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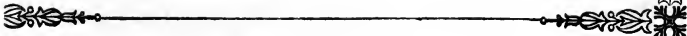
NORTH AMERICAN LICHENES,

WITH

AN ESSAY

ON THE

NATURAL SYSTEMS OF OKEN, FRIES, AND ENDLICHER.



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AN
ENUMERATION
OF
NORTH AMERICAN LICHENES,
WITH
A PRELIMINARY VIEW OF THE STRUCTURE AND
GENERAL HISTORY OF THESE PLANTS,
AND OF
THE FRIESIAN SYSTEM:
TO WHICH IS PREFIXED
AN ESSAY
ON THE
NATURAL SYSTEMS OF OKEN, FRIES, AND ENDLICHER.

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*"Ibis honestus,
Postquam egregiam tu quoque sortem
Nactus abis, dextri prece sollicitatus amici."*
MILT. SYLV.

CAMBRIDGE:
PUBLISHED BY JOHN OWEN.
1845.

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PREFACE.

THE preface, as the last part of an author's work, gives him an opportunity to review what he has written, to express his own sense of its merits and defects, and to put it in a true light. It is, then, my wish to introduce the preliminary sketch as valuable only for what it presents of truth of the systems it treats of, and as making no claim to other consideration. I feel too deeply the difficulty and the importance of accurate knowledge, to be willing to venture any opinions of my own on the topics of this paper without hesitation. Such reflections as occurred to me in writing it I have however set down, in the order in which they arose, and the manner which then suggested itself. The whole is very imperfect, but it contains what it purports to, and I am unable to devote more time to its adornment.

What follows is a View, as complete, so far as matter goes, as I can make it, of the present received doctrine of structure and metamorphosis in Lichenes, with such portions of the general history of these plants as seemed appropriate. There is nothing, to my knowledge, in English, which fully presents the views of the modern Swedish and German lichenists, nor are such introductions as that of Fries to his "*Licheno-graphia Reformata*" fairly appreciable by any but quite advanced and experienced cryptogamists. The whole of this part of the treatise is but a shadowing out of the Friesian method, with such other matter as I could bring together from Meyer, Wallroth, Eschweiler, and Luyken.

The System, at the end, comprises, it will be seen, a complete *conspectus* of all the European genera, and also a synopsis of the North American species which are satisfactorily known to me. This affords a tolerable view of lichenose (and, to some extent, byssaceous) vegetation in the northern half of North America, but it is, I fear, much less complete as respects the southern, except in so far as species and genera are common (which to great extent they undoubtedly are) to both districts. In the extreme south, some tropical genera are probably more or less represented, and no doubt numerous species occur, which are not found either at the north or in Europe. The whole number of our species here set down, excluding *Byssaceæ*, is 209, which is about 70 more than the largest and only general American catalogue contains; the species in this last being reckoned according to the principles which are expressed in my own. We have, then, as yet known, 43 species less than Britain, 61 less than Switzerland, 105 less than Sweden, and 111 less than France. In fact, however, it is quite probable that we have many more species than the richest European district, on the whole, if not in all particular genera.

I will add a single remark, which was meant to have been introduced as a note to a passage of Oken, afterwards left out. His system of materialism is so simple, so old, and so entirely hypothetical, that a naturalist may be pardoned the unwillingness to meddle with it at all. This I will do only to notice what follows, especially as it gives me the opportunity to reply in some harmonious words of another, who is less known than, perhaps, he deserves to be. The pertinent question, — why, if nature has

brought forth of itself all natural bodies, this law of nature has, at least within the compass of scientific history, ceased to manifest itself, all apparent exceptions being not only disputed, but at the best mere isolated contradictions to the whole tenor of knowledge, and in large part, perhaps, subjective,¹ — Oken can answer only by saying, that the relations of things have been altered already as much as they can be: — weil sie sich schon so viel geändert haben, als sie konnten, (*Naturgesch.* v. 2, p. 255), — which is not only too unsatisfactory, but altogether too stale, it being precisely Lucretius's way of attempting to escape the difficulty, which eighteen centuries ought to have improved upon, at least.

“Jamque adeo affecta est ætas; effætaque tellus
Vix animalia parva creat, quæ cuncta creavit.

Sed quia finem aliquam pariendi debet habere
Destitit, ut mulier spatio defessa vetusto.”

(*Lucr. lib. ii.* 1150, v. 825.)

And we may be well content, for our parts, to say, with the cardinal de Polignac's *Anti-Lucretius*²: —

“Sed quis eos sætus ipsa in tellure creavit?
Vas est, non opifex. Hic te tua fabula fallit
Et jugulat.
Impietas huc usque virum insanire cœgit!
Numine destructo, Fortunæ tradidit amens
Numinis officium! Quam prudens quamque benigna
Hæc Fortuna fuit! Quæ munificentia major,
Aut quæ cura magis materna in rebus alendis!
Qui talem agnoscit casum, non indiget ullo
Numinis auxilio: quin casum haud esse fatetur,
Invitusque DEUM commentis ponit in ipsis.”

CAMBRIDGE, 1st May, 1845.

¹ Fries has some observations upon this, which, as coming from a botanist of all others most familiar with the obscure forms of vegetation, wherein nature is supposed by the theorists itself to generate, are worthy of attention. “It has happened,” he says, “with Botany, as with the geography of the ancients, that to unknown regions, various phenomena, irreconcilable with the laws of nature, have been attributed, which, with advance of knowledge, have been transferred to regions yet beyond. So Cornari's theory of the transmutation of phanerogamous plants, and their equivocal generation, is driven now to the cryptogamous tribes. If there be among the lowest of these tribes some facts which seem to prove original generation in their case, it is, on the other hand, most certain that many of the gravest enigmas of this sort have, with fuller knowledge of the matter, vanished: — and the plants themselves even turned out to be no plants, but only mere *residua* or *exanthemata* of vegetation. For myself, I will here testify, that I have found the propagation of the lowest plants, in so far as I have understood it, equally normal and regular as that of the higher.” — *Lichenographia*, p. lv.

² *Anti-Lucr. lib. vii.* 118.

A VIEW

OF THE

NATURAL SYSTEMS OF OKEN, FRIES, AND ENDLICHER.

“Naturæ non imperatur, nisi parendo. . . . At qui formas novit, is naturæ unitatem in dissimillimis complectitur.” — BACON.

WE may view nature either as a whole, or as a whole subsisting in a multitude of distinct parts. With the former is especially concerned the speculative, and with the latter the empirical Natural Science. The speculative science, or the philosophy of nature, seeks to explain this objective generally, and its relation to us, and its ultimate end is also the end of all the researches of naturalists. In these researches we observe a constant tendency to arrive from nature at intelligence, to bring into nature theory. The perfect completion and satisfaction of all this will be found in the subordination of all nature under laws of intelligence; in the final knowledge of that absolute Unity, which comprehends the omniformity of being.

There is in all natural bodies a tendency to an individual and separate nature; this individuality is manifest in animals and plants, and is asserted also of minerals, from the definiteness in these last of the proportions of their chemical constituents. It is this which makes the empirical natural science possible, and in individuals and their relations it has its beginning and entire scope. We may from this run through the history of our studies, from general science arriving at botanical, and thence, from past researches, at those to which this essay is devoted.

The savage becomes acquainted with the animals of his neighbourhood, and the trees and herbs which he has found useful or hurtful to him. But his knowledge of them is not science, any more than the similar acquaintance with nature of the unthinking man of our own day. It is in the sage, the medicine-man of the savage tribe, that I find the first gleams of the twilight before the dawn of science. He learns some affinities, and perhaps observes some metamorphoses; and what he has thus gained becomes the ground of the knowledge of others who come after him, until, in some generalizing philosophical mind, science is born. It exists now, in its rudiments, in one thinking mind; the only necessary

condition of its existence. Most slowly does it extend, as disciples become masters, and hardly and not at all perhaps does it advance, as little minds falsely interpret and great ones are rare, and hindered as it is and hemmed in by circumstances of society, it is long peculiar to the nation wherein it arose. But Aristotle must be regarded, not only as himself competent to write the history of nature, but as representing others, who had before him, in different ages, comprehended not only the knowledge of their times, but expressed and transmitted it in philosophical form. By Aristotle and Theophrastus, the latter of whom is the father of Botany, science was established for ages, and the long era which follows them ends only with the rise of modern philosophy. This was the era of contemplation: the old civilization of Greece becomes extinct; a military power rises, domineers, and dies ignobly; the Goths appear, and while the nations which they grew into are developing and advancing, and more slowly yet the feeble aborigines of Europe and the old Roman colonies are becoming states, or at least civilized; while, to come down yet further, all men seem to be soldiers, and the highest refinement expresses itself only in chivalry, — this cannot be more than a contemplative period, and it is a doubtful chance if the great minds think of science at all. Dioscorides is the second father of Botany, and Pliny is the expression of Roman science, or rather of the want of it among the Romans. The Arabians reproduce Grecian science, but with reference mostly to medicinal or other art. And this is all we know of this long age.

The modern science dates, then, from about the beginning of the reign of Edward the Sixth, when light and liberty overcame every power of darkness, and shone forth, quickening and awakening all knowledge. Many struggles had there been before, and were after; and it was only in New England that the spirit of liberty of that age found in the next its true expression, and left its abiding influences in free institutions and a spiritual worship: — but with science happily the awakening was universal and the revival real everywhere. From its great superiority in the number of species over all the branches of zoölogy, except the lowest and least known, as well as from the universal distribution of its objects, Botany began now to receive great attention, and the grounds of a reasonable system were sedulously sought. Cæsalpinus, Ray, Morrison, and Tournefort are only a few of the more distinguished authors, who constructed more or less wholly artificial systems of plants. What with their labors, and the general activity of scientific men reacting upon every particular branch, researches were carried further and deeper in Botany than they had ever been before. The true principles of the physiology of plants were sought out; and numerous collectors brought together species from every country.

It was now that Linnæus appeared, whose keen eye penetrated all the science of his age, and the ages; whose genius comprehended it; whose philosophy established it anew; — who, while he indicated the affinities of nature, and pronounced their explication the true end of the science of plants, yet constructed also an artificial system, which so surpassed every other, that it seemed nigh to

overwhelming that very knowledge of affinities, to which, as just said, he had consecrated the whole design of Botany. From this latter artificial system, — the dictionary, as the natural method has been called the grammar, of the science, — the Linnæan school of botanists arose. Nor could it otherwise have happened during that century, for the Natural Method, though the proposed scope of botanists, existed as yet only in its rudiments. This want of all objective form hindered its progress long in Sweden, England, and Germany. It was thus that Linnæus proposed the natural families only to a few select disciples, as that which, without a key, he regarded as merely esoterical. It was thus, again, that they were lost sight of by Linnæan botanists, and their new establishment, from the passive observation of nature and physiology, was the work and is the honor of French science.

From Linnæus and Jussieu together, therefore, the school of our day proceeds, and they are the foundations of all our received views. From the former we have the laws of science and the ideas of affinities, as well as the ground-forms of all our constructions; from the latter, a natural disposition of the genera of plants. This disposition generally, and without reference to any particular changes made in it since Jussieu, may be said to be an arrangement, which, starting from the old distinction in the cotyledons, and adopting the ternary division, therefrom resulting, into *MONOCOTYLEDONEÆ*, *DICOTYLEDONEÆ*, and *ACOTYLEDONEÆ*, proceeds to bring together plants under these in *Classes*, which in the *Monocotyledoneæ* are distinguished by the hypogynous, perigynous, or epigynous position of the stamens; and in the *Dicotyledoneæ*, (which are divided generally into *Apetalæ*, *Monopetalæ*, and *Polypetalæ*,) by the differences of various organs, but in particular of the capsule and the seed; the *Acotyledoneæ* together constituting a class by themselves; — while all these classes are once more divided into natural *Orders* or families, under which the *Genera* are arranged. Or rather, and more truly, the Jussieuan Method may be said to be an arrangement of the *Genera* of plants in their natural *Orders*, which orders are again brought together in higher but less definite *Classes*, and the classes finally subordinated to the great divisions from the cotyledons.

The genius of Jussieu was devoted wholly to the elucidation of the natural *Orders* of families of plants; and upon his labors here rests the value of his *Disposition*; — the classes and other higher sections being only after arrangements of the orders, and understood to be more or less indefinite and unsettled.

Although the advance of knowledge expressed by the Method of Jussieu was very great, its grander outlines were still (and unavoidably) too indistinct to give it in any degree the advantage of a complete system. Botanists still remained disciples of the artificial Linnæan system, and according to its principles all the most important works were written. But a new school was silently growing up, worthy to represent, not what was called the Linnæan system, but Linnæus himself; nay, which surpassed Linnæus and all previous science, as it ought to have done; — the school of Richard and Decandolle, of Link and Nees, and finally of Robert Brown, who in

himself represents all the botanical knowledge of our day. By these has been established the present aim of botanists, to explain by a universal knowledge of vegetation its universal affinities and laws, accepting the principles of Linnæus and the method of Jussieu as the ground and starting-point of their researches. We proceed, then, in the determination of a plant, from a view of the whole structure and organs, to compare it first with all other plants, in the great *Divisions*; next with the larger groups, in the *Classes*; then with the lesser groups, in the *Orders*; then with the yet more definite *Genera*, and finally with the other species of the genus to which we have thus reduced it. From its remotest affinities we descend to its nearest, effecting the whole through the means of the *characters* of each division. This is our way of using the systematic manuals of the Natural Method; but there are some further remarks to be made, respecting the Method itself.

How far, asks Wahlenberg, can we simply follow nature, and where must art come in? From species, those definite quantities of nature, from which we start, we at once reach the perception of certain affinities which are formerly expressed in the notion Genus; and, indeed, in the systematic study of plants we arrive at this notion by the mere mechanical constraint of scientific form, a species in science being always a species of some *kind* or group. From Genus we may even proceed to Order or natural family, but to look beyond — above this, *hic labor, hoc opus*.

The difficulties of the remoter affinities belong more properly to the province of others; nor is it necessary to refer to them here, any further than simply to state what we know of a law of nature which concerns all plants, and seems to indicate a harmony which will never admit of complete expression in a system. “Do not all,” says Coleridge, “press and swell under one attraction, and live together in promiscuous harmony, in the immediate neighbourhood of myriad others that in the system of thy understanding are distant as the poles?” That the series of nature and of plants is not simple, neither as respects all plants, nor as respects particular groups; that the deviations observable from particular types do not form a single, but more, series; and therefore that there is much conspiring to the suggestion of centres, central types, and diverging or converging radii, is now generally admitted by botanists. Some further illustrations of this will be found in what follows, but so little is definitely known of the series of nature, and the attempt to represent them systematically otherwise than as combined in a single series has so rarely been made, that the most guarded language is required to express truly, as I have attempted above, the tenor of what I think is admitted.

But we have before us the system of Oken, the elements of which were proposed by that philosopher in 1810, and upon these the *Systema Mycologicum* of Fries elaborated in 1821, though, if I mistake not the first application of his principles, in detail, by the author himself is in his work now to be noticed, which appeared from 1839 to 1841.¹

¹ Allgemeine Naturgeschichte für alle Stände von Professor Oken. Stuttgart. 1839 - 1841. Vol. I. II. III. 1. 2. 3.

Ab initii. Natural History teaches the knowledge of single, individual things on the planet, their development and perfection, and all their relations. Water, Air, and Ether, or Light and Warmth, which do not appear as separate and individual things, belong to other sciences. But if we observe the Earth-element we find a remarkable deviation from the others just mentioned. Our planet consists, not of one and the same mass, but of a multitude of things extremely distinct from each other,—so that there is no such thing as earth in general, but only particular ingredients thereof, variously disposed. Thence follows a manifoldness of things, and thereout springs Natural Science; for were there only one Earth, as there is only one Water, one Air, and one Ether, Chemistry only, Physics, and Mathematics could be concerned with it.

The earthy things which are the objects of Natural Science have then their definite ingredients, properties, and forms, and we call them Individuals;—not animals only and vegetables, but inorganic bodies also, from the fixedness of their chemical constituents, since by chemical decomposition these last become wholly different from what they were before.

The differences of the Earth-element must have a cause outside of them, since nothing changes itself of itself. But there is nothing beside but Water, Air, and Ether or Fire. These three, then, have produced the changes in the Earth-element, and according as the combination is either, first, *binary*, when only a single element, as Water, Air, or Fire, combines with Earth; or, second, *ternary*, when two elements, Water and Air, are combined with Earth; or, third, *quaternary*, when Water, Air, and Fire, that is, all other elements, are combined with Earth;—the three kingdoms, mineral, vegetable, and animal arise.

The Plant, then, is formed by Earth, Water, and Air; receiving through the former nutrition, in the veins (intercellular passages); through the water digestion, in the cells; through the air the process of breathing, in the spiral vessels;—the Earth predominating in Acotyledonæ, the Water in Monocotyledonæ, and the Air in Dicotyledonæ. (So far I proceed with the general positions of the author: his further observations, in regard to the infusorial or living nature of the ground-matter of organisms; his hypothesis of life; and his consideration of the distinctions to be found between plants and animals may be turned to in his work.)

A perfect plant, then, is distinguished into Stalk and Bloom; organs, that is, of preservation and propagation.

In the Stalk we have Root, Stem, and Leaves.

In the Bloom we have Blossom, Capsule, Seed, and Fruit.

All consist of cells, veins, and spiral vessels.

In the Stalk, once more, we distinguish Bark, Liber, and Wood.

Those parts of an organism of which all others are composed are *Tissues*. Those which unsundered run through the whole are *Anatomical Systems*. Those which occupy a smaller and peculiar place are *Organs*. We arrange all, in the order of development, as follows:—

A. TISSUES. I. *Cells*; organs of digestion; Water:—II. *Veins*; organs of nutrition; Earth:—III. *Spiral vessels*; breathing organs; Air.

B. ANATOMICAL SYSTEMS. IV. *Bark*; cell-system:—V. *Liber*; vein-system:—VI. *Wood*; spiral-vessel-system.

C. ORGANS. a. OF THE STALK. VII. *Root*; cell or bark-organ:—VIII. *Stem*; vein or liber-organ:—IX. *Leaf*; spiral-vessel or wood-organ. b. OF THE BLOOM. X. *Seed*; root:—XI. *Capsule*; stem:—XII. *Blossom*; leaf:—XIII. *Fruit*; stalk.

All systems and organs are repetitions of the tissues; and the fruit is a melting together of the same, as is seen by the following.

1. Cells.	4. Bark.	7. Root.	10. Seed.	13. Nut.	} Apple.
2. Veins.	5. Liber.	8. Stem.	11. Capsule.	14. Plum.	
3. Spiral Vessels.	6. Wood.	9. Leaves.	12. Blossom.	15. Berry.	

The Seed, that is, becoming a Nut; the Capsule, a Plum or Drupe; the Blossom, a Berry; and the synthesis of all, an Apple.

Generally, then, all these parts may be taken as falling into three sections.

A. The Tissues. Cells, Veins, and Spiral Vessels, which we call *Pith*.

B. The Anatomical Systems. Bark, Liber, and Wood, here called *Sheaths*.

C. The Organs, as Root, Stem, Leaves, Blossom, and Fruit, *Organs*.

A plant is, then, generally,

A. *Pith*. (Parenchyma.)

1. Cell. (Cellula.)

2. Vein. (Vena.)

3. Spiral-vessel. (Trachea.)

B. *Sheaths*. (Vaginæ.)

4. Bark. (Cortex.)

5. Liber. (Liber.)

6. Wood. (Lignum.)

C. *Organs*. (Organa.)

a. *Of the Stalk*. (Truncus.)

7. Root. (Radix.)

8. Stem. (Caulis.)

9. Leaf. (Folium.)

b. *Of the Bloom*. (Flos.)

10. Seed. (Semen.)

11. Capsule. (Pistillum.)

12. Blossom. (Corolla.)

c. *Of the Fruit*. (Fructus.)

13. Nut. (Nux.)

14. Plum. (Drupa.)

15. Berry. (Bacca.)

16. Apple. (Pomum.)

Plants, then, cannot be any thing else than the gradual and independent evolution of these parts. There must, then, be just so many classes as parts, corresponding in rank to the rank of the parts,—Pomaceæ being the synthesis and highest perfection of the vegetable world.

Does the plant-kingdom answer to these divisions? It is divided into three great provinces, — ACOTYLEDONEÆ, MONOCOTYLEDONEÆ, and DICOTYLEDONEÆ.

A. ACOTYLEDONEÆ. These have neither separate Root, Stem, nor Leaves; neither Bark, Liber, nor Wood; they consist, then, merely of Cells, Veins, and Spiral Vessels. They are then essentially only Plant-Tissue, and are *Pith-plants*.

B. MONOCOTYLEDONEÆ. These have Blossoms in which the calyx is hardly distinct from the corolla; Sheaths instead of independent Leaves; and a Stalk, in which Bark, Liber, and Wood are not distinguishable. They represent, then, the Anatomical Systems, and are *Sheath-plants*.

C. DICOTYLEDONEÆ. These first show a perfect distinction into Root, Stem, and Leaves, and are the representatives of the Organs, — *Organ-plants*.

The Dicotyledoneæ fall again into three great divisions, 1. Monopetalæ, 2. Polypetalæ, 3. Apetalæ. The last have been reckoned imperfect, which holds only if the corolla be the highest development and the last end of the plant. But it is not; it being in the fruit that all parts of the flower combine, and all the strength of the plant is concentrated, whence may be inferred the possibility of diminution or destruction of parts in the corolla, and hence the propriety of regarding the Apetalæ, not so much as wanting corolla, but as having fruit. They are the *Fruit-plants*. Of the two other divisions, the first, Monopetalæ, must be taken for the lowest division of Dicotyledoneæ, and as answering to the Stem. They will be distinguished, then, especially by their development in Root, Stem, or Leaves, and will consist therefore of plants with knobbed or sappy roots, plants almost nothing but stem; or plants almost nothing but leaves; — as Thistles, Heaths, Mints. They are the *Stalk-plants*. As to the remaining division, Polypetalæ, the flowers are certainly most perfectly developed in them, and hence they are the *Bloom-plants*. We have, then,

- A. Pith-plants. Acotyledoneæ.
- B. Sheath-plants. Monocotyledoneæ.
- C. Organ-plants. Dicotyledoneæ.
 - a. Stalk-plants. Monopetalæ.
 - b. Bloom-plants. Polypetalæ.
 - c. Fruit-plants. Apetalæ.

These great divisions being settled, it becomes next the question, if the separate Classes depend also on separate Organs. And first, A., of the Pith-plants, or Acotyledoneæ. These consist of cells, veins, and spiral vessels. The cells we find in the Fungi, which consist wholly of cellular tissue, without higher development, or green hue. The spiral vessels we find in the Ferns, the first plants into which spiral vessels enter, which vessels therefore characterize this class. Having thus ascertained the two outside classes of the Pith-plants, we refer the remainder (Musci, aquatic Algæ, and Lichenes) — in which there are no spiral vessels, but

wherein the cellular tissue is regular and sometimes longitudinally extended, and green appears—to Vein-plants. Thus we have,

1. Cell-plants. Fungi.
2. Vein-plants. Musci, Algæ aquaticæ, Lichenes.
3. Spiral-vessel-plants. Filices.

B. Monocotyledonæ. These fall naturally into three sections, of which the Grasses seem to be merely Bark; the Lilies merely Liber; and the Palms merely Wood. Hence

1. Bark-plants. Glumacæ, Junceæ, &c.
2. Liber-plants. Liliacæ, Orchidacæ, &c.
3. Wood-plants. Palmi, Aroideæ, &c.

C. Dicotyledonæ. a. Monopetalæ. These fall into three sections;—1. epigynous, as Compositæ; 2. perigynous, as Campanulacæ; 3. hypogynous, as Labiatæ. Of these the first are lowest, reminding us in many respects of the Grasses;—they are collectively distinguished by their large and sappy roots, and hence are the Root-plants. The second section, or perigynous Monopetalæ, as the Heaths, Cinchonacæ, &c., are remarkable for a dry and woody stem and leaves; the stem then predominates, and in this the chemical strength seems remarkably concentrated;—they are the Stem-plants. And third the hypogynous, as Labiatæ, Solanæ, &c., wherein, with a weak stem, large and very numerous leaves, in which all the chemical strength of the plant seems to be concentrated, occur. They are the Leaf-plants. We have, then,

1. Root-plants. Epigynous Monopetalæ — Compositæ.
2. Stem-plants. Perigynous Monopetalæ — Ericæ.
3. Leaf-plants. Hypogynous Monopetalæ — Labiatæ.

b. Polypetalæ; which excel in the number of their families, and the manifold diversity of their flowers. Authors have divided them into epigynous, as Umbelliferæ; perigynous, as Rosacæ; and hypogynous, as Malvacæ. Here, however, the first two of these sections are referred to the other Fruit-plants hereafter to be treated of. A perfect flower is moreover defined as one in which all parts are developed independently, and hence distinctly from one another. This is the case with the third section, or hypogynous Polypetalæ, which represent, therefore, the Blossom-plants, and fall into three sections. And, first, we have those plants which are remarkable for large and showy flowers, becoming frequently double, wherein all parts of the bloom tend to pass into petals, and generally every thing tends to bloom, as Caryophyllacæ, Papaveracæ, &c. These are the Blossom-plants. (For the characters by which these sections of hypogynous Polypetalæ are distinguished from each other, see our author.) The other plants of this division agree in having mostly five petals and five to ten anthers, but differ greatly in the structure of the capsule. This is, then, firstly, split into separate carpels, which carpels may be taken to represent the seed-development, as in Ranunculacæ, and these are then the Seed-plants, forerunners of the Nut-plants. Or, secondly, the capsule consists of carpels fast grown together,—wherein we have a perfect capsule, one stigma and many seeds,—whence these are the Capsule-plants, and forerunners of the Drupe-plants. Thus, then,—

1. Seed-plants. Ranunculaceæ, &c.
2. Capsule-plants. Rutaceæ, &c.
3. Blossom-plants. Caryophyllaceæ, &c.

c. We have last the epigynous and perigynous Polypetalæ, — the Umbelliferæ, Rosaceæ, Leguminosæ, &c. Both in the structure of the flower and of the fruit, these connect themselves with the so called Apetalæ (as Proteaceæ) and the Diclincs (as Amentaceæ). The lowest of these are without doubt the Apetalæ, which are distinguished for the remarkable development of a single seed, which becomes a Nut; — hence Nut-plants. Next to these come Leguminosæ, &c., — the Drupe-plants. Thirdly, the Rhamneæ, Granateæ, &c., constitute the Berry-plants. And last, the Umbelliferæ, Rosaceæ, &c. the Apple-plants.

Looking, then, at the whole Plant-kingdom as divided into Countries and Districts, it will appear as follows: —

1st Country.

Pith-plants. Parenchymariæ. Acotyledoneæ.

(Spores; without flowers, capsules, or true leaves.)

1. Cl. Cell-plants. Cellulariæ. Fungi.
2. Cl. Vein-plants. Venariæ. Musci, Algæ aquaticæ, Lichenes.
3. Cl. Spiral-vessel-plants. Tracheariæ. Filices.

2d Country.

Sheath-plants. Vaginaræ. Monocotyledoneæ.

(Flowers; Capsules; Straight-nerved leaves.)

4. Cl. Bark-plants. Corticariæ. Gramineæ.
5. Cl. Liber-plants. Liberariæ. Liliaceæ.
6. Cl. Wood-plants. Ligniariæ. Palmi.

3d Country.

Organ-plants. Organariæ. Dicotyledoneæ.

(Root; stem; and reticulate leaves; seed; capsule and anthers.)

1st District. Stem-plants. Truncariæ. Monopetalæ.

7. Cl. Root-plants. Radicariæ. Epigynous Monopetalæ.
8. Cl. Stem-plants. Caulinariæ. Perigynous Monopetalæ.
9. Cl. Leaf-plants. Foliariæ. Hypogynous Monopetalæ.

2d District. Flower-plants. Florariæ. Hypogynous Polypetalæ.

10. Cl. Seed-plants. Seminariæ. Ranunculaceæ, &c.
11. Cl. Capsule-plants. Pistillariæ. Rutaceæ, &c.
12. Cl. Blossom-plants. Corollariæ. Caryophyllaceæ, &c.

3d District. Fruit-plants. Fructuariæ } Apetalæ; Diclincs; epigynous and perigynous Polypetalæ.

13. Cl. Nut-plants. Nucariæ. Apetalæ and Diclincs.
14. Cl. Drupe-plants. Drupariæ. Irreg. Peripetalæ. Leguminosæ.
15. Cl. Berry-plants. Baccariæ. Monog. Peripetalæ. Rhamneæ.
16. Cl. Apple-plants. Pomariæ. Polyg. Peripetalæ. Rosaceæ.

If we cast back a glance over the foregoing, says our author, we seem to see demonstrated the perfect regularity of the plant kingdom, and the definiteness of every thing therein. The whole is only one single plant in pieces, every piece whereof is independently developed into a peculiar structure; — like separate chapels in the great temple of nature, repeating in small the great design.

It is further to be remarked that there are three kinds of Affinity. 1. Affinity of Neighbourhood [or affinity properly so called], following the series of classes. 2. Affinity of Repetition [or Analogy], following the numbers of the classes in each division; so that the first class of the second division is a repetition of [or analogous to] the first class of the first division, and so on. They are potences of each other. Our author's first example is striking on several accounts: — Fungi — Gramineæ — Compositæ — Ranunculacææ — Amentacææ. And 3. Parallel Affinity [Analogy], in which, when the classes are placed parallel to each other, the orders and genera fall likewise parallel and correspond.

All these distinctions, and particularly the general one of Affinity and Analogy are most important; and will be several times referred to in this paper. Oken says they were confounded by botanists generally, till set forth in his system. That this *via subjectiva*, by which the whole Okenian Disposition might have been suggested, is perfectly safe in empirical science, or that it is in any way to be substituted for experience, no one will be rash enough to affirm. If, on the other hand, it were neglected (a case, indeed, quite impossible), science would suffer, and to the extent of the neglect.

With regard to the system, the elements of which have been above delineated, I have little to say, generally, that will not readily occur to others occupied in these studies. That a materialist should assume the possibility of constructing, — should, after his knowledge, so to say, construct the absolute system of nature, is not at all wonderful. But to those who start from other grounds, the absolute system of nature is itself *supranatural*. And thus I found myself, before reflection, and much more before experiment, at once refusing to receive Oken's system. With this, which is not wholly irrelevant, I will state a single fundamental objection to the above, sufficient, in my view, to justify us in rejecting it as a system. (The more general grounds of Oken's system of the world, of which the kingdom of plants is but a portion, and which are in part briefly presented in the above, are, so far as essential to the system, still more certainly uncertain and hypothetical, than the particular instance in Botany which I am to notice. Of all such views we may briefly say, they do not need to be disproved, but to be proved.)¹

The importance, then, attributed by the author to the *meatus* or *ductus intercellulares*, is not admitted by other botanists, and without further evidence than we have, must be pronounced merely hypothetical. An examination of the application of this hypothesis in detail is unnecessary, for a very glance at the Vein-plants, so called, in the tabular statements above, will, I think, be enough to satisfy any botanist that he is not here on firm ground. And to look at the primary, the true Vein-plants, which are the middle series of the Pith-plants: — we find here Mosses, aquatic Algæ,

¹ Naturalists have little to do with 'popular' hypothetical constructions, unless, as in the above, they be expressed definitely in a system. It is a pity there are any 'popular' books of the kind; for the uncertain regions of science seem hardly the sphere of members of parliament or general readers.

and Lichenes placed together, and placed here, because, 1. There can be but three series of the Pith-plants, corresponding to the three "tissues"; and, 2. The two outside series being determined in Ferns and Fungi, Mosses and Algæ *must* be the middle one.¹ I say nothing of the bringing together of Mosses and Algæ, which was another systematic consequence, nor will I say more of the matter. With these remarks, which might be extended to any length, but which I think enough in themselves, and the thoughts which they suggest, let us leave this temple, and return to free divine nature, and to the company of observers and searchers there.

In refusing to receive the system of Oken, we do not, we cannot, reject the ideas which were, however imperfectly, expressed in it, nor the truth which it contains. The most profound of all works on Fungi, the "Systema Mycologicum" of Fries, was constructed on principles which its author referred to Oken's philosophy. It will be interesting, therefore, to turn to the views presented in the Introduction to that work,² which appeared, however, it should be said, as long ago as 1821, when only the general principles of Oken's system were before the world. Beginning with an earnest vindication of the higher doctrine of Linnæus, Fries places himself at once among the disciples of the Natural Method, denying, in so many words, the alleged superior certainty and facility of the artificial system. He states formally the *quaquaversal* affinity of plants, and hence rejects once more the notion of a single series in nature. He declares species "*unica in natura fixe circumscripta idea*," and hence all superior sections are more or less indefinite. The method which seeks empirically to dispose all plants in a single series, must be constantly adapting diverse series to a correspondence, and is hence *Methodus adaptata*. In such, affinity is more or less truly indicated, but a hundred such systems, every one of which should excel in this or that respect, and thus be equally good, might be constructed. A certain universal view such give, but not the universal view. The design of a true system must be to express at once and make manifest all the affinities of plants. Oken has indicated such a system. We seek in a system, not how this and that species differ, but rather how the exterior discrepant form expresses the different purposes of these forms. These purposes of life or of organism the external organs express. Every essential organ represents, then, a peculiar class, to which class orders and genera, in which this organ is above all others developed, are to be referred. The class is again in the same way divided into orders; and the organ indicating the class indicates also the most perfect order under it. All this seems wonderfully to conspire with nature; nor

¹ Auf diese Weise haben wir die beiden Gränzpflanzen der Mark-pflanzen gefunden. Da nach allgemeiner Anerkennung, die Moose zwischen den Pilzen und Farren stehen, so werden sie hier zu *Aderpflanzen*, &c., III. 1. p. 17. An die Moose *schliessen* sich Flechten und Tange. Ibid.

² Systema Mycologicum, sistens Fungorum Ordines Genera et Species, quas ad normam methodi naturalis descripsit Elias Fries. Lundæ. 1821-1823. Vol. I., II., and Supplement.

does it readily appear how nature could otherwise express affinity. For what is affinity, if it be not the universal harmony of characters? If one organ is changed, we know another is always disturbed, if one is more perfect, another becomes less so. No change in the organs is unimportant. Whenever the system is perfect, all parts will explain each other, and the place of every object in the system will be indicated not only, but demonstrated. And on the other hand its place in the system will indicate the nature and characters of the object much more than its description. (It seems possible to express this by formulæ, by which, by the change of a single letter, all the differences of *Agaricus* are indicable, as see applied in the *Consp. Syst. Mycol.*) Every section which presents the organ the type of the section most perfectly developed, so that this section shall excel or often exclude all the rest of the sections, is called *Centrum*. It is evident that this must be most distinct from the other sections, and moreover that its relations with the other essential organs must be less altered, so that species in the centre will approach each other more nearly in resemblance. We find, then, that central genera, the types of orders, are always vast (*Agaricus*; *Fucus*; *Lichen* in the sense of *Wahlenberg*; *Hypnum*, &c.), and are divided into more genera with much greater difficulty than the *radii*, which are sections (whether they be genera or orders) which pass from the one to the other. These centres are the foundations of the whole system. The character of a class, then, will square best with the centre, and less perfectly with the *radii*, which recede toward other classes. The system expresses everywhere *radii* everywhere touching. The centre passes always into two series, an inferior and a superior, whereof the former more evidently approaches the preceding, and the latter the following class. (These latter principles are laid down by the author with reference to his system of the *Fungi*; they are, however, general, if rightly, that is *ideally*, taken.) The differences of Affinity and Analogy should be stated. *Affines*, then, are those which follow in the same series, and seem mutually to pass into each other. *Analogæ*, those which occupy parallel places in different series, and mutually correspond to each other. *Labiatae* and *Personatae* are *analogæ*; *Labiatae* and *Asperifoliae*, *affines*. *Potentilleae* and *Ranunculeae* are *analogæ*. (Many other illustrations given.) The more naturalists have given in to a superficial observation, the more they have confounded analogy with affinity. These differences are exemplified in every province of natural history.

These are some of the principles of the *Systema Mycologicum*, as they are displayed by the author. The skill with which they are applied, and the completeness with which the whole is set forth, are acknowledged by botanists. Such a trial of a system is most severe, and to me it is reasonable to doubt if any system will stand it. The truth, indeed, is eternal, but not the words which limit or express it, — not the principles necessarily, nor their systematic construction. I would regard, then, the above only as suggestive; and so once again return to nature.

The next general work of Fries was his "*Systema Orbis Vege-*

tabilium," which was received, when it appeared, with universal respect, though in many and important points it assumed and held new grounds. As a system it cannot be said to have succeeded better than others, but the high character of the views which it embodied, and the ability with which they were brought forward and sustained, together with the perfect devotion to truth and science which shone through the whole, have left abiding impressions on Botany.

Fries may be said to represent that higher school of Linnæans, which started from the great naturalist's *natural* doctrine, and asserting the parity, at least, of his method with that of Jussieu, so far as the former was developed, chose still to refer back to Linnæus. And what is it that we see and admire in Linnæus? A mind, I think, looking at once at and through objects to their laws:—that, with what is thus gained, looks further and deeper, while still the harmony which it seeks is foreshadowed, and objects become eloquent, and more and more akin to their fellows and to man. A mind to which all philosophy and every science is cognate; which seeks all, because in the entirety alone it can find satisfaction. To such a mind what an office is that of the naturalist,—what a privilege is life,—what a manifestation of God is nature! These are common words, but I know they are often mere words, and such they are not here. Would that I could express what I feel of the greatness and the worthiness of the position of Linnæus; could portray him aside from species and genera, from system and method,—the true man, the true philosopher, the true naturalist; and, going back to the ground of all this, I could show it in that universality and rejection of all prejudice, that progress from laws within to seek laws without, that continual faith in and seeking for harmony, in which Linnæus wholly lived.

"The tuneful voice was heard from high,
 Arise, ye more than dead.
 Then cold, and hot, and moist, and dry,
 In order to their stations leap,
 And music's power obey.
 From harmony, from heavenly harmony,
 This universal frame began:
 From harmony to harmony
 Through all the compass of the notes it ran,
 The diapason closing full in man."

As it is only the method of Fries,—his whole way of looking at nature,—with which we are here concerned, his particular systematic constructions become less important. The tone of his works is, to me, in perfect unison with that of the works of Linnæus. An exhausting observation is always directed by a comprehensive and genuine philosophy, and not one of his least important papers have I seen, that is not suggestive of wisdom in the study of nature. His "Systema Mycologicum," and his "Lichenographia Reformata," are classics already among the works on these plants; and these, and his lectures at Lund and at Upsal, have raised up in Sweden a class of younger botanists, worthy of the country and the university of Linnæus.

As the best further illustration of the method of Fries, I have

collected the following passages from his various works, not to convey any general notion, however, nor in any sense a complete view, but only as in themselves valuable or suggestive. They may take the form of aphorisms.

Ἀνδρῶν βιβλιῶν βοτανῶν.

I. Perfectissimæ Ideæ, licet sensim et successive explicatæ, primigeniæ sunt:—formæ imperfectiores, laterali evolutione, æquilibrio successu temporis magis magisque turbato, aberrantes, sæpius etiam ratione existentia secundariæ sunt. Quod in ingenii humani poesi maxime sublime, id naturæ ipsius, rite exceptæ adhuc sublimioris, de cujus veritate nunquam dubitandum, proxime accedere videtur.

II. Naturæ in procreando libera quocumque progreditur, nec in unum latus. Ramorum instar e trunco, aut velut continue scissi radii a centro, naturæ corpora, quo perfectius evoluta eo magis discreta, sed diversarum serierum evolutionis gradus simul et coetaneæ exstiterunt.

III. Singulæ speciei priva est idea, primitiva differentia, quæ mutatis externis momentis personari, non tolli potest. In affinis naturæ corporibus, sub iisdem aut diversis momentis ortis hæc differentia in constante, communi aut recedente, omnium partium typo, adumbratur.

IV. Forma optime explicata et perfectissima mihi semper etiam typica et primaria, eaque regio in qua planta optime explicatur, est ejus statio maxime naturalis.

V. Character characterem non antecellit nisi constantia. (Link.)

VI. Character non est, ut genus fiat, sed ut genus noscatur. (Linn.)

VII. Quo plenius et acutius characteres proponimus, eo magis non raro a natura aberramus. Characteres absolutas mens humana indicare non valet. Inde ortæ querelæ de specierum transitu. Licet harum constantiam, ut distinctarum naturæ Idearum, non magis quam existentiam Dei mens humana demonstrare valeat, utramque tamen ut assumamus et credamus necesse est.

VIII. Omnes querelæ de characterum inconstantia abessent, si primo ipsos recte, dein scientiam vere scientifico modo, — i. e. ideali, amplecteremur.

IX. Natura contigua est, quamquam circa certos typos formæ magis colliguntur, unde sectiones oriuntur. Sectiones inde plurimas nec absolute naturales, nec mere artificiales censemus.

X. Nec transitibus indirectis, nec characteribus speciei notitia nititur. Cardo est ut 1.) attendatur ad formas typicas rite evolutas; quot hæ, tot species; ex his nec e formis transitoriis pendet speciei distinctio:—2.) ut speciei limites, non ad singulas formas, sed ad integram directe transeuntium formarum seriem, ponantur; ne, v. c. ex infimis formis suppressis (v. c. *Epilobium alpinum*, ut vulgo receptum) novam speciem fingas:—3.) ut caute separentur analogæ diversarum specierum formæ:—et 4.) in specierum comparatione inter se tantum comparentur formæ in analogo evolutionis gradu.

It has already been seen, that the present position of Botanical Science is one purely of observation and analysis. In the former, in its highest degree, is demanded all acuteness, sagacity, and ex-

perience possible; and in the latter, all previous knowledge of its object, perfect patience, and tact. There will arise continually expressions of advancing science in systematical form, which are required, moreover, as manuals. Looking back now upon what we have gone through, we may say that we have rejected Oken's system, and therein the absolute system of nature of the materialists, as presented in Oken; that, leaving this, we have recognized its greater doctrines, as they are represented in the earlier work of Fries, and accepted them generally, without reference to system, or any hypothesis of the origin of things; that thence we have proceeded to attempt a view of the position of Fries as a botanist, and of his way of looking at nature, and expressed this last, so far as we were able, in the form of sentences collected from his works. We have acquired thus far, then, only principles, and with these we come to the examination of the two other systems to which this paper is devoted,—the system of Fries, and that of Endlicher.

Fries has presented his disposition of plants, so far as he could do it in a local flora, in his *Flora of Schönen in Sweden (Flora Scanica)*,¹ 1835. From the Introduction to this the following outlines are drawn. The author begins with some general remarks on the distinction of system and object, the impossibility of a merely empirical system, the essential oneness of nature rejecting all systematic sections, and hence the necessity that even the natural system should be at the same time artificial, *quoad formam*. The affinities of plants are as the myriads of stars; their families as the constellations. The attempt to construct the system of nature from the study of nature alone, is like building a tower of Babel, with the hope of reaching the heavens,—nor are the heaps wanting now, nor the confusion of tongues.

But this opinion is not to be misunderstood. In observation are the foundations of all systematic construction, but this last is not to be despised, nor confounded with the former. Linnæus called the natural families, without a key, a bell without a clapper. Without such a key, there is no end to the sundering of families. We have laid aside the artificial Linnæan system, but the natural system also must be disposed artificially. Finally, it is an error to consider any system vain because it is not perfect:—better it were, indeed, that it should contain principles of further evolution, but it is well if it expound only one new and true idea. The natural system respects the whole plant, of course. In the *embryo* the whole is contained, and hence very eminent botanists have taken this as their ground-principle, and *a priori* we cannot deny great force to it. But it is the way with theories that opposite opinions are defended with equal success and feebleness. So it is objected to this principle that the embryo is not a single part, but contains in it all the parts, and that we need not seek in its original obscurity what is afterwards developed and made manifest in the plant itself. And moreover, the differences of the embryo are often obscure and fallacious, and hence the controversies concerning them, and the at-

¹ *Corpus Florarum Provincialium Sueciæ. I. Floram Scanicam scripsit Elias Fries. Prof. Ups. Upsaliæ, 1835.*

tempts to adapt them to theories, with which descriptive botany has not to do.

The principle should be, then, that the essential differences of the organs and their connections, explained from the successive evolution of the whole plant and their mutual resilience, be combined into one. So, with every new degree of metamorphosis, new members of the system will appear. The grades of metamorphosis are essential in proportion as they are primary (as respects existence), since thus they have effect upon the whole fabric of the plant. This being understood, the gradation of the characters seems easy and to flow from the principle. First in rank are those of germination; second, of vegetation; third, of the flower; fourth, and last, of the fruit, which is the last metamorphosis. In the former of these degrees, there are but few typical differences; in the latter, many; hence, those are more suitable to distinguish higher sections, these to characterize lower divisions. I do not see what other natural gradation of characters there can be than this, following the evolution of nature itself.

The principle of *Germination* is the seed. In the nature of this, a two-fold difference, of all the most universal, is observed,—that of *Semina* and *Sporæ*. There is no other difference certainly which has such a resilience upon every succeeding degree of evolution. *Seeds* contain within their integuments cotyledons, whence plants germinating from seeds are called *COTYLEDONÆ*. From naked *Spores* germinating into elongated threads are produced *NEMÆ*. These two sections may be called the *hemispheres* of the vegetable world. (The *Cotyledonæ* never produce a simple thread in germination; and the *Nemæ* never form cotyledons; but we find sometimes the cotyledons obliterated in the former, and the threads in the latter, in which case both seem deficient, and we thus have *Acotyledonæ* and *Anemæ*.)

In *Vegetation*, beside the differences of germination, emerge new, which recur likewise in the succeeding degrees. These furnish another means of division. The *Cotyledonæ* in germination produce either one or two cotyledons, which differences are most manifest in the plant, which has hence either an endogenous or an exogenous stem; either simply nerved, or venose-reticulate leaves; and hence again they are divided into *Endogenæ*, or *Monocotyledonæ*, and *Exogenæ*, or *Dicotyledonæ*. In the *Nemæ*, germination and vegetation are not separated; they produce their fruit, either after a new metamorphosis is completed, or immediately by simple metamorphosis, and hence are *Heteronemæ* (*Filices*, *Musci*), or *Homonemæ* (*Algæ*, *Fungi*.) These four, *Monocotyledonæ*, *Dicotyledonæ*, *Heteronemæ*, and *Homonemæ*, are the four *provinces* of the vegetable kingdom.

In the *Flower*, we have the third degree of metamorphosis. In this, while many essential differences appear, there is none which surpasses the preceding, derived from germination and vegetation. But that these differences from the flower are superior in rank to those taken from the fruit, not only does theory clearly indicate, but experience demonstrates it. (What affinity is there among *Rosacæ* of authors, with what diversity of fruit. What difference be-

tween Alismaceæ, Spireæ, Ranunculaceæ, which yet are analogous as to their fruit.) From the Flower, then, we take the third means of division, and thereby form *Classes*. In the Nemeæ the present grade of metamorphosis is wanting, and its place is supplied by the relation of the whole fructification to the vegetative system. There are hence few classes in the Nemeæ, and many in the Dicotyledonæ, though the former are superior in the number of species. The classes, for the present, at least, received by me, are derived from the epigynous, amphigynous, (which I do not regard synonymous with perigynous), or hypogynous site of the corolla. The latter I consider the lowest, and the first in every point of view the highest, and no less I reckon the monopetalous corolla a higher degree of evolution than the polypetalous, and that the latter, and not the former, ascends naturally from the Apetalæ. I reduce, finally, all irregular corollas to their regular type.

Last, we have the *Fruit*, wherein the differences especially vary, so that all the primary kinds of fruit occur conjoined with a single type of flower. In this, then, we find the fourth means of subdivision, into *Orders*.

These, then, adds the author, are the lineaments of the system. Whether you call it artificial or natural is to me indifferent. The matter of it is certainly natural, and the form as certainly artificial. But this is to me of the very genius of a true system. By this key, I have not yet found that any plants, manifestly and by consent of all allied, are sundered; and in doubtful matters this has been to me itself a cynosure.

The only further view of the system of Fries that I can give, is the key prefixed by him to his above-cited *Flora Scanica*, which, however, may be taken as perfectly representative of the whole. As it is arranged to display affinity and analogy throughout, (the definition of which terms, as here understood, has already been given,) it acquires the more interest, and makes necessary a few remarks on series, which I take principally from the *Lichenographia*. Series are either *progressive* or *regressive*. In the progressive series the vegetative system is especially luxuriant, and it has affinity therefore both with inferior and superior provinces. In the regressive series, there is a tendency to fructification and the development of this system, and hence, the characters of the province being more sharply limited, and, as it were, forced to an extreme, there is no true affinity, either with superior or inferior sections, but the whole stiffens, so to speak, into forms especially allied to one another. Examples of regressive series are Musci; Lichenes among Algæ; and yet more Fungi; and again, Gramineæ among Monocotyledoneous plants. Of progressive series, we have examples in Filices, approaching Monocotyledonæ, and Monocotyledoneous Hydrophyta approaching Dicotyledonæ. We can discern these series in every province. The regressive series, however imperfect, is later in the series of evolution than the progressive: the most simple organisms, therefore, are not first in the order of production, nor does nature simply proceed, but also recede. The differences, finally, of superior sections, are signified, though less *discretely*, in inferior.

CLAVIS.

Plants are COTYLEDONEÆ (or Phanerogamæ), or NEMEÆ (or Cryptogamæ).

Cotyledonæ are either DICOTYLEDONEÆ or MONOCOTYLEDONEÆ.

I. DICOTYLEDONEÆ

† perianthio genuino, COMPLETÆ, toro pro petalis incrassato, staminifero :

*Stamina inserta :*A. *Corollæ*, Series I. COROLLIFLORÆ.

a. <i>epigynæ</i> :	b. <i>amphigynæ</i> :	c. <i>hypogynæ</i> :
Class. I. SEMINIFLORÆ.	Class. II. ANNULIFLORÆ.	Class. III. TUBIFLORÆ.
Ord. Synantheræ (<i>anth.</i> 5).	Campanulaceæ (<i>anth.</i> 5).	Solanaceæ (<i>anth.</i> 5).
Dipsaceæ (<i>anth.</i> 4).	(Gesneriæ), (<i>anth.</i> 4).	Personatæ (<i>anth.</i> 4).
Valerianeæ.	Polemon. Convolvulaceæ.	Gentianeæ.
Rubiaceæ.	Boragineæ (<i>anth.</i> 5).	Asclepiadeæ.
(et 5 andr. et 4 andr.)	Labiatae (<i>anth.</i> 4).	Primulaceæ.
Caprifoliaceæ.	(Hydroleaceæ.)	<i>recedentes</i> : Plumbagineæ, Plantagineæ.

B. *Receptaculo*, Series II. THALAMIFLORÆ.

a. <i>epigyna l. in disco</i> :	b. <i>amphigyna</i> :	c. <i>hypogyna</i> (nec disco ins.) :
Class. IV. DISCIFLORÆ.	Class. V. BASIFLORÆ.	Cl. VI. COLUMNIFLORÆ.
Ord. Corneæ.	Berberidæ.	Cistineæ.
Celastrineæ (<i>disco</i>	Cruciferæ (<i>Cal.</i> 4- <i>phyll.</i>).	Tiliaceæ (<i>Styl.</i> 1).
<i>adn.</i>)		
Malphigiaceæ (<i>dis-</i>	Papaveraceæ (<i>Cal.</i> 2- <i>phyll.</i>).	Hypericineæ (<i>Styl.</i> <i>pl.</i>).
<i>co lib.</i>)		
Araliaceæ (<i>baccatæ</i>).	Nymphæaceæ (<i>ovar. incl.</i>).	Gruinales (<i>ovar. concr.</i>).
Umbelliferæ (<i>fr.</i>	Ranunculaceæ (<i>ovar. lib.</i>).	Malvaceæ (<i>ovar. discr.</i>).
<i>sicci</i>).		
Loranthæ.	Balsamineæ.	Caryophylleæ.
		<i>Alsinaceæ.</i>

C. *Calyci*, Series III. CALYCIFLORÆ, *adnato toro*

a. <i>epi-perigyno</i> :	b. <i>amphigyno</i> :	c. <i>hypogyno</i> :
Class. VII. FAUCIFLORÆ.	Class. VIII. TORIFLORÆ.	Class. IX. CENTRIFLORÆ.
Ord. Calycanthemæ	Leguminosæ (<i>Legum.</i>).	Ericinæ.
(<i>Capsul.</i>)		
Rhamneæ (<i>Drupæ</i>).	Drupaceæ (<i>Drupa</i>).	Empetreeæ (<i>Drup.</i>).
Ribesieæ (<i>Pepo</i>).	Pomaceæ (<i>Pomum</i>).	(Aquifoliæ.)
Succulentæ.	Senticosæ.	Euphorbiaceæ.
Portulacaceæ.	Paronychieæ.	Polygoneæ (<i>vaginat.</i>).
		Chenopodiæ (<i>evaginat.</i>).

†† Apetalæ IV. INCOMPLETÆ, toro haud incrassato l. staminifero :

Perianthio

a. <i>gamosepalo-concentrato</i> :	b. <i>squamaceo-imbricato</i> :	c. <i>nullo l. ambiguo</i> :
Class. X. BRACTEIFLORÆ.	XI. JULIFLORÆ.	XII. NUDIFLORÆ.
Vepreculæ.	Fraxinæ.	(Chloranthæ.)
Aristolochiæ (<i>hermaph.</i>).	(Juglandinæ.)	(Piperaceæ.)
Cucurbitaceæ (<i>diclin.</i>).	Amentaceæ.	(Saurureæ.)
(Artocarpeæ.)	Salicineæ.	Callitrichinæ
Urticeæ.	Myriceæ (<i>distigm.</i>).	Nayadæ. }
(Balanophoreæ.)	Coniferæ (<i>monostigm.</i>).	Ceratophylleæ. }
? <i>Lycopodiaceæ.</i>	<i>Equisetum</i> (<i>astigm.</i>).	<i>Chara</i> (cryptogama).

II. MONOCOTYLEDONEÆ

Perianthio

† completo biseriali.		‡ incompleto l. nullo.
a. <i>Stamina epigyna</i> :	b. <i>Stam. amphygna</i> :	c. <i>Stamina hypogyna</i> :
Cl. XIII. FRUCTIFLORÆ.	XIV. LILIFLORÆ.	XV. SPADICIFLORÆ.
Ord. Orchidææ.	Liliacææ.	Callacææ.
Irideæ (<i>triandr.</i>).	Melanthacææ.	Orontiacææ.
Narcissææ (<i>hexandr.</i>).	<i>Heloniææ.</i>	<i>Sparganium.</i>
Hydrocharidææ.	Alismacææ.	Potamogetonææ.
(<i>Vallisneria.</i>)	Juncacææ.	Cyperacææ.
	<i>Typha</i> vid. Callææ.	††† bracteaceo, valvato:
		XVI. GLUMIFLORÆ.
		Graminææ.
Series fructu præpollens, epigyna, regressiva.	Series flore præpollens, centralis, amphygna.	Series vegetatione præpollens, progressiva, hypogyna.

NEMEÆ s. CRYPTOGRAMÆ.

Vegetation taken as the principle of disposition, fructification being more obscure. Hence, *plures rationes inversæ*. The inferior sections surpass the superior in fructification: as Marsileacæ the Ophioglossæ; Ophioglossæ the Polypodiæ; Hepaticæ the Bryacæ; Bryacæ the Lycopodiæ. So, too, Musci, in this respect, surpass Filices; and Fungi, Algæ. In the lowest of Lichenes and Ascomycetes, the Asci and Sporida are most perfect. While among Phanerogamæ the families with covered fruit come first, so in the Cryptogamæ those with fruit especially naked.

A. HETERONEMEÆ.

Fila germinantia in frondem caulemque heterogeneum abeunt, hinc fructus secunda metamorphi. Folia a trunco radiceque unitis discreta. Imperfecte vasculares, evidentius series vegetativa.

Fila germinantia

a. *solitaria*, simplicia in frondem dilatantur. b. *plura* ramificantia in caulem thallumve coalescunt.

Cl. XVII. FILICES.

(Monocotyledonæ cryptogamæ s. *Mononemeæ*, subendogenæ. Vegetatione, foliis, Muscis perfectior; fructificatio inferior.)

(Cycadææ.)

1. Caps. gyrate in frondis superf. aggregatæ: *Polypodiaceæ*.
2. Caps. semibivalves in spicis discretis pedunc. *Ophioglossææ*.
3. Caps. in receptac. ad basin foliorum. *Marsileaceææ*. Amphibiæ.

* Blastospora: *Isoetes*. Aquatica.

XVIII. MUSCI.

(Dicotyledonæ cryptogamæ s. *Dinemeæ*, subexogenæ. Serie contigua repetunt Nudifloras: Bryacææ *Mniopsin*, Hepaticææ *Lacin*, *Riccia Lemnam.*)

(Equisetum, Chara = Dicotyled.)

1. Caps in alis foliorum sessiles nudæ. *Lycopodiaceææ*.
2. Caps. seta pedunc: calyptra et operc. clausæ. *Bryaceææ*.
3. Caps. valvatæ, exoperculatæ. *Hepaticææ*. Amphibiæ.

* Blastospora: *Riccia*. Aquatica.

B. HOMONEMÆ.

Fila germinantia cum systemate vegetativo homogeneo (absque ullis partibus discretis) simularia. Fructus prima metamorphosis. Mere cellulares.

Gonidia

a. *præsentia*. Color vegetabilis. b. *nulla*. Color metallicus.

Cl. XIX. ALGÆ.

Cl. XX. FUNGI.

‘His radix, caulis, folia in unum.’
Linn. Vegetativæ.

‘Neque folia neque ullæ eis analogæ partes virides.’ Ray. Fructificativæ.

- | | |
|--|--|
| 1. Exogenæ, stratis thalli discretis: <i>Lichenes</i> . Aereæ. | 1. Exothalamii, sporidiis secedentibus. <i>Hymenomyces</i> . |
| 2. Heterogenæ, stratis thalli confusis. Amphibiæ. | 2. Heterothalamii, primo nucleiferi. |
| a. autonomæ, exscarpæ: <i>Byssacca</i> . | a nucleo in discum expanso sporidiis elasticæ rejectis. <i>Discomyces</i> . |
| b. elementares, anocarpæ: <i>Byssacæ spuria</i> . | b. nucleo incluso, cum sporidiis diffuente: <i>Pyrenomycetes</i> . |
| 3. Endogenæ, angiocarpæ: <i>Fucaeæ</i> . Marinæ. | 3. Endospori, angiocarpi: <i>Gasteromyces</i> . |
| 4. Homogenæ, subfilamentosæ, gonidiis ipsis multiplicatæ s. Blastosporæ: <i>Ulvacæ</i> . Aquaticæ. | 4. Homospori, sporidiis gonidiis similibus e filis discretis enati s. Blastospori: <i>Hyphomyces</i> . |

Appendix: Fructificatione nulla, thalli in granula l. frustula divisione, multiplicatæ: <i>Diatomacæ</i> . (Phytozoa, crystallina.) (Series vegetativa, progressiva.)	Appendix: Vegetatione propria nulla, e gonidiis l. chlorophyllo matris enati: <i>Coniomyces</i> . (Entophytæ. Exanthemata.) (Series fructu præpollens, regressiva.)
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As an artificial-natural system, which makes no pretence of presenting the system of nature absolutely, but offers itself to be proved and disproved by experiment, the above is proposed to botanists. That they should find the last systematic conclusions of such a mind as Fries useful and valuable, were to be expected, if any botanist's conclusions are of value to others. And if any there be, disposed to reject or neglect whatever does not come of their own system they are certainly losers, for they shut themselves out from truth. This does not belong to one, and opposite systems stand upon it; and we cannot arrive at all truth but through all systems, in science. And there are, moreover, two ways, in one or the other of which, or in both, it may be, united, naturalists proceed. For they start either simply from nature without philosophical grounds or ends, and accumulate only and then accommodate facts,—the observers; or again, knowing that man and reason are first, and that we cannot proceed but from them and with them, they begin scientifically with what they must begin with at any rate, (differing from the former, then, as mechanics do from mechanics,) and have hence a ground in the philosophy of their own being, and hence,

also, an aim, — the philosophical observers; or finally, in some large and beautiful minds, we can discern neither of these ways by itself, but only what seems their real and original union, wherein the divine reason appears, *αὐτόνομος αὐτόδικος*, and facts are observed not only, but eternal laws are prescribed to science,¹ — the naturalists. If, then, we are only observers, or only philosophical observers, we shall not only err, but tend in the one case to prejudice and blindness, and in the other to mere theory and speculation; hence, too, as we are in one or the other dilemma, we shall deny, virtually, the equally true and equally false way in which we are not proceeding, and hence finally follows that waste of time and heart in paper wars, when discord sits formally enthroned by man, in the very face and eyes of infinite Harmony.

Let us, then, possess ourselves of what Fries has discovered, and give him credit for all that he has taught us; for all the light from his words which has made nature brighter about us. But there is yet another artificial-natural system now on almost every botanist's table, that of Endlicher.² His "Genera Plantarum" is, of course, a universal work, and hence his system appears in it complete, which gives it great advantages practically. Starting from fundamental views not foreign to those of Fries, and adopting, indeed, to some extent the same general divisions, the system before us will be seen to differ from the other, and if rather apparently only, still considerably.

The following view of the construction of the system I take from the Grundzüge of Endlicher and Unger, p. 409, &c.

The Affinity of species consists especially in the similarity in structure of parts having the same functions, and is the greater, in proportion as more parts agreeing in functions agree also in structure.

Similar structure in parts which are dissimilar as to their functions, presents only Analogy.

Agreement in the characters of fructification, since it supposes similar anatomical relations, denotes a nearer degree of affinity than that which consists in a mere resemblance in anatomical relations.

The nearer degrees of Affinity of particular species may then be estimated by the agreement of their organological characters, and in particular of their characters of fructification, while only a remoter affinity is indicated by anatomical resemblance.

The affinity, moreover, seems the nearer, the more particular parts agree with one another, and the weightier the points of view are from which they can be compared together.

¹ Um die Fülle zu bewältigen, bedurfte es eines Mannes wie Linne, dem die wirksame Gewandheit nicht abging, um eine Methode, die, wie die *Philosophia Botanica*, den ewigen Gesetzen des menschlichen Verstandes entsprechend, nie altern wird, dem widerstrebenden Zeitalter aufzunöthigen. Endlicher & Unger. Grundzüge, p. xi.

C'est le livre le plus philosophique que j'ai vu de ma vie. J. J. Rousseau, Lettr.

Quippe qui et canones Philosophiæ Botanicæ ubique servare ac applicare religionis ducam. Sprengel, Syst. præf.

² Genera Plantarum secundum Ordines Naturales disposita, auctore Stephano Endlicher. Vindob. 1836-1840. Grundzüge der Botanik entworfen von Stephan Endlicher und Franz Unger. Wien. 1843.

Agreement of the parts of fructification, in all essential characters, gives us, as the nearest degree of systematical affinity, the notion *Genus*. Genera which are distinguished from one another by a greater or smaller number of characters, can once more, according to the degree of agreement of several or more characters of fructification, and according to the importance of the same, be considered as nearer or remoter allied; and further, according to the structure of the seed and the fruit, and no less according to the make of the axis of inflorescence, and the number, position, and relations of connection of the appendicular organs arranged upon it, be comprehended in *Orders* and *Classes*.

The anatomical characters which express the remotest degrees of affinity and the most essential distinctions, may be employed finally for the construction of principal sections and subsections of the whole Plant-kingdom, under which the inferior sections—Classes, Orders, Genera—can be arranged.

The Plant-kingdom presents no single unbroken series of forms gradually passing into each other, but much rather many Groups, quite distinct from each other, and representing differences of structure.

The signification, the importance, and the reciprocal relations of different forms, which appear as deviations from a common type, *within* the particular groups, are also incapable of being represented in a single series.

But the system, which cannot represent the groups formed after certain types, either as diverging from a common centre, or converging thereto, which must, therefore, place them in a single series, does this in an ascending sequence, according to the higher and more manifold development of all parts, in which sequence all are brought into order arbitrarily.¹ It can, therefore, be considered a natural scheme only in so far as it includes the notion of nearer affinity under that of remoter.

According to the two ground-differences which appear in the anatomical structure of plants, they divide into two principal groups, the one consisting wholly of cells—Cell-plants (*Plantæ cellulares*; *Thallophyta*), and the other of cells and vessels, and having, also, an axis and appendicular organs,—Vessel-plants or Axis-plants (*Plantæ vasculares*; *Cormophyta*).

The THALLOPHYTA fall into two Sections;—I. *Protophyta* (under which are the Classes Algæ and Lichenes), and II. *Hysterophyta* (Fungi).

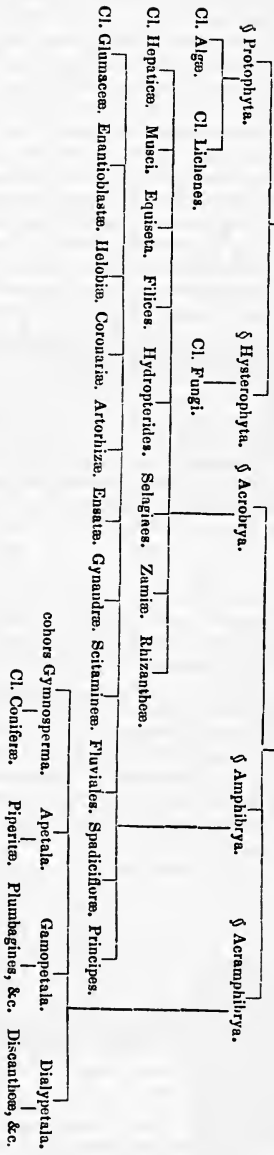
The CORMOPHYTA divide into three Sections;—I. *Acrobrya* (Musci; Filices; Cycadææ; Rhizanthææ;) II. *Amphibrya* (Gramineæ; Cyperacææ; Liliacææ; Orchidææ; Palmæ, &c.) III. *Acramphibrya* (containing the Dicotyledoneous plants generally).

Under these Sections the Classes are arranged, and under them follow the Orders. No further view of Endlicher's System seems necessary in this place beside what is given in the following scheme, which can be compared with the similar one of Fries's System, subjoined.

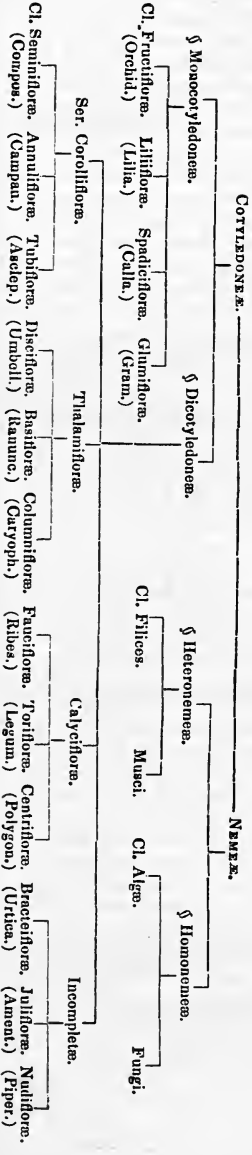
¹ It is, however, not essential whether the series be ascending or descending.

I. ENDLICHER.

PLANTÆ VASCULARES. ————— PLANTÆ CELLULARES.
Thallophyta. ————— *Cormophyta.*



II. FRIES.



So far as the Classes, then, we may thus compare the above, it being remembered that the table of Fries's disposition is from a local Swedish Flora, and therefore very incomplete. But I can extend this paper no further. I am far from satisfied with it in any respect, though it is the result of no little labor. That it may not be wholly without use to others is my earnest hope.

To botanists the sketches of Fries's method and system, too little known here, may be of interest and value; and to all who religiously admire nature, the general views of the distinguished writers mentioned are commended. Oken's work was written, not so much for scientific students as others, and though his system will not stand, there are great truths developed in it which must endure. We can follow these out and accept them in Fries. But as a System, I would no more accept it than I would build a system from the same rudiments, as they are truly and perfectly presented by Milton:—

“So from the root
Spirits lighter the green stalk: from thence the leaves
More airy: last, the bright consummate flower
Spirits odorous breathes.”

There is no such thing as science for the million. No man can be too able or too learned to teach, and what is false in itself can be true for no class. Hence, the system that is accepted by the highest suffrages of men of science is the only system for all; and on the other hand, what they reject as a system is rejected for all, and is of no use to any body, if it is reasonable that the best qualified should decide. So much for the system in itself; as to its truths, they are the property of science, which alone can make them available. Thus botanists have accepted nothing of Oken's philosophy thus far, except what Fries has represented, and as he has represented it. I have reviewed Oken's system, therefore, only to pass through and beyond it.

The difference between the mere scientific observers of nature and the complete naturalist has already been shadowed out. I will add only here, that we cannot come to the study of nature with minds too well developed, with a philosophy too deep and thorough, or with hearts too true. If the rapt admirer of the wonders and the beauties of life and being might well come to learn of our knowledge the laws and the history of what he loves, let us remember that we have the best right to all the pleasure that he has discovered, and that we are not complete if we do not possess it all. Linnæus was as hearty a lover and admirer of nature as if he had been nothing more.

“So build we up the being that we are;
Thus deeply drinking in the Soul of Things
We shall be wise performers;
Whate'er we see,
Whate'er we feel, by agency direct
Or indirect, shall tend to feed and nurse
Our faculties, shall fix in calmer seats
Of moral strength, and raise to loftier heights
Of love divine, our intellectual Soul.”¹

¹ Excursion.

AN ENUMERATION
OF
NORTH AMERICAN LICHENES,
WITH
A PRELIMINARY VIEW OF THE STRUCTURE AND
HISTORY OF THIS ORDER OF ALGÆ.

A VIEW

OF THE

STRUCTURE AND GENERAL HISTORY OF LICHENES.

LICHENES are Plants: of all plants most frequent throughout the globe; appearing wherever are rocks, stones, earth, and living or dead wood; wherever there is air moving over earth, and light, and time is given; extending from the burning deserts of the torrid zone to the frozen deserts of the arctic zone; ascending to the highest naked rocks of the highest alps; ceasing only at perpetual water and perpetual snow.

Lichenes are (considered as belonging to the system) an order of Algæ, or Protophyta, which is a section of Thallophyta.

THALLOPHYTA (Homonemææ, Fr.) are the lowest forms of vegetable life. With one of the two sections into which this greater division falls, — Protophyta or Algæ, — vegetation has been said to begin and from it to ascend: with the other, — Hysterophyta, or Fungi, — the whole vegetable system to be, as it were, concluded and finished.

Thallophyta are plants merely cellular; the external organs of which are confused and coadunate in one body; with a system of fructification immediately originating, by simple metamorphosis, from the primary vegetative system, — the cells collapsing into sporidia, and these germinating, themselves being prolonged into threads, which are either discrete, or confluent in a homogeneous mass.

PROTOPHYTA, or Algæ, are Thallophytal plants, and are either aerial or aquatic; they are distinguished by having reproductive gemmaceous cells (gonidia), which are the prototype or elementary analogue of leaves; they are successively developed and indefinite; and absorb nutrition from the surrounding element.

HYSTEROPHYTA, or Fungi, are Thallophytal plants, which are produced in decaying or perished organic matter; which want gonidia; and are thence at once perfectly developed without successive evolution, and definite; and absorb nutrition only from the matrix.

Obs. In Algæ, we discern the progressive series of Thallophyta; wherein the vegetative system is especially developed, and affinity both with superior and inferior sections is indicated; in Fungi, the regressive series is evidently expressed. The whole Fungus is a fructification, and in this the Fungi as much excel, as

they are inferior in the vegetative system. There is no prototype of fructification among the Algæ, which has not in the Fungi its ectype more perfectly developed. (Cf. Fries. Syst. Mycol. i. xxii., Lichenogr. p. xii.) The Algæ, moreover, having gonidia, or reproductive buds, are hence successively explicated; absorb and prepare nutrition from the surrounding element; and depend less upon place; propagating, moreover, more frequently, and in the lowest forms only, by gonidia: — the Fungi, on the contrary, wanting gonidia, have no successive evolution, and propagate normally by sporidia. (Compare the two classes of Homonemæ in the Clavis to Fries's system, given in the previous essay.)

ALGÆ are either aerial, (amphibial,) or aquatic, and fall into three Orders, Lichenes, Byssacæ, and Phycæ, which are distinguished as follows:—

Aerial Algæ, or *Lichenes*, are perennial, with interrupted vegetation (that is, subject to apparent death and revival, according as they are conditioned by moisture or drought); exogeneous, and forming distinct layers. *Amphibial Algæ*, or *Byssacæ*, are perennial, with vegetation at intervals retarded; heterogeneous, and not forming distinct layers. *Aquatic Algæ*, or *Phycæ*, have an uninterrupted vegetation, and are either endogeneous and multiplied by sporidia and gonidia — *Fucacæ*: or homogeneous and without apothecia or true sporidia, and hence multiplied only by gonidia — *Ulvacæ*.¹

Obs. The order Byssacæ, as separated and defined by Fries, seems necessary in the system, at least; and the plants composing it are well distinguished from Lichenes and Phycæ, both by characters and habit. (Cf. Fl. Scanica, p. 291, Linnæa, 1830, p. 535, Lichenogr. reform. Præl. ii., which may be compared with the author's earlier views in Stirp. Femsjö, p. 41.)

Character Phytographicus LICHENUM: Apothecia nucleo ascigero, raro primitus pulveraceo-collapso. Thallus strato infra corticale discreto.

BYSSACEARUM: Apothecia ascigera, raro in ascos dissoluta. Thalli strata, corticale et medullare, confusa.

FUCACEARUM: Apothecia e thallo formata, sporidiis peridiolis aut mucu involutis. Thalli stratum exterius, haud discretum, corticans, gonidiis sparsis.

ULVACEARUM: Apothecia et sporidia nulla. Thallus absque stratis dissimilibus et discretis, gonidiis sparsis, sporidiorum vicibus fungentibus.

Character Typicus LICHENUM: Stirpes radice (*cellulis fistulosis*), trunco (*lepra*) et foliis (*gonidiis*) in unum corpus corticatum confusis, sed in stratis discretis, fructificatione metamorphosi simplici enata.

BYSSACEARUM: Stirpes radice trunco et foliis cum strato corticali confusis, nullis stratis discretis; fructificatione simplici metamorphosi enata.

FUCACEARUM: Stirpes radice et foliis in corpus truncosum aut

¹ Fucacæ and Ulvacæ are used by Fries *sensu latiori*, to indicate the two great sections of Aquatic Algæ. They correspond, respectively to the Asco-phycæ, and Gongylophycæ of Reichenbach.

frondosum confusis, strato corticali nullo, sed extus compactiores et epidermidi vulgo tectæ, fructificatione metamorphosi simplici enata.

ULVACEARUM: Stirpes radice et foliis in unum corpus homogeneum et simile confusis; metamorphosi ad sporidia formanda nulla.¹

The place of Lichenes in the System, and their relations to other Thallophytal plants, as well as their more essential relations to other sections of Algæ, being thus indicated, it is next in order to describe their production, development, and the formation of their fructificative organs.

Auctores: — *Fries*, Lichenogr. præl. 1.; *Id.* Fl. Scan.; *Endlicher*, Gen. Pl. 1. 1.

I. GENESIS.

Original or equivocal generation has been assumed to occur in the Lichenes, and Meyer has even ventured to describe the process. But Fries declares that he has never been able to find any grounds for it; and moreover that the germination of lichens from sporidia, as observed by him, presented appearances so exactly corresponding with what Meyer described, that he cannot but conclude that sporidia were present in this case also.²

Lichenes are reproduced by, I. *Gonidia*, and, II. *Sporidia*.

The gonidial propagation will be first described. The thallus of lichens is disposed in four layers; the cortical, medullary, sporigerous, and gonimous; or, more essentially, it is distinguished into three layers: the cortical, medullary, and gonimous, of which last the sporigerous is a metamorphosis. The gonidia exist primarily as the gonimous layer, and are a disposition of cells immediately below the cortical, and above, or constituting the upper portion of the medullary layer; the cells normally green, spheroidal, originally composed of a hyaline membrane surrounding a grumose matter without apparent structure. While existing only as the gonimous stratum, it is evident that the gonidia cannot come to the surface of the lichen, and in this state, though most perfect, they are incapable of propagation. They appear on the surface in the form of *Soredia*, which, whether a powdery indumentum or rounded heaps, consist of gonidia, with more or less mixture of cells of the other strata. Here, then, the gonidia appear in their secondary state, constituting subspheroidal globules of a uniform grumose matter, which is scarcely or not at all cellular, and is apparently the same matter which exists primarily within the cells of the gonimous stratum. The first increment of the gonidia in the secondary state is therefore a mere confluence of single cells, and thence a dilatation and prolongation of the new mass. *Soredia* are exceedingly common in Lichenes, and the propagation by them is much more frequent than by sporidia. Their evolution depends as well on the predisposing individuality of the species, as on external moments (Mois-

¹ Fr. Lichenogr. p. 35.

² De hac theoria non plura a me afferenda sunt; fatear, me illam non intelligere, eamque mentis potius, quam oculorum acie, esse observatam, censere. (Fr. Lichenogr. p. 173.)

ture, Light). They are not to be confounded with certain other regular excrescences, first distinguished by Wallroth, (*stauromata*), which arise in and consist of the cortical layer alone, of the outer cells of which they are only anamorphoses.

Gonidia propagate either, 1st. in the matrix, or original thallus, forming leaves, scales, &c., thereon; or, 2d. by forming new thallus external to, and apart from, the original thallus, — new individuals, that is, of the original thallus, but not of the species. To the frequency of the gonidial propagation is to be ascribed as well the great excess of abnormal states in lichens, as the numberless variations into which the species run.

Obs. G. G. Koerber (*De Gonidiis Lichenum, Dissertatio, Berol.* 1839) has given the most comprehensive view of the Gonidia with which I am acquainted. He has embraced the most of Wallroth's important conclusions, and set them forth in a clear and somewhat improved form. I repeated myself some of Koerber's important experiments on the spot, with a powerful microscope, and with success. He concludes that the gonidia are the most essential parts of Lichenes, as they are taken by Fries to be the principal distinction of Algæ in general from Fungi: — that in fine the gonidium is the ultimate living atom and elementary monad of lichens; and hence that every lichen is a synthesis, a systematical individual which may contain countless numbers of true individuals; all of which flows directly from our primary views of the structure of lichens and the nature of the gonidia. Eschweiler dissents from some of the above views (*Fl. Bras.* 1, p. 56).

The second mode of propagation in Lichenes is by *Sporidia*. These are cells produced by a metamorphosis of gonidia. They are the analogues of seeds, and produce new individuals of the species, and the propagation by them is the typical and primary: — just as the gonidia are the analogues of buds, produce new individuals of the parent only, and are the medium of the succedaneous and secondary propagation. The sporidia are subglobose or elliptical, and either naked in the thalamium, or contained in elongated subvertical cells (*asci*; which are again sometimes themselves included in other *asci*), which are formed in the thalamium, or that part of the lichen which is the analogue of the blossom. The *asci* are very variable in form, but always elongated, and more or less cylindrical, clavate, or elliptico-cylindrical. They are commonly more obsolete in the higher and more perfect lichens, and most remarkable in the lower divisions. Very different genera have *asci* perfectly similar. The spores, when they occur naked, are for the most part collected together without order; frequently somewhat coherent; and black, or more rarely purple and lemon-colored: when included in *asci*, they appear either in a simple or in binary, ternary, or quaternary series, and are either colorless, or lightly tinged, — gray, yellowish, reddish. They germinate by simple elongation into threads, by the confluence of which the hypothallus is formed.

Obs. Eschweiler (*Syst.* p. 9.) has pointed out some differences between the spores of lichens and those of fungi, — and comparing the *asci* of more perfect lichens to those of fungi, he considers the

same parts in the less perfect (where they are largest, most constant in form, and most numerous) as rather resembling the asci of aquatic algæ, and not so much in these last seminal as infusorial in their nature. In his latest work (*Lich. in Mart. Fl. Brasil.* 1. p. 60) he denies that there is any certain limit between asci and sporæ in lichens, and further says, that it is almost impossible to decide whether the annulate appearance of the asci is occasioned by septa or strictures, or by included asci or sporæ. I can only briefly refer to these questions. The whole has been most fully illustrated by Fée, in the second part of his "*Essai sur les Cryptogames,*" &c., Paris, 1837; with five plates; containing a vast amount of information. The principles deduced by Prof. Fée, from the general results of his observations, will, perhaps, not be considered altogether admissible, though certainly of great value. They lead him to pronounce *Peltigera*, *Nephroma*, and *Solorina* distinct genera, which is confirmed by a striking natural habit in each. But again they compel him to separate *Umbilicaria pustulata* from the rest of the genus, and to make two genera of this most natural group,—a construction irreconcilable with our definite knowledge of these plants from all other points of view. In the same way, he is led to refer *Stereocaulon* to *Cladonia*. But it does not seem to me that the present views of the author are in any degree final, and they will probably be hereafter developed more satisfactorily.

Beside the propagation by *Gonidia*, and that by *Sporidia*, there may be mentioned another, which is, however, rather accidental in its nature, and perhaps only a modification of the gonidial propagation,—that by the *Hypothallus* (*Protothallus*, Mey.). This, originally the elementary state of lichens, in which their layers are confused, is afterwards discernible as cylindrical cells in the horizontal lichens, and also as the pythmenes or fibres occurring at their margins or on their under surfaces; and in crustaceous species it forms the base of the thallus closely adnate to the matrix, of various thickness, and in color varying from black or white. Crustaceous lichens, which had been scraped from rocks, were found by Fries to grow again from the remaining portions of the hypothallus. In like manner, Schærer found that new individuals of *Umbilicaria* were sometimes produced from the pythmenes or fibres of a species alone. "*Hypothalli vis individua propagandi non deneganda; continet enim gonidia in potestate.*" Fr.

Auct. de Genesi:—*Fries*, *Lichenogr.* p. 52; *Meyer*, *Entwick.* pp. 314, 319, &c.; *Wallroth*, *Naturgesch. der Flechten* 1. 255, &c.; *Eschweiler*, *Syst. l.c.*; *Koerber*, *Dissert. l. c.*

II. MORPHOSIS.

The ulterior evolution of the thallus consists in the segregation of organs, either together with, or from the hypothallus, which had been primarily involved in it. The *nisus* of the young thallus is either centrifugal, producing a thallus typically horizontally expanded,—or centripetal, producing a thallus normally arising vertically from the matrix. These directions are not, however, in polar opposition, since, by constriction, the centrifugal becomes centrip-

etal, as in *Cetraria*. In *Cladonia* and *Stereocaulon*, we observe a double thallus, that is, a vertical, which we call *podetium*, arising from the primary horizontal; and the former is, again, by the evolution of gonidia, also besprinkled with another kind of horizontal thallus in the shape of leaf-like scales. The horizontal thallus is either, I. Crustaceous; or, II. Foliaceous; which are well distinguished by habit, though their limits are not strictly definable. Thus a crustaceous lichen may become effigurate at the margin, or, with age, all over; and a foliaceous lichen, either by its evolution being hindered, or by anamorphosis, becomes often crustaceous. (This suggests another reason for caution in judging of lichens from a hasty view of the mere habit.) A crustaceous thallus of the most simple kind is one *equally* explicated and concrete of the hypothallus (*th. contiguus*), which, with age, becomes often cracked and chinky. Next to this is the thallus coming forth from the hypothallus, here and there conglobated, which is either innate in the hypothallus (*th. areolatus*), or more discrete from the hypothallus (*th. granulosus*), the *granula* being rounded in the latter, and flattened (*areolæ*) in the former. By the coalition of many *areolæ* or *granula* these become lobate, and pass thus into a new form (*th. crustaceo-squamulosus*.) In the younger state of a crustaceous thallus, it is, sometimes, from the presence of cylindrical cells, plicato-radiose at the margin, while yet in its older state, the lichen, in consequence of the vegetation of these cells becoming suppressed, returns to a uniform crustaceous habit. A foliaceous thallus is either originally composite (*th. squamulosus*, to be cautiously distinguished from the *th. crustaceo-squamulosus*), or it is more simple and entire (*th. frondosus*, *th. monophyllus*.) Of the vertical thallus there are two kinds, the compressed (*th. subfoliaceus*), and the terete (*th. fruticulosus*). Of both of these the *filamentous* and the *pendulous* thalli are degenerations; of which, indeed, there occur instances in the merely foliaceous thallus.

Among the lowest tribes of lichens, we find the thallus innate in the matrix of the plant (*th. hypophlæodes*) wherein the hypothallus is deficient, and the thallus is inconspicuous. Much as these recede from other lichens, it is only as a degeneration, nor are the limits determinable between the thallus which is innate in the matrix, and that which is superficial (*th. ectophlæodes*).

Auct. de Morphosi:—*Fries*, Lichenogr. p. 58; *Meyer*, *Entwick.* p. 316, &c.; *Wallroth*, *Naturgesch. der Flechten* I. p. 74, &c.

III. METAMORPHOSIS.

The only normal metamorphosis in Lichenes is the formation of *Apothecia*. These repeat, in narrower limits, the elementary organs of the thallus, which appear in them more defined and ennobled. In the structure of the parts of fructification, lichens agree with fungi, and hence these parts in both classes have the same names. We distinguish in the apothecium first the *Thalamium*, or fructification itself, and second, the *Excipulum*, or that which contains it. In the *thalamium* we find *sporidia* and *asci*; the *sporidia* being either naked, or included in the *asci*, which are themselves sometimes in-

cluded in other asci. Sporidia are the analogues of seeds, and the medium of the typical propagation of lichens. The *excipulum* is either of the same color with, and similar to, the thallus (*exc. thalloses*); or of different color, and heterogenous nature (*exc. proprium*). Both are sometimes present; but hardly ever, typically, are both absent. The excipulum becomes the margin of an open thalamium. It is sometimes suppressed by the growth of the thalamium, and is sometimes scarcely distinguishable from the thallus.

How the apothecia arise is easily to be seen, but what beside the nisus of nature determines their different evolution it is more difficult to perceive. In part this seems to depend on differences of climate, since many widely diffused species produce apothecia only in peculiar regions; in part, also, it would seem, on light, since apothecia are almost always produced on the upper surface (*apoth. antica*); and only very rarely on the under side (*apoth. postica*). The more imperfect the lichen the more profoundly do the apothecia arise: in the Calicia, the Verrucariæ, &c., even below the crust and in the matrix itself; in very many, in the medullary layer; and, in those best developed, even in the cortical layer. We have hence *apoth. immersa* and *superficialia*; *innata, adnata*; *sessilia* and *elevata*. The fulcrum of apothecia is either formed of the excipulum thalloses (*podicellus*; *apoth. podicellata*), or of the excipulum proprium (*stipes*; *apoth. stipitata*).

The typical form of apothecia is round, but oblong and linear apothecia occur normally, and these last by composition become ramose (*apoth. lirellæformia*). An excipulum proprium which is typically closed we call *perithecium*, as in Verrucaria. Besides these, we distinguish apothecia which are deeply excavated, with a contracted margin (*apoth. urceolata*); those slightly concave, with an elevated margin (*apoth. scutelliformia*); those dilated, flat, without prominent margin (*apoth. peltæformia*); those convex, in which the margin is repressed (*apoth. cephaloidea*); those between scutellate and peltæform (*apoth. disciformia*); and those between scutellate and cephaloid (*apoth. tuberculata*).

All apothecia are primarily closed, the included thalamium being conglobate, gelatinous-waxy, and the asci converging (*apoth. nucleiforme*). If the apothecia remain closed, the nucleiform thalamium deliquesces, and the sporidia escape through an ostiole, which is either a simple pore, or one at the summit of a papilla. If the apothecia themselves gape open, the thalamium is either flattened into a rigid and persistent lamina (*apoth. subdisciforme*), or shortly after, itself collapses into a powdery mass. If, finally, the nucleiform state of the thalamium is so quickly concluded that the lamina appears originally open, with not even connivent margins, which occurs especially in apothecia produced from the cortical layer, wherein a punctiform disk shows itself before the excipulum is formed, we have a third kind (*apoth. apertum*).

Among those lichens which have closed apothecia (Angiocarpi), many thalamia are sometimes included in a single excipulum (*apoth. composita*), and again many are sometimes confluent in one. In like manner, among the lichens with open apothecia (Gymnocarpi),

we find sometimes many disks confluent in one (*apoth. symphy carpæa*). There are many forms of composite-conglomerate apothecia. The apothecia of *Umbilicaria* are typically simple, and either scutelliform like those of *Lecidea*, or lirellæform like those of *Opegrapha*, but their gyrose-plicate evolution is so normal (even when the plicæ are deficient, the disk being chinked) that we are compelled to regard them, taking their other characters into consideration, a distinct genus.

Obs. Eschweiler's latest views of the apothecia (*Fl. Brasil. l. c.*) may be referred to, as also those expressed in his *Systema*. No one has studied the structure of these parts more accurately.

Auct. de Metamorphosi: — *Fries*, *Lichenogr.* p. 63; *Meyer*, *Entwick.* p. 314, &c.; *Eschweiler*, *Syst. l. c.* and *Fl. Bras. l. c.*; *Wallroth*, *Naturg. der Flecht. l. c.*

IV. ANAMORPHOSIS.

To abnormal development Lichenes are peculiarly exposed. The far greater frequency of the propagation by gonidia, producing new individuals of the original thallus only, gives rise to a vast number of varying, more or less imperfect, and atypical states. The monographical study of the class, without regard to the typical or atypical state of the forms of vegetation referred to it, or to the endless analogies of development in different genera, long obscured the scientific system of these plants, and infected it throughout with error. But besides the gonidial propagation, the variation of lichens has other and no less active causes,—in climate, station, age, and mechanical obstruction; and yet again in the original individuality of every species, developing progressively or regressively from its ideal type. It is, then, a wide field, that of the anamorphosis of lichens; one, indeed, which embraces the whole circuit of lichenose vegetation. In its history, the names of *Fries*, *Wallroth*, and *Meyer* will be always preserved.

The anamorphoses of the hypothallus are especially fallacious, since herein the whole lichenose habit disappears, and that of a *Byssus* is counterfeited (the hypothallus, considered *per se*, being itself a byssaceous development). In places exposed to the sun, this byssoid degeneration is more simple, as in the case of *Byssus antiquitatis*, L., which is derived from a black hypothallus. But in moist places it appears as floccose, often somewhat cæspitose, masses, of various stature, which occur in large patches, and in the mountains of Sweden have been satisfactorily referred to various *Lecidææ*, *Biatoræ*, and *Parmeliæ* (§ *Patellaria*). These byssoid states of lichens have been described as *Conferveæ* by authors, and with lichenists they have passed sometimes for accidental excrescences of lichenose vegetation, their apothecia, when they occurred, being taken to be fungi.

We have next briefly to glance at the anamorphoses of the thallus. These are referable in part to the gonidial propagation generally, that is, to the germination of the cells of the gonimous layer, either normally or abnormally, producing, in the first place, new

thallus of the matrix, either within or without it, and in the second, bursting through the thallus irregularly, and in various ways altering and even destroying its whole habit. (Another anamorphosis which is not to be confounded with that we are to describe, is that produced by a change of the exterior cells of the cortical layer into heterogeneous bodies (stauromata) already noticed, which often resemble, but are altogether different from soredia.)

In a very common kind of gonidial anamorphosis, the thallus, as it were, totally deliquesces, and the gonidia every where bursting through the cellular layer above them, an expanded powdery surface, consisting of gonidia intermixed with cells of the other strata, is formed, — which is what we call *Lepraria*. This is found in crustaceous, foliaceous, and vertical lichens, occurring more or less marked, and if sterile constituting the Acharian genus of the above name, which name is now used only to denote this abnormal condition of the lichenose vegetation.

Or, again, if the gonidia break out in those regular powdery heaps which we call soredia, (this evolution taking place atypically, that is, contrary to the original type of the species,) and overrun the lichen, the cells of the cortical layer adjacent are broken and altered, the whole plant becomes sterile, and a monstrous habit is induced, which we call *Variolaria*. The various forms of this, originating in different crustaceous (as most commonly in *Pertusaria*) or even foliaceous lichens, constituted the Acharian genus of the same name. Sorediiferous states of lichens cannot, generally, according to Fries, even be considered varieties; and he thus abolishes *Ramalina farinacea* (*Lichen farinaceus*, L.) as merely *R. calycaris sorediifera*; and in the same way some other long-received and common species and varieties. But we find in the manner of appearance of the soredia very great differences, and these diversities are of more weight than the mere presence or absence of this development. Their importance is manifest in the case of the *cyphellæ* of *Sticta*, the most remarkable form of soredia; and peculiar to a single very natural genus.

The two kinds of anamorphosis already described are common, says Fries, to all *Algæ*; but we have next to notice one, peculiar, it would seem, to lichens, — those coralline, subcylindrical, elevated, and here and there branched excrescences, which, appearing in and covering more or less a crustaceous thallus, were reckoned, together with the thallus in which they broke forth, forms of a distinct genus by Acharius, under the name of *Isidium*; a name still appropriated to this state of vegetation in lichens. The formation of *Isidium* is attributed by Meyer to an elevation of the cells of the cortical layer, by the protrusion of gonidia. It seems, however, difficult to determine the relative action of the different layers in the case with any certainty. A crustaceous thallus is often so much altered by this anamorphosis, that its original habit is almost, or entirely lost, and it is matter of praise, rather than censure, that Acharius separated and collected all these states, as he did those others already mentioned, — but the very same development occurs in foliaceous lichens, and is conspicuous in some of our largest *Par-*

melix, the isidiophorous American states of which differ so much from the smooth European lichens, that, when *Isidium* was not yet understood, they were reckoned distinct species. (*P. rudecta*, Ach. = *P. Borreri*, Turn., *isidiophora*.) The formation of *Isidium* is not found to be common to species otherwise allied, nor to all genera; it is wholly wanting among the inferior, the Myco-lichenes, and is, indeed, generally peculiar to the Parmeliaceæ and Endocarpeæ, in two northern states of the former of which, an isidio-morphous thallus seems to be normal. Perfect apothecia are commonly wanting in strongly marked isidioid states, but rudimentary developments or globules, often of a brownish hue, the result of an atypical metamorphosis of gonidia, occur frequently at the apices of the branches. The consummate descriptions of Turner and Borrer (*Lichenogr. Britt.*) afford the best view of *Isidium*, *Variolaria*, *Lepraria*, and *Spiloma*, that has been given. It is, moreover, manifest that these eminent botanists anticipated those views of anamorphosis now so well understood, (which others, indeed, had also, to some extent, foreseen,) and had even received and extended somewhat the rudiments of the true doctrine of the gonidia. Among the many other forms of thalline anamorphosis, we can in this place refer only to that remarkable and perplexing proliferation of the thallus, the Lichen parasiticus of E. Bot. (*Endocarpon parasiticum* of Acharius, and well described by Sommerfelt as *Lecidea Parmeliarum*). This forms minute, lobed, from cucullate, explanate leaves, varying from bluish green to glaucous, which grow cæspitously from the original thallus, and are often besprinkled here and there with hemispherical black cephalodia, much like the apothecia of *Lecidia*. It has been found to occur on several different species of *Parmelia* (§ *Imbricaria*), in each case participating more or less in the color and nature of the matrix, and with us is often observable, with all the above features, in *P. Borreri*.

We have now to consider the anamorphoses of the apothecia. These originate in a suppression of evolution, and have been made to characterize (of course while they were not understood) not only spurious genera of lichens, but even species of fungi. In some forms of *Spiloma*, to be hereafter described, spurious apothecia are formed by a semi-complete metamorphosis of gonidia. Besides this, the principal abnormal states which we have to notice are,

I. Angiocarpous states of *Gymnocarpi*, when, that is, the normal evolution of the apothecia is broken off, and we have atypically persistent the original nucleiform apothecium (q. v.), which, by further degeneration, is yet more altered. Various supposed species of *Endocarpon*, *Porina*, and many *Sagediæ* of Acharius are thus referable to imperfect states of *Parmeliæ*, while other *Sagediæ* and *Pyrenulæ* have arisen from abortive *Lecidææ*. It has been already remarked, that when apothecia arise from the cortical layer, the nucleiform, or disciform thalamium is more exerted, and appears primarily without any excipulum; if their further evolution be impeded, these rudimentary apothecia become blackish, and similar to the perithecia of *Verrucaria* or *Sphæria*, to both which tribes anamorphoses of this kind have been referred. And this is almost universally the explanation

of the *thallus nigro-punctatus*, which can no longer be made a specific character.¹ In the way above described, many *Gymnocarpi* are altered by anamorphosis, and vary according to the differences of the genera, the fructification of which is affected.

II. *Cephalodia*. These are monstrous *Parmeliaceae* apothecia, wherein the thalamium bursts forth alone without any excipulum thalloses, and is hence convex and subimmarginate. They are nearly akin to the preceding, as is abundantly evident in the lichen *parasiticus* already mentioned, when growing on *Parmelia saxatilis*; for here the black *Verrucarioid* dots of the latter are developed into *cephalodia* on the former. *Cephalodia* are, then, abortive apothecia of *Parmeliæ*, personating the apothecia of *Lecidinæ*. Where, as in *Usnea*, the disk is normally much attenuated, the *cephalodia* appear quite different; but where the contrary is the case, the *cephalodia* nearly resemble the true apothecia.

Another allied abnormal state of the apothecia is common in *Sticta pulmonacea*; this degeneration is accounted for by Fries, by the disk's originating below the gonimous layer.

III. *Arthonia*, that maculæform, oftener difform, immarginate apothecium, wherein the excipulum and all the included parts are confused; on which Acharius founded his genus of the above name. Eschweiler (*Lich. in Mart. Fl. Bras. l. c.*), on the strength of some Brazilian forms, hesitatingly restores the genus. *Arthoniæ* originate mostly from *Opegrapha*, but also, says Fries, from the *Verrucariæ*, and more rarely from the *Lecidinæ* and lowest *Parmeliæ*. This anamorphosis depends upon station, and is not known to occur in any but tree-lichens. The apothecia, nesting in the tender bark, wherein they occur, are interrupted in their normal evolution by the rapid growth of the matrix, and with the extension of the epidermis become dilated, until their interior parts are undistinguishable.

IV. *Spiloma*, that anamorphosis in which the apothecia are dissolved originally into heaps of granules, resembling naked spores. From genuine lichens with a collapsed disk, this is further distinguished by the absence of any excipulum. *Spilomata* are produced by too acute vicissitudes of climate, effecting the dissolution of the apothecia. This may be by heat, — whence those *Spilomata* peculiar to warm countries, and wholly deficient at the North. Or it may be by moisture and cold, when, sometimes, being less perfectly evolved, they become floccose and approaching to nemata, when they may be called viviparous apothecia. We see in this a reversion of the anamorphosis of the apothecia to that of the hypothallus, from which last the degenerate state just described is with difficulty distinguishable. So in *Umbilicaria pustulata*, it is matter of doubt whether the byssaceous pulvinules occurring on it are to be referred to abortive apothecia, or to proliferations of a degenerate hypothalline state of the thallus.

¹ In the third paper of the writer's Enumeration of N. E. lichens, a distinction was thus assumed for *P. Halseyana* there proposed, in its possessing these black apophyses; since Acharius had expressly denoted, as a distinction of *P. centrifuga*, to which the plant afterwards proved to belong, that it wanted such dots. They are indeed more commonly absent.

So long as the effects of morphosis and anamorphosis were not clearly distinguished, understood, and explained, all systematical efforts were vain. That which is vague and indefinite in observation becomes fallacious and unfaithful in construction. Less numerous, perhaps, certainly less various, than the vibrations of the lower families, the anamorphoses of lichens have yet knotted the Ariadnean thread of the system, so that neither ingenuity nor thought alone can bring it straight. We may briefly here consider the primary grounds of the system of lichens. That these are dependent on the apothecia has been an opinion so generally entertained, that the contrary was scarcely noticed by authors; notwithstanding which, this last has much influenced lichenists, and does yet. But we think there is no longer any doubt that the *facies externa* is of little moment, and indicative of analogy only, and not of affinity, whereof the former is inferior (Syst. Mycol. i. p. xv. &c.). Considering the matter morphologically, we see clearly the preëminence of the apothecia;—as indicating true affinity, as of themselves limiting the superior sections, as the organ of a higher metamorphosis, and especially as having definite and limited series of evolution. All which is contrary in the thallus, which offers no constant primary difference that is not comprehended in the character of the family; the morphoses and anamorphoses of which are never definite; which tends continually to new and altered forms; and finally, since it is continually in evolution, presents an absolute series of variation, and in its very last state of dissolution into the primitive gonidia, germinates into a new race. — *Fries.*

Eschweiler (Fl. Brasil. l. c.) goes so far as to say that there is no general differential character to be found in Lichenes, and he hence disposes the genera in a series of tribes, without admitting higher divisions. He avails himself, in distinguishing genera, of the thallus no less than the apothecia. (It is unfortunate that his valuable observations are everywhere obscured by a style singularly involved and inelegant.)

So much for the system; a word now of our study in nature. Our object is briefly each individual species; its totality; its morphosis, metamorphosis, anamorphosis, progressive, regressive, and accidental; its relations, near and remote, of affinity and analogy;—in one word its history; which one plant of a species will not teach us, perhaps not a thousand:—bearing ever in mind the master's maxim, that however any thing may subsist below it, nothing can ascend above its *Idea*;—*nil crescere potest, quod plenum est.* More and more shall we thus see that previous observers are of only secondary importance, that, beyond every thing else, we need minds and eyes to search nature. What therefrom results, will form itself indeed in words and books, and force its own way, destroying or building up; and thus will the silent understanding of that nature which works without words become the organ of the speech of nature in necessary truth and universal law.

Auct. de Anamorphosi:—*Fries*, Lichenogr. p. 70; *Meyer*, Entwick. p. 187, and *passim*; *Wallroth*, Naturgesch. der Flechten, I. *passim*;

Eschweiler, Lich. in Mart. l. c.; *Koerber*, Diss. l. c.; *Turner and Borrer*, Lichenogr. Britt. *passim*.

V. CHROSIS.

The intimate connection of color in lichens, both with the structure of the parts, and the progress of evolution of the whole plant, was indicated by *Eschweiler* (Syst. p. 6) in 1824. Observing the general occurrence of a black apothecium with a white thallus, and of a red apothecium with a green thallus, he inferred a chemico-polar secretion of coloring matter, the operation of which he compared to the separation into red and green of the purple tincture of *Roccella*, and many other lichens, at the poles of the Voltaic pile. Hence he further argued the remarkable distinction in this respect of Lichenes from aquatic Algæ and Fungi; their nearer approach to phanerogamous plants; and their intimate dependence on light. *Fries* (Lichenogr. l. c.) concludes, that the vital color in lichens is green, becoming more or less altered by external moments, and either normally or abnormally; that of the fructification red, regressively passing into black; and that white arises in every series of variation of color, and is apparently never normal. *Nimium ne crede colori sed crede colori*. In the infinite variety of hues in lichens certain primary types of color can be discerned and indicated; and these are observed to characterize, more or less distinctly, certain series of species, which vary within the limits of their types. And these series, if distinct, are sometimes so conspicuous, that species of the most different form, but congruous in their normal color, seem to possess more true affinity than others agreeing in form but differing in their normal color. The native and primitive color, as in all Algæ or *Protophyta*, is green, — (τὰ ὑπὲρ γῆς χλωρὰ πάντων φουμένων τὸ πρῶτόν ἐστι. *Arist.*), — which in the perfect lichen we find pure and persistent only in the gonidium, or vital principle.

The *Hypothallus*, where this is perceptible, is either palish (*hypoth. albus*), or blackish (*hypoth. niger*); the latter verging here and there to lurid, bluish, &c. The color of the *Thallus*, of primary importance in determining the affinity of species, inheres only in the cortical layer, and shows itself in four well defined series: e læte viridi *glauca*, — e flavoviridi *ochroleuca*, — e saturate viridi *fusca* l. *olivacea*, — e luteoviridi *citrina*. But these colors are variously aberrant. In the lower tribes the series are not defined; in those with a *thallus hypophlæodes* the color depends on that of the epidermis of the matrix, though this itself is variously changed by the lichen. Other mutations are dependent upon station: thus, in moist places the normal color becomes greener; in those too dry this appears whiter. White is peculiar to no series, and either as gray, or whitish, results manifestly in each. The cycle of variations of each series is best learned by use; in genere *glauca* pallide viridis, glaucus, cærulescens, stanneus, albus; *fusca* saturate viridis, olivaceus, cinereus, griseo-fuscus, badius; *ochroleuca* flavo-virens, ochroleucus, albescens; *citrina* viridi-luteus, aurantius, miniatus.

The *Thalamium* (possibly from the resinous principle *erythrinum*

peculiar to lichens¹) is typically *red*, but through impalpable gradations, and with increasing induration, it passes into rufous, fuscous, and nigrescent; the same species, and even the same individual, often going through the whole series. Exceptions, indeed, there are, and so normal, that they afford distinctive characters; but all are, notwithstanding, reducible without difficulty to the type. The color of the thallus without doubt tempers that of the disk, especially if this be extenuate and immediately margined by the thallus. In this way, and perhaps particularly by extenuation, we have the expallent disks of *Usnea* and *Ramalina*, an effect produced, also, in other species by moisture, as in *Biatora vernalis*. *Usneæ* and *Ramalinæ* do occur with reddish disks, which color appears also in the cephalodia when they are present. Black generally is peculiar to the genera that approach the fungi; red to the central and higher groups.

Besides the above, we have now to add a few words of those wholly foreign colors, with which many individuals occur so imbued, that the normal hue is altogether destroyed. Meyer has treated this at large (*Entwick.* p. 60, &c.), and Fries more briefly, as follows. To be first mentioned are those accidental colors dependent on inorganic oxides, the effects of which have been placed beyond doubt both by direct experiment and by observation. To the *oxide of iron* are referable all red and ochraceous-ferruginose crusts, occurring so commonly in our mountainous and alpine districts; to the *oxide of manganese*, according to Meyer, those which are roseate and purpurascens; and to the *carbonate of lime* those chalky-white crusts so common on calcareous rocks, wherein, also, the thallus more often appears in an atypical amylaceous state. Next we have the colors produced by parasitical *Byssi*, which infest especially the corticoline lichens, and occasion various shades of red. Lastly, lichens are sometimes tinged by the exuding sap of trees, and hence acquire a rufo-fuscous hue.

Auct. de Chrosi:—*Fries*, *Lichenogr.* p. 105; *Meyer*, *Entwick.* p. 60; *Wallroth*, *Naturgesch. der Flecht.* II. pp. 45, 417; *Eschweiler*, *Syst. l. c.*

VI. CHRISIS.

Having thus explained the beginning of the life of lichens, and the progressive development of their vegetative and fructificative organs; having, moreover, presented a view of their principal anamorphoses, and finally of their colors,—we come now to the history of these plants as objects firstly of use, secondly of study, and lastly of systematic arrangement.

Lichenes are, of all other cryptogamous plants, the most remarkable for their manifold and various uses in technology and medicine, no less than in the economy of Nature, and thence generally of Man. In what follows I have availed myself of all the authorities within my reach, disposing the whole as respecting, I. the Economy of Nature; II. of Man, generally; and III. particularly, and in the Arts.

Of the first of these heads very little is satisfactorily known.

¹ Götting. Gelehrt. Anzeig. 1830, No. 141, Fries, l. c. p. xxxvi.

The long-mooted question, whether lichens injure the trees on which they live, is not to be answered, says Fries, by mere denial. He does not consider it further, nor do I know of any thing of importance relating to it beside a chapter in Hagen's *Hist. Lich. Pruss.* 1782; a few pages by Hoffmann, 1786; part of one in Luyken's Dissertation, compiled, it would seem, from Hagen; and a brief paper by F. V. Merat, in the Transactions of the French Agricultural Society, 1837. The three first-named writers think that lichens do not injure trees, and the last that they do; but altogether they have contributed very little to our knowledge in the matter. Hagen considers the whole thing an aspersion upon lichens, and defends them most laboriously. Mr. Merat, on the other hand, is persuaded that lichens are mischievous plants, and after showing them up to the best of his ability, he gravely gives us recipes for their extirpation. On the whole it does not seem at all safe to deny the destructive power of these plants generally on the trunks (and dead wood) which so many species naturally and normally inhabit. And some years since (*Lich. N. Eng.*, in *Bost. Jour.* 1841, p. 458) I ventured to express this opinion without qualification, and to suggest the probability of a law determining their action in this respect in nature. Soils and other circumstances affecting the health of trees are so various and uncertain, that in the midst of what seems to indicate power of indefinite duration, we find constantly symptoms of disease and decay. Unhealthy young trees do not long survive after their epidermis is well covered with lichens, and in this stage it seems to me quite futile to remove the latter. But in older trunks the connection of these plants with any morbid condition of the tree is often very obscure, as indeed we might expect it to be. It is possible that an unhealthy state of the trunk, whether from soil or other circumstances, affords certain favorable conditions for the life and growth of the lichens which occupy it, and accelerate its death: or it may be that the lichens of themselves induce disease and accomplish dissolution; more quickly and visibly in a young tree, and more slowly and obscurely in an old. However it be, we assert generally, again, a probable connection between the life and growth of lichenose vegetation on trees, and the death of the latter; and infer thence the probability of a law determining in this way the action of lichens on living vegetable matter. The universality and frequency of lichens wherever are earth, and air, and light, and time is given, and their singular power of assimilating the substance of the matrix (in corticoline species the very epidermis of the tree fills often the place of a lichenose cortical layer; and on calcareous rocks we find the crustaceous thallus and the calcareous matrix together grown into a subcalcareous mass) must not be forgotten. And this leads us to the consideration of the action of lichens on inorganic natural bodies, and their precedence of vegetation as Protophytes, whereby they afford, also, the first beginnings of humus for after successions of higher and higher vegetable development. With regard to the first clause of the last sentence, I am unprepared to add any thing to the mere indication of the question, further than that these plants seem sometimes to aid in the disinte-

gration of rocks, but whether only mechanically, or chemically, or both, is as yet matter of inquiry. But Linnæus, (*Amæn. Acad. II. p. 25.*) and numberless writers after him, have beautifully displayed the rise and the progressive development of vegetation, from the protophyte, the crustaceous lichen on the dry top of the rock just emerging from the sea, to higher lichens, to mosses, to herbs, and stately trees.

We come now to the second part of this chapter, which concerns Lichenes as they respect the economy of Man generally. They afford protection to tender alpine plants without doubt. They are not only a refuge for insects, but serve also for the construction of the nests of certain kinds, as also of birds. But above all are they important, as furnishing food to the higher animals, in circumstances where these animals would perish without the lichens upon which, for the greater part of the year, they subsist. In this way certain species are essential to the very existence of Lapland as an inhabited region. "Hi Lichene obsiti campi sunt Lapponum agri, hæc prata eorum fertilissima." (*Fl. Lapp.*) Nor is it reindeer alone which are sustained by lichens; other deer, and horses, swine, oxen, calves, and sheep not only will live, but grow fat upon them, so that in Carniola they fatten lean cattle by pasturing them where nothing but *Cetraria Islandica* (Iceland Moss) grows. Finally, lichens serve as food to the wandering savage tribes of boreal America, and in frequent circumstances the Rock-tripe (*Umbilicaria*) may be said to be essential to their existence. "Next morning," says Franklin, in his thrilling "Journey to the Shores of the Polar Sea," "the breeze was light, and the weather mild, which enabled us to collect some *tripe de roche*, and to enjoy the only meal we had for four days. We derived great benefit from it, and walked with considerably more ease than yesterday. Without the strength it supplied, we should certainly have been unable to oppose the strong breeze we had in the afternoon." (P. 437, and see pp. 404, 436, &c.). According to Franklin, Muhlenberg's Rock-tripe (*Umbil. Muhlenbergii*), so common on the Blue Hills, the Lynn hills, &c., is the species preferred by the Indians, and he calls it, "with fish-roe or other animal matter, agreeable and nutritious."

There remains only to mention the universally known Iceland Moss (*Cetraria Islandica*) of which Proust has said, that "Nature can hardly furnish a more excellent article of food." This affords to the Icelanders both soup and bread, and, with *Cetraria nivalis*, is considered "wholesome, nourishing, and extremely agreeable." Indeed, Olafsen says, that they reckon a ton of the flour of the Iceland Moss to be equal to half a ton of ordinary flour or meal. I pass over other species which might here be referred to, and proceed to consider, lastly, the uses of Lichenes in the Arts. And here, well remarks Fries, almost all that is known has been owing to the Northern—the Anglo-Saxon, Scandinavian, and German nations, whom necessity constrained to value and to improve all of Nature's gifts. Throughout the North, lichens have been used as dye-stuffs from remote antiquity, and are still, to a great extent. Swedish writers have illustrated at large the whole matter, and es-

pecially Westring in his *Svenska Lafvarnas Färghistoria*, Stockh. 1805, the classical work. Many lichens, among which the Archil, Parelle, and Cudbear, are most distinguished, abound in coloring matter of equal elegance and tenacity, — and those mentioned are articles of commerce. Westring distinguishes between those lichens which impart color to pure water, which he calls essential pigments, and those which require a peculiar treatment to yield color — preparable pigments. A single species, with different treatment, affords very different colors, which he exhibits in every case. He considers that the colors afforded by lichens are remarkably efficacious in staining marble durably. There is no brief view of the uses of lichens as dye-stuffs so comprehensive as that given by Mr. Neil in his admirable article in the *Edinburgh Encyclopædia*. Coloring matter may be said, says Fries, to exist in all lichens, but it abounds especially in the crustaceous, the tartareous, and coriaceous kinds, and is almost deficient in those which are more delicate, or subgelatinous. And it is most remarkable, that not only the quantity, but the kind of color, differs in different states of evolution of species. Isidioid forms, he adds, are most rich in color; next to them are the Variolarioid; and the powdery, gonimous, and hypothalline states are the poorest. The color seems to depend on the resinous principle Erythrinum, already referred to, said to be peculiar to lichens. This affords red, purple, and brown hues, which differ very much, according to the treatment. The mucilage of lichens was proposed by Lord Dundonald to be applied to thickening the mordants, and fixing the colors in calico-printing. From *Umbilicaria pustulata* excellent Chinese ink has been made. Paper has been made from the gray foliaceous *Parmeliæ*. A gum as transparent as gum arabic was obtained by Georgi and by Amoreux, by evaporation of the mucilage of *Parmelia*, *Peltigera*, and *Ramalina*. In Siberia, the Lungwort lichen (*Sticta pulmonaria*) is a common substitute for hops, in the making of ale; and is also reckoned edible by Georgi, yielding “a yellow, nearly insipid mucilage,” which may be eaten with salt. And this species, and many others, from the tannin which they contain, are employed in some countries for tanning leather. Many crustaceous lichens contain oxalic acid in greater or less abundance; and according to M. Braconnot, this occurs in the bitter *Variolaria* (*Pertusaria pertusa*, β . *sorediata*, *c. orbiculata*, Fr.) in such quantity that 100 parts yielded 18 of lime, combined with 29.4 of oxalic acid; and the lichen is now employed in France in the manufacture of the acid on a very extensive scale.

In medicine, the uses of lichens were formerly so much thought of, that there was scarcely a disease for which some lichen or other was not regarded specific. Those still received are reckoned astringent, febrifugal, and stomachic; and more rarely they seem to be purgative and anthelmintic. *Parmelia parietina* was some years since declared to be a sufficient substitute for Peruvian bark, an opinion which gained some credit in Europe, and even now, I was assured by a competent person, is not wholly given up. That many lichens may be useful as febrifuges is hardly doubtful, and their

active properties are no doubt to be found in the bitter principle, which is combined with that nutritive and restorative amylaceous gluten with which they abound. A long list of medicinal "*Lichenes, quorum usus obsoletus est*" may be found in Luyken and his authorities. With the exception of what is above admitted, it is probable that Spielmann (Inst. Mat. Med., p. 388) is correct in saying that we know nothing with certainty of the particular uses of lichens in medicine. The symbolical or *physiognomistic* contemplation of nature — which Porta reduced to a system, and by which it was proposed to discover the virtues of plants through a sort of *homeopathy*, so to speak, of nature itself — extended to lichens also, and hence, says Fries, the reputed (which are, perhaps, not yet quite obsolete) virtues of *Peltigera aphthosa*, on account of its soredia, to cure the thrush (aphthæ); those of *Usnea* to strengthen the hair, and cure diseases of it; and those of *Sticta pulmonaria* in lung-complaints. And the Paracelsian school brought up at last that "*muscus cranii humani*," which was so long a sort of philosopher's stone among the adepts, no two of whom could agree upon what it was, or whether any body had got it; beyond which, in this regressive series of our knowledge of the uses of lichens, we cannot go.

Auct. de Chresi:—*Fries*, Lichenogr. p. cxi.; *L. Fl. Lapp. &c.* l. c.; *Hagen*, Hist. Lich. Pruss. Regiom. 1782, p. 20, &c.; *Hoffmann*, de vario lich. usu, Erlang. 1786; *Westring*, Svenska Lafvarnas Färghistoria, Stockh. 1805; *Luyken*, Hist. Lich. in genere, Götting. 1809, p. 22; *Neil*, Art. "Lichen" in Edinb. Encyc. l. c.; *Hooker*, Tour in Iceland, Lond. 1813, I. p. 130; *Id.* Br. Fl. II. *passim*; *Franklin*, Narrative of a Journey, Lond. 1823, l. c.

VII. LICHENOLOGI.

The name Lichen (*λίχην*) was applied originally by Dioscorides (lib. iv. cap. 53.), and after him by Pliny (lib. xxvi. cap. 3), to certain species of this order, on account of their resemblance to the cutaneous disease, so called, whence, also, they were supposed to be specifics for it. It was very long before these plants became objects of scientific study. Morrison and Ray reviewed all the cryptogamic tribes, and not in vain; but they left them still confused. It was TOURNEFORT (1719) who first more accurately limited the class, and assigned to it, as a distinct division of the vegetable kingdom, the name it bears. MICHELI (1729) followed, disposing the species in admirable sections, and analyzing the fructification, which he further illustrated by many good figures. These are the founders of our science, and from their *contemplative* studies we come to its second epoch (the *descriptive*) in Dillenius (1740). This great cryptogamist devoted himself wholly to the limitation, description, and delineation of the species, and his *Historia Muscorum* is classical. A new sun of Botany arose now in the North, whose rays reached also the Lichenes. LINNÆUS, with his native genius, conjoined the ideas of Micheli with the science of Dillenius, and from him once more the study started anew. Among the more distinguished of those who continued to illustrate the Lichenes, were Haller, Scopoli, Hudson, Necker, Weiss, Schreber, Lightfoot,

Weber, Hagen, Ehrhart, Dickson, Villars, Swartz, Smith, and Wulfen. And thus we arrive at the third epoch of *disposition*. The need of more genera was generally felt, and a more accurate analysis of the fructification which Hedwig began first to institute, proved their naturalness. Hill (1751) had, indeed, already, and Adanson (1763) attempted the distinction of some few genera, but of much higher import were the labors of Weber (1778), Willdenow, and Humboldt, to this end. Hoffmann (1784) attempted a complete reformation of the order, in several elegant but not thoroughly scientific works, wherein he indicated incompletely some important parts of our present system, and illustrated the species with figures. Schreber, also, about this time attempted a distribution of lichens in sixteen subgenera. But PERSOON and SCHRADER are the founders of our present views of the science generally,—the first establishing important genera, and the second proposing general principles of disposition from the fructification, which have now revived. ACHARIUS and FLOERKE followed,—the first devoted to the description and arrangement of species, the last to their careful study in nature. Wahlenberg elegantly described and disposed the lichens of Lapland, avoiding many of the common errors of the time. Turner observed carefully the British species, and, with BORRER, illustrated all the more difficult genera, in descriptions which have not been surpassed. Luyken collected with assiduity a view of all that was known generally of the science. Decandolle proposed a new but not altogether successful disposition. Ramond, Dufour, Sommerfelt, Delise, Fée, greatly increased the number of species. At length the observations of Fries and Schærer, and the analyses of Eschweiler brought in that reformation of the system which WALLROTH and MEYER accomplished. The whole has finally been comprehended, and, both in generals and particulars, systematically disposed in the consummate work of FRIES.

Auct. de Lichenologis:—*Fries*, Lichenogr. p. 115; Luyken, Diss. l. c.

VIII. APHORISMI.

1. *Species unica in natura fixe circumscripta idea. Fr. Syst. Myc.*
2. *Constat omne plantarum genus (et species) habere quod sit cujusque suum; quod quid sit, nisi continua contemplatione rimeris et extrices, nunquam adsequeris. Koch. Sal.*
3. *Tantum e re variis rationibus considerata plena nascitur cognitio. Verum et pulchrum sub variis formis manifestatur. Qui se unicum et summum justum in generalibus plene amplexum esse fingit, se et alios fallit. Fr.*
4. *Externa facies inter Lichenes fallacissima est. Fr.*
5. *Affinia non identica, et equidem lubentius distinguo simillima, in natura diversam evolutionis seriem servantia, quam dissimillia, sed ex eadem evolutionis serie facile confluentia. Ingenue fateor Lichenum formas, ut externa facie maxime differant, ita maxime mihi esse suspectas. Fr.*
6. *Præcipue cavendum ne ex apparentibus approximationibus speciminum atypicorum diversa confundamus. Ad transitus demonstrandos seligi possunt specimina omnium Cladoniarum, Biato-*

rarum, &c., tam sibi invicem ut apparet appropinquantia, ut, qui *singulam in natura* haud persecutus sit, omnia confluere paratus sit jurare. Fr.

7. Si rite excipere velis diversorum auctorum judicia de singulis speciebus, attendere debes ad diversum eorum genium; utrum species ad historiam (quod nobis primarium) an e characteribus distinguant; utrum ad transitus directos tantum an indirectos sive obliteratione ortos simul contrahant; utrum ad typos præcipue, an abnormes status æque, attendant. Fr. Mant. II.

IX. SYSTEMA.

We may proceed in the disposition of plants in two ways, either of which may be natural or artificial, according as we distinguish or confound affinity and analogy, or affinity and systematic character. If we merely collect things like and related, and, variously circumscribing the sections, neglect any common principle of disposition, we have a *Methodus*. If, on the other hand, such common principle be proposed, and the whole thereto conformed, arises the *Systema*. Examples are readily turned to:—of the first, in Eschweiler's Disposition, admitting nothing higher than Tribes, under which the genera are brought together; and of the second, in the System to be now set forth. Of the exclusive value of either way it is unimportant to speak; the Method should be the foundation of the System, and the System the scope of the Method. Among the earlier illustrators of the Lichenes, the *thallus* was primarily regarded; from this proceed the arrangements of Dillenius and Linnæus; and in later times, of Acharius (in his Prodrömus), Agardh, Delise; and with some reference to the fructification, of Hoffmann, Decandolle, Eschweiler (in his Systema), and Fée. We find, next, the *excipulum* taken as primary,—by Wahlenberg, and by Acharius (in his later works). Lastly, the *thalamium* was assumed as primary (as first by Micheli, says Fries); which is the principle of the arrangements of Persoon, Schrader, Luyken, Fries, and Meyer. The instructive view of the thalline or Féean system, wherein Lichenes are regarded as either Myco-lichenes or Phyco-lichenes; and of that of Acharius, proceeding from the excipulum, and distinguishing them into Cœnothalami (exc. *proprium*), and Idiothalami (exc. *thallodes*), which Fries has given, and which, as he presents it, is full of new light on the whole order, should be here referred to. We proceed now to a view of the Friesian System in detail, as it is presented in the Lichenographia Europæa Reformata, with constant reference, however, to the latest expression of it in the Flora Scanica, and with some few other modifications which I have myself been led to prefer. The principles of the Disposition were proposed by Schrader and Luyken, as above said, and from these the earlier disposition of Fries, that of Meyer, and the present, have proceeded. As possibly adding somewhat to the value of what follows, I give, also, in their places, a list of such New England, and other American species, as I am sufficiently acquainted with; promising, however, that it is incomplete, that but little time has been given to it, and that it is intended only for practical convenience.

CLAVIS DISPOSITIONIS FRIESIANÆ.

Τὸ γράμμα αποκρίνεται, τὸ δὲ πνεῦμα ζωοποιεῖ.

Ord. I. GYMNOCARPI, Schrad.

CHAR. Apothecia aperta, *discifera*.

Trib. I. PARMELIACEÆ, Fr. Discus subrotundus, persistens, ab excipulo thallode marginatus.

A. *Usneaceæ*, Eschw. Discus apertus. *Thallus subverticalis (aut pendulo-sarmentosus), centripctus, hypothallo destitutus.*

I. USNEA, Dill. Hoffm. Apothecia orbiculata, peltata; discus apertus, strato medullari filamentoso impositus. — *Stratum thalli corticale a medullari filamentoso secedens.*

1. *abrata*, (L.) Fr.

α. *florida*, Fr. (U. *florida*, Ach.)

β. *hirta*, Fr. (U. *hirta*, Ach.)

γ. *plicata*, Fr. (U. *plicata*, Ach.)

δ. *dasy-poga*, Fr. (U. *barbata*, Ach.)

2. *longissima*, Ach.

3. *homalea*, Tuckerm. MS. (Ramalina, Ach.)

II. EVERNIA, Fr. Apoth. orbiculata, scutelliformia; discus apertus, strato medullari floccoso impositus, *coloratus*. — *Thallus stuppeus, fistulosus aut strato medullari floccoso contiguo farctus.*

§ 1. *Cornicularia*, Dec. fruticulosæ (aut sarmentosæ) apoth. lateralibus.

1. *jubata*, (L.) Fr.

α. *bicolor*, Fr. (*Cornicularia*, Ach.)

β. *chalybeiformis*, Ach. (*Alectoria*, Ach.)

γ. *implexa*, Fr. (*Alect. Ach.*)

2. *divergens*, (Ach.) Fr.

3. *ochroleuca*, (Ehrh.) Fr.

α. *rigida*, Fr. (*Cornicularia*, Ach.)

γ. *sarmentosa*, Fr. (*Alectoria*, Ach.)

4. *vulpina*, (Wulf.) Ach.

§ 2. *Dufourea*, Ach. fruticulosa, inflata, apoth. terminalibus.

§ 3. *Physcia*, Dec. foliaceo-compressa, (filamentosa semper sterilis) subtus canaliculata.

5. *prunastri*, (L.) Ach.

6. *furfuracea*, (L.) Mann. (Borrera, Ach.)

III. RAMALINA, Ach. Apoth. orbiculata, scutelliformia; discus strato gonimo (viridi) impositus *subconcolor*. *Thallus subcartilagineus, undique fertilis et similis.*

1. *calicaris*, (L.) Fr.

α. *fraxinea*, Fr. (R. *fraxinea*, Ach.)

β. *fastigiata*, Fr. (R. *fastigiata*, Ach.)

γ. *canaliculata*, Fr. (R. *fastigiata*, var. Ach.)

δ. *farinacea*, Tuck. (R. *farinacea*, Ach.)

2. *polymorpha*, Ach.

IV. ROCCELLA, (Bauh.) Decand. Apoth. orbiculata, scutelliformia; discus strato carbonaceo impositus, *ater pruinosis*. *Thallus cartilagineo-coriaceus.*

- V. **CETRARIA**, Ach. Fries. Apoth. oblique marginata, peltæformia, nuda. *Thallus adscendens, subtilus glaber.*
- § 1. *Cartilagineæ*, Fr. suberectæ.
1. *aculeata*, (Ehrh.) Fr. (Cornicularia, Ach.)
 2. *Islandica*, (L.) Ach. α .
 γ . *crispa*, Ach.
 3. *Richardsonii*, Hook.
 4. *cucullata*, (Bellard.) Ach.
 5. *nivalis*, (L.) Ach.
- § 2. *Membranaceæ*, Fr. Depressæ, adscendentes.
6. *glauca*, (L.) Ach.
 7. *lacunosa*, Ach.
 8. *Tuckermanii*, Oakes.
 9. *ciliaris*, Ach.
 10. *sepincola*, (Ehrh.) Ach.
 11. *Oakesiana*, Tuckerm.
 12. *juniperina*, (L.) Ach.
 13. *pinastri*, (Scop.) Sommerf.
- B. *Parmeliæ*, Eschw. Discus clausus, dein discoideo-apertus. *Thallus horizontalis, centrifugus, hypothallo instructus.*
- VI. **SOLORINA**, Ach. Apoth. subrotunda, laminæ thalli adnata, maculæformia, velata. *Thallus coriaceo-membranaceus.*
1. *crocea*, (L.) Ach.
 2. *saccata*, (L.) Ach.
- VII. **PELTIGERA**, Hoffm. Apoth. antice thalli lobis producta, raro margini adnata. *Thallus coriaceo-membranaceus, subtilus venosus.*
1. *malacea*, Ach.
 2. *aphthosa*, (L.) Hoffm.
 3. *canina*, (L.) Hoffm.
 4. *rufescens*, (Neck.) Hoffm.
 5. *polydactyla*, (Neck.) Hoffm.
 β . *scutata*, Fr.
 6. *horizontalis*, (L.) Hoffm.
 7. *venosa*, (L.) Hoffm.
- VIII. **NEPHROMA**, Ach. Apoth. postica, thalli lobis adnata, reniformia. Velum nullum. *Thallus subtilus avenius.*
1. *arctica*, (L.) * (N. polaris, Ach.)
 2. *resupinata*, (L.) Ach.
 3. *parilis*, Ach.
 4. *Helvetica*, Ach. (N. aspera, Tuckerm.)
- IX. **STICTA**, Schreb. Ach. Apoth. nuclei instar infra stratum gonimon oriunda, dein prorumpentia disciformia, nuda, excipulo thallode subdiscolori. *Thallus frondosus, coriaceus, subtilus villosus, avenius, sæpius cum cyphellis.*
1. *aurata*, (Sm.) Ach.
 2. *crocata*, (L.) Ach.
 3. *sylvatica*, (L.) Ach.
 4. *anthraspis*, Ach.
 5. *quercizans*, (Michx.) Ach.
 6. *fuliginosa*, (Dicks.) Ach.

7. *limbata*, (Sm.) Ach.
 8. *scrobiculata*, (Scop.) Ach.
 9. *pulmonaria*, (L.) Ach.
 10. *glomerulifera*, (Lightf.) Delis.
 11. *herbacea*, (Huds.) Delis.
- X. PARMELIA, Ach. Fries. Apoth. scutelliformia, primitus clausa, margine thallo concolori. Stratum carbonaceum sub disco nulum. *Thallus foliaceus aut crustaceus, subtilis discolor l. adnatus, absque venis et cyphellis*
- SECT. I. *Hypothallus thallo foliaceo discreto adnatus.*
- Sub-sect. I. IMBRICARIA, Fr. Discus membranaceus, nudus, strato gonimo impositus. *Thallus foliaceus, membranaceus, imbricatus.*
- Ser. I. *Glaucescentes.*
1. *perforata*, (Jacq.) Ach.
 2. *crinita*, Ach. (P. perforata, β . Fr.)
 3. *perlata*, (L.) Ach.
 4. *tiliacea*, (Ehrh.) Fr.
 5. *scortea*, Ach.
 6. *Borreri*, Turn. α .
 β . *rudecta*, Tuck. (P. rudecta, Ach.)
 7. *saxatilis*, (L.) Ach.
 8. *placorodia*, Ach.
 9. *aleurites*, Ach.
 10. *colpodes*, Ach.
 11. *terebrata*, (Hoffm.) Mart. (P. diatrypa, Ach.)
 12. *physodes*, (Hoffm.) Ach.
 13. *enteromorpha*, Ach.
- Ser. II. *Olivaceo-fusca.*
14. *olivacea*, (L.) Ach.
 15. *Fahlunensis*, (L.) Ach.
 16. *stygia*, (L.) Ach. α .
 β . *lanata*, Fr.
- Ser. III. *Ochroleuca.*
17. *caperata*, (L.) Ach.
 18. *conspersa*, (Ehrh.) Ach.
 19. *incurva*, (Pers.) Fr.
 20. *ambigua*, (Wulf.) Ach.
 21. *centrifuga*, (L.) Ach.
- Ser. IV. *Citrina.*
22. *parietina*, (L.) Fr.
 α . *foliacea*, (Fr.)
 β . *laciniosa*, Duf.
 γ . *polycarpa*, Fr.
 δ . *lobulata*, Fr.
 ϵ . *subcrustacea*, (Fr.)
 ζ . *crustacea*, (Fr.)
 η . *citrinella*, Fr.
 23. *chrysophthalma*, (L.) Ach.
 24. *Columbiana*, Tuck. Ms. (Borrera, Nutt.)
- Sub-sect II. PHYSCIA, Fr. Discus ceraceus, subpruinato-velatus,

strato medullari impositus. *Thallus foliaceus, stellatus, adscendens.*

25. *erinacea*, (Ach.) Fr. (Borrera, Ach.)
26. *leucomela*, (L.) Ach.
27. *ciliaris*, (L.) Ach.
28. *detonsa*, Fr. (P. Novæ Angliæ, Tuck. olim.)
29. *pulverulenta*, (Schreb.) Wallr. (P. venusta, Ach.)
30. *hypoleuca*, Muhl.
31. *speciosa*, (Wulf.) Ach.
32. *astroidea*, (Clement.) Fr.
 - α *sideralis*, (Fr.)
 - β *Clementiana*, (Fr.)
33. *stellaris*, (L.) Wallr.
 - α . *stellari-expansa*, (Fr.) (P. *stellaris* & *aipolia*, Ach.)
 - β . *hispida*, Fr. (Borrera *tenella*, Ach.)
 - γ . *tribracia*, (Fr.) (Lecanora, Ach.)

34. *cæsia*, (Hoffm.) Ach. α .

β *tenella*, Fr.

γ *squamulosa*, (Fr.)

35. *obscura*, (Ehrh.) Fr. α . (P. *cyclosetis*, Ach.)

β . *ulothrix*, Fr. (P. *ulothrix*, Ach.)

SECT. II. *Thallus foliaceus membranaceus, dein granuloso-conglobatus. Hypothallus fibrillosus matrici adnatus.*

Sub-sect. III. AMPHILOMA, Fr. Excip. thalloses accessorium. *Thallus platyphyllinus, submonophyllus. Hypothallus spongiosopannosus.*

36. *Russellii*, Tuckerm. Ms.¹ (P. *plumbea*, Auct. Amer. quorund.)

37. *lanuginosa*, Ach. α .

β . *granuloso-pulverulenta*, (Fr.)

* *leproso-byssina*. (Lepraria *incana*, Auct. qu.)

Sub-sect. IV. PSOROMA, Fr. Apoth. biformia: e squamulis orta margine thallose; ex hypothallo margine proprio. *Thallus minute squamulosus.*

38. *microphylla*, (Sw.) Ach.

39. *triptophylla*, Fr. (L. *brunnea*, Auct. pl.)

40. *Hypnorum*, (E. Bot.) Fr.

SECT. III. *Thallus crustaceus, squamuloso-aut in ambitu effiguratus. Hypothallus glaber.*

Sub-sect V. PLACODIUM, Fr. Apoth. plano-scutellata, disco immarginato, nudo.

41. *straminea*, Wahl.

42. *saxicola*, (Poll.) Ach.

43. *chrysoleuca*, (Sm.) Ach.

44. *oreina*, Ach.

45. *elegans*, (Link.) Ach.

46. *murorum*, (Hoffm.) Ach. α .

β *miniata*, Fr. (Parmelia, Ach.)

¹ In honorem amic. inventoris, Rev. Joh. Lud. Russell, Lichenum Nov. Ang. illustratoris.

Sub-sect VI. *PSORA*, Fr. Apoth. ex urceolato scutellata, disco marginato normaliter cæsio-pruinoso.

47. *cervina*, (Pers.) Sommerf.

α. *glaucoarpa*, Fr.

β. *squamulosa*, Fr.

γ. *discreta*, Fr.

SECT. IV. *Thallus crustaceus, uniformis.*

Sub-sect. VII. *PATELLARIA*, Fr. Apoth. plano-scutellata, disco immarginato, haud cæsio-pruinoso.

48. *pallescens*, (L.) Fr. α.

β. *Parella*, Fr. (*Lecanora*, Ach.)

49. *tartarea*, (L.) Ach.

50. *rubra*, (Hoffm.) Ach.

51. *oculata*, (Dicks.) Fr.

52. *subfusca*, (L.) Fr.

α. *discolor*, Fr.

β. *distans*, Fr.

γ. *albella*, Fr.

δ. *angulosa*, Fr.

53. *atra*, (Huds.) Ach.

54. *cinerea*, (L.) Fr.

55. *badia*, (Ehrh.) Fr.

56. *sophodes*, Ach.

57. *ventosa*, (L.) Ach.

58. *varia*, (Ehrh.) Fr. α.

β. *polytropa*, Ach.

59. *vitellina*, (Ehrh.) Ach.

60. *aurantiaca*, (Lightf.) Fingerh.

61. *cerina*, (Hedw.) Ach.

Sub-sect. VIII. *URCEOLARIA*, Fr. Apoth. immersa, suburceolata aut tuberculoso-protuberantia, disco submarginato, cæsio-pruinoso.

62. *sordida*, (Pers.) Wallr.

α. *glaucoma*, Fr. (*Lecanora*, Ach.)

63. *impolita*, (Ehrh.) Fr.

64. *verrucosa*, Ach. Fr.

α. *Urceolaria*, Fr.

β. *Pertusaria*, Fr.

65. *calcareia*, (L.) Ach.

66. *scruposa*, (L.) Ach. α.

β. *bryophila*, Ach.

XI. *DIRINA*, Fries. Apoth. primo tuberculiformia clausa, demum centro dehiscentia scutellata a thallo marginata. Discus strato carbonaceo impositus. *Thallus crustaceus.*

XII. *GYALECTA*, Ach. Fr. Apoth. urceolata, primo clausa, dein varie dehiscentia, limbo libero colorato cingentia discum e gelatinoso rigescentem. *Thallus crustaceus.*

1. *cupularis*, (Hedw.) Schær. (*Lecidea*, Ach.)

TRIB. II. *LECIDEACEÆ*, Fr. Discus subrotundus, persistens, *excipulum proprium* primitus apertum demum subobtegens, cephaloideus.

XIII. STEREOCAULON, Schreb. Ach. Apoth. turbinata, demum cephaloidea solida, *podetiis solidis intus filamentosis* suffulta.

1. *tomentosum*, Fr.
2. *corallinum*, Schreb. Laur.
3. *ramulosum*, (Sw.) Ach.
4. *paschale*, (L.) Ach.
5. *condensatum*, Hoffm.
6. *denudatum*, Floerk.
7. *aciculare*, Tuckerm. Ms.¹

XIV. CLADONIA, Hoffm. Apoth. scyphuliformia, mox cephaloidea inflata, nuda, (sæpe symphycarpeo-diformia,) *podetiis fistulosis inanibus* suffulta. *Thallus primitivus squamulosus aut crustaceus.*

Ser. I. *Glaucæ*, apoth. rufis.

1. *alcicornis*, (Lightf.) Fr.
2. *turgida*, (Ehrh.) Hoffm. (Cenom. *parecha*, Ach.)
3. *Papillaria*, (Ehrh.) Hoffm.

Ser. II. *Fuscæ*, apoth. fuscis.

4. *cæspiticia*, (Pers.) Fl.
5. *pyridata*, (L.) Fr.
6. *gracilis*, (L.) Fr.
 - α. *verticillata*, Fr. (C. *verticillata*, Ach.)
 - β. *hybrida*, Fr.
 - γ. *elongata*, Fr. (C. *gracilis*, Ach.)
7. *degenerans*, Floerk. α. (C. *gonorega*, Ach.)
 - β. *cariosa*, (Fr.) (C. *cariosa*, Ach.)
8. *fimbriata*, (L.) Hoffm.
 - α. *brevior*, (Fr.)
 - β. *tubæformis*, Fl.
 - γ. *radiata*, Fl.
9. *decorticata*, Floerk.
10. *cenotea*, (Ach.) Schær. (C. *brachiata*, Fr.)
11. *delicata*, (Ach.) Fl.
12. *squamosa*, Hoffm.
 - α. *ventricosa*, Fr.
 - β. *attenuata*, Fr.
13. *furcata*, (Schreb.) Fl.
 - α. *crispata*, Fl. (C. *crispata*, Ach.)
 - β. *cristata*, Fr.
 - γ. *racemosa*, Fl. (C. *racemosa*, Ach.)
 - δ. *subulata*, Fl. (C. *furcata*, Ach.)
 - ε. *pungens*, Ach.
14. *rangiferina*, (L.) Hoffm. α.

¹ *Bæomyces*, Ach. Meth., *Cenomyce*, Ach. Lich., *Cladonia*, Floerk., & Fries. Discovered on the coast of Oregon by Menzies! 1787, and since found on the Rocky Mountains by Douglas! and Scouler! My specimens are from the discoverer, and Sir W. J. Hooker. We have a very nearly allied lichen in New England. I have another apparently undescribed species from Mr. Lambert's herbarium, which was, it would seem, collected by Mr. L. Goulding, but the station is not given:—*S. sphærophorooides*, Tuck. Ms.: *podetiis laxis teretibus subsimplicibus, squamulis fibrillosis pulcherrime sphærophoroideo-ramosis; apoth. sparsis minusculis.*

- β. *sylvatica*, Fl.
 γ. *alpestris*, Fl.
 Ser. III. *Ochroleucæ*, apoth. carneolis.
 15. *carneola*, Fr.
 16. *uncialis*, (L.) Fr.
 α. *elator*, Fr. (C. *adunca*, Ach.)
 β. *humilior*, Fr. (C. *uncialis*, Ach.)
 γ. *turgescens*, Schær.
 δ. *reticulata*, Russell. (C. *lacunosa*, Bory Ms.)
 Ser. IV. *Coccineæ*, apoth. coccineis.
 17. *cornucopioides*, (L.) Fr. (C. *coccifera*, Ach.)
 18. *bellidiflora*, (Ach.) Schær.
 19. *Floerkeana*, Fr.
 20. *sulphurina*, (Michx.) Fr.
 21. *deformis*, (L.) Hoffm.
 22. *digitata*, (L.) Hoffm.
 23. *macilenta*, (Ehrh.) Hoffm.
 24. *leporina*, Fr. Ms.
 XV. ΒÆΟΜΥCΕΣ, Pers. Apoth. *globosa*, *immarginata*, *inania*, *velata*,
 basi stipitem arcte amplectentia. *Thallus mere horizontalis*
crustaceus.
 1. *roseus*, Pers.
 XVI. ΒΙΑΤΟΡΑ, Fries. Apoth. *discoidea*, *solida*, *ceracea*, *nuda*, *marginata*
 proprio *ceraceo* (disco pallidiori) sæpius demum excluso
cephaloidea. *Thallus mere horizontalis (foliaceus l.) subcrustaceus*.
 SECT. I. *Thallus crustaceus*, *effiguratus*, *squamosus*, s. in ambitu *lobatus*.
 Ser. I. *Glaucæscentes*, hypothallo albo.
 Ser. II. *Fuscescentes*, hypothallo nigro.
 1. *decipiens*, (Ehrh.) Fr. (Lecidea, Ach.)
 2. *globifera*, (Ach.) Fr. (Lecidea, Ach.)
 3. *atorrufa*, (Dicks.) Fr. (Lecid. *demissa*, Ach.)
 4. *placophylla*, (Ach.) Fr. (Bæomyces, Ach.)
 5. *byssoides*, (L.) Fr. (Bæomyces *rufus*, Ach.)
 SECT. II. *Thallus crustaceus*, *effusus*, *uniformis*.
 Ser. I. *Glaucæscentes*, hypothallo albo.
 6. *icmadophila*, (Ehrh.) Fr. (Lecid. Ach.)
 7. *vernalis*, (L.) Fr.
 α. *luteola*, Fr. (Lecid. Ach.)
 β. *conglomerata*, Fr. (Lecid. *vernalis*, Ach.)
 γ. *pineti*, Fr. (Lecid. Ach.)
 8. *decolorans*, (Hoffm.) Fr.
 Ser. II. *Fuscescentes*, hypothallo nigricante.
 9. *rivulosa*, (E. Bot.) Fr.
 10. *uliginosa*, Fr.
 Ser. III. *Ochroleucæ*, hypoth. nigro, rariss. albo.
 11. *lucida*, (Ach.) Fr.
 Ser. IV. *Citrinæ*, hypoth. nigro.
 12. *aurantiaca*, (Lightf.) Fr.
 XVII. LECIDEA, Ach. Fries. Apoth. *primitus* *aperta*, *patellæformia*

aut hemisphærica, excipulo proprio *carbonaceo* aterrimo marginata. Discus contiguus, æquabilis, raro papillatus, corneus (aut ceraceus margine atro). *Thallus crustaceus, (l. foliaceus)*.

SECT. I. *Thallus foliaceus*.

1. *sorediata*, Muhl.

SECT. II. *Thallus crustaceus effiguratus*.

Ser I. *Glaucescentes*.

2. *candida*, (Web.) Ach.
3. *vesicularis*, (Hoffm.) Ach.

Ser. IV. *Citrinæ*.

4. *Wahlenbergii*, Ach.

SECT. III. *Thallus crustaceus uniformis*.

Sub-sect. I. *Areolata*, hypothallo nigro.

Ser. I. *Glaucescentes*.

5. *albocærulescens*, (Wulf) Fr.
6. *contigua*, Fr.
7. *lapicida*, Ach.
8. *parasema*, Ach.
9. *enteroleuca*, Ach. Fr. α .
 β . *olivacea*, (L. *eleochroma*, Ach.)

Ser. II. *Fuscescentes*.

10. *atroalba*, (L.) Ach. α .
 β . *subconcentrica*, Flot. (*Lecid. petræa*, Ach.)
11. *panæola*, Ach.
12. *fuscoatra*, (L.) Fr.
13. *confluens*, (Web.) Schær.

Ser. IV. *Citrinæ*.

14. *geographica*, (L.) Schær.
 α . *atrovirens*, Fr.
 β . *contigua*, Fr.

Sub-sect. II. *Granulosæ*, hypothallo albo.

Ser. I. *Glaucescentes*.

15. *sanguinaria*, (L.) Ach.
16. *alboatra*, (Hoffm.) Schær.
 α . *corticola*, Fr.
 β . *saxicola*, Fr.
17. *dolosa*, Wahl.

Ser. II. *Fuscescentes*.

18. *sabuletorum*, (Schreb.) Fr.
19. *milliaria*, Fr.

Trib. III. GRAPHIDACEÆ, Fr. Discus difformis, sæpius lirellæformis, excipulo normaliter l. proprio l. thallose (aut nullo).

XVIII. UMBILICARIA, Hoffm. Apoth. varia, primitus clausa, mox aperta, excipulo carbonaceo. Discus rimosus aut sæpius in gyros lirellasve dehiscentes abiens. *Thallus horizontalis, frondosus, umbilicato-affixus, sub-peltatus*.

1. *pustulata*, (L.) Hoffm. (*Gyr. papulosa*, Ach.)
2. *polyphylla*, (L.) Hoffm. α . (*G. glabra*, Ach.)
 β . *deusta*, Fr.
3. *hyperborea*, (Ach.) Hoffm. α .
 β . *deusta*, Tuckerm.

4. *Pennsylvanica*, Hoffm.
 5. *Muhlenbergii*, (Ach.) *
 6. *erosa*, (Web.) Hoffm.
 7. *proboscidea*, (L.) Fr. α .
 β . *tornata*, Ach.
 γ . *arctica*, Ach.
 8. *vellea*, (L.) Fr.
 9. *depressa*, Schær. (U. *velleæ*, var. Fr.)
 10. *hirsuta*, (Ach.) Stenh. (U. *velleæ*, var. Fr.)
- XIX. OPEGRAPHA, Humb. Apoth. lirellæformia, excipulo proprio subcarbonaceo (atro) libero, primitus conniventi-clauso, rima longitudinali dein aperta, disco canaliculato. *Thallus crustaceus*.
1. *varia*, Pers.
 α . *pulcaris*, Fr. (O. *vulvella*, &c., Ach.)
 β . *notha*, Fr. (O. *notha*, Ach.)
 γ . *signata*, Fr. (O. *signata*, Ach.)
 δ . *diaphora*, Fr. (O. *diaphora*, Ach.)
2. *atra*, Pers.
 α . *stenocarpa*, Fr. (O. *stenocarpa*, *denigrata*, & *vulgata*, Ach.)
 β . *abbreviata*, Fl. (O. *depressa*, *pedonta*, &c., Ach.)
 γ . *macularis*, Fr. (O. *radiata*, Pers., *Arthonia astroidea*, Ach.)
 δ . *siderella*, Fr. (O. *siderella*, &c., Ach.)
3. *herpetica*, Ach.
 4. *scripta*, (L.) Ach.
 α . *pulverulenta*, (Fr.) (O. *pulverulenta*, Ach.)
 β . *recta*, Fr. (O. *cerasi*, *betuligna*, &c., Pers.)
 γ . *serpentina*, Fr. (Opegrapha, Ach.)
- XX. LECANACTIS, Eschw. Apoth. difformia, elongatave, excipulo proprio carbonaceo (atro) semper aperto cum thallo connato; disco planiusculo pruinoso-velato. *Thallus crustaceus*.
- * CONIANGIUM, Fr. Apoth. adpressa, difformia, suboblonga, immarginata, lamina persistente sporos coloratos obtegente. *Thallus crustaceus*. Genus atypicum.
- * CONIOCARPON, Dec. Schær. Apoth. adpressa, difformia, lirellæformiave, lamina rumpente in soros spororum coloratorum fatiscencia. Genus forsan spurium.
- Trib. IV. CALICIACEÆ, Fr. Discus globosus aut orbicularis, in sporidia nuda collabens, excipulo proprio.
- XXI. CONIOCYBE, Ach. Apoth. spherica, stipitata, immarginata, e vertice fatiscencia, excipulo suberoso.
- XXII. CALICIUM, Pers. Ach. Apoth. crateriformia, excipulo proprio carbonaceo marginata, disco in sporidia nuda collapsa.
1. *lenticulare*, (Hoffm.) Ach.
 2. *subtile*, Pers. Fr.
 3. *trachelinum*, Ach.
 4. *melanophæum*, Ach. Fr.
 5. *phæocephalum*, Turn. & Borr.
 β . *trabinellum*, Fr.
 6. *roscidum*, Floerk.
 7. *tigillare*, (Ach.) Turn. & Borr.

8. *stigonellum*, Ach. (C. sessile, Pers.)

9. *turbinatum*, Pers.

* TRACHYLIA, Fr. Apoth. sessilia, convexa, immarginata, excipulo carbonaceo, disco pulveraceo. Genus dubium.

ORD. II. ANGIOCARPI, Schrad.

Char. Apothecia clausa, *nucleifera*.

Trib. I. SPHÆROPHORACEÆ, Fr. Excipulum mere thalloses clausum, lacero-dehiscens. *Thallus verticalis*.

XXIII. SPHÆROPHORON, Pers. Apoth. terminalia, spherica, lacero-dehiscencia, nucleo pulveraceo atro.

1. *compressum*, Ach.

2. *globiferum*, (L.) Dec.

3. *fragile*, (L.) Pers.

XXIV. SIPHULA, Fr. Apoth. in apicibus thalli tumescentibus et lacero-dehiscantibus, nucleo ceraceo-gelatinoso disparente colorato.

Trib. II. ENDOCARPACEÆ, Fr. Excipulum mere thalloses, aut thalloses mutatum simul, clausum, ostiolo pertusum. *Thallus horizontalis, primo genere excepto crustaceus*.

XXV. ENDOCARPON, Hedw. Apoth. thallo inclusa, excipulo membranaceo pallido (thallose mutato) cingente nucleum gelatinosum coloratum. *Thallus foliaceus*.

1. *miniatum*, (L.) Ach. α .

β . *complicatum*, Schær.

2. *fluviale*, (Web.) Dec. (E. Weberi, Ach.)

3. *pusillum*, Hedw. (E. Hedwigii, Ach.)

XXVI. SAGEDIA, Ach. Fries. Apoth. thallo immersa, excipulo membranaceo cum nucleo gelatinoso nigricante.

XXVII. CHIODECTON, Ach. Apoth. verrucæformia, e strato thalli medullari erumpente formata, nucleos ceraceo-gelatinosos nigricantes includentia.

XXVIII. PERTUSARIA, Dec. Apoth. verrucæformia, e thallo formata, includentia nucleos (1—00) nudos ceraceo-gelatinosos coloratos.

1. *pertusa*, (L.) * (P. communis, Dec., Fr.)

b. *leioplaca*, Fr. (Porina, Ach.)

β . *sorediata*, Fr.

b. *orbiculata*, Fr. (Variolaria faginea, Auct., V. communis, Ach.)

2. *Wulfenii*, Dec. α .

β . *variolosa*, Fr. (Variolariæ, Auct.)

XXIX. THELOTREMA, Ach. Apoth. verrucæformia, e thallo formata, dein aperta, includentia nucleum collapsio-disciformem velatum.

1. *lepadinum*, Ach.

2. *cinereum*, Schwein. (Pyrenula, et Verrucaria demum Spreng.)

Trib. III. VERRUCARIACEÆ, Fr. Excipulum proprium clausum (*perithecium*) ostiolo contiguo pertusum, nucleo deliquescente subhyalino. *Thallus crustaceus*.

XXX. SEGESTRIA, Fr. Stroma thalloses nullum. Perithecia denudata, ceraceo-membranacea (colorata) ostiolo simplici.

- XXXI. VERRUCARIA, Pers. Stroma thalloses nullum. Perithecia solitaria prominula, carbonacea (aterrima), ostiolo simplici.
1. *rupestris*, Schrad.
 2. *umbrina*, Ach. Wahl.
 3. *pulla*, Ach.
 4. *nitida*, (Weig.) Schrad.
 5. *alba*, Schrad.
 6. *gemmata*, Ach.
 7. *epidermidis*, Ach. Fr.
 - α. *analepta*, (Fr.)
 - β. *cerasi*, (Fr.)
 - γ. *diminuta*, (Fr.)
 8. *punctiformis*, Pers. (V. *cinerea*, Pers., *stigmatella*, Ach.)
- Trib. IV. LIMBORIACEÆ, Fr. Excipulum proprium carbonaceum clausum (*perithecium*) dein varie et irregulariter dehiscens. *Thallus crustaceus*.
- XXXII. PYRENOTHEA, Fr. Perithecia carbonacea, clausa, ostiolo pertusa, nucleum subgelatinoso-fatiscentem protrudentia, dein dehiscentia.
1. *leucocephala*, (Ehrh.) Fr. (*Lecidea abietina*, Ach.)
- XXXIII. CLIOSTOMUM, Fr. Perithecia carbonacea, clausa collapsa rugoso-plicata, rugis demum dehiscentibus.
- XXXIV. LIMBORIA, Eschw. Perithecia carbonacea, clausa, demum e centro versus ambitum in lacinias stellatim dehiscentia.
- XXXV. STRIGULA, Fr. Perithecia carbonacea, clausa, disco collabentia. *Subepiphylla*.

With the genus *Strigula*, so exactly on the confines of Lichenes and Fungi, that it is included in the system of each class, we reach the most imperfect lichenose vegetation to which we can descend. There remains one other of the three orders of Algæ to be illustrated here, — the Byssacæ, which are the intermediate and amphibial tribes between aerial Algæ or Lichenes, and aquatic Algæ, or Phycæ. Their position in the System has already been indicated, in the first part of this treatise. Before taking them up, however, I wish to present Fries's disposition of the genera of Lichenes, according, simply, to affinity and analogy, as thus arranged by him in parallel series.

THALAMIUM.

A. Discoideum, receptum ab excipulo		B. Nucleiforme, receptum ab excipulo	
a. proprio.	b. thalode.	a. proprio.	b. thalode.
* Stereocaulon. Cladonia.	* Usnea. Evernia. Ramalina. Roccella. Cetraria.	* Sphærophoron. Siphula.	
**Bæomyces? Umbilicaria. Biatora. Lecidea.	**Peltigera. Sticta. Parmelia, A.— Parmelia, T. VI. VIII.	** Endocarpon. Pertusaria. Sagedia.	** (Exotica.) Segestria. Verrucaria.
Lecanactis.	Dirina. Gyalecta.	Chiodecton. Thelotrema. (Exot.)	Pyrenothea. Limboria. *** (Oxystoma.) **** Strigula.
***Opegrapha	(Leucogramma		
****Calicieæ.	etc. exotic.)		

Ord. BYSSACEÆ, Fr.

Char. Thallus liber, discretus, hygrophanus, floccosus l. in frondem gelatinosam absque omnibus stratis discretis conglutinatus. Sporæ receptæ ascis thalamio vulgo immersis, interdum liberis. *Algæ amphibicæ, perennes per intervalla in vegetatione retardatæ, heterogeneæ, nulla vero strata discernentes, sporidiis gonidiisque multiplicatæ.*

Trib. I. COLLEMACEÆ, Fr. Thallus gelatinoso-conglutinatus, caulescens aut foliaceus. Apoth. endogenea.

I. LICHINA, Ag. Apoth. clausa terminalia, libera, poro pertusa, tandem explanata; *thallus cartilagineus, dichotomus.* (In scopulis marinis.)

II. NOSTOC, Vauch. Apoth. clausa minutissima, thallo immersa, nucleum eructuantia; *thallus gelatinosus, filis moniliformibus curvatis farctus.* (Nostocia plura terrestria ad Collemata pertinent. Fr.)

1. *commune*, Vauch.

III. COLLEMA, Hoffm. Apoth. discoideo-aperta, excipulo thalode; *thallus pulposus, contextu moniliformi-filamentoso.*

1. *pulposum*, (Bernh.) Ach.

2. *tenax*, (Sw.) Ach. *α.*

β. *pallescens*, Ach.

3. *melænum*, Ach.

4. *fasciculare*, (L.) Ach.

5. *pustulatum*, Ach.

6. *palmatum*, (Huds.) Ach.

7. *saturninum*, (Dicks.) Ach.

8. *nigrescens*, (Huds.) Ach.

9. *pulchellum*, Ach.

10. *lunæforme*, Ach.

11. *furvum*, Ach.

- IV. LEPTOGIUM, Fr. Apoth. discoideo-aperta, excipulo proprio; *thallus membranaceus, contextu celluloso.*
1. *Tremelloides*, (L.) Fr.
 2. *lacerum*, (Sw.) Fr.
- Trib. II. BYSSEÆ, Fr. Thallus filamentosus aut floccosus, haud gelatinosus. Apoth. subexogenea.
- V. THERMUTIS, Fr. Asci thalamio immersi, excipulo proprio e pluribus fibris hypothalli copulatis enato.
- VI. EPHEBE, Fr. Asci thalamio immersi, excipulo thallode e singula fibra enato.
1. *pubescens*, (L.) Fr. (Cornicularia, Ach.)
- VII. RACODIUM, Pers. Asci e fibris ipsis mutatis, contiguis, medio fertilibus. (Sola autonoma generis stirps. Fr.)
1. *rupestre*, Pers.
- VIII. BYSSUS, L., Fries. Asci e fibris ipsis mutatis, apice subincrassatis, articulatis.
1. *aurea*, L. (Dematium petræum, Pers.)
 2. *abietina*, (Pers.) Fr. (Dematium, Pers.)

Byssaceæ Spuriæ.

We bring these in only as an appendix to the System, which excludes them as spurious. They arise either, I. in the dissolution of the bodies of other plants, as *Leprariæ* among the Lichenes, *Mycinemata* among the Fungi, and other like forms among the aquatic Algæ; or, II. from degenerated organs of the vegetative system, as *Phylleriaceæ* in Fungi, &c.; or, III. they are the primordia,—the first beginnings of other plants, the further evolution of which has been concluded. Such is *Protonema*, green, rooting, persistent threads, which occur in the Filices, the Musci, &c.: *Byssocladium*, similar threads without color, belonging to the Fungi: *Protococcus*, the primordial subgelatinous globular gonidia of Algæ, which passes into Ulvaceæ, *Palmella botryoides*, and even Lichenes: and *Phycomater*, in Fungi, an almost inorganic mucilage without gonidia.

FINIS.

ERRATA.

Page 3, line 36, for	<i>of</i>	read	<i>or.</i>
" 47, " 3, "	<i>Ord.</i>	"	<i>Div.</i>
" 47, " 12, "	<i>abrbata</i>	"	<i>barbata.</i>
" 56, " 5, "	<i>Ord.</i>	"	<i>Div.</i>







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