati, minutissime scabrelli.

Hanc filicem nobilem, quam speciem *Alsophilæ* esse judico, non obstante, indusio obsoleto, legi ad pedes collium Nagadictorum, Martio. 12, 1836.

Si nova species sit dicatur *A. Sollyana*.

Pl. CXXXI. Fig. I.

1.' Pinna.

2.'2.' Lobes of pinna and sori in the dry state.

3.' Ditto a lobe in the moist state.

4.' Long section of a lobe and fructification.

This plant belongs to the same genus as the *Cyatheo-Dicksonia*, from which it differs in habit in the involucre being less membranous and closed, and the pedicellate capsules, which appear to fall off leaving their stalk behind.

Sori marginales. Involucre exsertum cyathiforme, margo externus e margine frondis incurvata constitutus. Capsulæ pedicellatæ. Habitus *Davalliæ*.

Frons 1 $\frac{1}{2}$. pedalis; tenera, 1 pinnata ambitu oblongo linearis, stipes albus. Pinnis confertis alternantibus pinatifidis apice lobatis lobis dentatis.

Costis (pinnarum ultimis) inconspicuis, venulis secundariis tot quot lobis, et his respondentibus.

Sori marginales rotundati.

Indusium sporulis substrat. clausum membranaceum: lateri exterior. sæpissime cum margine intra flexo, frondis confluent demum aperiens; margine lacerum et subbilabiat. Receptaculum elevatum o, capsulæ subsessiles sporula lævia.

Infra Budrinath. Mont. Himalayensium. Mr. Edgeworth.

This Fern appears to me intermediate between *Dicksonia* and *Cyathea*, or *Alsophila*, with the former it agrees in the inflexed margin of the frond, assisting in the formation of the indusium, in the subbilabiate dehiscence of this, and in the venation, or rather in the sorus being terminal (on the venules.)

With *Cyathea*, it agrees in the indusium being continuous and nearly entirely capsulis substratum; besides which, the sori are occasionally, especially towards the ends of the pinnae, decidedly intro-marginal; with no inflexion of the margin of the frond. But in these instances we may assume that the formative force is partially expended, and that in consequence of this, the indusium assumes a simpler form.

In one instance I have seen a real *Cyatheous* indusium, with an inflexed process of the margin, equitant on the indusium. see fig. 8.

Pl. CXXXI. Fig. I.

1. Frond rather larger than natural size.
 2. Portion of pinna.
 3. Ditto ditto more enlarged.
 4. Sorus and portion of pinna shewing a subbilabiate dehiscence of indusium.
 5. Sorus and Ditto shewing that it is not always marginal.
 6. Sorus and Ditto shewing a genuine *Cyatheous* form.
 7. Section of sorus; the capsules ought to be nearly sessile.
 8. Shew an equitant, but free inflexed margin of leaf and *Cyatheous* sorus.
 - 9.,9. Capsules.
 10. Sporules.
- Seharanpore Dec. 26, 1840.*

Cyatheoides, Pl. CXXIX. Fig. II.

1. Portion of frond.
2. Do of pinnula upper surface.
3. Do under.

4. Longitude section of sorus,
5. Vertical views of sorus with portion of pinnule, the hairs spread out.
6. Hairs of receptacle.
7. Theca.

This has the habit of *Cyathea*. The sori occupy the tertiary veins, and are never found on the fork of the central one.

The receptacle is much developed, the theca subsessile and immersed in the hairs which are of very irregular form, and not unfrequently cohere. With *Trichopteris* it agrees in habit, but the venation is different, and that genus has no receptacle, it agrees also with it in the subsessile theca, and in the form of this organ. Whence my specimen came I am unaware.

It agrees almost entirely with an *Alsophila*, I have from Gubroo Purbut, (Assam.) in which the indusium is reduced to a series of hairs, and these are likewise produced from the receptacle. The principal distinguishing mark of *Alsophila*, is the situation of the sorus.

Did the hairs only originate from the base of the receptacle, the plant would be nothing more than a *Cyathea*, but as they originate from the whole of its surface, it is distinct.

It will perhaps hence appear, that the receptacle of *Cyathinæ*, is the most permanent character, as might be expected from *Woodsia*, and those species of *Alsophila* in which the indusium is obsolete.

In *Cyathea longifolia*, as Brown has pointed out, the sori are on the lateral veins. In *C. venulosa*, which has a similar habit, the pinnulæ being entire, the sori have a similar distribution, but occasionally occupy a furcature. The habit of these are so distinct from the true *Cyatheæ*, that there is no doubt of their forming a distinct genus. They agree in habit with the present subject. *Cyathea sinuata* Hook. et Grev. vol. 1 t. 106 will belong to the same as *C. longifolia*, and *C. venulosa*, if its simple frond is not sufficient to distinguish it.

Kaulfussia assamica Gr. Pl. CXXXVII.*As. Res. Vol. 19 p. 108. Macrostoma. id. MSS.*

1. Portion of the frond viewed on its inferior dorsal face.
2. Capsule viewed vertically and on its lower face.
3. Ditto ditto upper face.
4. Ditto longitudinal and central section.
5. Ditto transverse section, towards the middle.
6. Portion of the membrane of the cells.
7. Sporules viewed as opaque objects.
8. Ditto immersed in water.
9. Long section of a portion of the frond, carried through one of the stomata.
10. Stoma viewed vertically, and exteriorly.
11. Long section of the apex of a rhizoma.

 Pl. CXXXVI. Fig. III.

1. Leaf with the sori-like productions.
2. Sporules which are always (geminate ?)
3. One burst by pressure, shewing the escape of the inner membrane, and of the grannules contained in this latter.
4. Inner membranes detached by pressure, some are ovate, others appear geminate. X.
5. Nostoc ? 6 in portion of the membrane and globules or sporules.
7. Moniliform annulate body.

I have described this down to the mark X as Cryptogamous. I believe however that it is not; it has the habit of Helleboreæ. The pustules are the fructification of a Puccinia, especially *P. variabilis* Grev. Vol. 2. t. 75. The round globules of another genus, perhaps allied to Nostoc.

The pustules are not, confined to the leaves but occur occasionally on the petioles.

Sent from Munnipore, Nov. 23, 1834.

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ERRATA.

- Page 277 line 3 from bottom for radiaton read, *radiation*.
" 278 " 9 " top for spagnoides read *sphagnoides*.
" 377 " 15 " bottom for Orthotrichum read *Orthotricha*.
" 400 " 10 " bottom for Orthotrichum read *Orthotrichum*.

END OF PART II.
