REPORTS AND PAPERS

ON

BOTANY.

Vol. I.

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TRANSLATED BY GEORGE BUSK, F.R.C.S.

ON BOTANICAL GEOGRAPHY, BY PROFESSOR GRISEBACH.
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ON THE

MORPHOLOGY OF THE CONIFERÆ,

BY DR. J. G. ZUCCARINI.

TRANSLATED BY GEORGE BUSK, F.R.C.S.E.

MORPHOLOGY OF THE CONIFERÆ.

SECTION I.

NUMBER OF SPECIES AND GEOGRAPHICAL DISTRIBUTION.

THE family of the Coniferæ is one of those which, although they form a most important element in the vegetation of the regions of whose Flora they constitute a part, derive their importance, not so much from the number of their genera and species, as in consequence of the extent of the forests composed by them, and the size of the individual trees. Owing to this it is, that a few species of *Abies* and *Pinus*, are sufficient to impress a predominant character upon a large portion of the north of Europe and Asia, where they exclusively constitute vast forests. The determination, however, of the absolute number of all the species at present known, is attended with considerable difficulty, since many, even up to the most recent period, have been ill understood; and this has been the case, as in many other families, partly even among those forms which, from their frequent occurrence with us, might the most readily have admitted of correct description. Thus even Mirbel, on the authority of Thunberg, states that *Pinus sylvestris* and *Cembra*, *Abies excelsa*, *pectinata*, *Larix*, &c. extend as far as

Japan; and from this the European and Siberian species have been considered identical, an assumption, however, which is probably, in part at least, incorrect. At all events it is very strange that *P. Cembra* for instance, and *Juniperus Sabina*, which in Europe are not found beyond the chain of the Alps, should be again met with in the greatest abundance in Siberia. In this way, not only have distinct species been erroneously associated, but, on the other hand, local forms have been too readily raised to the rank of species, as, for instance, *P. Pumilio, obliqua, rotundata, uncinata, pyrenaica,* and *rubra,* all of which may be referred to *P. sylvestris.*

Jacquin's error in confounding *P. austriaca* and *sylvestris* has only recently been rectified; and it is still a question, whether the former (as well as *P. halepensis taurica,* or *Pinaster taurica M. B.*) be not identical with the *P. Laricio* of the islands and coasts of the Mediterranean, as it very probably is. The species of *Juniperus, Thuja, Callitris, Cupressus, Podocarpus, Dacrydium, Taxus* have also, as yet, not been made out sufficiently to allow of their number being accurately determined.

To these sources of uncertainty may be added the confusion of names in plants cultivated in the garden, and which are usually too young to admit of their being identified; the defective condition in which specimens of this family occur in most Herbaria; and lastly, the uncertainty of the terms employed by travellers, who, in different languages, and without consideration, arbitrarily use the names of Pine, Fir, &c. (*Fichten, Tannen oder Föhren,*) or, in general terms, of Coniferous trees.

In the following summary consequently, the number of known species is given only as an approximation to the truth, but the list will still, to a great degree suffice for the determination of the extent of range of this family, as those species only, which are known with some degree of certainty have been admitted into it; and although subsequent discoveries may be expected to add to the absolute number of species, there is no reason for supposing that they will materially interfere with or alter our present views with regard to their distribution.

At present there are known,

1. ABIETINÆ		105
Pinus, Rich.	55	
Abies, Rich.	46	
Araucaria, Juss.	4	
2. CUNNINGHAMIEÆ		6
Cunninghamia, R. Br.	3	
Dammara, Rumph.	2	
Sciadopitys, S. and Z.	1	
3. CUPRESSINÆ		61
Juniperus, L.	27	
Thuja, Tourn.	9	
Thujopsis, S. and Z.	1	
Callitris, Vent.	12	
Retinispora, S. and Z.	3	
Cupressus, Tourn.	5	
Cryptomeria, Don.	1	
Pachylepis, Brong.	1	
Taxodium, Rich.	2	
4. TAXINÆ		36
Podocarpus, Herit.	23	
Torreya, Arn.	3	
Cephalotaxus, S. and Z.	2	
Salisburia, Smith.	1	
Phyllocladus, Rich.	2	
Dacrydium, Sol.	1	
Taxus, L.	4	
		208 sp.

Of which there occur in

	Europe	Asia.	Africa	America	Australia	In the northern hemisphere	In the southern hemisphere.
Pinus, Rich.	8	17	4	32	0	55	0
Abies, Rich.	5	20	0	21	0	46	0
Araucaria, Jup.	0	0	0	2	2	0	4
Cunninghamia, R. B.	0	1	0	0	2	1	2
Sciadopitys, S. and Z.	0	1	0	0	0	1	0
Dammara, Rump.	0	1	0	0	1	1	1
Juniperus, L.	7	16	5	12	2?	25	2?
Thuja, Tourn.	0	5	1?	4	2?	8	4?
Thujopsis, S. and Z.	0	1	0	0	0	1	0
Callitris, Vent.	0	0	1	0	11	1	11
Retinispora, S. and Z.	0	3	0	0	0	3	0
Pachylepis, Broug.	0	0	1	0	0	0	1
Cupressus, Tourn.	1	4	1	1?	0	5	0
Cryptomeria, Don.	0	1	0	0	0	1	0
Taxodium, Rich.	0	0	0	2	0	2	0
Podocarpus, Herit.	0	11	3	6	12	5	23
Torreya, Arn.	0	1	0	2	0	3	0
Cephalotaxus, S. & Z.	0	2	0	0	0	2	0
Salisburia, Smith.	0	1	0	0	0	1	0
Phyllocladus, Rich.	0	0	0	0	2	0	2
Dacrydium, Sol.	0	0	0	0	1	0	1
Taxus, L.	1	2	0	1	0	4	0
	22	87	16	83	35	165	51

Thus in the Northern Hemisphere		165 (*sic*)
(*a*) From the North Pole to the Tropic of Cancer	159	
(*b*) From the Tropic to the Equator	6	
In the Southern Hemisphere		51
(*a*) From the Equator to the Tropic of Capricorn .	17	
(*b*) From the Tropic to the South Pole . . .	34*	
		216

Or,

From the North Pole to the Tropic of Cancer		159
(*a*) *Abietinæ*	101	
(*b*) *Cunninghamieæ*	2	
(*c*) *Cupressinæ*	46	
(*d*) *Taxinæ*	10	
Between the Tropics		24
(*a*) *Abietinæ*	1	
(*b*) *Cunninghamieæ*	3	
(*c*) *Cupressinæ*	7	
(*d*) *Taxinæ*	13	

* The difference in the number of species (216-208) arises from this, that some species near the equator occur in both hemispheres.

From the Tropic of Capricorn to the South Pole . .		33
(*a*) *Abietinæ*	3	
(*b*) *Cunninghamieæ*	1	
(*c*) *Cupressinæ*	12	
(*d*) *Taxineæ*	17	
		216

Thus we see that by far the greater number of the Coniferæ are peculiar to the northern hemisphere, and limited in it to the temperate zone, in which the specifically rich genera of *Abies* and *Pinus* exclusively occur.

The intertropical regions possess the smallest number of species, and the southern torrid zone has still fewer than the northern, but from the tropic of Capricorn southwards the number of species increases, though in a subordinate proportion. Of the twenty-two genera, twelve belong exclusively to the northern, four to the southern, and six are common to both hemispheres.

The northern limits of the family coincide, in the low country, almost with those of vegetation itself; although the number of species which reach these high latitudes is very small. Among the principal of these is *Juniperus communis*, which is found at the North Cape, or at 70° N., and in company with some small *Ericeæ* is distributed around the North Pole. *Pinus sylvestris* also, in Scandinavia, reaches 70° 30′ N., though in Asia it rarely passes 63° N., and is totally wanting in North America.

The Siberian stone-pine (*P. Cembra*) attains to about 67° N., but that only eastward of the Ural Mountains in 70° E., whilst in Europe, it probably never passes beyond 48° N. *Abies excelsa* occurs in Sweden up to 69° N., and in Norway to 67° N.; in the same latitude in Siberia it is represented by *Abies obovata* (Ledeb.) *A. larix* is at present found in Europe, only on the Alpine and Carpathian ridges; in Siberia its place is supplied by *Larix sibirica*, which extends from 58° N. in the Ural, and 67° on the Ob, to 68° and 69°, between the Jenisei and Kolima (on the Lena, near Siktanskoë, almost to 70° N.), and further on towards

Kamtschatka and Dauria. It is probably also this species which in European Russia extends from the Dwina to the White Sea, since our larch is not elsewhere found in Russia. In North America, where the arboreal vegetation in general, ceases at a lower latitude, the limit of the Coniferæ is placed towards the west on the Mackenzie, between 67° N. and 68° N., at which point *Abies alba* and (*Larix*) *microcarpa* still appear, but for the last time; whilst towards the east, in the country about Hudson's Bay, they disappear much earlier; even below 60° N. in Labrador. It may thus be assumed that the northern limit of the Coniferæ is, in general, placed between 68° and 70° N., receding only on the Atlantic coasts of North America to 60° and 58°. Towards the south, the range of some species extends to the extremity of the continents; thus *Podocarpus alpina* (R. Br.) occurs even at 45° S. in Van Diemen's Land, and *Juniperus uvifera* (Don) at Cape Horn (55° and 56° S.)

In the lowlands of the tropical regions, especially north of the equator, the distribution of this family appears to be interrupted, for in these regions the few species which do occur are confined to the high mountains, as for instance, *Podocarpus* and *Dammara* in the Moluccas. It appears indeed that generally, even at 30° N. no species is any longer found in the lowlands, nor except at an elevation of at least 2000 feet above the sea. The altitude at which some species will flourish, naturally depends also upon the latitude of the place. In the East Indies, *P. longifolia* occurs, in the latitude of 28° N. at an altitude of between 2000 and 6000 feet, whilst *P. Gerardiana* on the Sutlej, makes its first appearance between 5000 and 10,000 feet; *Abies Khutrow* in Gurwhal and Bissehur, between 7000 and 10,000, and *A. Pindrow* at an elevation of from 10,000 to 12,000 feet.

In the mountains of Mexico, according to Galeotti, (Bullet, de l'Acad. de Bruxelles, vol. X, No. 2,) some of the Coniferæ are found at an altitude of from 3500 to 12,500 feet, as *P. occidentalis,* (which is, however, stated by Swartz to occur in one place in the West Indies at an elevation of about 2000 feet above the sea,) but the greater part of them do not flourish at a less elevation than from 7000 to 8000 feet, and lower stations near the tropic are exceptions; an instance of this, however, besides *P. occidentalis,* is afforded by *Pinus canariensis,* in the Canaries (2000 — 8000 feet). *Podocarpus taxifolius* occurs in Orizala between 7000 and 10,500 feet; *Juniperus* between 5500 and 12,500; and, lastly, *Taxodium* between 4500 and 7500 feet.

The extent of distribution of individual species is very various, and with respect to many, such as for example, with the cypresses and pines, on account of the great length of time they have been cultivated, scarcely admits of determination. The range, however, of *Pinus sylvestris* embraces 30° of latitude (from the North Cape to the Abruzzi),* or from 70° 30′ N. to about 40° N.; but in the southern portion of this range it no longer occurs in the lowlands, but only on the higher mountains. In Scandinavia, near Talvig, at 70° N., from the level of the sea it still ascends to an altitude of 700 feet; at 67° N., on the mountain slopes near Sulitelma, to one of 1350; at Sneehæten at 62° 30′ N. (snow line 4860) it reaches 2280 feet; and in the south of Norway about 3000 feet.

In the north of Germany it extends from the sea level to all the mountain summits; but in the south it was, probably even in ancient times, exotic in the valleys, and confined to the mountain heights alone, whence it did not descend to the level country, until the forests of other trees had become gradually thinned. In the Alps, from the foot of the mountains, to the altitude of 5500 feet, it retains its erect form, and usually becomes stunted, at

* According to Schouw and Presl, it is, however, met with on Ætna between 4000 and 6200 feet; but the species occurring there is considered by Link to be *P. Laricio.*

from 4500 to 6500 or 7000 feet. In the Pyrenees, on the contrary, it first appears at about 3500, and extends to 7400 feet. On the other side of the Alps it is never found below 2000 feet; and in the Abruzzi it exists only on the mountain heights in the stunted form of *P. Pumilio*. Its occurrence in the Caucasus is doubtful.

With respect to longitude, the species extends from Scotland and the Pyrenees, or from about 14° E., certainly to about 90° E. in the Kirghese steppes (Ledebour). If, however, the Siberian form be really *P. sylvestris*, it reaches, according to Pallas, as far even as the Lena, or to about 145° E., or, according to Sauer, Steller, and Georgi, who mention it as occurring even in Kamtschatka and Dauria to about 180° E. Thus altogether it has a range in latitude of from 30° to 31°, and in longitude of about 166° (especially between the parallels of 60° N. and 45° N.) An equal extent of distribution is enjoyed only by *Juniperus communis*, which, in the latitude of 60° N., crosses the whole breadth of America, and consequently encircles the pole.

Thus, excepting the Araucariæ, the whole group of the Abietinæ is confined to the northern hemisphere; but it is otherwise with respect to the Cupressinæ, one third of which occur south of the equator, though the greater part are found between 40° and 20° N. So that very few (*Juniperus communis*, *Thuja occidentalis* and *excelsa*, *Taxodium sempervirens*) are met with in the arctic zone. Many of the genera (at least as far as is at present known) are limited to the Flora of certain regions only, such as *Thujopsis*, *Cryptomeria*, *Retinispora*, which have as yet been found only in Japan, and *Pachylepis* at the Cape. Others again, though with interruptions, are very widely distributed, as *Juniperus* and *Thuja*. The latter genus for instance, occurs in Asia, in Siberia, and again in China, Japan, and Nepaul; in America, in Canada, at Sitcha, and in the south on the Andes of Chili. Doubtful species have been brought also from

St. Helena, Madagascar, and New Zealand. The distribution of *Callitris* is likewise remarkable, of which, at present, only one species has been met with in North Africa, and all the rest in Australia.

The Taxinæ have the fewest representatives in the north temperate zone, and two only of them (*T. baccata* and *canadensis*) approach the arctic circle up to about 60° N.; all the rest remaining below 40° N. Some genera, as is the case with the Cupressinæ, have a very limited range, as *Cephalotaxus* and *Salisburia* in China and Japan, and *Phyllocladus* and *Dacrydium* in Australia; whilst *Taxus*, on the other hand, occurs in Europe, North America, and Asia, as far as Nepaul and Japan; and a doubtful species is even mentioned as occurring at Penang, as far south as 5° N. Species of *Torreya* are found in Florida and Japan.

The genus which enjoys the widest extent of range is *Podocarpus*, which belongs almost entirely to the southern hemisphere. Its most northern representatives in Asia are found in Japan, China, and Nepaul; and in America, in the Antilles. It is, however, extremely abundant in South America, South Africa, and Australia, in which regions it replaces as it were, the Abietinæ, so abundant in the north.

The Coniferæ, especially those of the north temperate zone, are gregarious, but not all so in an equal degree. Thus the red pine and fir usually occupy extensive tracts of country almost exclusively, and (especially the former) scarcely allow of an undergrowth, even of herbaceous plants. The white pine (*A. pectinata*), on the contrary, more readily admits of a mixed growth. The larch also, when unmixed, grows rather thinly, and other species are now scarcely ever gregarious, though they were so at a former period, such as the yew. The extent of distribution of several species has been much modified by the agency of man, as is the case with regard to the Yew, Larch, and *Pinus Cembra*, which have disappeared from many districts; whilst the Cypresses and Pineæ, in consequence of their having been so long cultivated, have become distributed over the whole of the south of Europe to a much greater extent than they originally occupied. In Great Britain, according to Loudon, all the Coniferæ with the exception of *P. sylvestris*, (which is, however, indigenous only in the Highlands of Scotland,) have been introduced since the sixteenth century. In Germany and France, the thinning of the forests has favoured the extension particularly of the fir and red pine, which have established themselves in localities where they were previously wanting. This phenomenon of the great proportionate increase, especially of these two Coniferæ, has been explained in various ways, and many have attributed the decrease of the leaf trees directly to it, which is not, however, exactly the case, since those trees die off in many places, independently of the introduction of the Coniferæ; evident instances of which may be seen, for example, in the neighbourhood of Munich.

This would appear to afford some foundation for the conjectural existence of a grand cycle or rotation in the natural productiveness of the soil, which becoming at length exhausted, as regards other classes of trees, in consequence of their continued growth upon it for many thousand years, nevertheless still remains adapted to the support of the Coniferæ; for although the nutriment from it required by both classes is probably the same, yet the latter are satisfied with a smaller quantity. And besides this, it is not the fact that all the Coniferæ are on the increase; for, to say nothing of the yew and stone pine (*P. Cembra*), the white pine (*A. pectinata*) is also probably rather on the decrease, and it is only those species which require but little moisture that are increasing, such as the fir and red pine; from which it would appear that the hygrometric condition of the atmosphere is in this respect chiefly concerned. It certainly cannot be denied, that the climate of Germany for example, has, within the historical period, in consequence of the increase of agriculture, and the diminution and thinning of the forests, become much less humid than it was formerly. This greater dryness of the atmosphere was, in the first instance probably opposed to the further extension of the forest trees, and still conduces to their continued decrease, and it is to this cause, as it would appear, that the dying off of the trees is to be attributed, and not to the encroachment upon them of the Coniferæ; and it may be also observed that in districts where sufficient moisture is retained for the growth of trees of that family, the oak and beech are again springing up vigorously under their shelter.

It is thus probable that the rotation witnessed in the production of trees is owing mainly to human agency, and is dependent much more upon the degree of moisture of the air than on the fertility of the soil. As to the relations in which the Coniferæ stand with regard to other classes of plants in respect to distribution, it is to be observed that they are almost always associated with other amentaceous trees, especially with Cupuliferæ and Betulineæ, in such a way that they form a boundary to the former, towards the north in the lowlands, or on mountains as in a higher zone, and to the latter, on the south, or as in a lower zone.* The Coniferæ and Palms, however, on the other hand, appear to reciprocally exclude each other very rigorously; for those very regions beyond the arctic circle in which the Coniferæ are wanting, or the tropical regions, are the most rich in Palms and have but a few Coniferæ scattered on the mountains. It is only on the contiguous boundaries of the respective districts that these two families occasionally come in contact, as, for instance, on the southern point of Europe, where we see *Chamærops humilis* and *Pinus Pinea* together with *Cupressus sempervirens*, or what is still more remarkable, in Mexico, *Brahea* and *Chamædorea* occurring together with *Abies*, at about 6000—8000 feet above the sea. In Nor-

* The Ranunculaceæ, Rosaceæ, and Ericeæ, also have very nearly the same limits of distribution as the Coniferæ and among single genera this is particularly the case with *Carex*.

folk Island *Araucaria excelsa* occurs together with a palm and a tree fern; and in Brazil *A. brasiliensis* also with a palm. The nearly allied Cycadeæ, it is true, supply in some degree in the torrid zone the place of the Coniferæ, but, both in the size and number of individual species, they are far from compensating fully for them. No family, however, has a better right than the Coniferæ to be compared with the noble palms of the tropics, or to be considered as their representatives in more rigorous climates. They involuntarily challenge this comparison, notwithstanding the entire dissimilarity of the individual organs, by their majestic habit and size, and by their elegant growth, and the general impression produced by their aspect.

SECTION II.

FORMATION OF THE ROOT.

All the Coniferæ when young produce a strong taproot which, in many species at a later period ceases to grow, and is almost entirely concealed by the progressive increase of the fibrous roots, as in the Red pine. It is not, consequently, easy to understand how Richard can say that a taproot is always wanting, the contrary being evident in the trees of our forests, and especially in *A. pectinata* and *A. larix*. As little foundation is there also for the opinion that the roots of the Coniferæ generally, are as regards the size of the trees, disproportionately small, and that in this respect the family admits of being compared with the palms. The fibrous roots, which usually run near the surface of the ground, frequently extend to a considerable distance, and are sufficiently strong and numerous to prevent the trunk being broken down by the wind, as the uninterrupted density of the foliage of pine woods proves. Circumstances which interfere with the free development of the root appear to act at the same time very prejudicially to the growth of the crown of the tree, as may be seen in the stunted form of the dwarf firs on the Alps, and of the Filzkoppe of our peat moors. In both these cases, in the one owing to the rocky substratum, and in the other to the ground water, the growth of the taproot is impeded, in consequence of which the main stem above ground becomes very much stunted, and the vegetation thrown out, as it were, laterally into the branches, which are widely extended. The roots never send out shoots, either during the life of the stem, or when it has been cut down, nor even when they themselves have been wounded. On the other hand, many instances are known of the growing together of distinct roots of different individuals (even of different species), in consequence of which a certain degree of vitality is retained in the stump of the cut-down stem, even for a considerable number of years. This has been observed especially in the white pine (*A. pectinata*, De C.), and very seldom in the red pine (*Abies excelsa*,) and fir (*P. sylvestris*). The stumps under these circumstances most generally present an attempt at cicatrization of the cut surface, but without exhibiting any disposition to throw out green buds. This cicatrization is effected by the deposition, even after the fall of the trunk, of new concentric layers or annual rings of wood between the bark and wood of the stump, the cut surface of which is covered by the turning over and gradual advance upon it of these new deposits. In these cases, however, there is always an accretion (sometimes of the bark only, and sometimes of the wood) of one or more of the roots of the stump with those of a neighbouring uninjured tree, in consequence of which a degree of vitality is communicated to the roots of the stump, which enables them to continue the deposition of the ligneous layers in it. The crude nutriment is apparently absorbed by them from the soil, and passes by means of the adhesions into the roots of the still growing tree, ascending in the first place into its foliage, whence it is returned as prepared cambium for the formation of the ligneous rings of the stump; so that the latter becomes as it were a branch of the growing stem. Göppert,* to whom we are indebted for the most accurate account of this proceeding, found in many of these aftergrowths (*Ueberwallungen*, overflows) as many as 100 annual rings, and

* Beobachtungen ueber das sogenannte "Ueberwallen" der Tannenbaüme. Bonn, 1842. 4to, mit 3 lith. Tafeln. On the same subject, also see Meyer's Abhandlung, in der Preussische Provincial Blätter. N. Folge, 1843. Mohl. Botan. Zeitung, 1843. S. 13.

also observed, though not often, green twigs springing from the newly-formed wood of the aftergrowth. The curious conical protuberances on the roots of *Taxodium distichum*, which attain a height of four to five feet, and are said to be always hollow within, are as yet too little known to allow of their being explained, but they may probably arise in a similar attempt at cicatrization, induced by some previous interruption of growth at the spot where they are situated.

SECTION III.

FORMATION OF THE STEM AND DURATION OF LIFE.

All the Coniferæ without exception, are naturally disposed to form an erect tree-like stem, and the disposition to do so may be observed even in those cases in which this mode of growth is usually imperfectly developed, as in *Juniperus;* all species, however, return to it under favorable circumstances.

But the size which the stem may attain, the proportion of its length to its diameter, the rapidity of its growth, and the possible life of the individual, are extremely various.

With respect to longevity, the Coniferæ are one of the longest-lived families, since there is probably no species among them which may not live 100 years. Of the larger German species, the red pine (*Abies excelsa*), white pine (*A. pectinata*), and firs (*P. sylvestris*) of the lowlands not unfrequently live 200 to 300 years; and the alpine species and larches are frequently 500 years old; and the cypress in the south of Europe appears to attain an age at least equally great; whilst the cedar considerably exceeds it and will last 800 years.

De Candolle (Physiolog. Vegetal. ii, p. 1001) estimates the age of the largest yews as much greater. Assuming that in the transverse section of the tree, including both semi-diameters, each annual ring of the first 150 years of growth has a thickness of a French line, and afterwards something less, he demonstrates from the given measurements of the largest yews, especially in

Great Britain, that the stem of one growing at Fountains Abbey in Yorkshire, which was measured by Pennant in 1770, and found at that time to have a circumference of 26·6 feet, would contain 1214 annual rings, and would consequently be that number of years old. Another in the churchyard of Crowhurst in Kent would possess 1458 annual rings; one in the churchyard of Fotheringhal in Scotland, measuring 58·6 feet in circumference, 2588; and one in the churchyard of Brayburn in Kent, according to the measurement of Evelyn in 1660, would at that time have attained an age of 2880 rings or years.

Lastly, enormous trunks of *Taxodium distichum* are met with both in Florida and in Southern Louisiana, as well as in Mexico. Michaux mentions some of these stems of forty feet in circumference above the rounded, enlarged base, which was three or four times that size. The so-called Cypress of Montezuma, in the garden of Chapultepec (Mexico), measures forty-one feet (English) in periphery. But all these dwindle to nothing before the gigantic trunk near Santa Maria del Tule, in the province of Oaxaca, which was first mentioned by Exter, who found its circumference to be 117·10 feet (French.)

With respect to this account, however, De Candolle thought that either several trees might have grown together, or were this not the case, that the measurement had been taken round the dilated base of the trunk. By the kindness of Baron Von Karwinski, who twice measured the tree and has sent me a drawing of it, I am enabled to remove these doubts. The measurement was always taken above the dilatation, and on each occasion the size was found somewhat to exceed 117 feet. The dilated base was not measured, but from the drawing it must have a circumference of at least 200 feet, and thus the diameter of the trunk must be about 37·2 feet, and of the enlarged base about 60·5 feet. The dilated base surrounds the whole trunk equally, so that it cannot readily be supposed that the size is owing to the accretion of several trunks.*

Now if we take as a basis for computation the statement of Michaux, given by De Candolle, that the most thriving specimen of the tree in France attained in forty-five years a diameter of one foot or 144 lines, and consequently, that annual rings were formed of the thickness of 3·2 lines, and supposing a similar increase of wood to occur up to the most recent period of growth, it would appear that the trunk in question, which has a diameter of 5352 lines, would be 1672 years old. This supposition, however, is rather improbable, since perhaps none of the Coniferæ in the later periods of their growth ever deposit so much as 12·8 lines of wood within four years.

If again we assume the annual increase to average only one line, we get 5352 rings, and, consequently, that number of years as the age of the tree; but if we take the mean of these two numbers, we should arrive at 3512 as the most probable number of years of age, and at an annual addition of ligneous rings of 1·6 lines in thickness, which is sufficiently considerable. The uncertainty, however, of all such computations of age, taken from the measurement of the trunk, without actual counting of the rings, and what differences in this respect are caused by climate and soil, may be seen from some examples.

De Candolle considers the increase of diameter of the yew, at least in the first 150 years, to be about one line annually.

In 120 years, consequently, a tree should be 120 lines, or ten inches thick.

But four sections of the trunks of *Taxus* of various thickness have been measured in the mountains of Bavaria, and their annual rings counted with the following results:

* On the other hand, H. Galeotti (Bull. de l'Acad. de Bruxelles, tom. x, No. 2) has also twice measured the tree in 1839 and 1840, and found the circumference, four feet from the ground, to be only 105 French feet.

	Diameter.	An. rings.	Transverse thickness of rings in the diameter.	in the semi-diameter.
1.	56‴	115	0·48″	0·24
2.	69	214	0·33	0·16
3.	132	292	0·42	0·21
4.	132	294	0·42	0·21

Thus the thickness of the annual rings amounts to only from one-fifth to nearly half a Bavarian line, a result which, if transferred to the large English specimens mentioned above, would double or treble their age. The thickness of the rings, however, was at the same time so various in the different individuals, that in Nos. 1 and 2, 13 lines of difference in the diameter correspond to 99 annual rings; whilst in Nos. 2 and 3, 63 lines of difference correspond to only 78 rings, results which harmonize with the average thickness of the rings stated above, only inasmuch as that the individual rings of the same stem differ considerably among themselves. Four sections of *Pinus sylvestris*, taken from very different localities, were estimated in the same way.

Locality.	Diameter.	No. of An. rings.	Thickness of rings.	
1. Plain (unknown)	50‴	13	3·8‴	1·10‴
2. About 5500 feet altitude, *dwarf*	72	186	0·39	0·19
3. About 5000 feet altitude, *tall*	84	154	0·54	0·27
4. About 3500 feet altitude, *tall*	84	56	1·50	0·75

Thus in these four stems, the thickness of the annual rings amounts to between 3·8 lines and 0·39 lines. At the same time, in Nos. 1 and 2, 22 lines of difference in diameter correspond with 173 annual rings; but between Nos. 3 and 4 and No. 2, the proportion is reversed, since in the two latter, a greater diameter corresponds with a less number of rings, for whilst in No. 4, the 84 lines of diameter correspond with 56 rings, in No. 2, 72 lines give more than three times that number, or 186 rings.

Similar anomalies are presented by the red pine (*A.*

excelsa), larch (*Ab. larix*), and also by the *P. Cembra*. These statements, however, suffice to prove that conclusions as to the age and number of annual rings of a tree cannot, at present, be drawn with any, or with only occasional probability, from the diameter, except in those cases in which the growth has taken place, under exactly similar external conditions. The four yew stems were from the Bavarian Alps, and the altitude of the respective localities at which they grew cannot differ more than 3000 feet; the thickness of the rings varies among them almost one-third; but in comparison with the instances given by De Candolle, more than the half or even two thirds. According to this, yews of the same diameter may be 100, 200, or 300 years old.

But in the fir (*P. sylvestris*) the difference in the thickness of the rings, under great differences of external condition (as between Nos. 1 and 2) amounts to one ninth; and under nearly similar circumstances (as between Nos. 2 and 4) to at least a third, or (as between Nos. 1 and 4) to one half.

It would be a highly interesting contribution to science, if numerous comparative calculations and measurements were made in different countries, and under every variety of external conditions, for the accurate determination of the limits of this disparity in the growth of trees of the same species.

The height of these trees has probably been exaggerated, when that of *Araucaria imbricata* has been stated to reach 260 feet, although 220 feet have also been given as that of *Araucaria excelsa*. In all the rest, the average height scarcely exceeds that of our white and red pines, which under very favorable circumstances will attain from 160 to 180 feet. The fir (*P. sylvestris*) and larch, with many others, though not of such lofty growth, nevertheless exceed 100 feet, and there are very few which do not reach 50 feet. The relative proportion of diameter to height varies extremely, as may be seen from these examples :—

	Height.	Diameter.	Proportion.
Araucaria excelsa	220	24	1 to 9
Abies excelsa	180	6	1 30
Abies pectinata	180	7	1 26
Abies larix	120	12	1 10
Taxodium distichum	120	36	1 3·5
Taxus baccata	120	18	1 7
Pinus bracteata	120	1	1 120
Pinus sylvestris	130	6	1 22

This table shows that the proportion between height and thickness varies from 1 : 3·5 to 1 : 120, and the difference with respect to dimensions which has been heretofore stated to exist between Monocotyledons and Dicotyledons cannot be maintained as regards this family. On the other hand, the trunk of the so nearly-allied Cycadeæ is frequently stunted to such a degree that its transverse diameter is almost equal to its length. The annual elongation is so small that scarcely any distinct internodes are observed between either the bud scales or the fan-like tufts of leaves, and the whole surface of the stem appears closely imbricated with the remains of the dry scales and leaves. Exactly the same formation, with the exception of the texture of the wood, obtains in several of the Coniferæ, in the lateral branches, where the afflux of the sap is diminished, and the longitudinal growth consequently reduced to the lowest possible degree, as, for instance, in the Larch, Cedar, Salisburia, &c. These stunted lateral branches, which are for the most part also fructiferous, present the greatest analogy in their formation with the stems of the Cycadeæ, as may be seen in the figures of *Salisburia* and *Cedrus*. (Tab. iii, figs. 1 and 2.)

SECTION IV.

FORMATION OF THE CROWN.

In almost all the Coniferæ the branches are arranged verticillately and at regular distances, on the main trunk. This mode of arrangement arises from the circumstance that by far the greater number of the leaves of the annual top shoot have either no buds at all, or only flower-buds developed in their axils, and that leaf-buds are formed only in the axils of those leaves which are placed immediately below the terminal bud of the year. Thus every annual shoot is simple up to its summit, where in the first year are seen the buds of the shoots, and in the second the branches, arranged circularly in a close spiral or whorl, and thus in a series of years the old stem exhibits nothing but whorls of branches with naked interspaces or internodes corresponding to the budless extensions of the annual shoot.

This is the normal arrangement of the branches as regards the main stem, but on the lateral branches the ramification is modified in various ways. In many true species of *Pinus*, the ramuli of the principal branches are usually arranged in whorls, as in Pinus sylvestris; whilst in *Abies* and others, although it is true that the ramuli arise normally only towards the extremity of the annual shoot, yet they grow horizontally on each side only of the parent branch. The angle formed by the latter with the main stem seems in this case to be of no consequence, since the same distichous arrangement is observed also in the abruptly ascending branches of *Thuja orientalis*. It rarely happens, and only as an exception, that a bud of one of these lateral branches alters the direction of its growth immediately after bursting, and rises perpendicularly parallel with the main stem; but when the direction of the branch is changed in this manner, it also itself throws out buds arranged in a whorl, and thus constitutes a true secondary top or crown; and, owing to this circumstance, we sometimes observe in mountainous districts trees of *A. excelsa* with 5—7 or more lateral tops, but still retaining the original summit. The height of the principal summit or top, in comparison with the lateral branches, varies extremely. In the red pine (*A. excelsa*) it is very long in proportion, and the length of the upper branches being less than that of the lower, the crown assumes a pyramidal form. In many species of *Pinus* (*nigricans*, *Pinea*), the top is scarcely higher than the side branches and those immediately beneath it, the consequence of which arrangement is to give the whole crown an umbellate appearance. In *Araucaria* and *Cunninghamia*, at least when young, the top shoot is always shorter than the uppermost lateral branches, and the crown is consequently depressed at the summit.

The angle formed by the branches with the main stem, is, in many species, very variable, without any corresponding difference in the position of the buds, as in *Cupressus sempervirens*, in some individuals of which the branches project horizontally, whilst in others they ascend perpendicularly closely adpressed to the stem.

The important influence which locality and conditions of soil have in the development of the crown is well known. In situations freely exposed to the sun, but where there is sufficient moisture and fertility of soil, the red pine (*A. excelsa*) retains all its branches down to the ground, even at an advanced age; whilst, according to Wahlenberg, towards the northern limits of its range, it rises as a simple stem almost entirely without lateral branches, and to a height of not more than ten or fifteen feet.

In those forms of the fir which are characteristic of the higher Alpine regions, and the high-lying moors (especially in Bavaria), or in the *Pinus pumilio* (*Legföhre*) and Filzkoppe, the lower branches in particular spread horizontally above the surface to a considerable distance, whilst the growth of the top and upper branches remains stationary, and the tree becomes stunted into a shrub. It is remarkable that in the extreme north of Asia, towards the coasts of the Frozen Sea, this stunting into a dwarf growth should take place in the lowlands, also with the indigenous larches and stone pines, whose analogous forms with us always occur as erect trees.

Here, however, should be observed the remarkable obstinacy with which the lateral branches of coniferous trees, especially among the Abietinæ and Cunninghamiæ, when planted as cuttings and brought to root independently, refuse in spite of their now erect position, to throw out verticillate branches, like the main stem, but, on the contrary, persevere in maintaining the distichous arrangement of their branches. This is observable especially in the garden cultivation of *Cunninghamia* and *Araucaria;* but in the wild state also, as for example, in *Abies excelsa*, the top shoot is seldom replaced by one of the lateral branches when the former, in advanced age, has been broken off by a storm or other injury. In the younger state of the tree this substitution occurs more readily, as we see in hedges of *Abies excelsa* which have been neglected in the cutting, or in plantations, parks, &c.; in which cases a top is formed and rapidly grows up, where some branches of a few years' growth have accidentally escaped mutilation. In these instances, however, the already formed and repeatedly mutilated lower branches acquire such a tenacity of life, that they do not allow themselves to be long overtopped by the ascending main stem, and form for many years a thick bushy pyramid around its base.

This distichous arrangement of the lateral branches is most distinctly evident in those instances in which, as in *Thujopsis*, some Thujæ and Retinisporæ, each twig assumes, as it were, the function of a true leaf, as indicated by the circumstance that all the leaflets or scales situated on their under surface are furnished with *stomata*, which are wanting in those of the upper side. In *Phyllocladus* these twigs eventually become *phyllodia*; of which more will be said afterwards.

SECTION V.

GEMMATION.

THE buds of the Coniferæ, independently of their position, of which we have already spoken, are sometimes *scaled* and sometimes *scaleless*.

They are *scaled* in the Abietinæ, Taxinæ, and some Cunninghamiæ, and *scaleless* in the rest of that subdivision, and in the Cupressinæ.

The scales are always imbricated and arranged in a spiral form, numerous and closely adpressed. The texture of the external ones is for the most part coriaceous, and of the internal, more dry and membranaceous. In shape they vary from oval to linear-lanceolate, and they are frequently keeled on the dorsal surface, with a fringed and scalloped margin. In the Abietinæ they are often completely covered and cemented together by resin. In *Pinus* the apex is usually reverted.

The leaf- and flower-buds are for the most part separate, and are either terminal, or issue from the axils of the leaves of the last year's shoot. The genus *Pinus* forms an exception, however, to this, inasmuch as that each of the autumnal buds contains numerous secondary, also scaled buds, which are capable of becoming either altogether leaf-buds, or both male and female buds as well; but with the exception of the terminal female buds, they are all situated in the axils of the separate scales of the principal bud.

After the bursting of the bud the scales of the leaf-shoot, in many cases, especially in *Abies*, remaining closely crowded together, (except the innermost more tender ones, which either fall off or being still closed like a hood, are pushed off by the increasing growth of the shoot,) form a ring encircling the base of the new branch, which is persistent upon it for many years; but in others the bud-scales on the new shoot become separated considerably from each other, and the shoot is consequently developed more between than above them. This more simple condition obtains in *Sciadopitys*, in which the widely separated bud-scales are distributed over almost the whole length of the new shoot, whilst the true leaves, though numerous, are crowded into a very short spiral, and constitute a many-rayed whorl at its summit. The same thing occurs in *Phyllocladus*, only that the scales and leaves are less numerous. The habit of the tree in consequence of this mode of arrangement of the leaves becomes essentially altered, for if the bud-scales remain adherent only at the base of the branch, which is itself covered throughout with leaves, it naturally follows that, in those instances in which the leaves are persistent for several years, all the branches of the crown which are thrown out within that period are thickly covered with leaves; so that, as for instance in *Abies*, in which the leaves adhere for seven years, all the younger branches appear covered with leaves throughout their whole length; and the thick shade of these trees is caused in this way. But in those cases on the other hand in which the leaves are shed annually, as in *Larix*, the shade afforded by the trees is necessarily very scanty, (and especially so on account of the greater distance apart of the leaves themselves on the rapidly growing shoots.) Almost the same to the fifth year their relations are changed. From this time onwards, the bud-scales, after the bursting of the buds, become more widely separated, and occupy the whole surface of the young shoot, without being succeeded towards the apex by true leaves, as in *Sciadopitys*. The annual shoots are thus, strictly speaking, leafless. But at the same time, secondary buds spring up in the axil of each scale, each of which secondary buds produces two, three, or five leaves, surrounded by from ten to twelve scales, set round an extremely shortened axis. These leaves are normally persistent for three years, and constitute the foliage of the tree. The axis of these secondary buds never produces flower buds, nor, except in very rare instances, is it prolonged into a leaf shoot. They usually fall off at the end of three years, without leaving a mark; whilst, on the contrary, the bud-scales of the annual shoot remain much longer attached to the branch on which they are decurrent, and becoming woody at the base, lose only their membranous portion or apex, which withers off during the first summer. In *Taxodium*, however, the greater part of the annual shoot, although it has a much more elongated axis, and is furnished with numerous leaves, falls off in the autumn of the same year; in this respect reminding us of *Myricaria* and several *Euphorbiaceæ*.

A sort of double mode of development of the buds occurs in *Abies*, *Larix*, *Cedrus*, *Deodara*, as well as in *Salisburia* and others. This double mode of development appears in the circumstance that, in the vigorous terminal shoots, as in other firs, the bud-scales remain adherent and crowded into a ring, but the leaves are distributed along the branch at due distances apart, whilst in the lateral shoots, the leaves although developed in greater numbers remain adherent, and are crowded together in the same manner as the bud-scales, and thus form thick tufts.

In this way are constituted fertile branches, as in the Pomaceæ, which branches also, as in that family, produce flowers of both sexes, but otherwise in their whole growth very much resemble the stems of the Cycadeæ, of which more will be said hereafter.

In the genera in which the buds are not scaled, the leaves which surround the young shoot in place of the *perulæ*, are usually distinguished by their less size, and even after the bursting of the bud by their more crowded position.

The dissimilarity in form of the leaves at different ages of the tree (*Araucaria*), or at the same time in different branches, or often on the same branch (*Juniperus*) which has been mentioned as especially characteristic of these genera, and in consequence of which the leaves sometimes assume the form of green scales and sometimes of leaves, cannot here be considered, as it does not stand in any direct connexion with the periodicity of their development.

The following genera have *scaled* buds: *Pinus*, *Abies*, *Sciadopitys*, *Taxus*, *Cephalotaxus*, *Torreya*, *Phyllocladus*, *Salisburia*, *Podocarpus*, (most of the species.)

The buds are *without scales* in *Cunninghamia*, *Araucaria*, *Cupressus*, *Thujopsis*, *Cryptomeria*, *Thuja*, *Retinispora*, *Callitris*, *Pachylepis*, *Juniperus*, *Dacrydium*, and some species of *Podocarpus*.

The flower-buds resemble the leaf-buds in being scaled or scaleless; but I am not acquainted with any instance of a scaled flower-bud of either sex inclosing leaves at the same time. The leaves in the bud before it bursts, are almost always adpressed flat to the axis and closely packed upon each other; but in *Salisburia* they are spirally convoluted, and present in this respect a strict resemblance to the mode of folding of the segments of the leaves of *Encephalartus horridus*. (Tab. ii, figs. 1, 2.)

It must here also be remarked that, the circinate vernation of the Cycadeæ belongs only to the genus *Cycas;* for in *Zamia* the segments of the leaf lie flat upon each other along the axis, as is clearly seen in the young leaf of *Zamia integrifolia*. (Tab. ii, fig. 3.)

SECTION VI.

FORMATION OF THE LEAF.

In most of the Coniferæ there is no distinct division of parts in the leaf, as into sheath, petiole, and blade or lamina; or it may be said, that in most cases the leaves in this family are only modifications of the sheath portion, and that there is no true petiole and blade, which exist distinctly only in those species of *Abies* in which the cicatriculæ of the leaves are circular (the true Piceæ), and in a somewhat modified form in several Taxinæ. In all the other Abietinæ, Cunninghamiæ, and Cupressinæ, as well as in many Taxinæ, the leaf assumes the appearance of a scale, the form and texture of which vary very much, and which, as it is usually expressed, is decurrent more or less along the branch, with its proportionately expanded base, or, more correctly speaking, which quits the branch at a short distance above its origin. This inferior portion of the leaf, or that by which it is attached to the branch, retains either the same texture as the superior portion during the whole life of the leaf, as in the Cupressinæ, or becomes ligneous soon after its development, and forms a projecting decurrent pulvinus or *coussinet*, which assumes various forms, as for instance, in those species of *Abies* which have quadrangular leaves. In the latter instance, the projecting portion of the leaf, upon the exhaustion of its vital activity (in *Abies*, generally after seven years, in *Larix*, at the end of one summer), dries off up to the extremity of the pulvinus and is detached, leaving a cicatrix, as if it had been articulated; but in the former cases the whole of the scale gradually withers off, without presenting any appearance of articulation of the projecting portion; the latter varies very much, both in its shape and in its proportionate size in relation to the inferior decurrent part. In the various species of *Callitris*, for instance, it is almost wholly wanting, or forms only a very short and minute tooth, or in other words, the scale in these plants is adherent to the branch almost up to its point. The figures 2, 3, 4, in Tab. i, represent the summits of branches of a young plant of *Callitris*, on which is seen the gradual transition of the leaves, which at the base are free, into the adherent scales of the later growth. In other cases it is distinctly developed, and is either—

a. Of nearly the same shape at all ages of the plant as in *Abies*, or

b. Of a different shape in the youth of the plant to that which it presents at a more advanced period of its growth, but yet at each period is of the same shape throughout the tree—as in *Pinus*, *Araucaria*, *Thuja*, &c., or, lastly,

c. It presents various shapes at one and the same time in the same individual, and indeed without any perceptible relation to situation, as in many *Juniperi*, in which it not unfrequently happens that adherent scales alternate irregularly with projecting leaves on the same branch; or with a more definite reference to situation, as in *Thuja* and *Thujopsis*, in which of the four decussating rows of scales, the left and right rows on the sides of the branch are always differently formed to those on the superior and inferior surfaces.

The form of the leaf may be referred to two fundamental types, which however, in many cases, run into each other, and which themselves also present many modifications.

Thus, it is either flat and presents an evident upper and under surface, the former of which is usually concave, and the latter convex, as in *Juniperus* and others (Tab. i, figs. 14, 17, 19, &c.), or it is compressed laterally with an acute superior and inferior edge, and consequently exhibits on a transverse section a variety of rhomboid forms; or lastly, it is perpendicularly linear, as in the phyllodia of the Acaciæ. (Tab. i, figs. 20, 23, 24.)

The transition of the two fundamental types is most clearly exhibited in the distichous leaves of *Thuja* and *Thujopsis*. These short scale-like leaves are concave on the upper surface towards the base, which embraces the axis of the branch, but towards the apex the surface becomes gradually convex, and rises into a ridge or keel above the margins, whilst the under surface remains convex, or is also keeled, in consequence of the more marked projection of the midrib. (Tab. 1, figs. 25-28.) A similar difference exists in *Pinus*, but only in different species. In all the species with two leaves in a fasciculus, their upper surface is concave and furrowed; whilst in all that have three or five leaves in a fasciculus, the upper surface rises into an acute though veinless ridge, which either slopes off uninterruptedly to the margins, or leaves a small flat surface on either side. The under surface, however, is not altered in its form in these cases, but remains semicylindrical, and the margins also retain the same distance from each other, and as elsewhere are widely serrated, proving that the acute ridge of the superior surface is not caused by their approximation and union. (Tab. i, figs. 16, 17.) These forms of coniferous leaves have thus no resemblance to the folia equitantia of the monocotyledons, as, for instance, of the Irideæ, in which the margins of the leaf, which is concave at the base, may be seen gradually to approximate towards each other and to cohere, so that further on the two surfaces having become perpendicular, appear to be only the halves of the original inferior surface. This form of leaf attains its greatest perfection among the Coniferæ, in the *Araucariæ*, and in *Cryptomeria* (Don). In these cases, however, there also occur important varieties. We are not as yet acquainted with the leaves of the young plant of *Cryptomeria*, but at a later period of its growth they are always compressed laterally, of a rhomboid form, and with a prominent decurrent keel. (Tab. i, fig. 24.) In *Araucaria excelsa* and *Cunninghami*, on the other hand, this form is exhibited only in the young plant, whilst in older individuals the leaves are always scale-like and flat, and concave on the upper side. (Tab. i, fig. 22.)

In some species of *Podocarpus* from Java and New Zealand, the leaves of the principal shoots are reduced to the form of scales, and are more or less concave on the upper surface; whilst at the same time, those of the less vigorous lateral shoots are elongated, and present a much compressed rhomboid form on their transverse section.

In those species of *Abies* which form a group with *A. excelsa* (*Picea*, Link), the leaves of the one-year old plant are also furrowed on the upper surface, but those of a later growth, in consequence of the elevation of the upper surface, are all of a rhomboid form (Tab. i, fig. 20), but they are not compressed on the sides. Many species exhibit the transition into the flat leaves of the white Pines, in which, as for instance, in *Abies Mertensiana*, the upper surface of the leaves presents in the middle merely a prominent line, but otherwise remains flat.

Those leaves which present a rhomboid form on the transverse section are either laterally compressed or not, but they are always more or less falcate towards the apex.

As regards the venation of the leaves of the Coniferæ, although a midrib is certainly frequently present and forms a projecting ridge or keel on the dorsal surface of the leaf, yet the veins are never ramified in such a way that the ramifications filled up by cellular tissue constitute a surface with a developed system of vessels. Even the broad-leaved species of *Podocarpus* form no exception in this respect. An apparent exception however exists in *Sciadopitys*, in the occurrence of two parallel veins running on each side of the true central line of the leaf. (Tab. i, fig. 12.)

In the quadrangular or laterally compressed leaves, the principal vein usually occupies the centre, and is otherwise most evident in *Abies* (especially in the white pine, *A. pectinata*), and in the Taxinæ. But just as frequently the vascular bundle, immediately upon reaching the expansion of the leaf, is split up into numerous parallel veins, in consequence of which the development of a central vein is completely suppressed. Sometimes, on the contrary, a sort of forked venation may be observed, as is most distinctly seen in *Salisburia* (Tab. ii, fig. 4), but it is quite distinct also in *Pinus*, in the skeleton of the fruit scale, (Tab. iii, figs. 3, 4, 5, 6, 7.) In *Salisburia* the vascular bundle is divided, even at the extremity of the inferior petiole-like portion of the leaf into two bundles, and the central portion continued on into the expansion, and being as it were arrested in its development, causes by its contraction the bilobate form of the leaf; whilst the lateral fasciculi take their course immediately within the margin, surrounded on their external aspect by a little cellular tissue, and sending out from their inner side numerous parallel veins, which diverge more and more from above downwards, and in this way give the leaf its expanded form; but in other and more frequent instances, the rays proceeding from the principal vascular fasciculus, converge again towards the apex of the leaf, presenting a distinctly dichotomous arrangement as in the fruit-scales of *Pinus* (Tab. iii, figs. 3 and 4), and being less distinctly forked at the base in the leaf-scales of *Cunninghamia*, *Araucaria brasiliensis*, &c. In all the other forms also, the leaves are traversed only by parallel veins, or by divergent ones, which converge again towards the apex. Even the expanded leaves of the *Podocarpi* contain no vascular tissue, excepting the midrib, and in *P. Nageia, latifolia*, and others, there is not even a midrib; which is also absent in *Dammara*. (Tab. i, fig. 21.)

Putting all these facts together, it would appear that the leaves of most of the Coniferæ are wholly different in their structure from those of all other dicotyledons (Rich. Conif. p. 92), and, on the contrary, that their structure much more closely resembles that which usually obtains in the leaves of the greater part of the monocotyledons, or to speak perhaps more correctly, that as they are composed only of parallel vessels which either converge or diverge as they proceed, without other branching or anastomosis, and are connected so as to form a surface merely by cellular tissue, they in most cases are to be considered only as expanded petioles, with the lamina of the leaf entirely suppressed.

In *Phyllocladus*, true leaves are entirely wanting, their place being supplied merely by bud-scales or leaf-like twigs. The principal axis of the stem or of the branch produces buds with scales, which are narrow and linear, or acicular, membranaceous, and expanding. They are disposed on the axis at regular distances, and supply the place of leaves, and usually, no further buds are developed in their axils; they also soon wither off. (Tab. i, fig. 1, *a a*.) The three to five uppermost scales only, on the extremity of each annual shoot are crowded into a circle, and each bears in its axil a leaf-like twig. (Tab. i, fig. 1, *b*.) These twigs are articulated at the base like leaves, and are partially thus thrown off. They are furnished with minute, distichous, alternate, remote, decurrent bracts or stipules, of which in young plants from ten to twelve, but in older ones frequently, only four or five occur on each twig. (Tab. i, fig. 1, *c c*.) From the axil of each of these bracts issues a leaf-like, flattened, and irregularly divided twig or phyllodium, which approaches in its nature to that of a leaf, inasmuch as that the under surface only, or that which looks towards the earth, is in the young plant of a whitish colour, and furnished with numerous stomata (Tab. i, fig. 29), whilst the upper surface is green and without stomata (Tab. i, fig. 1, *d d*.) In plants of older growth, the bracts from the axils of which these phyllodia arise, ascend and are united to the edge of the latter, appearing at first sight to constitute merely its lowermost segment. Lastly, the branch terminates at the apex, either in phyllodium similar to the rest, and thus forms as it were a complete leaf, which also in due season falls off, or it ends but beyond all the phyllodia in a scaled bud, like those of the principal stem, and consequently becomes a permanent true axis, from which in the next year a whorl of similar branches is produced. (Tab. 1, fig. 1, *e e*.) These different modes of development of the branches do not appear to occur with any regularity, and each sort of termination may be observed in branches of the same whorl. I have observed only in a young seedling, that the whole of the branches of the previous year terminated in phyllodia, whilst three of those constituting the uppermost and latter whorl all terminated in buds. (Tab. i, fig. 1.)

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This formation among the Coniferæ recalls, in the first place, that which obtains in *Taxodium*, in which the annual lateral shoots also for the most part die off, but chiefly that which is observed in *Zylophylla*, among the Euphorbiaceæ, in which a similar ambiguity exists between leaf and branch. The pinnules, however, or segments of the equivocal branches in *Phyllocladus*, never produce flowers or leaf-buds.

In all the Coniferæ, except *Salisburia*, the leaves are furnished in various ways with stomata, and the situations in which these openings are placed are usually indicated by a blueish white colour. They are never situated on the vessels, and are commonly arranged in several regular and parallel rows.

In the flat leaves they usually occur only on the dorsal surface, on each side of the midrib and form, as for instance in *Abies pectinata* and others, between the rib and the margin, two distinct white striæ. (Tab. i, figs. 13, 14, 15.) In *Sciadopitys*, on the other hand, the leaf is traversed by two parallel costæ, between which, instead of a midrib, is a strip of cellular tissue, in which the rows of stomata are situated. (Tab. i, fig. 12.) In *Phyllocladus* they are irregularly distributed between the veins, all over the under surface of the leaf (Tab. i, fig. 29), whilst in *Juniperus* they occur in the upper surface, in a central tract. (Tab. i, fig. 19.) In *Thujopsis*, on the contrary, and the *Retinisporæ* with adpressed leaves and distichous branches, and in which the under side of the leaf alone is ever visible, stomata occur on the surfaces of all the leaves situated on the under side of the branch. In those cases, however, in which the leaves are decussate, the under leaf of that pair which is placed above and below, is furnished with two rows of stomata, and none exist in the upper; and whilst the inferior half of each of the leaves constituting the lateral pair which embraces the stalk presents stomata, there are none on the superior halves of the same leaves. (Tab. i, figs. 25, 26.) This arrangement of the stomata appears to indicate the existence of a common or joint life in all the leaves on the branch, such as obtains in a more restricted form in the branch-like phyllodia; and in it an analogy may be perceived with the mode of growth peculiar to the lateral branches of the Coniferæ when planted as cuttings, and of which mention has been before made. The branch has become in a manner transformed into a leaf, and its still ununited leaflets constitute a common upper and under surface. In *Retinispora squamosa*, however, which has deciduous leaves, the stomata are always situated in a double series on the dorsal surface.

In these species of *Pinus*, with two channelled leaves in each fasciculus, the stomata are ranged in rows on each side, as also in the Araucariæ with flattened leaves. (Tab. i, fig. 16.) In those species in which the leaves have a longitudinal ridge on the upper surface, there is most usually a series of stomata on each side of the ridge, and none on the opposite surface of the leaf. (Tab. i, fig. 16.)

In the Araucariæ with laterally compressed leaves, and in the similar leaves of *Cryptomeria*, the stomata are arranged in four rows, on the four sides of the elongated rhomboid (Tab. i, fig. 24); and there is also a row of stomata in each of the four sides of the quadrangular leaves of some of the Abietinæ. (Tab. i, fig. 20.) In *Cunninghamia* they are placed on the dorsal surface in two rows near the midrib, as also in *Taxodium*, *Taxus*, *Cephalotaxus*, and *Torreya*, and in the species of *Podocarpus* with distinct midrib (Tab. i, figs. 13, 14, 18); but in those species of the latter genus in which no midrib is developed, as well as in *Dammara*, they are observed to constitute numerous very minute rows on the dorsal surface. (Tab. i, fig. 21.)

Individually they appear to be largest in the Abietinæ and smallest in the Taxinæ. That the white colour caused by their presence on the part of the leaf where they are situate is not owing to the deposit of resinous matter, is proved by the fact of its not being removed by the immersion of the leaf in alcohol. Besides, the colour is frequently altogether absent, particularly in the Taxinæ.

The margin of the leaf is for the most part quite entire, without teeth or incisions; but in *Cunninghamia* and *Pinus* it presents minute, remote serratures, which may be observed also on the projecting keel of the upper surface in the species with more than two leaves in a fasciculus. In many genera the margin is thickened and surrounded with a sort of marginal vein.

The apex is sharp, and often pointed, when the midrib is continued to the extremity, or when all the veins, converging to the apex, are reunited. It is emarginate when the midrib terminates in the body of the leaf, as in the white pine (*A. pectinata*).

In the leaves in which the veins continue to diverge up to the apex, as in *Phyllocladus* and *Salisburia*, their unequal length produces an uneven margin, such as occurs in the so called folia præmorsa. The leaves of *Salisburia* are besides this, in consequence of the total absence of a midrib, deeply divided. This division, however, as well as the marginal serratures, are distinctly marked only in the sterile branches, for on the fertile ones the leaves are undivided and usually entire; and in *Abies pectinata* also, the otherwise emarginate leaves are mucronate on the fertile branches.

Varieties in the form of the leaves are upon the whole rare among the Coniferæ. Their size, however, not unfrequently varies, either throughout the individual plant according to the locality of its growth, or in single branches from causes in part unknown; an instance of which may be seen in the alternation of scales and elongated leaves in many of the *Juniperi*. In those genera which have naked buds it may frequently be remarked that the leaves which are situated immediately above or below the innovation are by far the smaller, as in *Cryptomeria*, *Dacrydium*, and others. In the former of these genera they are frequently arranged in a spiral form round the branch, which thence acquires a screw-like appearance.

The duration of the leaves is very various. An annual duration, as in *Larix*, is that which is most rarely observed. In the majority of instances they continue green for at least three years, as in the Pineæ; and in many, as in most of the Abietinæ, they are persistent for seven years. No regular period of falling off is observed in those leaves which are scale-like, with an expanded and decurrent base, as in *Cupressus*, *Thuja*, and others, in which they dry up and wither gradually; although this change also, occurs in annual periods with tolerable regularity. As long as the axis of the branch retains green leaves, its longitudinal growth between them appears to be continued.

In *Cupressus* and *Thuja* the scale-like leaves are seated so closely together on the annual shoot, that they entirely

SECTION V.

GEMMATION.

The buds of the Coniferæ, independently of their position, of which we have already spoken, are sometimes *scaled* and sometimes *scaleless*.

They are *scaled* in the Abietinæ, Taxinæ, and some Cunninghamiæ, and *scaleless* in the rest of that subdivision, and in the Cupressinæ.

The scales are always imbricated and arranged in a spiral form, numerous and closely adpressed. The texture of the external ones is for the most part coriaceous, and of the internal, more dry and membranaceous. In shape they vary from oval to linear-lanceolate, and they are frequently keeled on the dorsal surface, with a fringed and scalloped margin. In the Abietinæ they are often completely covered and cemented together by resin. In *Pinus* the apex is usually reverted.

The leaf- and flower-buds are for the most part separate, and are either terminal, or issue from the axils of the leaves of the last year's shoot. The genus *Pinus* forms an exception, however, to this, inasmuch as that each of the autumnal buds contains numerous secondary, also scaled buds, which are capable of becoming either altogether leaf-buds, or both male and female buds as well; but with the exception of the terminal female buds, they are all situated in the axils of the separate scales of the principal bud.

After the bursting of the bud the scales of the leaf-shoot, in many cases, especially in *Abies*, remaining closely crowded together, (except the innermost more tender ones, which either fall off or being still closed like a hood, are pushed off by the increasing growth of the shoot,) form a ring encircling the base of the new branch, which is persistent upon it for many years; but in others the bud-scales on the new shoot become separated considerably from each other, and the shoot is consequently developed more between than above them. This more simple condition obtains in *Sciadopitys*, in which the widely separated bud-scales are distributed over almost the whole length of the new shoot, whilst the true leaves, though numerous, are crowded into a very short spiral, and constitute a many-rayed whorl at its summit. The same thing occurs in *Phyllocladus*, only that the scales and leaves are less numerous. The habit of the tree in consequence of this mode of arrangement of the leaves becomes essentially altered, for if the bud-scales remain adherent only at the base of the branch, which is itself covered throughout with leaves, it naturally follows that, in those instances in which the leaves are persistent for several years, all the branches of the crown which are thrown out within that period are thickly covered with leaves; so that, as for instance in *Abies*, in which the leaves adhere for seven years, all the younger branches appear covered with leaves throughout their whole length; and the thick shade of these trees is caused in this way. But in those cases on the other hand in which the leaves are shed annually, as in *Larix*, the shade afforded by the trees is necessarily very scanty, (and especially so on account of the greater distance apart of the leaves themselves on the rapidly growing shoots.) Almost the same may be observed in *Sciadopitys* and *Phyllocladus*, in which the greater extent of the shoot, being furnished only with minute, remote bud-scales, appears naked, and tufts of leaves are found only at the extremity of the three-year old twigs.

In *Pinus* and *Abies*, in the first year of growth, bud-scales and simple leaves alternate; but from the fourth to the fifth year their relations are changed. From this time onwards, the bud-scales, after the bursting of the buds, become more widely separated, and occupy the whole surface of the young shoot, without being succeeded towards the apex by true leaves, as in *Sciadopitys*. The annual shoots are thus, strictly speaking, leafless. But at the same time, secondary buds spring up in the axil of each scale, each of which secondary buds produces two, three, or five leaves, surrounded by from ten to twelve scales, set round an extremely shortened axis. These leaves are normally persistent for three years, and constitute the foliage of the tree. The axis of these secondary buds never produces flower buds, nor, except in very rare instances, is it prolonged into a leaf shoot. They usually fall off at the end of three years, without leaving a mark; whilst, on the contrary, the bud-scales of the annual shoot remain much longer attached to the branch on which they are decurrent, and becoming woody at the base, lose only their membranous portion or apex, which withers off during the first summer. In *Taxodium*, however, the greater part of the annual shoot, although it has a much more elongated axis, and is furnished with numerous leaves, falls off in the autumn of the same year; in this respect reminding us of *Myricaria* and several *Euphorbiaceæ*.

A sort of double mode of development of the buds occurs in *Abies*, *Larix*, *Cedrus*, *Deodara*, as well as in *Salisburia* and others. This double mode of development appears in the circumstance that, in the vigorous terminal shoots, as in other firs, the bud-scales remain adherent and crowded into a ring, but the leaves are distributed along the branch at due distances apart, whilst in the lateral shoots, the leaves although developed in greater numbers remain adherent, and are crowded together in the same manner as the bud-scales, and thus form thick tufts.

In this way are constituted fertile branches, as in the Pomaceæ, which branches also, as in that family, produce flowers of both sexes, but otherwise in their whole growth very much resemble the stems of the Cycadeæ, of which more will be said hereafter.

In the genera in which the buds are not scaled, the leaves which surround the young shoot in place of the *perulæ*, are usually distinguished by their less size, and even after the bursting of the bud by their more crowded position.

The dissimilarity in form of the leaves at different ages of the tree (*Araucaria*), or at the same time in different branches, or often on the same branch (*Juniperus*) which has been mentioned as especially characteristic of these genera, and in consequence of which the leaves sometimes assume the form of green scales and sometimes of leaves, cannot here be considered, as it does not stand in any direct connexion with the periodicity of their development.

The following genera have *scaled* buds: *Pinus*, *Abies*, *Sciadopitys*, *Taxus*, *Cephalotaxus*, *Torreya*, *Phyllocladus*, *Salisburia*, *Podocarpus*, (most of the species.)

The buds are *without scales* in *Cunninghamia*, *Araucaria*, *Cupressus*, *Thujopsis*, *Cryptomeria*, *Thuja*, *Retinispora*, *Callitris*, *Pachylepis*, *Juniperus*, *Dacrydium*, and some species of *Podocarpus*.

The flower-buds resemble the leaf-buds in being scaled or scaleless; but I am not acquainted with any instance of a scaled flower-bud of either sex inclosing leaves at the same time. The leaves in the bud before it bursts, are almost always adpressed flat to the axis and closely packed upon each other; but in *Salisburia* they are spirally convoluted, and present in this respect a strict resemblance to the mode of folding of the segments of the leaves of *Encephalartus horridus*. (Tab. ii, figs. 1, 2.)

It must here also be remarked that, the circinate vernation of the Cycadeæ belongs only to the genus *Cycas;* for in *Zamia* the segments of the leaf lie flat upon each other along the axis, as is clearly seen in the young leaf of *Zamia integrifolia*. (Tab. ii, fig. 3.)

SECTION VI.

FORMATION OF THE LEAF.

In most of the Coniferæ there is no distinct division of parts in the leaf, as into sheath, petiole, and blade or lamina; or it may be said, that in most cases the leaves in this family are only modifications of the sheath portion, and that there is no true petiole and blade, which exist distinctly only in those species of *Abies* in which the cicatriculæ of the leaves are circular (the true Piceæ), and in a somewhat modified form in several Taxinæ. In all the other Abietinæ, Cunninghamiæ, and Cupressinæ, as well as in many Taxinæ, the leaf assumes the appearance of a scale, the form and texture of which vary very much, and which, as it is usually expressed, is decurrent more or less along the branch, with its proportionately expanded base, or, more correctly speaking, which quits the branch at a short distance above its origin. This inferior portion of the leaf, or that by which it is attached to the branch, retains either the same texture as the superior portion during the whole life of the leaf, as in the Cupressinæ, or becomes ligneous soon after its development, and forms a projecting decurrent pulvinus or *coussinet*, which assumes various forms, as for instance, in those species of *Abies* which have quadrangular leaves. In the latter instance, the projecting portion of the leaf, upon the exhaustion of its vital activity (in *Abies*, generally after seven years, in *Larix*, at the end of one summer), dries off up to the extremity of the pulvinus and is detached, leaving a cicatrix, as if it had been articulated; but in the former cases the whole of the scale gradually withers off, without presenting any appearance of articulation of the projecting portion; the latter varies very much, both in its shape and in its proportionate size in relation to the inferior decurrent part. In the various species of *Callitris*, for instance, it is almost wholly wanting, or forms only a very short and minute tooth, or in other words, the scale in these plants is adherent to the branch almost up to its point. The figures 2, 3, 4, in Tab. i, represent the summits of branches of a young plant of *Callitris*, on which is seen the gradual transition of the leaves, which at the base are free, into the adherent scales of the later growth. In other cases it is distinctly developed, and is either—

a. Of nearly the same shape at all ages of the plant as in *Abies*, or

b. Of a different shape in the youth of the plant to that which it presents at a more advanced period of its growth, but yet at each period is of the same shape throughout the tree—as in *Pinus*, *Araucaria*, *Thuja*, &c., or, lastly,

c. It presents various shapes at one and the same time in the same individual, and indeed without any perceptible relation to situation, as in many *Juniperi*, in which it not unfrequently happens that adherent scales alternate irregularly with projecting leaves on the same branch; or with a more definite reference to situation, as in *Thuja* and *Thujopsis*, in which of the four decussating rows of scales, the left and right rows on the sides of the branch are always differently formed to those on the superior and inferior surfaces.

The form of the leaf may be referred to two fundamental types, which however, in many cases, run into each other, and which themselves also present many modifications.

Thus, it is either flat and presents an evident upper and under surface, the former of which is usually concave, and the latter convex, as in *Juniperus* and others (Tab. i, figs. 14, 17, 19, &c.), or it is compressed laterally with an acute superior and inferior edge, and consequently exhibits on a transverse section a variety of rhomboid forms; or lastly, it is perpendicularly linear, as in the phyllodia of the Acaciæ. (Tab. i, figs. 20, 23, 24.)

The transition of the two fundamental types is most clearly exhibited in the distichous leaves of *Thuja* and *Thujopsis*. These short scale-like leaves are concave on the upper surface towards the base, which embraces the axis of the branch, but towards the apex the surface becomes gradually convex, and rises into a ridge or keel above the margins, whilst the under surface remains convex, or is also keeled, in consequence of the more marked projection of the midrib. (Tab. 1, figs. 25-28.) A similar difference exists in *Pinus*, but only in different species. In all the species with two leaves in a fasciculus, their upper surface is concave and furrowed; whilst in all that have three or five leaves in a fasciculus, the upper surface rises into an acute though veinless ridge, which either slopes off uninterruptedly to the margins, or leaves a small flat surface on either side. The under surface, however, is not altered in its form in these cases, but remains semicylindrical, and the margins also retain the same distance from each other, and as elsewhere are widely serrated, proving that the acute ridge of the superior surface is not caused by their approximation and union. (Tab. i, figs. 16, 17.) These forms of coniferous leaves have thus no resemblance to the folia equitantia of the monocotyledons, as, for instance, of the Irideæ, in which the margins of the leaf, which is concave at the base, may be seen gradually to approximate towards each other and to cohere, so that further on the two surfaces having become perpendicular, appear to be only the halves of the original inferior surface. This form of leaf attains its greatest perfection among the Coniferæ, in the *Araucariæ*, and in *Cryptomeria* (Don). In these cases, however, there also occur important varieties. We are not as yet acquainted with the leaves of the young plant of *Cryptomeria,* but at a later period of its growth they are always compressed laterally, of a rhomboid form, and with a prominent decurrent keel. (Tab. i, fig. 24.) In *Araucaria excelsa* and *Cunninghami,* on the other hand, this form is exhibited only in the young plant, whilst in older individuals the leaves are always scale-like and flat, and concave on the upper side. (Tab. i, fig. 22.)

In some species of *Podocarpus* from Java and New Zealand, the leaves of the principal shoots are reduced to the form of scales, and are more or less concave on the upper surface; whilst at the same time, those of the less vigorous lateral shoots are elongated, and present a much compressed rhomboid form on their transverse section.

In those species of *Abies* which form a group with *A. excelsa* (*Picea,* Link), the leaves of the one-year old plant are also furrowed on the upper surface, but those of a later growth, in consequence of the elevation of the upper surface, are all of a rhomboid form (Tab. i, fig. 20), but they are not compressed on the sides. Many species exhibit the transition into the flat leaves of the white Pines, in which, as for instance, in *Abies Mertensiana,* the upper surface of the leaves presents in the middle merely a prominent line, but otherwise remains flat.

Those leaves which present a rhomboid form on the transverse section are either laterally compressed or not, but they are always more or less falcate towards the apex.

As regards the venation of the leaves of the Coniferæ, although a midrib is certainly frequently present and forms a projecting ridge or keel on the dorsal surface of the leaf, yet the veins are never ramified in such a way that the ramifications filled up by cellular tissue constitute a surface with a developed system of vessels. Even the broad-leaved species of *Podocarpus* form no exception in this respect. An apparent exception however exists in *Sciadopitys,* in the occurrence of two parallel veins running on each side of the true central line of the leaf. (Tab. i, fig. 12.)

In the quadrangular or laterally compressed leaves, the principal vein usually occupies the centre, and is otherwise most evident in *Abies* (especially in the white pine, *A. pectinata*), and in the Taxinæ. But just as frequently the vascular bundle, immediately upon reaching the expansion of the leaf, is split up into numerous parallel veins, in consequence of which the development of a central vein is completely suppressed. Sometimes, on the contrary, a sort of forked venation may be observed, as is most distinctly seen in *Salisburia* (Tab. ii, fig. 4), but it is quite distinct also in *Pinus*, in the skeleton of the fruit scale, (Tab. iii, figs. 3, 4, 5, 6, 7.) In *Salisburia* the vascular bundle is divided, even at the extremity of the inferior petiole-like portion of the leaf into two bundles, and the central portion continued on into the expansion, and being as it were arrested in its development, causes by its contraction the bilobate form of the leaf; whilst the lateral fasciculi take their course immediately within the margin, surrounded on their external aspect by a little cellular tissue, and sending out from their inner side numerous parallel veins, which diverge more and more from above downwards, and in this way give the leaf its expanded form; but in other and more frequent instances, the rays proceeding from the principal vascular fasciculus, converge again towards the apex of the leaf, presenting a distinctly dichotomous arrangement as in the fruit-scales of *Pinus* (Tab. iii, figs. 3 and 4), and being less distinctly forked at the base in the leaf-scales of *Cunninghamia*, *Araucaria brasiliensis*, &c. In all the other forms also, the leaves are traversed only by parallel veins, or by divergent ones, which converge again towards the apex. Even the expanded leaves of the *Podocarpi* contain no vascular tissue, excepting the midrib, and in *P. Nageia*, *latifolia*, and others, there is not even a midrib; which is also absent in *Dammara*. (Tab. i, fig. 21.)

Putting all these facts together, it would appear that the leaves of most of the Coniferæ are wholly different in their structure from those of all other dicotyledons (Rich. Conif. p. 92), and, on the contrary, that their structure much more closely resembles that which usually obtains in the leaves of the greater part of the monocotyledons, or to speak perhaps more correctly, that as they are composed only of parallel vessels which either converge or diverge as they proceed, without other branching or anastomosis, and are connected so as to form a surface merely by cellular tissue, they in most cases are to be considered only as expanded petioles, with the lamina of the leaf entirely suppressed.

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The individual phyllodia (or pinnate leaves of anthers) do not appear to be capable of any further development.

This structure will, we believe, justify us in saying, that *Phyllocladus* has no true leaves, which are represented only by minute bud-scales, but that the functions of green leaves are performed by leaf-like, expanded, divided, aborted branches, which like true leaves are incapable of further development, and like them also present an inferior surface, differing in function from the superior.

This formation among the Coniferæ recalls, in the first place, that which obtains in *Taxodium*, in which the annual lateral shoots also for the most part die off, but chiefly that which is observed in *Zylophylla*, among the Euphorbiaceæ, in which a similar ambiguity exists between leaf and branch. The pinnules, however, or segments of the equivocal branches in *Phyllocladus*, never produce flowers or leaf-buds.

In all the Coniferæ, except *Salisburia*, the leaves are furnished in various ways with stomata, and the situations in which these openings are placed are usually indicated by a blueish white colour. They are never situated on the vessels, and are commonly arranged in several regular and parallel rows.

In the flat leaves they usually occur only on the dorsal surface, on each side of the midrib and form, as for instance in *Abies pectinata* and others, between the rib and the margin, two distinct white striæ. (Tab. i, figs. 13, 14, 15.) In *Sciadopitys*, on the other hand, the leaf is traversed by two parallel costæ, between which, instead of a midrib, is a strip of cellular tissue, in which the rows of stomata are situated. (Tab. i, fig. 12.) In *Phyllocladus* they are irregularly distributed between the veins, all over the under surface of the leaf (Tab. i, fig. 29), whilst in *Juniperus* they occur in the upper surface, in a central tract. (Tab. i, fig. 19.) In *Thujopsis*, on the contrary, and the *Retinisporæ* with adpressed leaves and distichous branches, and in which the under side of the leaf alone is ever visible, stomata occur on the surfaces of all the leaves situated on the under side of the branch. In those cases, however, in which the leaves are decussate, the under leaf of that pair which is placed above and below, is furnished with two rows of stomata, and none exist in the upper; and whilst the inferior half of each of the leaves constituting the lateral pair which embraces the stalk presents stomata, there are none on the superior halves of the same leaves. (Tab. i, figs. 25, 26.) This arrangement of the stomata appears to indicate the existence of a common or joint life in all the leaves on the branch, such as obtains in a more restricted form in the branch-like phyllodia; and in it an analogy may be perceived with the mode of growth peculiar to the lateral branches of the Coniferæ when planted as cuttings, and of which mention has been before made. The branch has become in a manner transformed into a leaf, and its still ununited leaflets constitute a common upper and under surface. In *Retinispora squamosa*, however, which has deciduous leaves, the stomata are always situated in a double series on the dorsal surface.

In these species of *Pinus*, with two channelled leaves in each fasciculus, the stomata are ranged in rows on each side, as also in the Araucariæ with flattened leaves. (Tab. i, fig. 16.) In those species in which the leaves have a longitudinal ridge on the upper surface, there is most usually a series of stomata on each side of the ridge, and none on the opposite surface of the leaf. (Tab. i, fig. 16.)

In the Araucariæ with laterally compressed leaves, and in the similar leaves of *Cryptomeria*, the stomata are arranged in four rows, on the four sides of the elongated rhomboid (Tab. i, fig. 24); and there is also a row of stomata in each of the four sides of the quadrangular leaves of some of the Abietinæ. (Tab. i, fig. 20.) In *Cunninghamia* they are placed on the dorsal surface in two rows near the midrib, as also in *Taxodium*, *Taxus*, *Cephalotaxus*, and *Torreya*, and in the species of *Podocarpus* with distinct midrib (Tab. i, figs. 13, 14, 18); but in those species of the latter genus in which no midrib is developed, as well as in *Dammara*, they are observed to constitute numerous very minute rows on the dorsal surface. (Tab. i, fig. 21.)

Individually they appear to be largest in the Abietinæ and smallest in the Taxinæ. That the white colour caused by their presence on the part of the leaf where they are situate is not owing to the deposit of resinous matter, is proved by the fact of its not being removed by the immersion of the leaf in alcohol. Besides, the colour is frequently altogether absent, particularly in the Taxinæ.

The margin of the leaf is for the most part quite entire, without teeth or incisions; but in *Cunninghamia* and *Pinus* it presents minute, remote serratures, which may be observed also on the projecting keel of the upper surface in the species with more than two leaves in a fasciculus. In many genera the margin is thickened and surrounded with a sort of marginal vein.

The apex is sharp, and often pointed, when the midrib is continued to the extremity, or when all the veins, converging to the apex, are reunited. It is emarginate when the midrib terminates in the body of the leaf, as in the white pine (*A. pectinata*).

In the leaves in which the veins continue to diverge up to the apex, as in *Phyllocladus* and *Salisburia*, their unequal length produces an uneven margin, such as occurs in the so called folia præmorsa. The leaves of *Salisburia* are besides this, in consequence of the total absence of a midrib, deeply divided. This division, however, as well as the marginal serratures, are distinctly marked only in the sterile branches, for on the fertile ones the leaves are undivided and usually entire; and in *Abies pectinata* also, the otherwise emarginate leaves are mucronate on the fertile branches.

Varieties in the form of the leaves are upon the whole rare among the Coniferæ. Their size, however, not unfrequently varies, either throughout the individual plant according to the locality of its growth, or in single branches from causes in part unknown; an instance of which may be seen in the alternation of scales and elongated leaves in many of the *Juniperi*. In those genera which have naked buds it may frequently be remarked that the leaves which are situated immediately above or below the innovation are by far the smaller, as in *Cryptomeria*, *Dacrydium*, and others. In the former of these genera they are frequently arranged in a spiral form round the branch, which thence acquires a screw-like appearance.

The duration of the leaves is very various. An annual duration, as in *Larix*, is that which is most rarely observed. In the majority of instances they continue green for at least three years, as in the Pineæ; and in many, as in most of the Abietinæ, they are persistent for seven years. No regular period of falling off is observed in those leaves which are scale-like, with an expanded and decurrent base, as in *Cupressus*, *Thuja*, and others, in which they dry up and wither gradually; although this change also, occurs in annual periods with tolerable regularity. As long as the axis of the branch retains green leaves, its longitudinal growth between them appears to be continued.

In *Cupressus* and *Thuja* the scale-like leaves are seated so closely together on the annual shoot, that they entirely cover the axis of the branch, but they become more remote in the second year, and in the fourth and fifth years considerable internodes are left between them.

The cicatricules which remain on the branches after the falling off of the leaves vary much in shape, according to the mode of attachment and form of the transverse section of the leaves themselves. They afford in many genera certain permanent marks for the distinction of species, and might even assist in the comparison of fossil forms with the related ones still living.

The most marked differences are presented in the genus *Abies*, eighteen species of which we have figured in the 'Flora Japonica,' (vol. ii, tab. 137) with reference to this point; and have here again given figures of the principal forms. (Tab. i, figs. 5, 10.) In the first place, we observe leaves either decurrent below the point at which they begin to quit the branch, and having a prominent base (*pulvinus* or *coussinet*), as in figs. 5, 8, or (and this is the case when the point at which they begin to quit the branch coincides with the real base of the leaf) these dilated bases, and together with them the prominent angles of the branch, are entirely wanting. This is their condition in the true Piceæ, with petiolated, flattened, and for the most part emarginate leaves, as in our *Abies pectinata*. As a second point of distinction in the latter, it may be added that the cicatricule itself is always circular, or at least more or less elliptical. (Tab. i, figs. 9, 10.)

The species, however, which have decurrent leaves, exhibit in this respect two varieties. The pulvinus, for instance, is either attached to the branch throughout its whole length, and has a semicircular *cicatricule* at its extremity, as in *A. canadensis* (fig. 5), or its apex projects more or less from the branch, and presents a rhomboid cicatricule, as in figs. 6, 8, in the red pine, larch, and cedar. The Abietinæ will consequently admit of being divided in the following way:—

1. Those with a circular cicatricule.

The decurrent base of the leaf becomes enlarged superiorly, but without projecting from the branch. (Tab. i, fig. 5.) *Ab. canadensis, brunoniana, Thuja.*

2. With a rhomboid cicatricule.

a. The decurrent base of the leaf does not become enlarged superiorly, nor does it project from the branch. (Tab. i, fig. 7.) *Ab. Larix, leptolepis.*

b. The decurrent base of the leaf is enlarged superiorly, but from the point at which it begins to project from the branch it decreases in size, and constitutes a process which remains after the falling off of the leaf. (Tab. i, figs. 6, 8.) *Abies excelsa, alba, nigra, Deodara,* &c.

3. With a circular cicatricule, and a scarcely enlarged pulvinus; the branches generally covered with fine hairs. (Tab. i, figs. 9, 10.) *Abies pectinata, homolepis, balsamea,* &c., all the Piceæ.

SECTION VII.

MALE FLOWERS.

In order to explain the male blossom of the Coniferæ, it is necessary first to bear in mind once more the ambiguous relations which exist in this family generally between leaves and branches.

The normal abortion of the axes of most of the branches, as for instance, in *Pinus*, together with the also normal development of a few, though of a definite number of leaves, (in *P. sylvestris* 2, in *P. tæda* 3, in *P. cembra* 5,) leads to the supposition that a relation obtains in these cases which is not readily perceived in any other group of plants. Such a determinate abortion of the axis of a branch never occurs in any other of our trees, even in their most stunted fructiferous branches, nor in the lowermost branches, though deprived of their nutriment by the more rapid growth of the upper ones. As many leaves, however, are annually developed on these stunted or arrested shoots, as the quantity of nourishment will admit of, and it depends simply on the quantity of nutriment whether the hitherto stunted branch does not, even after the lapse of several years, again make up for its interrupted growth. That this, however, occurs but very rarely among the Coniferæ, any one will be convinced who has looked for shoot buds in *Pinus sylvestris*, or buds which, springing up between the two leaves, might carry on the development which has normally come to an end, into an elongated branch axis. Besides this, it is to be stated, that the number of leaves which is constant in each species of *Pinus* also determines their form, and that in all those species where there are but two leaves in a fascicle, they are concave on the upper surface and convex beneath, whilst in those with from three to five leaves the latter are always sharply keeled above, and rounded or even convex beneath. This difference of form cannot be explained by merely supposing that they have, in the respective instances, an opposite position in the bud, (vernation,) for in that case it would disappear with the complete development of the leaves; but taken in connexion with the equally constant number of leaves in each fascicle, it shows that the effort towards the complete suppression of the axis of the branch, or the indication of its presence merely by a few leaves, depends upon some deeply founded cause.

Another evident transition state between leaf and branch has been observed by us in *Thujopsis* and *Thuja*, in the circumstance that the whole of the under surface of the lateral branches, or of that surface which is directed towards the ground, assumes in common the function of the under surface of a leaf, and the same thing may be seen still better in the branched phyllodia of *Phyllocladus*. A similar intermediate state between flower axis and individual stamens must, in my opinion, be supposed to exist also in the male flower of the Coniferæ; and it is in this point of view that we must regard the various modes of development which the latter assume. I am well aware that the opinion which my worthy friend, Prof. Mohl, expresses in his 'Memoir on the male Blossom of the Coniferæ,' appears to be opposed to this view. That acute observer noticed, for instance, monstrous female cones of *Ab. alba*, in which the bracteæ were partly converted into anthers, exactly as they exist in the male catkins, and thence inferred that, at least in *Pinus*, each anther proceeds from the metamorphosis of a single leaf, which is to be compared, not to the fruit scales or carpellary leaves, but to the bracteæ of the female catkin.

It is a matter for future determination how far the fruit scale can be considered merely as a carpellary leaf; at present the only question is, whether the circumstance of the bracteæ of the female catkin, being capable by monstrosity of becoming developed into anthers, also proves that the normal anthers of the male catkin are to be considered precisely analogous to these bracts, in so far as that they correspond in being nothing but modified leaves, that is, leaves of the axis of the male catkin. We believe, at all events, that this is not to be assumed unconditionally, if we again advert to the ambiguous relations which exist between leaf and axis in the green organs of the Coniferæ, and though certainly granting to these stamina the form of a leaf, yet claim for them really the character of an axis.

If, in order to justify this conclusion, we consider the different degrees of development in which the male flower exhibits itself in different genera of the Coniferæ, it will be most convenient to commence with the most perfect form, or that which occurs in *Taxus*. (Tab. iv, fig. 8.) In this plant there are usually six, more rarely seven or eight simple anther cells, arranged in a circle and connected together at the central angle up to the summit, so that when they are viewed from above they present the appearance of a scutiform disc with a lobed margin, supported on a central pedicle the so-called filament, and which is dehiscent beneath with as many radiating valves as there are anther cells. Although we will not venture to assert that this formation indicates a real circle of originally distinct anthers, and consequently to claim for it exactly the same value with the male blossom of other plants (though indeed the earlier formation in *Taxus* would appear to entitle it to be so considered), still we here behold a symmetrical form of development, and one which is completed on all sides, and which may henceforth be regarded as exhibiting among the Coniferæ the most complete analogy with a perfect male flower, or if we might venture so to express it, the most successful attempt at the elevation of the leaf into an independent axis.

Proceeding from *Taxus* to the mode of formation which exists in *Araucaria* and *Dammara* (Tab. iv, fig. 9), we see in these instances, apparently at the base of a pedunculated scale, from six to eight (according to other observations even more) anther cells arranged in a double series, but in such a way that all the cells of each row open inwards; this would exactly resemble a depressed flower of *Taxus*, if we supposed the disc in that case were not flatly depressed towards the filament, but prolonged into a conical head. The male blossom of *Araucaria* and *Dammara* is nevertheless almost equally symmetrical with that of *Taxus*, only that the circle of anther cells forms a very long ellipse, the two sides of which usually represent two distinct series.

In all the other genera greater degrees of abortion present themselves, so that the anther cells are not developed all round the central filament, but to the number of four at most, occupy only one half of the circle, the other half of which is represented more or less by a semicircular scale. In *Cephalotaxus* (Tab. iv, fig. 4), and in *Torreya*, this scale is almost wholly deficient, and the formation resembles that of a flower of *Taxus* divided into halves; whilst in the Cupressinæ it is always fully developed, as the figures of *Thuja* (Tab. iv, fig. 7), and of *Thujopsis* (Tab. iv, fig. 5) show, but in this case the scale still retains the horizontal (scutiform) position, with respect to the central filament. In *Cunninghamia* (Tab. iv, fig. 6), on the other hand, it ascends, and together with the filament assumes the form of a pedunculated bract. In *Pinus*, *Abies*, and *Calisburia* (Tab. iv, figs. 1, 2, 3) lastly, the number of cells is reduced to two, and the contracted (scale) portion of the little disc is sometimes more, sometimes less developed; but the perfect anther cells are always, with reference to the position of the little disc, placed the lowest on the axis.

From this arrangement, the flower as a whole naturally exhibits the closest resemblance to a bilocular anther inclosed in a membranous covering. We see consequently that this, which is the most stunted, or least developed form, should not be taken as a type to which the other more expanded and complete modes of development should be referred. On the contrary, it appears more correct to consider the symmetrically developed stamen of *Taxus* as the normal form, and as the one which most nearly corresponds with a distinct or individual flower, and to deduce from it the less developed forms, even when they may finally appear to be reduced to the condition of simple scales.

If this view be correct, it follows that each separate stamen on the axis of the male catkin of the Coniferæ will represent a distinct male flower. These flowers are not however individually, as exactly defined as they are in other families, but are intermediate in form and essential nature, between independent axes and individual leaves advanced into stamens. They correspond consequently, with the equivocal forms of the green organs, among which the leaf and branch run into each other in a similar way. This opinion is supported by the circumstance, that the catkins occasionally become branched, as is the case in *Podocarpus Nageia;* which could not occur if each amentum consisted of a single expanded male flower.

The similarity which exists between the male blossom of the Coniferæ and that of the Cycadeæ, has been frequently remarked.

In *Cycas*, *Zamia*, and *Encephalartus*, the stamens or individual flowers, each of which consists of a short filament supporting beneath it from two to four separate anther cells, are placed on the under side of scales, which are truncated anteriorly, and upon which, though closely packed (Tab. iv, fig. 10,) the stamens are nevertheless arranged in a definite and regular order. (Tab. iv, fig. 12.)

The circular mode of arrangement of these anthers, strikingly recalls that which is exhibited in the flower of *Taxus*, only that in that case the anther cells are mutually connected at the inner angle; and were all the anthers (in the Cycadeæ) distributed on the axis, in the same way that they are in the Coniferæ, no one would ever have doubted the close analogy of the two cases; but as it is, they occupy only the under side of a support, which being attached together with many other similar ones to a common axis, can be viewed only as a scale of a large cone of blossoms, of a cone, in fact, constituted by their aggregation.

It is from this circumstance that the male amentum of the Coniferæ has usually been compared with the whole male cone of the Cycadeæ, and the scales of the latter covered on one side with anthers, have been considered analogically equivalent to the unilaterally developed flowers of *Pinus*, *Juniperus*, &c., in which the anther cells also appear to be placed on the inferior surface of a scale-like support. But we must perhaps advance a step farther, in order to obtain sufficient ground for this analogy.

Let us therefore suppose that the male cone of the Cycadeæ is not a simple catkin, but one of a compound nature, in which the secondary axes are placed indeed spirally and closely crowded around the principal axis, but are themselves capable only of a unilateral development. Let us also allow that each scale as represented in Tab. iv, figs. 10, 11, is of itself equivalent to a true catkin, but one which produces blossoms only on the lower side, and consequently resembles the modifications of development which are exhibited by the lateral axes, at each stage of the formation in the Coniferæ generally, but particularly in the partial abortion of the anthers in *Juniperus*, *Pinus*, &c. Admitting these suppositions to be true, it appears to me that the analogy between the male inflorescence of the Coniferæ and that of the Cycadeæ is completely restored, and in both it will probably admit of being defined in the following manner:—

CONIFERÆ.—Male flowers disposed spirally in a simple amentum, which is rarely branched at the base; the individual flower consisting of a short, unarticulated, and naked filament, which either terminates in a complete circle of anther cells or is prolonged, in consequence of the partial abortion of the cells, into a variously formed scale, which is always directed towards the apex of the amentum, so that the fully developed anther cells always occupy that side of the circle which is directed towards the base of the amentum.

CYCADEÆ.—Male blossoms in large, cone-like, compound catkins; the secondary axes disposed spirally and closely imbricated around the principal axis; each secondary axis is itself in the form of a scale, which is thickened and expanded anteriorly, and either truncated or terminated by a short point. The individual flowers are all closely crowded on the dorsal surface of the secondary axes; and each is constituted of a short filament, terminating in four (or by abortion in fewer) anther cells, which are free, and disposed in a circle.

These views, however, can still only be regarded as hypothetical, and the fact of their being unsupported by analogies drawn from other families may be especially remarked.

But is it in fact the case that the Coniferæ and Cycadeæ, whose mutual relationship cannot well be denied, are so allied with other families that they must necessarily follow the usual type which obtains in them? We see too many groups in the vegetable kingdom, which being at present either incorrectly defined or really isolated, protest against the forced affinities imposed upon them by systems, to allow ourselves to be startled by apparent anomalies. The natural law of *paucity* in the number of means, and *abundant* variety in the modifications of their adaptation to the same object, should never be lost sight of, but that the transitions from one modification to another should necessarily be traceable, does not equally follow, since, with respect to this point, we have not as yet solved the most important question, whether the organisms existent at the present period of the globe exhibit a whole, complete in itself, but of which we are as yet unable to apprehend the mutual connexion of the individual parts, or whether, like mountains which are sunk into islands in the ocean, they do not represent isolated links of earlier formations, which in their totality no longer exist, and thus, as historical ænigmata, disturb the present series of forms. A clever writer, however, has with respect to this promised us a still farther perfection or alteration of the vegetable kingdom, to occur in a new phase of the earth's existence, and which is to be attended with a greater development of the fruit.

So much, for the present, upon the male blossom of this family, so puzzling on account of the many points in which its character diverges from that of all others. We intend, in a future essay, which will embrace principally the formation of the female blossoms and fruit, to return to the consideration of the comparative relations of the male.

In conclusion, there are, however, some remarks to be made upon the genera *Taxus* and *Torreya*.

It is well known that Kæmpfer (Amæn. Exot. v, p. 814) first gave a notice of a Japanese tree which he called *Taxus nucifera*, and which Linnæus placed under that name as the second species of the genus. Thunberg, in his 'Flora of Japan,' confirmed the correctness of this definition, and also enumerated it as one of the four species of *Taxus* which he assigned to Japan, among which, however, there is certainly but *one* species of *Taxus*.* In this he was followed by all subsequent authors; but Persoon inquired whether the plant might not be referred to *Podocarpus*.

Latterly it has been believed that the same species has

* *Taxus baccata* (Thunb.) is *S. cuspidata* (Sieb. and Zuccar.) *T. nucifera* is *Torreya*. *T. macrophylla* is *Podocarpus*, and *T. verticillata* is *Sciadopitys*. Vid. Siebold and Zuccar. *Flor. Japon.* vol. ii, fasc. i, viii.

been discovered in the mountains of India, in Thibet and Nepaul; and Wallich gives a description and figure of the Nepalese tree (Tent. Flor. Nepal. p. 57, tab. 44), which he afterwards also introduced into his Herbarium. Siebold was the first who brought perfect specimens of the flowers and fruit to Europe, and thus afforded the opportunity of their being figured in tab. 129 of the *Flora Japon.*, with the necessary analysis. As regards the structure of the flower and fruit, I did not doubt for an instant that the plant could be referred neither to *Taxus* nor to *Podocarpus*, but that it constituted a distinct genus, to which I gave the name of *Caryotaxus*. But just then I received the 'Annals of Natural History,' in which Arnott, in the year 1838, established the genus *Torreya* from a tree in Florida, and I immediately conjectured that the Japan plant might be referred as a second species to the same genus.

Through the kindness of my very worthy friend Prof. A. Gray, of New York, I obtained specimens of the fruit of the American tree, which fully confirmed my conjecture, and also afforded a fresh proof of the close alliance that exists between the Flora of Japan, and that of North America.

Both species differ from *Taxus* in having dimidiate stamens, with the four anther cells disposed in a semicircle on the filament; in the fleshy drupe, the fibrous flesh of which is filled with a viscid, nauseously smelling resin; in the albumen, which is ruminate, like that of many *Palms;* and in the disproportionately small size of the embryo, as compared with that of all the Coniferæ. In both species also, the wood is very soft, spongy, with coarse fibres, and white, whilst in the true species of *Taxus* it is very hard, fine grained, and dark coloured. It is consequently sufficiently clear that *Taxus nucifera* is a second species of *Torreya*. Probably *Taxus globosa* (Schechtdl.) from Mexico belongs, as a third species, to the same genus. Next to them stand two other Coniferæ from Japan, which have altogether the habit of *Torreya*, but whose male catkins are placed, many together upon a common scaly peduncle, and indeed each of them issues from the axil of a special scale-like bract, whilst the female flowers, also crowded into a head on a common peduncle, are always in pairs, and naked in the axil of a decurrent leaf-like bract; they are not furnished with the succulent cup of *Taxus;* the albumen also is not ruminate, but of uniform substance, and the embryo large. To this genus I have given the name of *Cephalotaxus* (Flor. Jap. ii, tab. 130-32).

The *Taxus nucifera* of Japan having thus been referred to *Torreya,* it remains to inquire how Wallich's plant of the same name is to be disposed of. From the original specimens in my possession, it must be considered a true *Taxus,* since the male flowers are not dimidiate, as in *Torreya* and *Cephalotaxus,* but present five or six anther cells, arranged in the form of a circular disc, as in *T. baccata.* Wallich himself saw no female flowers, and only unripe fruit, of which he says, "*Nux immatura indistinctâ arbore, axillaris, solitaria, subrotunda, apiculata, lævis, nitida, magnitudine seminis Coriandri, ferè occultæ, calyculo multibracteato, pedicellato.*"

The want of the succulent cup around the fruit, usually present in *Taxus,* together with the similarity of habit, induced the learned author of the 'Flora Indiæ' to suppose that his plant might be identical with that of Japan. But I must here remark also, that in *Taxus baccata,* even in the ripe fruit, the cup does not always become fleshy, but frequently remains dry (Tab. ii, figs. 10, 11), as I have had many opportunities of observing in living plants on the mountains of Bavaria, as well as in dried specimens from the Pyrenees; so that the cupula carnosa cannot be considered as an important generic character in *Taxus.* I would therefore propose to include the *Taxus nucifera* of Wallich in that genus, under the name of *Taxus Wallichiana;* and referring to the elaborate description of it in the 'Tent. Flor. Nepal.,' would define the species as follows:—*Taxus Wallichiana* (Zucc.)

T. foliis solitariis, lineari-falcatis attenuatis acutis, distantibus subdistichis, perulis gemmæ acutis, bracteis alabastri interioribus longioribus obovato-spathulatis.

Taxus nucifera? Wallich, Tent. Flor. Nepal., p. 57, tab. 44 (*ex. Syn.*)

Crescit in monte Sheopore Nepaliæ à clav. Wallich, *mense Martio florens inventa* (v. s.)

REPORT

ON THE CONTRIBUTIONS TO

BOTANICAL GEOGRAPHY,

DURING THE YEAR 1842,

BY PROFESSOR GRISEBACH.

TRANSLATED BY W. B. MACDONALD, B.A.

BOTANICAL GEOGRAPHY.

Martius has published comparative observations on the zones, within which the northern trees which occur also on the Alps are met with. These observations were made partly on the coasts of Scandinavia and partly in Switzerland, on the northern declivity of the Grimsel (Comptes rendus, 1842, and Ann. des Scien. Nat. 18, p. 193). He opposes the opinion of Wahlenberg, that the trees do not disappear towards the North in the same succession as they do on the Alps towards the snow-line. The relations which obtain in this respect, in the Bernese Oberland, probably more resemble what occurs in Scandinavia than those of the north of Switzerland, where Wahlenberg made his observations. On the Grimsel, Martius met with but one anomaly in comparing the boundaries of the trees there indigenous with those of Norway.

It might be supposed that, on account of the unequal distribution during the year of an equal mean temperature, the parallelism of the polar and altitude boundaries, as regards individual plants, would not be perfect; and this would be more evident in the case of a forest tree. The single exception, however, which is adduced by Martius is one only in appearance.

It consists in the fact that on the northern slope of the Grimsel, the oak ceases at 800 m., and the beech at 985 m.; while in Sweden and Norway, on the contrary, the oak occurs further north than the beech. This fact is correct, and generally admitted.

But the oak which in the Swiss Alps grows at that height is *Q. Robur*, while in Norway, as well as Russia, *Q. pedunculata* only is met with. Martius is mistaken in asserting that *Q. Robur* occurs so far north as 61° N. In Sweden this tree is indigenous only on the S.W. coast in the beech forest district, as Wahlenberg had already remarked in the Flora Suecica. There may be some cultivated trees at Stockholm; but Martius himself mentions that there is a beech even in the Botanic Garden of Upsal, and that he has also seen one 20′ high, and bearing fruit even at Elfkarleby, 43″ north of Upsal. *Q. Robur* retains the same relative position, it remains below the beech; whilst *Q. pedunculata*, which in the middle of Europe occurs only on the plains, lives in the open air at Trondjem, in Norway, up to the 64°. In the distribution of the birch, which extends northward so far beyond the Coniferæ, the anomaly, as in the case of the oak, is also one only in appearance. According to Martius, *Betula alba*, on the Grimsel, attains an elevation of 1975m., leaving the fir and pine behind, and would there form the arboreal limit, as in Scandinavia, did not *Pinus Cembra* occur along with it, a tree which is not met with in the north of Europe. But such a vertical extension of the *birch* is quite unusual on the Alps. It is there a rare tree, and it is well known that the forest boundary on those mountains is almost everywhere formed by *Pinus Abies*, which in Norway is left so far behind the birch. It seems as if the birch, which in the north, both above and together with the Coniferæ, forms such extensive forests, did not, in the woody regions of the Alps in general, meet with the climatic conditions necessary for its existence. This contrariety, however, depends on a difference of species, for the birch of the high northern latitudes is *Betula pubescens*, of which Blasius, in his travels in Russia, expressly remarks, that it retains the white, smooth bark much longer than

B. alba, Aut. Now, as the Linnæan *B. alba* is recognized in the northern birch, this may be called *B. corticifraga*, from the bark on the older stems cracking off, and by its broken portions giving the tree its different habit.

Martius's original observations, which are related in his memoir, are the following:—In Sweden, the highest point north at which he observed the oak was at Laeby (60° 6′), and a planted one at Hudickswall (61° 44′). The apple and pear were observed farthest north at Sundswall (62° 23′); further, *Abies* lastly, south of Karasuando (formerly Enontekis, at 68° 15′; *Pinus sylvestris* and *Sorbus aucuparia*, near Bohekop (70°); *Betula* and *Juniperus* as far as Hammerfest (70° 40′).

On the northern declivity of the Grimsel, the limits of trees, measured by Martius, are:—

Quercus Robur	(800m.)	=	2460′
Fagus sylvatica	(985m.)	=	3030
Prunus Cerasus, Corylus Avellana	(1060m.)	=	3260
Pinus Abies	(1545m.)	=	4760
Sorbus aucuparia	(1620m.)	=	4990
Pinus Mughus	(1810m.)	=	5570
Betula alba	(1975m.)	=	6080
Pinus Cembra	(2100m.)	=	6460

Hinds has given some critical remarks on the division of the earth's surface into "natural floras" (Journ. of Bot. 1842, pp. 312-18). This essay, as well as a second one by the same author, "on the regions of Alpine vegetation" (*Ibid.* pp. 128-33), without being either complete or precise, contains only the most well-known facts, whilst on the other hand, erroneous generalizations prove that, without sufficient literary knowledge, the author has yielded to the impressions received in a long sea voyage. In a more detailed manner, though uncertain in particulars, and hurrying over important points of view with superficial brevity, he has treated of the first-mentioned subjects in Sir E. Belcher's Voyage (A Narrative of a Voyage round the World during the years 1836-42, 2 vols. 8vo, London), in an appendix to which (The Regions of Vegetation, by Hinds, vol. ii, pp. 325, 460) he distinguishes and characterises 48 natural Floras. As far as his views are novel, and derived from actual observation, they will be noticed among the special works.

Another Essay by Hinds, on the 'Connexion of Climate with Botanical Geography' (Ann. Nat. History, vol. ix), is much more correct, and at the same time very copious, embracing known meteorological relations. It contains no new points, but presents to the reader a summary collection of correct views on the subject. The influence, however, of the seasons, in certain particulars, is too little attended to.

In a treatise by Langethal, on the 'Dependence of Plants upon certain kinds of Soil' (Cotta's Anleitung zum Studium der Geognosie, 1842, Hft. iv, pp. 545-60), along with a classification of plants according to the substratum upon which they grow, appears the new but quite unproved hypothesis, that the occurrence of the mountain plants of central Germany, e. g. *Trientalis, Veronica montana, Circæa alpina, Arnica montana,* in the plains of Pomerania and Mecklenburg, does not probably depend on temperature, but on the proportion of moisture.

Were this fact limited to the coast, it might probably be thus explained, but the same plants grow also at Hanover and Brunswick in the plains 20 or 30 miles from the sea. The author asserts that *Ilex Aquifolium* perishes by the frost in Thuringia and Saxony, while it supports in Rügen a winter of 12°—18°. I doubt the fact, as this plant grows in all the beech forests of Hanover, where I have experienced a cold in winter of 24° R.

He supposes that the wet summer in Rügen may alter the capacity of the plant for heat; but were it the fact that it does not thrive properly in central Germany, on how many different circumstances might not this depend?

According to some statements of the author, which are to be farther followed up, certain plants will be found in different districts to be always distributed in entirely different localities; for instance, *Myosotis sylvatica* occurs in leafy woods in central Germany, and on the sunny plains of the peninsula of Mönkgut; *Vicia Sepium* in Germany among shady bushes; in England in meadows; *Alchemilla vulgaris* in Thuringia in the forests; in Switzerland in the meadows. I made a similar observation in reference to *Vaccinium uliginosum*, where scarcely any doubt can arise as to species, which grows in Norway everywhere in the woods, and often on the dryest soils under Coniferæ.

Poech has published 'New Observations on the Vegetation of the Calcareous and Slaty Alps' (Regensb. Flora, 1842, pp. 359-67).

Fries mentioned some problems in Botanical Geography at the meeting of the Scandinavian naturalists at Stockholm (1842): he particularly explained the destructive influence of cultivation on the natural character of the vegetation of the earth. As Swedish plants now extinct he enumerated *Trapa natans* and *Xanthium strumarium*. Also the so-called ruderal plants he holds to be originally indigenous; but to the question of Schouw as to their original locality, he could assign them no other habitat except mountain precipices and the sea-shore, where they may have been easily choked up or washed away, so that now they are only to be seen like the domestic animals in the neighbourhood of man.

St. Hilaire expatiates on those plants which have followed man, spontaneously, to other parts of the earth, in an essay 'De la dispersion des Plantes sur la Globe' (Nouv. Ann. d. Voyages, 1842, pp. 54, 62); he mentions, e. g. that in Brazil and St. Paulo *Marrubium vulgare* and *Conium*, in Porto Allegre *Rumex pulcher*, in Monte Video *Echium italicum*, in Minos Geraes *Verbascum Blattaria* and *Poa annua* are to be found.

Hinds has undertaken the useful task of summing up the different species of plants in each division of the earth, in the first four volumes of De Candolle's 'Prodromus' (Ann. Nat. Hist. ix, p. 415). Of 20094 species, 3210 are European, 5004 Asiatic, 3731 African, 2111 North American, 5742 South American, and 922 Australian. It is to be desired that the author would communicate the results of this laborious enumeration in greater detail.

I.—ARCTIC ZONE.

Ruprecht and Savelieff have explored Arctic Russia in Europe between the White Sea and Petschora (Bullet. Petersb. x, p. 29). The peninsula of Kanin is flat; what is designated in charts as a chain of mountains consists only of low hills. On the island of Kolgnieff the soil is constantly to the depth of an *Arschine*, as in Northern Siberia. The plants collected are not yet published.

These regions, though poor in species, are yet covered with a pretty thick vegetation, which begins to decrease towards the north coast of Kolgnieff; it differs considerably from the Flora of Lapland. The forests have receded from the coast of the Icy Sea. Undoubted signs have been discovered that large trees formerly grew near it, but now the nearest wood is four or five miles distant.

Baer has published the corrected results of the meteorological observations in Boothia Felix (70° 2′ N.L.) Bullet. Petersb. ix, p. 10.

RANGE OF THE TEMPERATURE IN BOOTHIA.

January	=	— 26° 7 F	July	=	+ 41° 3 F
February	=	— 32 1	August	=	+ 38 5
March	=	— 29 1	September	=	+ 25 4
April	=	— 2 4	October	=	+ 9 4
May	=	+ 15 4	November	=	— 6 3
June	=	+ 34 3	December	=	— 22 6

II.—EUROPE.

Beilschmied has compared Wirzen's 'Flora of Kasan' with Weinmann's 'Flora of Petersburg' (Regensb. Flora, 1842, pp. 561-70).

The sketch of the vegetation at Hochland, in the Gulf of Finland, by Schrenk (v. Baer's Beiträge zur Kenntniss des russischen. Reichs, bd. iv, pp. 143-62), contains a view of the indigenous vegetation, with a catalogue of all the species.

The small rocky island formed of porphyry, rising to a height of 350′, is surrounded by barren cliffs, whose covering of lichens is but rarely alternated with a green sward of *Arctostaphylos*, *Linnæa*, and other less characteristic forms. Thin woods of fir and pine of low growth, cover the slopes, here and there intermixed with birches. Where the wood is more dense, it shades an undergrowth of *Rubus idæus*, *Ribes rubrum* and *alpinum*, *Viburnum Opulus*, *Daphne Mezereum*, *Vaccinium Myrtillus*, and *uliginosum*, or a mossy turf of *Polytrichum commune* and *Hypnum splendens*. The plants in the shade are *Fragaria vesca*, *Pyrola uniflora* and *secunda*, *Oxalis acetosella*, *Anemone nemorosa*, *Convallaria majalis* and *Polygonatum*, *Majanthemum*, *Linnæa;* the Glumaceæ, *Carex panicea* and *Melica nutans*. Characteristic forms of the morasses composed of *Sphagnum*, in the valleys :—*Myrica*, *Ledum*, *Betula fruticosa*, *Vaccinium Oxycoccos* and *uliginosum*, *Salix rosmarinifolia*, *Rubus chamæmorus*, *Cornus suecica*, *Neottia cordata*, *Drosera*, *Eriophorum*, *Carices*. The banks of small lakes present besides, *Scheuchzeria* and *Rhynchospora fusca* and also *Lobelia*.

These include all the formations, which, with the same elements are so widely spread over the continent. The most remarkable plant of this island is certainly *Lychnis alpina*, found on a sterile rocky summit of a wall of porphyry, called Hauka-Wuori, 448′ high and almost perpendicular; this and *Sedum annuum* are the only mountain-plants.

A third Mantissa of Fries's Scandinavian Flora has appeared which is again very important in regard to the systematic arrangement of that Flora; it bears, with the earlier divisions the common title: 'Novitiæ Floræ suecicæ. Continuatio sistens Mantiss.' I. II. III. uno volumine, comprehensas. Accedunt de stirpibus in Norvegia recentius detectis prænotiones e maximâ parte communicatæ à Blytt. Lund. 1842, 8vo.

Oersted laid before the meeting of the Scandinavian naturalists observations on the distribution of the *Algæ* in the Sound. On the Danish and Swedish coasts, three Algan regions may be distinguished. The highest corresponds to the stratum of the shore within reach of the waves, on which the *Algæ* are loosened by storms, and become accumulated on the coast; in the middle region in particular grow the Fucoideæ and *Zostera*, and in the lower the Laminariæ and Florideæ are found adhering to the solid rocks. Agardh, who was present, remarked upon this statement that, the green Algæ flourished always nearest the light in shallow water, but that the Fucoideæ and Florideæ grew independent of it in deep water.

A treatise of considerable importance on the vegetation of the Scottish Highlands has appeared, by Watson, who has measured with the sympiezometer the boundaries of the altitude of 400 plants, which are there indigenous. (The plants of the Grampians, viewed in their relations to altitude, in 'Journal of Bot.' 1842, pp. 50, 72, 241-54.)

His account expressed in English feet, relates only to the mountains between Clova and Ben Nevis, near latitude 57°. The plants of the alpine region in Scotland, extend into a much lower level than on the mountains of Norway; however, I find in this catalogue only four species, which belonging to the range of alpine forms descend to the sea coast. This is the case with *Saxifraga aizoides*, *Rhodiola rosea*, *Alchemilla alpina*, *Polygonum viviparum*. I have met with the last three of these also, on the sea-shore of Norway. The facts communicated by Watson on the altitudinal limits of the alpine and ligneous plants, are all contained in the following list:

ALTITUDINAL LIMITS OF THE ALPINE PLANTS IN THE GRAMPIANS.

Thalictrum alpinum, L. . .	1050′		3900′
Draba rupestris, Hook. (*hirta* Sm.)	3700		3900
Draba incana, L. . . .	2000		3200
Arabis petræa, Hook. . . .	2000		3000
Silene acaulis, L. . . .	1250		4300
Lychnis alpina, L. . . .	3000		3200
Alsine rubella, W. . . .	2550		3300
Cherleria sedoides, L. . . .	2500		4000
Spergula saginoides, L. . .	1950		2700
Stellaria cerastoides, L. . .	2700		3800
Cerastium alpinum, L. . .	2300		4000
latifolium, L. . .	3100		3600
Astragalus alpinus, L. . .		2500′	
Oxytropis campestris, D. C. . .		2000	
Dryas octopetala, L. . . .	2500		2700
Potentilla salisburgensis, Jacq. .	1500		2700
Rubus chamæmorus, L. . .	1750		3300
Sibbaldia procumbens, L. . .	1500		4100
Alchemilla alpina, L. . .	0		4000
Epilobium alpinum, L. . .	1400		3900
alsinifolium, Vill. .	800		2900
Rhodiola rosea, L. . . .	0		3900
Saxifraga cernua, L. . . .	3750		3900
rivularis, L. . .	2700		3600
nivalis, L. . .	2000		4000
hypnoides, Sm. . .	1200		3900
oppositifolia, L. . .	950		4000
stellaris, L. . .	1400		4100
aizoides, L. . .	0		3200
Cornus suecica, L. . . .	1750		2850
Menziesia cærulea, Sm. . .		2700	
Azalea procumbens, L. . .	1850		3550
Arbutus alpina, L. . . .	1850		2700
Gnaphalium supinum, L. . .	1400		4250
Erigeron alpinum, L. . . .		2500	
Saussurea alpina, D. C. . .	2000		4000
Apargia Taraxaci, W. . .	2300		3000
Hieracium alpinum, L. . .	1850		3000
Veronica alpina, L. . . .	2500		3700

Veronica saxatilis, L.	2100′		2700′
Myosotis alpestris, Schm.	3100		3900
Oxyria reniformis, Hook.	800		4000
Salix limosa, Wahl. (arenaria Sm.)	1050		2500
lanata, L.		2500	
reticulata, L.	2500		3300
herbacea, L.	1850		4300
Betula nana, L.	1600		2750
Luzula arcuata, Hook.		4300	
spicata, D. C.	1600		4300
Juncus trifidus, L.	2000		4250
castaneus, Sm.	2400		3000
biglumis, L.	2800		3000
triglumis, L.	1750		3000
Carex Vahlii, Schk.		2500	
rigida, Good	1850		1000
aquatilis, Hook.		2700	
pulla, Good	2500		3100
atrata, L.	2500		2700
capillaris, L.	1700		2700
rariflora, Sm.	2300		2700
Poa alpina, L.	2500		4000
Alopecurus, alpinus, L.	2400		2700
Phleum alpinum, L.	2400		3500
Aira alpina, L.	2200		4100

According to the first appearance of the alpine Glumaceæ, the lower boundary of this region in the Grampians may be fixed at about 2500′, and Watson's statement of the arboreal limits leads to the same result, as the Pine ceases at 2230′, and the Birch at 2000′, though on Ben Nevis it may reach as high as 2700′.

ALTITUDINAL LIMITS OF THE LIGNEOUS PLANTS IN THE FOREST REGION.

	0′	2500′
Pyrus Malus, L. }		
Prunus spinosa, L. }	0	400
Viburnum Opulus, L. }		
Ribes rubrum, β. Hook.	0	600
Fraxinus excelsior, L. }		
Salix caprea, L. }	0	800
Sambucus nigra, L. }		
Ilex Aquifolium, L.	0	1000
Ulmus campestris, L. }	0	1050
Ribes nigrum, L. }		
Quercus pedunculata?		
Cratægus Oxyacantha, L. }		
Prunus Padus, L. }	0	1100
Ribes Grossularia, L. }		
Ulex europæus, L. }		

Rosa canina, L. / *Lonicera periclymenum*, L.	0′	1200′
Alnus glutinosa, G. / *Corylus Avellana*, L. / *Rosa villosa*, L. Sm.	0	1500
Populus tremula, L.	0	1600
Myrica Gale, L.	0	1700
Rubus idæus, L. / *Salix fusca*, L. / *Sarothamnus scoparius*, W. G.	0	1950
Genista anglica, L. / *Erica cinerea*, L.	0	2150
Pinus sylvestris, L.	0	2230
Erica Tetralix, L.	0	2370
Sorbus aucuparia, L.	0	2500
Betula alba, E. Bot.	0	2000 / 2700

The following ligneous plants of the Scottish coast extend into the alpine regions.

Arbutus Uva ursi, L.	0′	2800′
Calluna vulgaris, Salisb.	0	3150
Vaccinium Myrtillus, L.	0	4200
uliginosum, L.	0	3500
Vitis idæa, L.	0	3300
Oxycoccos, L.	0	2700
Empetrum nigrum, L.	0	4000

Thus, only Ericeæ, and forms allied to them, thrive equally on the coast, and in the regions where no trees grow. In this list *Juniperus communis* alone is omitted, (0′—2750′) as the British botanists make no distinction between it and *J. nana*, W. Those shrubs peculiarly belonging to the alpine regions, which are contained in the first list, are certainly for the most part found distributed also in the forest region, but not as far as the sea coast; they are as follows: *Menziesia cærulea*, Sm., *Arbutus alpina*, L., *Azalea procumbens*, L., *Betula nana*, L., and the *Salices*.

The works published on the British flora in 1842, are a fifth edition of Sir W. Hooker's 'British Flora' arranged according to the natural system (London, 8vo.) The 'Phytologist', a journal relating to the localities of British plants, which has appeared since June of that year.

Deakin's 'Florigraphia Britannica' (Sheffield, 1835-1842); a popular work with plates, on British plants. —Lee's 'Remarks on the Flora of the Malvern Hills in Worcestershire,' &c. (read in the Botanical Society of London).—Balfour has made a report of an excursion in the district of Braemar in the Scottish Highlands (Ann. Nat. Hist. x, p. 117.)—Edmonstone has sent to the Edinburgh Botanical Society, a list of his Flora of the Shetland Islands, increased by fifty phanerogamic species (Ann. Nat. Hist. ix, p. 69.)

Van der Bosch has published an appendix to his Flora of Zealand. (Van der Hoeven's Tijdschr. 1842, pp. 245-65.)

Four Decades of the sixth century of Reichenbach's 'Icones Floræ Germanicæ' have appeared in 1842, containing the Caryophylleæ; twenty-three Centuries of the 'Flora Germanicæ exsiccata' have been published. Eighty-eight numbers of the first part of Sturm's 'Flora Deutschlands' are now completed. An illustrated work on the 'Flora Deutschlands' by V. Schlechtendal and Schenk, has reached the first number of the fourth volume. A similar one on the plants of Thuringia by the same authors has reached the thirty-eighth number. Lincke has also published figures to the German Flora, of which twenty-one have appeared; and also, the wild plants of Prussia, of which seventeen numbers have appeared. The third volume of a 'Flora Deutschlands,' by Meigen, has come out. The fourth Century of the instructive collection of dried *fungi*, begun by Klotzsch and continued by Rabenhorst, has been published. Of German provincial Floras are to be mentioned: Klinsmann 'Novitiæ atque defectus floræ Gedanensis (in the 'Schriften der Danziger naturf. Gesellsch,' Bd. iv); Reichenbach 'Flora Saxonica', (Dresden, 1842, 8vo. Also, under the title of 'Der deutsche Botaniker,' Bd. 11), which besides the kingdom of Saxony comprehends also the Saxon dukedoms, the adjacent Prussian provinces, and the principalities included in this area; Heinhold and Holl 'Flora von

Sachsen,' (Dresden, 1842, 8vo,) which comprises the same district; Hampe's appendix to his catalogues of the plants found on the Harz, (Linnæa, 1842, pp. 380-3, and in the pamphlet: 'Vier Verzeichnisse zur Kenntniss des Harzes.,' Nordh. 1842, 8vo); Dolliner 'Enumeratio plantarum phan. in Austria inferiori crescentium' (Vind. 8vo); Maly 'Nachträge zur Steirischen Flor' (Regensburg Flora 1842, pp. 251-6.)

In the professional journies of Ratzeburg through the German forests, are included the character of the great forests of northern Germany, with reference especially to matters of forestry, though constant regard is paid to the nature of the soil as dependent upon the substratum, and to other relations connected with the botanico-geographical characteristics of the forest formation. (Berlin, 1842, 8vo.)

The author attempts to prove the influence of the geognostic formations on the intimate nature of the soil, and gives many hints which should be further followed by the botanist. The investigation of the soil has reference to the following geognostic formations, and is particularly directed to—(*a*) its power of retention of water; (*b*) its contents in parts which can be washed away (clay and fine sand); (*c*) in combustible parts; (*d*) in water; (*e*) in oxydes soluble in hydrochloric acid; (*f*) insoluble earthy components. In this way the sorts of soil of the following mountain formations are compared. What in this table is wanting in 100 parts, always corresponds to the insoluble earthy ingredients.

	a	*b*	*c*	*d*	*e*	*f*
1. Speckled sandstone of Solling and from Grubenhagen.	45·57 54·6	39·45	 2·78	 1·6	 2·8	24·0 per cent.
2. Porphyry free from quartz from Ilefeld	22·25 33·8	8·65 18·79	0·31	0·06	0·46	 28·65
3. Basalt from Solling	89·24	21·6			0·65	35
4. Clay slate from the Harz at Lauterburg	45·2	18·1	0·2	0·27	0·29	
5. Trachytes from the Rhenish Siebengebirge	38·58	20·08			0·62	30·54
6. Porous lava of the Laacher See	81·1	5·2	3·01	2·41	1·66	

The separated oxydes under (*e*) occurred in the following proportions :—

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Calcareous earth	0·83	0·126	0·07	0·04	0·07
Aluminous " .	0·605	0 288	0·25	0·18	0·28
Talcose . " .	0·224	0·038	0·01	0·065	(in the C.E.)
Oxide of iron .	0·908	(in the Al. E.)	0·31	(as No. 2)	0·22
Alkalies . . .	0·23	0·007	0·01	0·005	0·05
	2·797	0·459	0·65	0·29	0·62

The fertility of volcanic hills is therefore principally owing to their power of retaining water, as well in the basalt as in the lava soil of Eifel, without its being rich in aluminous constituents, capable of being washed away. This quality appears therefore dependent on the minerals constituting the sand of these soils. The author characterizes the sylvan vegetation on this and other geographic formations, and also completes this description by lists of the shade plants which occur in the greatest numbers. I here arrange from this catalogue the results for twenty of the most widely distributed wood plants, the occurrence of which the author compared in great masses in the ten following different localities :

I. In beech woods	*a*	On the Porphyry at Ilefeld.
	b	Clay slate of the Rhenish Schiefergebirges.
	c	Trachyte of the Siebengebirges.
	d	Granite of the Spessarts.
Mixed with oaks	*e*	Speckled sandstone of the Spessarts.
II. In oak woods	*f*	Alluvium of Upper Silesia.
III. In woods of *P. Abies*	*g*	Granite of the Riesengebirges.
IV. " *Picea*	*h*	Alluvium of Upper Silesia.
Mixed with *Abies*	*i*	Humus soil of the Upper Silesian alluvium.
	k	Granite of the Riesengebirges.

PREVAILING PLANTS.

Hypnum crista castrensis, a. g. h.
Schreberi, a. g. h.
splendens, a. g. h.
Aspidium filix fœmina, e. g. i.
Polypodium Dryopteris, a. e. g.
Agrostis vulgaris, b. e. k.
Aira flexuosa, b. e. g.
Deschampsia cæspitosa, a. b. g.
Luzula albida, a. b. c. e.
Urtica dioica, a. f. g.
Atropa belladonna, b. e. h.
Hieracium sylvaticum, c. e. g. h. k.
Prenanthes muralis, a. b. h. k.
Senecio Jacobæa, b. c. d.
Cirsium lanceolatum, a. f. h.
Fragaria vesca, a. b. h.
Epilobium montanum, a. b. c.
angustifolium, b. g. h.
Hypericum perforatum, a. b. h.
Oxalis acetosella, a. g. h. i.

Ratzeburg's descriptions of the German forests refer to the Harz, Solling, the Rhenish Schiefergebirge, the Eifel, the pit-coal formation between Trier and Südweiler, the beech and oak woods of which, he declares to be the most beautiful in Prussia, the Spessart, French Jura, the Riesengebirge, and the alluvium of the Oder in Upper Silesia, containing the largest forests, whose soil composed of humus is like bog with a mixture of loam, but free from acid and iron, and bears very splendid mixed woods of *P. picea* and *P. abies*. I may mention, from isolated observations of the author on geographic botany, what he says of the boundaries of the height of the beech. This tree forms in the Siegen a lofty forest, even at 2065′, and extends in these mountains higher than the oak, while in the Harz it does not reach to much above 2000′. In Hundsrück at Tronecken, the beech reaches to 2500′, but in the Riesengebirge as high as 4000′.

Wallroth draws out the following list of calcareous plants of the southern Harz in Ratzeburg's journeys (p. 15): *Calamagrostis montana, Stipa capillata, Sesleria cærulea, Festuca glauca, Carex humilis, Allium montanum*, Schm., *Anthericum ramosum, Orchis ustulata, Ophrys myodes, Epipactis atrorubens, Cephalanthera rubra, Betula pubescens, Thesium intermedium* and *montanum, Lithospermum purpuro-cæruleum, Alectorolophus angustifolius, Gentiana ciliata, Scabiosa suaveolens, Inula hirta, Cineraria campestris* and *spathulifolia, Scorzonera purpurea, Asperula tinctoria, Cornus mascula, Libanotis vulgaris, Potentilla supina, Rubus saxatilis, Rosa cinnamomea, Viola arenaria, Gypsophila fastigiata* and *repens, Reseda lutea, Biscutella lævigata, Hutchinsia petræa, Arabis auriculata, Erysimum virgatum* and *odoratum, Thalictrum montanum*. Some names are here altered, and plants which occur certainly in general on limestone, but are likewise distributed on other sub-soils, omitted, as also, calcareous forms, which I do not hold as specifically different from others.

List of the calcareous Cryptogamia of the southern Harz: *Gymnostomum curvirostrum, pusillum, trichodes;*

Jungermannia incisa and *gypsophila*, W.; *Marchantia commutata*, *hemisphærica*, and *umbonata*, W.; *Grimaldia inodora*, W., *punicea*, W., *ventricosa*, W., *Verrucaria mutabilis*, W.; *Patellaria cæsia*, W., *epipolia*, *saxicola*, W., *variabilis*, W., *intermedia*, W., *candida*, *lentigera*, *teicholyta*, W., *fulgens*, W., *decipiens*, W., *testacea*, W.; *Parmelia gypsophila*, *versicolor*, W.

Poech has described the vegetation of the calcareous formation of St. Iwan in Bohemia (Regensb. Flora, 1842, pp. 410-14.) Characteristic plants of the rocks there: *Dracocephalum austriacum*, L., *Hieracium echioides*, Kit., *Artemisia scoparia*, Kit., *Alsine setacea*, K., *Saxifraga cæspitosa*, L., *Potentilla cinerea*, Ch., *Sempervivum hirtum*, L., *Seseli glaucum*, Jacq., *Allium strictum*, Schr. and *fallax*, Don, *Gagea bohemica*, R. S., *Iris bohemica*, Schm. Growing among the oak bushes: *Carex Michelii*, Host., *Cytisus biflorus*, L'Hér., *Hieracium Nestleri*, Vill., *Silene nemoralis*, Kit. In the leaf-woods: *Adenophora suaveolens*, Fisch. Botanical travels through the Julian Alps by Sentner, and in Frioli by Tommasini, are of local interest. (Ibid. pp. 442-79, and (609-35.)

Schärer has communicated some facts on the distribution of the lichens on the highest summits of the Swiss Alps, (Linnæa, 1842, p. 65.) Saussure, senior, had brought from the highest point of Mont Blanc, *Parmelia polytropa*, Schär., and *Lecidea confluens*, Ach. In Sept. 1841, Agassiz found on the top of the Jungfrau (12,850′) the following: *Lecidea conglomerata*, Ach., and *Parmelia elegans* var. *miniata*, both with undeveloped fruit; of *Lec. confluens* var. *Steriza*, Ach., fruits without thallus; and two Umbilicariæ *U. atropruinosa* var. *reticulata*, Sch., and a new species *U. virginis*, Sch., allied to *U. hirsuta*.

Wierzbicki has made a report of botanical travels in the Banat. (Regensb. Flora, 1842, pp. 257-80.) We find in them more exact information on the Hungarian oak (*Q. conferta*, Kit.), which may be compared with *Q. apennina*, Lam. Besides this, *Q. robur* and *Q. cerris* grow in the woods of the Banat.

Of French local floras have appeared: Holandre (Nouvelle Flore de la Moselle, ed. ii,) and Delastre (Flore de la Vienne, Paris, 1842.) The works of Desmazières during the past year are confined to French Fungi. (Ann. Sc. Nat. 17, pp. 91-128.)

W. P. Schimper has described the moss and lichen-vegetation of the sandstone of the Vosges. (Regenb. Flora, 1842, pp. 337-59.) He remarks that, the Vosges sandstone, through weathering, forms a sandy soil; but the speckled sandstone of Alsace forms a clayey marl, which produces some moss and lichens, e. g. *Barbula aloides, brevirostris* and *rigida, Funaria hibernica, Grimmia ovalis* and *leucophæa, Lecidea reticularis*, which are not found on the Vosges sandstone. The granite group of the Ballons is covered with firs, while the Vosges sandstone mostly bears beech, among which single birches or oaks are found. Coniferæ have only lately sprung up in artificial plantations. At Offweiler, *Castanea* also forms a wood, but on the south side of the mountain it only reaches to a height of 600′. The Vosges sandstone is very rich in mosses and lichens, the localities have been specially given by Schimper.

In a review of Boissier's 'Flora of Granada,' I have drawn attention to the varied distribution of the S. European mountain-plants (Gött. gel. Anz., 1842, p. 599.) Thus the plants which inhabit the alpine region of the Sierra Nevada, fall into six classes, according to their distribution.

1. Endemic plants of the region which are found nowhere on the earth but above the tree-boundary of Sierra Nevada.

2. Endemic plants of Spain, which, in consequence of their indifference to climate, ascend from the lower regions to the high mountains.

3. Arctic-alpine plants, which occur also upon the high mountains of central Europe, on the Pyrenees and Alps, as far as the Caucasus, partly without difference of altitude; whose natural habitat everywhere is only above

the tree boundary, and some of which again appear in Lapland on the low hills. These form in many families about the half of the species observed in the Sierra Nevada, above the level of 5000′; but, on the other hand, in the Umbelliferæ only one quarter, in the Synanthereæ and Scrophularineæ only one fifth.

4. South European mountain-plants, which first appear beyond the Alps, and there grow on most mountains above the tree-boundary. Of these, however, the greater number are found only in the lowest part of the alpine zone, and descend abundantly into the forest region.

5. Central European plants, of which certain species, only extend to the mountain and alpine region of S. Europe, while a greater number grow on the Mediterranean, on an equally low level as in the plains on this side.

6. Lastly, there are a number of Mediterranean plants which ascend from the coast into the alpine region. It is evident that these different component parts of the alpine vegetation, although found here, united under the same conditions of climate, by no means possess the same receptivity in regard to the external influences to which they are exposed. In a systematic point of view, they are thus in part widely separated, and we consequently find that, the most characteristic families of the Alpine Flora, are richest in plants of the third class, and that forms of a similar type can be distinguished in the 1st and 4th classes in a still higher degree than in the rest.

I have remarked (ibid. 606) on the 'Distribution of the Leguminosæ' in the south of Europe, that the maximum of the Genistæ is in Spain, of the Trifolieæ in Italy, and that the Viciæ increase in Greece, while the Astragaleæ first preponderate in Asia Minor.

Schouw has made researches on the plants dug out in Pompeii, and believes he can prove from these remains that, *Agave-americana* and *Opuntia* were known in ancient Italy. He read a report on this subject at the meeting of naturalists in Stockholm, but I am not in a condition to be able to express an opinion on so remarkable and unexpected a result.

Tenore has written a treatise on the species of Cotton cultivated in the Neapolitan States, (in the 'Atti del real Istituto di Napoli,' 1840, pp. 175-206.) From the *Gossypium herbaceum*, L. (Cav. diss. t. 164, f. 2), cultivated most abundantly in the south of Europe, he distinguishes a new species *G. siamense*, Ten (l. c., t. 2), which bears flowers without spots. In Naples it is called *Cotone siamese* or *turcheso*, in commerce also *C. di Castellamare*. It has been generally considered as *G. religiosum*, but it is not a shrub, but rather an herbaceous biennial like *G. herbaceum;* it does not, however, seem different from *G. hirsutum*.

Of Italian local floras, and other contributions to the knowledge of the plants of that country, have appeared (Gr. Trevisan) 'Prospetto della Flora Euganea' (Padova, 1842, 8vo,) which contains a catalogue of Paduan plants, as a precursor of a complete Flora; Parlatore (Plantæ novæ s. minus notæ, Paris, 1842), 8vo, not unimportant systematically, on the subject of the Italian Gramineæ and some other plants; Meneghini (Alge italiane e dalmatiche illustrate, Fasc. 111, Padova, 1842, 8vo); J. G. Agardh (Algæ maris Mediterranei et Adriatici, Paris, 1842, 8vo); Zanardini (Synopsis Algarum in mari Adriatico hucusque collectarum, in the Memorie dell'Academia di Torino, 1842, pp. 105-256,) embraces 245 species of Algæ in 79 genera; De Notaris (Algologiæ maris Ligustici Specimen,—ibid. pp. 273-316) embraces 127 species in 56 genera; Meneghini (Monographia Nostochinearum Italicarum addito specimine de Rivulariis, Turin, 1824, 4to.) The work of Bertoloni on the Apennines of Bologna, mentioned in last year's report, has been published in the 'Novi Commentarii Bononienses,' the fifth volume of which appeared in 1842.

Hogg has published a catalogue of Sicilian plants, collected from former sources. (Ann. of Nat. Hist., x, pp. 287-335.) This useful collection is on the Linnæan system. The critical observations of the author, in comparison with Philippi are unimportant, except the assertion, that the cultivation of the vine on Ætna ceases at a height of 2600′, and not 3300′.

In Biasoletto's Travels in Dalmatia, no view is given of the relations of vegetation, except an appended catalogue of the plants collected; and although this contains the greatest portion of the Dalmatian flora, yet it has been rendered superfluous by the excellent work of Visiani, which has appeared in the meanwhile, (Flora Dalmatica, Lips., 1842, 4to, vol. 1;) in the introduction, some contributions are made to the botanico-geographical characteristics of the country. The annual course of vegetation on the coasts of Dalmatia is as follows: after a short mild winter, several spring plants come out, even at the end of December or beginning of January; *Corylus Avellana, Colchicum montanum, Helleborus multifidus, Erodium pimpinellifolium* flower at that time, and *Amygdalus* somewhat later; in February the whole vegetation awakes, and the blossoming of almost all the Dalmatian plants occurs in this and the following months up to May, when the dry hot summer begins which lasts till the end of September, a season during which vegetation is almost wholly interrupted, as the annual plants have quite disappeared, the bushes are no longer green, and even in the trees and shrubs the formative impulse stagnates; lastly follows the rainy autumn in October and November, in which many plants blossom for the second time. Visiani, quite in accordance with nature, divides the Flora of Dalmatia into three regions, the upper of which in that country, on account of its want of wood, probably descends unusually low. He characterizes these regions by the following plants:—

1. Coast-region, 0′—1410′. *Olea, Arbutus Unedo, Laurus nobilis, Nerium, Pinus Pinea* and *halepensis, Pistacia lentiscus, Phillyrea, Rosmarinus, Rhamnus Alaternus, Cistus villosus* and *Monspeliensis.—Trichonema Bulbocodium, Andrachne telephioides, Crozophora tinctoria, Arum tenuifolium.*

2. Hill-region, 1400′—3000′. *Fagus, Acer pseudoplatanus* and *obtusatum, Quercus Cerris.—Cytisus Weldeni, Rubus idæus.—Gentiana lutea, Valeriana montana* and

tripteris, *Teucrium Arduini*, *Prenanthes purpurea*, *Centaurea montana* and *tuberosa*, *Helleborus multifidus*, *Hypochaeris maculata*, *Cerastium grandiflorum*, *Primula suaveolens*. A singular mixture of plants of the central European mountains, and of Roumelia, in which in this locality, as on the Scottish coasts, some alpine forms occur at a lower level.

3. Subalpine region, 3000′—6000′. *Juniperus nana*, *Rosa alpina*, *Lonicera alpigena*.—*Dryas octopetala*, *Arabis alpina*, *Androsace villosa*, *Pæonia Russi*, *Silene graminea*, *pusilla* and *Tommasinii*, *Campanula pumilio* and *serpyllifolia*, *Arenaria Arduini* and *gracilis*. This region is rich in endemic species.

The author characterizes also most of the groups of plants of Dalmatia, in doing which, however, he pays too much attention to the rare species, to afford a distinct representation. He advances as a striking peculiarity, that many vicarious species of the same genus may be remarked, if the Dalmatian Flora be compared with that of the neighbouring countries, or its own regions with each other. As for example, in the wood or hill-region, *Thymus Serpyllum*, *Salvia pratensis*, *Phleum pratense*, *Thesium Linophyllum*, *Genista sylvestris*, *Onopordon Acanthium*, *Anthriscus trichosperma*, appear in the place of those inhabiting the coast-region, as *Thymus acicularis*, *Salvia verbenaca*, *Phleum echinatum*, *Thesium divaricatum*, *Genista dalmatica*, *Onopordon illyricum*, *Anthriscus Cerefolium*.

The portion of this flora which has as yet appeared, contains about a fourth of the whole in detailed systematic order, particularly the monocotyledons and apetalous dicotyledons. When the work is completed, the statistical numerical relations will be brought together.

Margot and Reuter have completed the catalogue of a Flora of Zante, begun in 1839, and which appeared in 1841, in the 'Mémoires de la Société de physique, &c. de Genève.' This list contains 621 phanerogamic and 42 cryptogamic plants, and is an important contribution to the Greek Flora. I do not notice any new species in the second division. Beside the localities, there is always one distinguishing synonyme for the species; the authors have but rarely found occasion for critical remarks.

Spruner in Athens, who for some years has distributed collections of Greek plants, has made a report on a botanic journey to the southern Pindus. (Regensb. Flora, 1842, p. 636.) He ascended the Velugo near Carpenitzi, which rises to 7000′ the highest top of Pindus in Greek Roumelia. This mountain which consists of limestone is clothed with wood to an altitude 5500′. The oak woods reach on the south to 3000′, the rest of the space is occupied by Coniferous forests. Above the tree-boundary succeeds a zone of *Traganthastragalus*, and on the topmost summit, as upon Athos, *Prunus prostrata*, Lab. grows. C. H. Schultz has described several Greek Synantheræ collected by Fraas. (Regensb. Flora, 1824, Beibl. p. 158.)

III.—ASIA.

The Flora of the East has also been systematically studied last year in every direction. Boissier has continued his examination of Aucher-Eloy's collection, and published the results, partly in the 'Annales des Sciences Nat.' for 1842, and partly in a separate synoptical work, under the title 'Diagnoses Plantarum Orientalium' (Fasc. 1, 1842, Genèv. 8vo), of which the first number appeared in 1843. The former work embraces only the Cruciferæ, of which Aucher has collected no fewer than 343 species. In this family the East seems inexhaustible in the multitude of fugacious annual species, and the narrow bounds of their distribution. A review of remarkable forms with numerous new species is given, particularly of *Hesperis*, *Alyssum*, *Cochlearia:* 2 new *Morettiæ* from Muscat; *Diceratium* B.: Persian subfrutex; *Parlatoria*, *Zerdana*, and *Strophades*, Sisymbreæ from Kurdistan and Persia; several *Drabæ* from the Armenian and Persian mountains; *Moriera*, *Brossardia*, and *Heldreichia*, new Persian Thlaspideæ; several species from the allied group of *Æthionema*. In Boissier's separate work, new species only are described, among which, besides those of Aucher, there are also some Greek and Roumelian ones from the following families: 3 Capparideæ, 5 Resedaceæ, 3 Violaceæ, 4 Polygaleæ, 101 Caryophylleæ, 4 Lineæ, 4 Hypericineæ, 6 Geraniaceæ, 4 Zygophylleæ, 2 Rutaceæ, 9 Ranunculaceæ, 1 Fumariacea, 15 Cruciferæ, 5 Rhamneæ, 1 Terebinthacea, with 190 Leguminosæ, and 14 Dipsaceæ. It is to be desired that the complete view of Aucher's collection should not be interrupted by this publication.

In Russegger's Travels in Greece, Lower Egypt, Syria, &c. (Bd. I, Stuttgart, 1841, 8vo), some information is to be found on the Flora of the Taurus, it has, however, been borrowed from the 'Researches' of Ainsworth, which appeared in 1838. The work contains a botanical appendix by Fenzl (pp. 883-990), in which the new species of plants collected by Kotschy in Syria and the Taurus are described at length. In the introduction, Fenzl reports on the considerable extent of the collections of Kotschy, which are preserved in the Vienna Museum. The first parcel sent home contained 700 species, mostly from the Western Taurus, the rest from the Orontes and from Karamania and Lebanon; another collection consists of about 300 species from Aleppo. The Synanthereæ, Labiatæ, Leguminosæ, and Umbelliferæ prevail in these herbaria; next follow the Caryophylleæ, Cruciferæ, and Scrophularinæ; the character of Mediterranean vegetation displays itself throughout with a mixture of the Caucasian forms. Even most of the new genera and species, although they certainly form the eighth part of the collection, bear the stamp of forms complementary to the European; a few only can be adduced as characteristic of the vegetation of those parts, e. g. *Pelargonium Endlicherianum* from the Taurus; *Heldreichia Kotschyi* from the alpine regions of the mountain; *Silene pharnacefolia* and *stentoria*, *Viola pentadactyla*, *Elæochytris meifolia*, and *Actinolema eryngioides* from Syria. The diagnoses of the new species have been printed separately by Fenzl in his 'Pugillus Plantarum Novarum Syriæ et Tauri Occidentalis primus,' (Vindob. 1842, 8vo,) and are also given by Walpers in his 'Repertorium.' In the year 1843, the first livraison of a book of plates, which Fenzl has grounded on the materials collected by Kotschy, has also appeared.

Forbes has given some account of the time of flowering of the plants, which bloom during the winter months in Lycia (Ann. Nat. Hist., ix, p. 251).

The first seven livraisons of Gr. Jaubert's and Spach's 'Illustrationes Plantarum Orientalium,' have appeared (1842), to which it is more convenient to recur afterwards.

Bertoloni has begun to labour completely at the plants collected by Chesney on the Euphrates expedition, and divided by Lindley, of which many cursory notices have been given. The species belonging to the first eight Linnæan classes have been described by him in the 'Commentarien des Instituts von Bologna,' (1842), but he does not seem to have made sufficient use of the more recent literature on the Flora of the East. There are figures of several new species.

C. Koch, who lately published at Cotta a description of his first journey in the Caucasus, with which I am not yet acquainted, has continued his catalogue of Caucasian and Armenian plants. During last year the following families have been discussed, (Linnæa, 1842, pp. 347-373): 71 Rosaceæ (new, 1 *Rubus*, 1 *Potentilla*,) 1 Myrtaceæ, 4 Crassulaceæ, 2 Saxifrageæ, 1 Philadelpheæ, 1 Lythraræe, *Trapa* from Mingrelia, 6 Onograriæ, 3 Ribesiaceæ (1 new *Ribes*), 60 Umbelliferæ (12 new species, among which are the newly characterized genera *Sympodium*, *Fuernrohria*, *Froriepia*, and *Eleutherospermum*), 1 Araliaceæ, 2 Corneæ.

Godet has made a catalogue of the plants found in the environs of the Caucasus baths of Petigorsk, which forms an appendix to the fourth part of Dubois de Montpéreux's 'Voyage autour du Caucase,' (Paris, 1840, 8vo,) and refers partly to his collections made on the Beschtau, one of the mountains of the Caucasus, about 4100′ high, composed of trachytic porphyry, completely covered with woods of *Fagus*, *Carpinus*, *Quercus*, and *Acer tataricum*.

Some notices on the course of the vegetation on the Caucasus are contained in the introduction to Eichwald's 'Fauna Caspiocaucasia,' (Petrop. 1841, 4to.) At the northern foot of the Caucasus, e. g. towards Derbend, and also at Kuban, the plants are already all withered in

July and by the end of September the country around is found quite barren from the drought. In the valleys of Imaretia, on the other hand, the summer is moist, for here all the aqueous vapour which rises from the Black Sea, attracted by the large woods, is changed into mist.

Two important and larger works on the Flora of Asiatic Russia, founded on accurate and very recent researches, are contained in the 'Bulletin de la Soc. imp. des Natur. de Moscou,' (Mosc., 1842), of which the first three numbers have been received. The one is a copious Flora of the Baikal region, by Turczaninow, the other a description of the plants collected in the year 1841 by Karelin and Kirilow, in the steppes of eastern Soongaria, and on the Alps of Alatau. Both treatises are arranged according to De Candolle, the former, still incomplete, characterizing 277 species, reaches to the termination of the Rutaceæ; the other comprehending 932 species, is already finished.

Turczaninow's Flora commences with an interesting introduction on the peculiarities of the Baikal Flora, comprising the districts of Nertschinsk, Werkné-Oudinsk, and Irkutsk; the first he usually calls the *Daurian*, the second, the *Transbaikal*, and the third, the *Cisbaikal* district. The complicated mountain tracts there often rise above the forest-boundary, but never reach the snow-line. Adjoining the hills and their forests are large steppes, partly stony, partly covered by a soil containing a bitter salt, rarely sandy; they often inclose lakes and marshes. The Baikal itself is nearly everywhere encircled by rocky mountains. The whole materials collected by Turczaninow appear to consist of about 1400 phanerogamic plants; he remarks that, 452 of these are also found in the 'Flora Suecica' of Wahlenberg, and 756 are also indigenous in the Altai. Three families represented in the Altai are wanting in the Baikal, the Frankeniacæ, Paronychieæ, and Apocyneæ; while the Menispermaceæ of the Baikal are wanting in the Altai. The lists of the plant-limits observed in the Baikal region are more important; they show that many plants do not pass beyond the Baikal lake; others are confined to Dauria; but the plants mentioned are too numerous, and later researches will doubtless shorten these lists considerably. I find also several errors in the catalogue of European plants, which indigenous in Dauria are wanting in Siberia, which lies between. As such statements are most to be depended upon with regard to ligneous plants, I shall here only mention them. 1. Among about ninety plants found in Irkutsk, but distributed eastward as far as the Baikal, are *Cotoneaster multiflora*, *Arctostaphylos alpina*, *Andromeda calyculata* and *polifolia*, *Daphne Mezereum*, *Salix microstachya*, T., *Betula fruticosa*. 2. Among about 160 plants found in the Transbaikal district, extending westwards also as far as the Baikal, but partly again appearing in the region of the Altai are: *Rhamnus daurica* and *Erythroxylon! Caragana microphylla! pygmæa* and *spinosa! Amygdalus pedunculata! Spiræa thalictroides* and *hypericifolia! Ribes diacantha*, *pulchellum*, T.! and *Dikuscha*, Fich.! those marked with an (!) are wanting eastwards in Dauria. 3. Among about 140, found only in Dauria are: *Rhamnus polymorpha*, T., *Armeniaca sibirica*, *Spiræa sericea*, T., *sorbifolia* and *lobata*, *Viburnum dauricum*, *Lonicera chrysantha*, T., *Betula daurica* and *Gmelini*, Bg., *Alnus sibirica*, Fisch., *Quercus mongolica*, Fisch., *Pinus daurica*, Fisch.

Of the families hitherto treated there are: 81 Ranunculaceæ, 1 Menispermeæ, 1 Berberideæ, 5 Nymphæaceæ, 3 Papaveraceæ, 6 Fumariaceæ, 78 Cruciferæ, 19 Violaceæ, 2 Droseraceæ, 2 Parnassiæ, 3 Polygaleæ, 22 Sileneæ, 1 Spergularia, 36 Alsineæ, 1 Lineæ, 1 Malvaceæ, 2 Hypericineæ, 8 Geranieæ, 1 Balsamineæ, 1 Oxalideæ, 1 Zygophylleæ, 2 Rutaceæ. The new species, as well as those described by Karelin and Kirilow, have already been given in the appendix to Lebedour's 'Flora Rossica.'

A more detailed analysis of the plants found in the Soongarian steppes, might have been given from the two catalogues of Karelin and Kirilow, in conjunction with

Schrenck's discoveries, if these collectors had more exactly distinguished the localities on the Alatau and Altai. In this year's publication I find about 300 distinct steppe-plants, while more than two thirds of those collected grow in the Alatau. According to that list, the steppe Flora of eastern Soongaria, contains the following series of prevailing families: (1) the Leguminosæ with 30-40 species, particularly Astragaleæ; and (2) Cruciferæ; (3) Synanthereæ, especially represented by *Artemisia* and *Cousinia*, about 30 species; (4) Cruciferæ with 20-25 species; and (5) Gramineæ; (6) Boragineæ with 10-15 species; (7) Liliaceæ and Umbelliferæ; then follow Labiatæ, Caryophylleæ, and Cyperaceæ.

Several plants lately discovered by Schrenck in Soongaria, particularly on the Tabaryatai and Alatau, are published in the 'Bulletin scient. de S. Petersbourg, (vol. x, pp. 253 and 353.) They belong to the following genera: *Picea*, *Populus*, *Stellera*, *Rheum*, *Rosa*, *Oxytropis* (3 species); *Astragalus*, *Swertia*, *Solenanthus*, *Calamintha*, *Chamæpeuce*, *Saussurea* (2 species); *Allium* (3 species); *Carex*, *Bromus*, *Triticum*. The new genera of Synanthereæ, *Cancrinia*, *Waldheimia*, *Richteria*, and *Acanthocephalus*, all from the Alatau, are described by Karelin and Kirilow in the 'Bullet. de Moscou (1842, pp. 124-8); in their larger work are two new genera of Cruciferæ, *Spirorhynchus*, and *Cryptospora*, as well as two new genera of Liliaceæ, *Ammolirion*, and *Henningia*.

Siebold's 'Flora Japonica,' which has been elaborated by Zuccarini, has advanced to the third number of the second volume (Lugd. Bat. 1842, 4to.) The last three numbers contain the Coniferæ. The following species of this family are Japanese: *Sciadopitys verticillata; Abies leptolepis; Tsuga firma, homolepis, bifida, jezoensis, polita; Pinus densiflora, Massoniana.* The species distributed most abundantly from the coast to 3500′ are *parviflora, koraiensis.*

We are indebted to Cantor for some information about the Island of Chusan on the Chinese coast (30° 0′ N. L.), who, in the months from July to September, collected there an herbarium of 150 species; the generic names of which have been revised by Griffith (Ann. Nat. Hist. ix, p. 265.) Chusan is about four geographic miles long, two broad, rises to the height of 1800′, and is covered by rocky hills, composed of clay-stone porphyry, and green stone. All the water is artificially collected for agricultural purposes; the woods have all been rooted up; and every spot of land is cultivated for the greatest possible amount of produce. In the cultivation of Chusan, rice holds the first rank, and yields, as it appears, two crops. Of other kinds of grain, Maize, *Coix Lacryma*, *Sorghum*, *Polygonum*, are mentioned. Among other vegetables, *Convolvolus batatas* (sweet potato) is the most important. The culture of tea is inconsiderable; the shrub flowered in July, had ripe fruit at the end of September, and flowered again at the commencement of November. *Stillingia sebifera* is cultivated to a considerable extent; it flowers in July and August, and the fruit arrives at maturity in November. The seeds, after having been taken out of the capsules, are thrown into large vessels of boiling water, upon the surface of which, after it is allowed to cool, the white tallow-like substance is left. Small plantations of *Elæococcus Vernicia* Juss. are cultivated for the purpose of making varnish. Oaks and pines are there planted for timber. The extremes of temperature must be considerable. In the year 1840, after a hot summer, heavy showers fell from the end of September till the end of November; snow fell in the end of December, and in January the thermometer sunk to 22° F. In the following summer, Cantor observed the range of temperature as follows:

	Highest.	Lowest.
July	86°	79°
August . . .	93	76
September . . .	100	71
October . . .	84	58

The vegetation of Chusan has a true European character; the few Indian forms which occur are not characteristic, and many of them, such as the Palms and the Musaceæ, which are cultivated, do not bear ripe fruit. *Humulus Lupulus* is extraordinarily abundant, and Gützlaf's inquiries have established it beyond doubt to be indigenous. Cantor saw in a tea plantation a grouping of plants, highly characteristic of the Chusan Flora. A *Tea tree*, around which was entwined a *hop vine*, afforded shade to *Artemisia vulgaris*, *Hypericum perforatum*, *Viola canina*, and in its neighbourhood were *Rubus idæus* and *Fragaria*, together with *Pinus* and *Quercus*, a *Musa* and *Raphis flabelliformis*. The list of genera is of less interest, in consequence of the cultivated and ruderal plants not being distinguished from the rest. I here place together the forms which are not European, and which compose only the fifth part of the genera enumerated, and add to these the cultivated plants, or species otherwise remarkable: *Nelumbium*, *Sterculia*, *Gossypium*, *Citrus*, *Thea chinensis*, *Camellia*, *Vitis vinifera*, *Zanthoxylon*, *Phaseolus*, *Persica*, *Prunus*, *Pyrus*, *Cydonia*, *Eriobotrys japonica*, *Lagerstroemia indica*, *Myrtus*, *Punica*, *Cucumis Melo*, *Cucurbita maxima* and *lagenaria*, *Actinostemma* Gr. (new Cucurbitacea), *Hamamelis*, *Panax* (the Cinchonaceæ), *Pæderia* and *Gardenia*, *Olea fragrans*, *Convolvulus Batatas*, *Ipomœa cœrulea*, *Capsicum*, *Rosmarinus*, *Clerodendron*, *Sesamum*, *Celosia*, *Begonia*, *Polygonum fagopyrum*, *Rheum*. *Stillingia* and *Elæococcus* (v. sup.), *Phyllanthus*, *Chloranthus*, *Salix babylonica*, *Cannabis sativa*, *Morus*, *Ficus*, *Juglans*, *Quercus*, *Salisburia*, *Pinus*, *Juniperus*, *Cupressus*, *Zingiber*, *Musa*, *Pardanthus*, *Commelina*, *Rhaphis*, *Aseca*, *Catechu*, *Triticum*, *Zea*, *Saccharum*, *Bambusa*, *Oryza*, *Coix*, *Sorghum*, *Lygodium*, *Nephrodium*, *Pleopeltis*.

Hinds has given an account of the vegetation of Hong Kong, an island at the mouth of the Canton river, and his plants collected there have been described by Bentham. (Journ. of Bot. 1842, p. 476, 494.) Hong Kong is a bare rocky island, the valleys of which are covered by a fertile soil, resting upon granite, and are well cultivated. The climate is subject to a variation of temperature from 26° to 94° F. The hottest months, June, July, and August, have a mean temperature of 89°, 94°, 90° F.; the coldest, December, January, and February, 57 5, 51°, 51° 5. The atmospheric deposits, although irregular, as might be expected at the edge of the monsoons, are still very considerable; they are estimated at 70", 6 of rain. The summer months, May to August, are the wettest, December and January the driest, yet rain falls every month. The vegetation treeless, except in a few instances of *Pinus sinensis*, wants all the southern richness; there are, however, many evergreen shrubs, and the forms belong to tropical families. Hinds remarks, what has already often been mentioned of the Southern Chinese Flora, that a mixture of European and Indian genera distinguishes it. The presence of the American Orchidean genus *Broughtonia* is very remarkable. The herbarium collected by Hinds contains only about 130 species, but amongst them no fewer than fifty-one families are represented. List of the genera: 17 ferns (*Davallia*, *Lindsæa*, *Adiantum*, *Blechnum*, *Meniscium*, *Pteris*, *Aspidium*, *Polypodium*, *Niphobolus*, *Lygodium*, *Mertensia*, *Osmunda*); 16 Synanthereæ, (*Vernonia*, *Diplopappus*, *Amphiraphis*, *Siegesbeckia*, *Wollastonia*, *Gnaphalium*, *Gynura*, *Emilia*, *Senecio*, *Barkhausia*, *Sonchus*, *Brachyrhamphus*); 8 Leguminosæ (*Crotalaria*, *Indigofera*, *Desmodium*, *Cantharospermum*, *Milletia*, *Cæsalpinia*, *Bauhinia*); 6 Rubiaceæ, (*Mussaenda*, *Ixora*, *Psychotria*, *Hedyotis*); 5 Myrsineæ (*Choripetalum*, *Embelia*, *Mæsa*, *Ardisia*); 5 Rosaceæ, (*Rubus*, *Rosa*, *Raphiolepis*); 4 Melastomaceæ, (*Osbeckia*, *Melastoma*, *Allomorphia*); 4 Smilaceæ, (*Smilax*, *Dianella*, *Asparagus*); 3 Ericeæ, (*Enkianthus*); 3 Verbenaceæ, (*Callicarpa*, *Vitex*); 3 Euphorbiaceæ, (*Glochidion*, *Melanthera*, Decaisn., *Ricinus*); 3 Urticeæ, (*Ficus*, *Sponia*); 3 Cyperaceæ, (*Lepidosperma*, *Scleria*, *Carex*); 3 Gramineæ, (*Rottboellia*, *Bambusa*, *Erianthus*); 2 Violaceæ, (*Viola*); 2 Celastrineæ, (*Evonymus*, *Catha*); 2 Apocyneæ, (*Cerbera*, *Hollarrhena*); 2 Labiatæ, (*Scutellaria*, *Leucas*); 2 Solaneæ, (*Solanum*); 2 Schrophularineæ, (*Pterostigma*, *Bonnaya*); 2 Lentibulariæ, (*Utricularia*); 2 Acanthaceæ, (*Barleria, Rostellaria*); 2 Polygoneæ, (*Polygonum*); 2 Thymelaæ, (*Daphne, Cansiera.*) Single representatives of the following families: Anonaceæ (*Unona*), Bixineæ (*Phoberos*), Droseraceæ (*Drosera*), Caryophylleæ, (*Stellaria*), Malvaceæ, (*Sida*), Byttneriaceæ (*Waltheria*), Sterculiaceæ (*Helicteres*), Ternstroemiaceæ (*Polyspora*), Aurantiaceæ (*Atalantia*), Oxalideæ (*Oxalis*), Connaraceæ (*Connarus*), Zanthoxyleæ (*Zanthoxylum*), Rhamneæ (*Berchemia*), Myrtaceæ (*Myrtus*), Onagrariæ (*Jussieua*), Lythrariæ (*Ammannia*), Araliaceæ (*Paratropia*), Crassulaceæ (*Bryophyllum*), Lobeliaceæ (*Lobelia*), Ebenaceæ (*Diospyros*), Sapoteæ (*Sideroxylon*), Mitrasacmeæ (*Mitrasacme*), Amaranthaceæ (*Amaranthus*), Laurineæ (*Cassytha*), Coniferæ (*Pinus*), Orchideæ (*Broughtonia chinensis*, Lindl.), Restiaceæ (*Eriocaulon*), Lycopodiaceæ (*Lycopodium*), lastly, the genus *Blackwellia*. Hinds names the potato as the most important among the cultivated plants. Besides this two other tuberose plants, Yams and *Cocoes* (*Dioscora* and *Arum*) are also cultivated.

He points out the mixed character of the vegetation of Canton (the Regions of Veg. p. 427) by this, namely, that *Viola* flowers there in the shade of *Melastoma; Bambusæ* grow on the same heights with Coniferæ, and potatoes and the sugar-cane are cultivated in the same field; the woods contain some species of *Quercus*, besides *Pinus*.

Some account of the vegetation of the plateaus of Thibet are contained in 'Moorcroft's Travels in the Himalayan Provinces,' &c. (London, 1841, 2 vols. 8vo). Ladak forms a plateau of 11,000′ elevation, composed of narrow valleys and hills rising a little above them. Some of the northern valleys lie even 13,000′ high; the southern mountain passes 16,000′. The uncultivated soil, even in the valleys, is quite bare and sterile; the only trees belong to the genera *Populus* and *Salix*. The scanty vegetation consists of some steppe plants, grasses, and furze, as it is called by the Himalayah surveyors (according to Royle, *Astragalus Moorcroftianus, Gerardianus*, and *spi-*

nosissimus). Frost and snow begin early in September, and continue with little interruption till the commencement of May. The greatest cold on the 1st February, was 9° 5 F.; from the middle of December, the thermometer during the night rarely stood above 15° F. The rays of the sun are very powerful in summer. On the 4th July, the thermometer stood in the sun at 134° F., another time at 144°, and during the night at 74°. Even in winter the rays of the sun are warm for an hour or two about mid-day; on the 30th January, they raised the mercury to 83°. The great effect of the sun compensates for the shortness of the summer, and quickly ripens the grain. The barley in Pituk, 800′ below Lè, was ripe for the sickle two months after being sown. The wheat required four months, it must consequently be sown immediately after the melting of the snow. The climate is notoriously one of the driest in the globe; in summer it rains very seldom, and always in small quantity, the greatest portion of the moisture falls as snow. The agriculture, which besides the two species of grain mentioned, also includes buckwheat, is however, very prolific by the Chinese mode of culture and watering. The only cultivated fruits are Apricots, Apples, and *Sarsin* (*Elæagnus Moorcroftii*). The highest spot where corn is cultivated is the village of Kiwar, the elevation of which, according to Trebeck Moorcroft's companion, is at least 13,000′. (i, p. 78.)

Moorcroft's reports also upon Cashmere, grounded upon a long residence, contain much that is important, compared with the results of other travellers. There is also here as in Ladak, a principal valley, but at half the altitude 5800′—5000′, besides a series of smaller valleys or glens; the mountains covered with snow are wooded below. The upper woods, according to V. Hügel, (Kaschmir and das Reich der Siek, 1840, 8vo, Bd. ii, s. 245,) consist of *Pinus Deodara*, and six other Coniferæ, these extend to 7000′. Below this, according to Jacquemont, a thicket of wild fruit trees is extended, formed of *Pyrus*, *Persica*, *Ar-*

meniaca, *Punica*, *Prunus*, *Morus*, *Juglans*, and entwined by vines; Moorcroft remarks that the vegetation, on account of the greater moisture, is, in fact, more luxuriant than in the other valleys of the Himalayah. Snow falls in the lower regions from December to March; and from the end of March till May, frequent heavy rains and violent gales succeed; the rest of the summer months are warm, and cultivated plants quickly ripen; the atmosphere, also, is much more protected from drought by lakes and rivers than in Thibet. The uncultivated soil forms meadows in the valleys, but most of the arable land is cultivated. A productive alluvial soil, rich in humus, produces very rich crops, particularly of rice, which is sown in the beginning of May and reaped in the end of August; an uncommonly short season of vegetation! The other esculent plants are wheat, barley, buckwheat, maize, millet, and pulse of various kinds; he describes circumstantially the floating gardens for cucurbitaceæ, the use of the water nut (*Singhara*), and of the *Nelumbium;* and is, in all respects, more correct than V. Hügel, who, for example, describes and figures the fruit of the *Trapa* as its roots. (Bd. ii, s. 278.)

The most important botanico-geographical results have been communicated by Griffith, in letters to Von Martius on his herbarium collected in Affghanistan, consisting of 1400 species. (Münch. gel. Anz. 1842, No. 87.)

The character of the vegetation resembles that of Asia Minor; the collection comprised 270 Gramineæ, 230 Synanthereæ, many Cruciferæ and Chenopodeæ. Thorny Staticeæ were very abundant, and amongst the Leguminosæ sixty Astragali. Ferns and Orchideæ, are perhaps wholly wanting in western Affghanistan, only some single plants occur near Hindostan.

Falconer read before the Linnean Society the description of two new genera from Peschawur, of the Myrsineæ *Edgeworthia*, and of the Asclepiadeæ *Campelepis*. (Ann. Nat. Hist. x, p. 362.)

Forty-nine livraisons of Jacquemont's 'Voyage dans l'Inde' have now reached us, which will be reported on hereafter. Montagne has described the cryptogamous plants, collected on the Neilgherries by Perrottet. (Ann. Sc. Nat. xvii, pp. 243-56, and 18, p. ix, 23.) The number of leaved mosses extends to sixty-six species; they are principally found in the forest region and are distinguished by the manifold character of their forms, as no fewer than thirty-one genera are represented by them. *Hypnum* numbers fourteen, *Neckera* five, *Fissidens*, *Macromitrium*, and *Brachymenium*, each four species. The only new genus *Symphyodon* has been already described. As so many tropical mosses have been made known of late years, and as their area usually extends over several Floras, it is not surprising that only about a sixth part of them are new; but it appears more remarkable that so few European forms are contained in the collection. These also form about a sixth part of the species, of which again a third belongs to *Hypnum*. For example, we may mention some of the species which are remarkable for their general dispersion, and are even found on the Neilgherries; *Grimmia ovata*, H., *Mnium rostratum*, H., *Hypnum alopecurum*, L., *cupressiforme*, L., and *tamariscinum* H., in the forest region; moreover, *Ceratodon purpureus*, Brid., *Bryum argenteum*, L., *Funaria hygrometrica*, H., *Bartramia fontana*, β., *falcata*, H., also upon the plateau. Perrottet has collected thirty-four species of *Hepaticæ*, of which five only are new; most of them also occur in Java. The European forms are *Lophocolea bidentata*, N., *Trichocolea Tomentella*, N., *Metzgeria furcata*, N. With these are ranked thirty-six lichens, almost only cortical ones, of widely-distributed forms, generally *Parmeliæ* or genera allied to *Sticta* and *Usnea*, finally, five species of *Collena.* Several Fungi (twenty-three species, a fourth part new), conclude this memoir.

The Fungi collected by Cuming on the Philippines have been determined by Berkeley (Journ. of Botany, 1842, pp. 142-57.) This collection contains about thirty-five species, of which only a fifth, according to

Junghuhn and Montagne, occur also in Java, and to this fifth belong also four *Polypori*, found in all tropical countries. Although, however, the species of the Javanese equatorial Flora are different from the monsoon Flora of the Philippines, yet the character of the Hymenomycetæ remains the same, in so far as in both places *Polypori annui* of the section *Apus* prevail. Berkeley has described two thirds of Cuming's species as new. The collection consisted for the most part of Hymenomycetæ.

Junghuhn has worked at the Javanese Balanophoreæ (Art. Leop. Cæs. 19, Suppl.); Hasskarl has described some new species from Java, and published systematic remarks on all the plants of that island. (Regensb. Flora, 1842. Bd. 2. Beiblätt, s. i, 114.) He had an opportunity of making observations on the living plants while gardener to the Botanic Garden at Bogor, in Java. The greatest part of his labour has been expended on the Leguminosæ, but he has only few new species, and their descriptions appear very incomplete.

Botta has published his travels in Southern Arabia. (Rélation d'un Voyage dans l'Yémen par Botta; Paris, 1841, 8vo.) I am only acquainted with this work, which probably also gives a view of the character of the vegetation of this country, from the analysis of it contained in the 'Annales des Voyages.'

IV.—AFRICA.

Seventy livraisons have now appeared of the work of Webb and Berthelot on the Canary Islands; the systematic account of the phanerogamic plants, according to De Candolle's arrangement, has proceeded as far as the conclusion of the Rubiaceæ.

Schnitzlein has made a report on the plants sent by Kotschy from Nubia and Kordofan (Regensb. Flora 1842, Beibl. 1, s. 129-49). This collection, which is to be disposed of by the Würtemberg Society of Travellers, contains about 400 species of 56 families. The richest are the Leguminosæ (61), Gramineæ (48), Synanthereæ (28), Euphorbiaceæ (22), Malvaceæ (20), Convolvulaceæ (18), Cyperaceæ (15), Acanthaceæ (14). More than half the Leguminosæ consist of Loteæ, the most of which belong to the division of the Galegeæ, particularly *Indigofera* (13 species), *Tephrosia* (6), *Sesbania* (4). The Trifolieæ are represented almost only by *Lotus*, the Genisteæ by *Crotalaria* (7 species). To the Loteæ succeed the Phaseoleæ with nine species, then the Cæsalpiniæ, with eight species of *Cassia* and *Bauhinia*, finally, five Mimoseæ, four Hedysareæ, and one *Moringa*. Among the Gramineæ the Paniceæ preponderate; the Chlorideæ are also numerous, and the Stipaceæ contain seven species of *Aristida*. The Synanthereæ belong to many different genera, and exhibit, so far as they are presented to us, no definite character. Of the Euphorbiaceæ, perhaps about a third part belongs to *Euphorbia*, whilst *Acalypha*, *Croton*, and *Phyllanthus* also number several species. The Malvaceæ consist, for the most part of species of *Pavonia, Sida, Hibiscus*, and *Abutilon;* the Cyperaceæ of *Cyperus*. The Acanthaceæ are rich in generic types, and the Convolvulaceæ so much the poorer.

The following families are not so numerously represented in these Nubian herbaria; 11 Boragineæ mostly belonging to *Heliotropium;* 10 Amaranthaceæ; 10 Scrophulariaceæ; 10 Cucurbitaceæ; 9 Portulaceæ, particularly *Mollugo* and *Trianthema;* 8 Rubiaceæ without Stellatæ; 7 Tiliaceæ; 7 Lythariæ, principally *Bergia*; the Capparideæ, Cruciferæ, Labiatæ, and Solaneæ number six representatives. The characteristic genera of the remaining families are: *Nymphæa* (3), *Boerhaavia* (3); among the Phytolacceæ, *Giesekia* and *Limeum;* among the Combretaceæ, *Poivrea* and *Guiera;* Saxifrageæ, *Vahlia* (2); Polygoneæ, *Ceratogonon;* Gentianeæ, *Hippion;* Palms, *Crucifera thebaica*. Schnitzlein has very properly compared this collection with the neighbouring Floras, and has found that about the sixth part of Kotschy's Nubian plants are also met with in Egypt. It should, however, here be remarked that these species, almost without exception, are indigenous only to Upper Egypt, in the neighbourhood of the tropic, where the Nubian vegetation also begins. This is completely different from the Egyptian Flora, except some species washed down by the Nile, and others spread by cultivation.

One result, confirmed anew by this collection, is much more interesting, viz.: that the tropical Floras of the old world are not so strongly defined from each other as the American. Thus, of Kotschy's Nubian plants, on the one side, about the fifth part also grow in the East Indies; on the other side, according to Buchinger's correction of the accounts of Schnitzlein (Regensb. Flora 1842, 2, s. 479), of 400 about 120 species grow likewise on the west coast of Africa, from Senegambia to Guinea. But of this collection there remain not less than 140 new plants endemic to Nubia, and thus an independent Nubian Flora seems to be sufficiently established. It is desirable that the botanic collections of German travellers in the east of Africa should give occasion to a comprehensive systematic work; for although these herbaria are in many hands, yet we have only fragmentary communications upon them. To these belongs a memoir by C. H. Schultz on the Compositæ of Rüppel's and Schimper's Travels in Abyssinia, as well as of Kotschy's Nubian Travels. (Regensb. Flora 1842, s. 417-24, and s. 433-42).

The author possesses 163 Synanthereæ, mostly undescribed, from Abyssinia; of these 6 only are also contained in the Nubian collection. He mentions that he has received from Abyssinia and Nubia 20 Vernoniaceæ, 2 Eupatoriaceæ, 48 Asteroideæ, 72 Senecionideæ, 17 Cynareæ, 25 Cichoraceæ, and 2 Mutisiaceæ. He promises to work at these systematically, and publishes, by way of commencement, as new Abyssinian genera: *Wirtgenia, Dipterotheca, Schnittspahnia.* Steudel has described the new Cyperaceæ from Schimper's Abyssinian collections (ibid. s. 577, 599). Of 16 species of *Cyperus* collected by him 12 were new; of 9 *Kyllingiæ*, 7; 3 new species of *Mariscus* have also been characterized. Hochstetter has instituted the following new Abyssinian genera (ibid. s. 225): *Cyclonema* (Verbenaceæ) of which 3 other species have been collected by Krauss at Port Natal, *Lophostylis* (Polygaleæ), *Kurria* (Rubiaceæ), *Valoradia* (Plumbagineæ). The genus *Raphidophyllum*, mentioned in last year's report, has not been separated by Bentham from *Gerardia.*

Lindley has described several new Orchidaceæ from the Cape of Good Hope (Journ. of Botan. 1842, p. 14-18). They belong partly to *Disa, Penthea,* and *Disperis,* partly to the genus *Brownleea,* founded by Harvey. Harvey has, besides this, lately characterized the following genera of the Cape Flora (ibid. pp. 18-29); *Choristylis* (Escalloniæ), *Pentanisia* (Rubiaceæ), *Raphionacme* and *Chymocormus* (Asclepiadeæ), *Toxicophlæa* and *Piptolæna* (Apocyneæ), *Brehmia* (Strychneæ), and *Acanthopsis*

(Acanthaceæ). Hochstetter (l. c.) separates *Eurylohium* from *Stilba*, and describes the new Campanulacea *Rhigiophyllum*.

Several new genera, from Port Natal, contained in the collection of Krauss, have been described by Harvey (l. c.) in January, and by Hochstetter in April 1842; No. 348 is *Diplesthes*, Harv. (Hippocrateaceæ); No. 186, *Ctenomeria*, Harv. (Euphorbiaceæ), Rubiaceæ; No. 178, *Mitrastigma*, Harv. (*Phallaria lucida*, Hochst.); No. 121, *Kraussia floribunda*, Harv. (*Coffea Kraussiana*, Hochst.); No. 131, *Pachystigma*, Hochst.; No. 144. *Mitriostigma*, Hochst.; No. 129, *Lachnosiphonium*, Hochst.; and No. 427, *Cyathodiscus*, Hochst. (Daphnoideæ). Harvey has borrowed from other collections from Port Natal the new genera of Acanthaceæ, *Crabbea*, *Ruttia*, and *Sclerochiton*.

Meissner has begun to give contributions to the South African Flora from Krauss's collections (Journ. of Bot. 1842, pp. 459-76). The first part is confined to the Ranunculaceæ, Nymphæaceæ, Cruciferæ, Violarieæ, Droseraceæ, and Polygaleæ.

Banbury has made a report on his botanical travels in South Africa (Journ. of Bot. 1842, pp. 540-70). His description of the character of the vegetation in the environs of Cape Town is so much the more interesting, as being accompanied by Harvey, who is intimately acquainted with the Cape Flora, he was enabled to acquire an exact knowledge of the species. The first impression of the Cape vegetation was very unfavorable, as he landed in the dry season; the bushes, although varied in forms, yet everywhere appeared dried up, stinted in growth, and destitute of blossom; herbaceous and bulbous plants were entirely burnt up by the scorching heat; the valleys and lower declivities of the hills were thinly clad with *Ericæ* and similar shrubs, between which grew sapless Restiaceæ, grasses, and low thornbushes (*Cliffortia*); there are, however, some pretty considerable woods of *Leucadendron argenteum* in this steppe; it is the only tree of moderate height which appears to be indigenous to the peninsula of Cape Town, and is 30-40′ high; its branches are directed obliquely upwards, and the glittering white silver colour of the leaves gives it an uncommonly beautiful appearance, particularly when the thick foliage is set in motion by the wind. The bark of the stem is also gray, and always remains smooth, and even on the highest trees moss or lichens never grow. It is known that this tree, which is found so abundantly in the neighbourhood of Cape Town, is entirely confined, geographically, to that locality. Several of the Cape Proteaceæ, to which this silver tree or Witteboom also belongs, are social, and cover large surfaces with their unmixed vegetation. This is particularly the case on the peninsula, with two bushes, the Kreupelboom (*Leucospermum conocarpum*), which forms a large bush about 8-10′ high, with gray-coloured foliage, at the foot of the Devil's and Table Mountain, and the Sugarbush (*Protea mellifera*), one of the most beautiful, and, at the same time, most abundant Proteaceæ of the Cape, with bright green leaves and large variegated blossoms of green, red, and white. These flowers when they burst open secrete such a quantity of sugary fluid, that when reversed it runs out as if from a cup, by which swarms of insects are allured, and are continually passing in and out. The environs of Cape Town are very rich in Proteaceæ; they spring up readily in the driest soils, in loose arid sand, or among sharp fragments of rock. Though the Silver tree occupies such narrow limits, yet other forms have a wider range; *Protea cynaroides*, though usually only a foot high, has the largest blossoms of all the Cape Proteaceæ, and is distributed from the flats or the sandy isthmus of the peninsula, as far as the point of the Table Mountain, and from Cape Town to the eastern bounds of the colony; its flowers are of a pale red colour, and form a head nearly as large as the crown of a man's hat. *Cliffortia ruscifolia*, one of the most abundant shrubs of the peninsula, is a tough, low bush, the thorny foliage of which is very annoying to the traveller, more so than that of the broom, for its leaves, which are as pointed as needles, very readily break off, and remain sticking in the skin and clothes. This bush formation has the type of the European heaths, and put Banbury particularly in mind of the coasts of Provence, where the Ericæ compose the principal part of the vegetation.

The Ericæ of the Cape which, in their own country, as Lindley supposes, are not less beautiful than in our hot-houses, fall into three divisions according to their locality. Some grow in company in great masses like the European, and cover large surfaces, as *Erica corifolia, ramentacea, racemifera, flexuosa, baccans, Blaeria muscoides,* and *ericoides.* Others are certainly also very abundant, but vegetate in a scattered manner among other plants, as *E. mammosa, cerinthoides, Plukenetii, Sebana.* Finally, there are species which are only found singly here and there in a cleft of rock. *E. cerinthoides* has the widest area, and is even found eastward of Graham's Town.

The Pelargonia are of less importance to the character of the vegetation of the peninsula, although a considerable number of them are indigenous. Few plants have gained so much by culture as these; the most abundant species in the mountains is *Pelargonium cucullatum,* a shrub, with large purple-coloured flowers, which grows generally with *Leonotis Leonurus* in all the defiles and valley tracks; when both are in flower, the glittering red of the one and the burning orange of the other produce a very rich effect.

When Banbury returned to Cape Town from a journey into the interior, at the end of the wet and cold season, which corresponds to our summer months, vegetation had in the meanwhile unfolded itself, and was now brilliant in all its beauty, in the peculiar richness of its forms. During August, September, and the first half of October, the Ixiæ everywhere put forth their brilliant blossoms, and cast a lively glow over the Erica steppe. The Irideæ are not confined to one definite kind of soil or degree of moisture, as they are so rich in species at the Cape that every locality numbers its separate forms. Some grow in loose sand, others on hard clay or soil containing iron. The geognostic substratum of the peninsula is generally granite to a height of 1500′, sandstone in horizontal layers succeeds as far as the summit of Table Mountain, 3582′ high. Whilst on the outer coast, at Greenpoint, *Sparaxis grandiflora* and several species of *Babiana* blossom, the rose-coloured *Ixia scillaris,* the yellow *Ixia conica,* and the extremely varied forms of *Gladiolus* unfold themselves on the Devil's and Lion's Mountains. The splendid *Antholyza æthiopica* raises its slender ears of yellowish red blossoms above the turf of the Restiaceæ and grasses, on moist spots, by the banks of mountain brooks. *Babiana ringens* unfolds itself on the moist sand of the Muysenberg, with its singular scarlet flowers stuck in the ground. On the flats *Aristea* and *Watsonia* thrive, and in the open spaces of the city different species of *Trichonema.*

Together with the Irideæ in this season, the Orchideæ are next to be mentioned. *Disperis Capensis* is one of the most abundant, and grows everywhere among the bushes, it is called Hottentot caps, from the peculiar form of the purple and green spotted blossoms. The most beautiful, but also the rarest of all the Orchideæ of the peninsula, is *Disa grandiflora,* the ornament of Table Mountain, where it is only found in a single locality at the top, among the bushes, on a black morass; its colours are nearest those of *Tigridia,* but the scarlet is much brighter. Many other Orchideæ, particularly species of *Disa* and *Satyrium,* are native to this district, but none of the group of the Epiphytæ, for which the climate seems neither sufficiently moist nor warm; it is, however, worthy of remark that several parasitic Orchideæ are found at Graham's Town, where considerably less rain falls than in Cape Town.

The Amaryllideæ are less abundant than the Irideæ, yet species of *Brunsvigia* and *Hæmanthus* grow on sandy soil.

The dependence of the plant formation on the nature of the soil is everywhere apparent; the sandy bottom of the flats is an inexhaustible mine of peculiar plants. Here, according to the degree of moisture, two formations of shrubs are to be distinguished, of which the one follows the streams, and consists of *Cliffortia strobilifera*, *Erica concinna*, *Psoralea pinnata*, *Leucadendron floridum*, *Brunia* and *Rhus*, the other clothes the flats with the social Ericæ, *Cliffortia ternata* and *juniperina*, *Chironia*, *Borbonia*, *Struthiola*, *Mimetes*, and Restiaceæ; this latter formation is only 2-3 feet high, and under it are numerous bulbous plants, *Lobeliæ*, Synanthereæ, and other herbs; *Erica concinna*, on the contrary, grows to the height of a man.

Banbury has also communicated the botanical relations of several other localities, but without describing their vegetation minutely. He twice ascended to the summit of Table Mountain in company with Harvey, where, on the highest platform, mostly veiled in clouds (table-cloth), vegetation is composed of the following forms: The Ericoid bushes are here formed of 7 *Ericæ*; 2 *Penææ*, *Grubbia rosmarinifolia*, the Bruniaceæ, *Stavia glutinosa*, and the Scrophularineous *Teedia*. Among these appear numerous Restiaceæ, seven bulbs of the family of the Orchideæ, Irideæ, and Amaryllideæ, also several Synanthereæ, the Umbelliferous *Hermas*, the Gentianaceous *Villarsia ovata*, the parasitic Scrophularineæ *Aulaya*, *Crassula*, and two Ferns, *Todea* and *Schizæa*. The summit of Table Mountain is also rich in mosses and lichens; the rocks in the waterfalls are clothed with *Andreæa subulata*, Harvey, and *Jungermannia Hymenophyllum*, Hook, *Racomitrium lanuginosum*, *Dicranum flexuosum* and *Sticta crocata* are also common here. Banbury is of the same opinion with those who believe that the richness of the Cape Flora, notwithstanding all the numerous and successful researches, is not yet nearly exhausted. Many plants are limited to such narrow boundaries, that the region where they grow may be long examined without finding their locality. Some have a very short period of vegetation, and many of them, particularly those of the 'Karroo,' require circumstances for their complete development which can only occur after periods of several years. In concluding his report with the remark that South Africa, as respects its natural flora, belongs to the most distinctly marked regions of the earth, Banbury takes a similar view to that which I expressed in last year's report on New Guinea, namely, that the distribution of animals and plants is not subject to exactly the same laws. Swainson and others have shown that many birds are indigenous in both Senegal and the Cape, whilst not a single plant is common to the two districts, and not even in Congo can a specimen be found of the group of plants characteristic of the Cape Flora.*

Bojer has described several new plants from the Comoro Islands, Madagascar, and Mauritius. (Ann. Sc. Nat. 18, pp. 184-92.) They belong to *Calpidia* and *Boerhaavia* (Nyctagineæ), *Hilsenbergia* and *Dombeya* with *Melhania* (Byttneriaceæ), and to *Erythroxylon*.

* The striking difference between the distribution of plants and that of animals in Africa is highly worthy of attention, and shows how both can be distributed independently of each other. South Africa has not only a considerable number of species of all classes of animals common in central Africa, but also even in their characteristic forms there is no distinction between the two Faunæ (dies. Arch. 1843, i, bd. s. 201). And although the Flora of New Holland is especially comparable with that of South Africa, this analogy in the Fauna is perceptible only in a very subordinate degree. (Arch. d. N. 1842, i, bd. s. 89.)

V.—AMERICA.

As the 'Travels' of the Prince v. Wied, in North America have been completed in the last year, we have now to report in detail on the botanical descriptions contained in them. They are accompanied, as formerly mentioned, by very characteristic sketches of the country, and, in regard to system, rely principally on the labours of Nees v. Esenbeck, on the plants collected by the Prince himself, which forms a supplement to the 2d vol. (pp. 429-54), under the title of 'Systematische Uebersicht der von der Reise auf dem Missouri zurückgebrachten Pflanzen.' A great part of this collection has been unfortunately lost; and, although the increase of material conducive to knowledge of prairie vegetation is, on this account, not considerable, yet the information on the relations of botanical geography is so much the richer and more valuable.

The prairies are as definitely separated from the vast primitive forests, only here and there opened up by the hand of man, which cover the greatest part of North America, as the bed of a large inland sea. Enclosed by the Rocky Mountains and the course of the Mississippi, extending from Texas to the Hudson, this undulating hilly plain, covered with Gramineæ, touches on the primitive forests in a long meridian line situated on the average twenty geographical miles to the west of the Great River, and twice in Illinois and Alabama stretches over this boundary into the wooded district like a bay of the sea. The cause of this great division of the United States into two zones of vegetation, independent of level, is altogether obscure. Under the tropics it is easier to conceive the connexion between the steppe formation and the prevailing winds, than in the temperate zone. The climatic relations also of the prairies are too little known, but we are indebted to the Prince v. Wied for important contributions. The very great contrast between the climate of the east coast of North America and of the prairies is shown not only in the atmospheric deposits, dependent in a great measure on the form of vegetation itself, but particularly in the variations of temperature.

Mädler, who has arranged the climatic data of the Prince, remarks, in this respect, that the annual as well as daily variations of the thermometer exceed all that has hitherto been known from these latitudes, even in the interior of Russia. There prevails here a continental climate in the strictest sense, presenting the greatest extremes, while beyond the Rocky Mountains it is exactly the contrary. (See last year's Report.)

The meteorological observations of the Prince v. Wied, made in the district of the Mandan Indians on the Upper Missouri do not, unfortunately, extend over the whole year. His own thermometrical measurements, instituted at Fort Clarke, include only the winter months, and consequently are of less interest in Botanical Geography. On the other hand, the results obtained by Mackenzie, from observations made at Fort Union, at the mouth of the Yellowstone river, on the Missouri, in about 48° N. 86° W. (Ferrol), relate to the whole season of vegetation, and are deficient only from October to December. Mackenzie has calculated the mean temperature according to the method of the least quadrate, and fixed it at nearly 5°·72 R. The observed mean temperature of each month is—

		1833.	1832.
January	. . =	— 4°·75 R.	
February	. . =	— 6·46	
March	. . =	+ 0·21	
April	. . =	+ 7·03	+ 8°·91 R.
May	. . . =	+ 8·94	+ 6·90

		1833.	1832.
June	. . =	+ 15°·03	+ 15°·20
July	. . =	+ 18 ·41	+ 18 ·58
August	. . =	+ 17 ·20	
September	. =	+ 11 ·75	

The difference, therefore, between the mean temperature of the warmest and coldest months amounts to 23° ·2 R. The daily fluctuations are also extremely great. They are greatest in March, when they amount, at an average, to 11°·57 R. Once the thermometer rose, on the 14th March, in six hours 20°·9 R. It fell, on the 21st February, 1833, from 12h. till the following morning, 37°·3 R. The prevailing currents of air blow from the west. The principal direction is W., 13½° S. The north-west is the coldest wind, the south the warmest. According to the experience of the Prince v. Wied, the climate of Fort Union is dry and stormy. To the severe and uninterrupted winter succeeds, in spring, the wettest season of the year, during which the prairies are in blossom, which in the remaining months bear only parched-up, or snow-covered grass. There begins about the middle of July an absolutely dry season, which lasts until the end of autumn, with scarcely any rain. Here, as in the Russian steppes, vegetation is, as it were, interrupted by a double winter sleep. Even during April violent snow-storms sometimes occur; near the Mandan villages the leaves do not come out till May, although something earlier in the bank Salicetæ; it has even been known, that in the end of that month the trees were not yet green. (ii, s. 74.) The flowers of the prairie also unfold themselves in May, but in the end of June the hills about Fort Union were still almost without blossom. (i, s. 435.) At that time the whole country was covered with short dry grass, among which, in roundish patches, the stunted bushes of *Opuntia Missouriensis* (D. C.) were scattered in plenty, unfolding their yellow blossoms at the same time with *Artemisia Gnaphalodes* (Nutt.) Thus the season of vegetation in the prairies lasts from

May to July. July is the only month in which there is really no night frost. In the forests the leaves remain till October. In November the Missouri first freezes; then the snow remains lying, and does not begin to disappear till March. The soil in the prairies is composed of a sandy clay, often containing a mixture of saline particles. It would, however, be sufficiently fertile for agricultural purposes, were it not parched by a constant wind which blows from the plateau of the Rocky Mountains. The Indians, indeed, cultivate maize, but with success only on the lowlands on the banks of the streams, where the crops are sheltered from the west wind.

The botanical productions of the great plain of the prairies appear to consist of very few species, and present great uniformity. Even the Gramineæ, with which the whole steppe is more or less luxuriantly covered, are not numerous.

To the strongest grasses belong *Uniola spicata*, L., *Spartina patens*, Mühl., and *Atheropogon olygostachys*, Nutt., which last attains more than a man's height in the flat prairie near Fort Clarke. (ii, p. 81.) Other prairie grasses are *Hierochloa fragrans*, Kth., in many places in these Travels, by a singular mistake, called "Ribes aureum," (i, pp. 319-26; ii, p. 325); *Agropyrum repens*, P. B., *Sesleria dactyloides*, Nutt. Among the plants growing intermixed with these Gramineæ, several are social, but which, for the most part, change at wide distances, so that by the less number of these forms, the traveller may, to a certain extent, ascertain his position in this wide desert according to certain plants. Thus, on the long journey from the mouth of the Missouri to its falls near Fort Mackenzie, under the Rocky Mountains, there are successively enumerated as such characteristic forms: *Oxytropis Lamberti*, P., *Cristaria coccinea*, P., *Allium reticulatum*, Fras., *Amorpha nana*, Nutt., *Rudbeckia columnaris*, P., *Solidago fragrans*, W. But all these, and other plants, are by far surpassed by *Artemisia* *gnaphalodes*, Nutt., which is spread over nearly the whole district, and often, together with the prairie grasses, covers wide tracts almost exclusively. Next to these, may be ranked the two Cacteæ of the prairie, *Opuntia Missouriensis*, and one of the Mamillariæ described by Asa Gray, which, together with *Yucca angustifolia*, P., especially characterize the steppes of the Missouri. Finally, there are also met with universally some low shrubs, which cover large tracts of country, and are then suddenly replaced by another as abundant species.

On ascending the Missouri, the Buffalo-Beng-Shrub (*Shepherdia argentea*) makes its first appearance towards the south as a prairie shrub, at about 42° N., and thence onwards becomes more and more frequent. In the country of the Mandan Indians, in 47° N., *Juniperus repens* commences, by which, together with *I. communis*, L., the hills on the Missouri near Fort Clarke are covered. Above the mouth of the Yellowstone appears the "Pulpy Thorn" of Clarke, (*Sarcobatus Maximiliani*, Nees.,) (a new genus, doubtfully placed among the *Urticeæ*); which, from this place to the Rocky Mountains, grows everywhere, mixed with the *Artemisia*. The characteristic forms of the prairie plants are, according to the collection of the Prince v. Wied, the following: Leguminosæ—*Astragalus, Oxytropis, Thermopsis, Amorpha, Sophora;* Synanthereæ; e. g. *Iva, Artemisia, Senecio, Solidago, Helianthus, Rudbeckia, Chrysopsis, Sideranthus, Aster, Erigeron, Stenactis, Achillæa, Cirsium, Jamesia,* (*Prenanthes*, Torr.); Cruciferæ—e. g. *Vesicaria, Erysimum asperum*, D.C.; Boragineæ—*Batschia, Myosotis, Lithospermum, Echinospermum*; certain genera of the Malvaceæ—*Cristaria;* Onagrariæ—*Ænothera*, with several species, *Linum, Galium;* of the Hydrophylleæ—*Ellisia;* Scrophularineæ—*Penstemon;* Santaleæ—*Comandra;* Chenopodeæ—*Kochia diæca*, Nutt.; and of the Polygoneæ—*Eriogonum sericeum*, P.

Woods occur but rarely, and, as it appears, principally in the border districts of the prairies, but they do occur in the low grounds on the banks of the rivers, and afford the only timber to the inhabitants. In consequence of the prairies being traversed by the Missouri and its numerous tributary streams, they are much more accessible to culture than any other steppes, and for the same reason, at the present time they also afford shelter to innumerable animals. These woods on the banks of the rivers consist, for the most part, of *Populus angulata,* W., or of willows, particularly *S. lucida,* W., and *longifolia,* Torr. However, there also occur even in central Missouri, and consequently in the midst of the prairie, of larger trees, two *Oaks,* one *Ash,* and *Negundo.*

Descending the stream, in the border district of the prairie of Osage, the number of trees gradually increases, until at St. Louis the sylvan character of Indiana is already attained. From this point onwards, even the so-called "red cedars" of the Mississippi spread themselves outwards pretty nearly to the Missouri. At 43° N. there is an island in the stream called "Cedar Island." On this is situate a clump of Coniferæ (*Juniperus barbadensis,* L.), mixed, however, with leaf-trees which rises fifty feet above the poplars and willows by which they are surrounded, and under which is an undergrowth of *Shepherdia* and *Cornus sericea.*

The same appearance recurs on the N.W. border of the prairie. At the foot of the Rocky Mountains, near Fort Mackenzie, the woods of *Populus angulata,* however, always predominate, although there are also groves of Pines (*Fichten*), consisting, in this part, of *Pinus flexilis,* Jau., which species disappears eastwards, at the mouth of the Yellow-stone.

Between Fort Union and the "Cedar Island" there is, consequently, scarcely anything but *Poplars* and *Willows.* The jungle in these poplar woods consists of several roses, particularly *Rosa Maximiliani,* Nees., also of *Amelanchier sanguinea,* D. C., *Prunus serotina,* Ehrb., *Symphoria, Cornus, Ribes,* especially *R. aureum,* P., and *Shepherdia;* the climbers are *Clematis cordata,* P., *Vitis* *cordifolia*, Mich., *Celastrus scandens* and *Humulus*. On the Mississippi also, near St. Louis, are still found these woods of *Populus*, which are highly characteristic of the whole of this country. In many places the Poplars form dense woods, surrounded towards the river by Salicetæ. In the neighbourhood of rock, however, the poplars on the Mississippi and on the Lower Ohio are replaced by the North American cedar (*Juniperus Virginiana*.) The communications of the Prince v. Wied on the character of the North American forests are of greater importance. During a prolonged residence in the Alleghany Mountains of Pennsylvania, and afterwards at New Harmony, in Indiana, he had an opportunity of comparing the difference of the forest formation, in the Northern and Western States. In Pennsylvania, the woods on the Lecha, e. g., near Bethlehem, consist of *Quercus coccinea*, *rubra*, *tinctoria*, *alba*, *Juglans nigra*, *Castanea*, *Prinos*, *Laurus sassafras*, with a thick underwood of *Rhododendron maximum*, and the climbing *Vitis Labrusca*. In other leaf forests, e. g., in the passes, 1050′ high, between the Delaware and Susquehannah, are found—besides the ever predominating Oak, Chesnut, and also Walnut, *Fagus*, *Carpinus*, *Betula*, *Ulmus*, *Nyssa*, *Acer*, and *Liriodendron*. In the Alleghany, above these forests, follows a region of Coniferæ, which is formed partly of pines, (*Pinus rigida*, Mill.,) partly of firs, (*P. Canadensis*, Ait.) On the lower boundaries of the Coniferous woods, in the district of the Delaware, grow oak bushes, e. g., *Q. Banister*, Mich., from among which single trees of *Pinus rigida* arise. In the Western Alleghany, on the contrary, the forests at the mean altitude, e. g., in the passes, 2400′-3000′ high, between the Susquehannah and Ohio, are, for the most part, a mixture of leaf-trees and Coniferæ, to which, towards Pittsburg, oaks, either alone or with chesnut trees and *Robiniæ*, succeed. The climbers consist of *Vitis*, *Ampelopsis*, and *Smilax*

There is an accurate account of the vegetation of the Coniferous region in a catalogue appended to the Travels of v. Schweinitz, which contains the plants found on the Pokono, a summit of the "Blue Ridge," or Eastern Alleghany, not far from Bethlehem. This mountain was also ascended by the Prince. The underwood here, likewise consists of *Rhododendron maximum*, and several other Rhodoreæ, as *Kalmia latifolia, Andromeda racemosa*, some Vaccinieæ, *Comptonia asplenifolia*, and the before-mentioned oak. There are still other shrubs and subfrutices, namely, *Gaultheria procumbens, Rhodora canadensis*, species of *Oxycoccus, Cornus, Prinos laevigata*, and *Dronia glabra*. From the burnt down forests of the Alleghany, arise *Rhus typhinum, Phytolacca*, and *Verbascum*. We have received accounts of the vegetation of the Southern Alleghany, from Asa Gray. (Jour. of Bot. 1842, pp. 217-37; and 1843, pp. 113-25.) The extensive Virginian longitudinal valley, between the "Alleghany Proper" and the "Blue Ridge," extending in a breadth of from 4-6 geographical miles, nearly from the 36th to the 42d deg. N., is everywhere covered with a rich fertile soil, mostly containing lime, but it has already, in a great measure, lost its primitive vegetation. European weeds, particularly *Echium vulgare*, have here established themselves over extensive tracts. This plant has taken complete possession of a space more than twenty geographical miles wide of uncultivated ground; often even on the cultivated fields, since whereever limestone exists the whole plain becomes blue with it. *Bupleurum rotundifolium, Marrubium vulgare, Euphorbia Lathyris*, and *Melissa Nepeta*, are also found here now very plentifully. In the circuit of this valley there are several tree-boundaries, *Robinia pseudacacia*, which is not found on the east of the mountains, first appears where the Potomac crosses the Blue Ridge, and is abundant from this place towards the south. To the south of the Lexington, *Gleditschia triacanthos* first grows, and also *Negundo*. Here also the Papaw tree begins, (*Uvaria triloba*,) which, in the Western States, acquires so much importance; and towards the New River, for the first time, *Æsculus flavus* is seen. Asa Gray's researches extended as far as the mountain-chains in North Carolina, where, in the Black Mountain, they attain almost their greatest elevation, rising to 6476′, by Michaux's barometrical measurement. The dicotyledonous woods about Jefferson are similar to those of Pennsylvania. They consist of *Castaneæ*, *Quercus alba*, *Liriodendron*, *Magnolia auriculata*, and sometimes *Acer saccharinum*. The mountains are usually wooded to the tops, as the "Grandfather" in the Blue Ridge, 5556′ high, which the traveller ascended. The Coniferous region of this mountain consists solely of Firs, more particularly of *Pinus Fraseri*, P., together with *P. nigra*, Ait. The blocks of mica slate, and fallen trees of this region are thickly covered with moss and lichens. Here is repeated exactly the character of the dark solitary forests on the river St. Lawrence, only that the trees in the mountains of Carolina are smaller than in the northern plains of New York and Vermont. This resemblance extends over the whole vegetation. The shrubs and herbage, also, are, for the most part, Canadian. With these are mixed some endemic mountain forms, as *Astilbe decandra*, *Chelone Lyoni*, *Aconitum reclinatum*, Gr., *Saxifragra Careyana*, G. Among the shrubs of the Southern Alleghany, Gray mentions particularly *Rhododendron Catawbiense*, *Menziesia globularis*, *Leiophyllum serpyllifolium*, D. G., *Vaccinium erythrocarpum*, *Sorbus Americana*, *Pyrus melanocarpa*, thus, almost only Rhodoreæ and Rosaceæ. If we compare the woods of the Eastern and Western States, there will be the same general result, that on this side of the Alleghany the underwood is chiefly formed of Rhodoreæ, on the other side, of an Anonacea, of *Uvaria triloba;* on the Lower Mississippi we find, instead of thick strong underwoods, the tall reed of the woods, the *Miegia macrosperma*, and lastly, in the primitive forests, on the boundaries of the prairies, only *Equisetum hyemale*. The Prince v. Wied first became aware of these differences in the formation of the underwood when travelling to the west of the Alleghany, he traversed the primitive forests on the Ohio below Pittsburg. Here *Rhododendron maximum* had already disappeared, and was represented by the Papaw, a tree 20′-30′ high, with violet-brownish flowers, beautiful, large, smooth, bright green leaves, and edible fruit. Of tall forest trees, the plane and the beech here begin to prevail, intermixed with *Liriodendron*, *Acer*, *Tilia*, *Juglans*, *Fraxinus* and *Ulmus*, while the oak and chesnut disappear. The common climbers still continue to be *Vitis* and *Ampelopsis*. From this place the Papaw accompanied the traveller through Ohio, Indiana, Illinois, and Missouri, till in the prairies of Osage it is seen for the last time. But towards the west it gradually decreases. Already, on the Lower Ohio, there are tracts, in which the soil of the primitive forests, instead of underwood, is covered with *Miegia*. However, this wood-reed does not grow so high here as in Louisiana; it is only 8′-10′ high, but forms a dense coppice, which in winter remains green, while under the trees there no evergreen forms occur. On the Lower Missouri the wood-reed is entirely wanting, but the already-mentioned *Equisetum*, about 2′ high, here covers the soil in the natural forests so densely that a walking-stick can scarcely reach the ground between its stalks. The woods of Indiana are composed of very many kinds of trees, of which the Prince v. Wied counted about sixty. In the lofty forest the following genera are found: *Platanus occidentalis* (Buttonwood), *Liriodendron* (Poplar), *Accr*, 6 species, *Quercus*, 9 species, particularly *A. macrocarpa*, *Gymnocladus canadensis* (Coffee-tree), *Juglans*, 10 species, *Gleditschia*, 2 species, (Locust,) *Liquidambar Styraciflua*, (Sweet-gum,) *Catalpa*, *Tilia*, *Ulmus*, 3 species, *Fraxinus*, 2 species, *Nyssa sylvatica*, (Black-gum,) *Fagus Americana*, *Robinia pseudacacia*, *Diospyros*. In these forests the underwood is usually 15′-30′ high, and into its formation, besides the Uvariæ, *Laurus Benzoin*, (Spice-wood,) and *Cercis canadensis*, (Red-bud,) enter. The remaining low arboreal forms belong to *Populus*, *Carpinus*, *Ostrya*, *Morus*, *Celtis*, *Laurus Sassafras*, *Cornus florida*, *Pyrus coronaria*, *Mespilus arborea*, and *Prunus Virginiana*.

Smaller thickets are formed principally of *Evonymus*, *Cratægus*, *Spiræa*, *Rubus*, *Corylus*, and *Salix*. Other forms found there are *Symphoria glomerata*, *Hydrangea arborescens*, *Ceanothus Americanus*, *Staphylea trifolia*, *Amorpha fruticosa*, *Hamamelis Virginica*, and *Gonolobium hirsutum*. The climbers are here more numerous than in Pennsylvania, several *Bignoniæ* make their appearance, especially *B. radicans*, and besides several species of *Vitis* and *Smilax*, *Celastrus scandens*, and *Clematis Virginiana*, also occur. But the most remarkable climber of Indiana is *Rhus radicans* "the Poison vine," the tendrils of which lie close to the stem, and are fixed by innumerable aerial roots. From this felt-like mass of roots the branches project in a rectangular direction, and then curve upwards, with their pinnate leaves. In travelling through those forests from the Alleghany onwards, what is most striking, besides the difference in the underwood here, is that the Coniferæ are entirely wanting, and that the Chesnut and Magnolia have likewise disappeared.

The soil in the primitive woods of Indiana consists mostly of a black *humus-mould;* where this is not the case, or where, for example, in some places between Harmony and Vincennes, a looser sand alternates with the stiff covering of humus, the character of the woods also changes suddenly, and instead of luxuriant mixed woods, the low-growing *Quercus nigra* alone is met with, from 30-40′ high. The climate of Indiana is rude. Cotton here no longer thrives. The chief product of husbandry is maize, which grows to the height of 12-15′. The potato is also cultivated, and the four kinds of grain of the north of Europe.

Hinds has given a report of the character of vegetation on the north-west coast of America from his own observation. (The Regions of Vegetation, pp. 331-35.) A continuous natural forest covers the coast, from 68°-46° N.; but on the Columbia River there is a sudden change in the vegetation, the mouth of that river forming a distinct boundary line to the Flora of California. The dense forest that stretches so far to the north from the Columbia, contains but few species. All the large trees are Coniferæ—three kinds of fir (*Abies*) and *Cupressus thyoides*, L. The smaller arboreal forms belong to *Cratægus*, *Prunus*, *Betula*, *Salix*, and in the south also *Diospyros*. The situation of this coast, open and exposed to frequent storms from the west, in conjunction with the constant wetness of the climate, which on the Columbia produces 53″6 rain, occasions in these natural forests, a very early decay of the trees. Hinds remarks, that here the ground is so thickly covered with fallen stems as to remind one of the period of the coal formation. Trees scarcely full-grown, clothed with cryptogamic vegetation, lie everywhere, horizontally, in the forest. The underwood is in these north-western pine-forests developed in great luxuriance. There are numerous forms of *Vaccinium*, *Menziesia*, *Rubus*, and *Ribes*. Farther south there are added to these, *Lonicera*, *Mahonia*, *Gaultheria*. A social fern, *Aspidium munitum*, by itself alone covers extensive tracts in the forest. Various species of the same genus appear in different latitudes, particularly of *Ribes*, *Lupinus*, and the Rosaceæ. Two plants with very large leaves, one an Aroideous the other an Araliaceous plant, are here very widely spread. *Dracontium Kamtschaticum* and *Panax horridum* both occur from the Columbia, as far as 61° N. For the rest the genera are perhaps, almost without exception, as is known, European, and nearly the half of the species are also found in Europe or Siberia; only once, in the vicinity of their northern boundary, are these forests broken in upon on the coast, towards the Aleutian Islands, by a tract of country without trees, which in summer bears a luxuriant vegetation of *Rosa*, *Salix*, and *Lupinus*. These together form a thick vegetation with which many herbaceous plants, as *Mimulus luteus*, *Geranium eriostemon*, *Lupinus Nootkaensis*, *Epilobium latifolium*, *Polemonium humile*, together with some *Ferns*, and European grasses, are mixed.

South of the Columbia, where the Californian Flora begins, the woods of Abies suddenly cease, and give place in the forests almost entirely to Pines and Oaks. The country here, however, is for the most part open. The formations of the Californian Flora are not sufficiently known, nor are they, with the exception of the forests, happily characterized by Hinds. (pp. 345-48.) According to that traveller, the oak woods of California contain two deciduous species and two evergreens. The latter are found along the coast, only however, between 34° and 38° N. The other trees are not numerous: *Acer*, *Æsculus*, two Laurineæ (*Tetranthera Californica*, and *Laurus* species), and on the banks of rivers, *Platanus*, *Fraxinus*, *Juglans*, *Salix*. The jungle in the woods consists of *Rubus*, *Ribes*, *Rhus*, *Vaccinium*, *Cornus*, *Lonicera*, and ligneous Synanthereæ. In the Californian peninsula, the most important forms of vegetation belong to the Cacteæ, but they extend only to 34° N. Hinds considers the Californian Flora to extend on the south-east as far as the Colorado.

Martius has published some diagnoses of newly obtained plants from Illinois, and Missouri. (Bullét. de l'Académie de Bruxelles, 1841, i, pp. 65-8.) Schouw has read to the Copenhagen Academy, some of Liebmann's 'Botanical Letters' from Mexico, which lie before me only in the still unfinished translation by Hornschuch. (Regensb. Flora, 1843, s. 109-18.) In "Tierra caliente" between Vera Cruz and Xicaltepec, the Palmaceæ are much more plentiful than has hitherto been believed. The most plentiful Palm is *Acrocomia spinosa*, Mart., but at Laguna verde, *Sabal Mexicanum*, M., forms close, thick, 40′ high, palm groves, which are not intermixed with any other kind of tree.

Liebmann describes more accurately the forests of the "Tierra fria," near Turutlan. The soil of the elevated plains consists of sandy clay, which usually rests on sandstone, and is very fertile when it does not remain too long dry. The temperature of the earth here, amounted to 13° R. Ridges of hills rise above the plateau, and on these alone do the forests occur, while the plain is bare and naked.

In the forests at Turutlan, nine species of Pine are met with, particularly *P. Montezumæ*, *P. Teocote*, and *P. Ayacahuite*, C. Ehrenb., of which, the last mentioned is the most remarkable. It attains a height of about 120′, and is the most resinous of all, and its cones reach the astonishing length of 15-16″. Intermixed with the Coniferæ, grow five species of *Quercus* and *Alnus*. There are very few shrubs, or little undergrowth in these woods. To the former belong (generally diffused over the plateau) *Myrica jalapensis* and *Helianthemum glomeratum;* to the latter, *Fragaria Mexicana*, and a variety of *Pteris aquilina*. On the Pines is found as a parasite *Viscum vaginatum*.

Kickx has described some new Mexican *fungi*. (Bullét, de l'Académie de Bruxelles, 1841, ii, pp. 72-81.) Breutel has published his 'Botanical Observations on St. Kitts and St. Thomas,' (Regensb. Flora, 1842, s. 549-60.) Of Bentham's elaboration of Schomburgh's Plants, the Ferns (79 species), and the Lycopodiaceæ (6) have appeared. J. Smith has undertaken this division. (Journal of Botany, 1842, pp. 193-203.)

Of the important collection of plants which Hostmann has begun to send from Surinam, and which is to be published by Sir W. Hooker, only some *fungi* have as yet been described by Berkeley. (Journ. of Bot. 1842, pp. 138-42.) Splitgerber has published a series of new plants from Surinam (v. d. Hoeven n. Vriese Tijdschr. 1842, pp. 5-16 and 95-114.) These belong to the Bignoniaceæ, (among which is the new genus *Couralia*), Dilleniaceæ, Anonaceæ, Tiliaceæ, Ternstrœmiaceæ, Guttiferæ, Sapindaceæ, Leguminosæ.

Miguel has also written on the Bignoniaceæ of Surinam. (Regensb. Flora, 1842, pp. 224-341.)

In the third to the fifth numbers of the 'Flora Brasiliensis,' by Endlicher and V. Martius, another series of plant formations has been illustrated by plates and copious descriptions. The bank vegetation of the Amazon is developed between the river and the primitive forest on the Laa-Ygapo, and especially on the sandy islands. It consists partly of low trees growing in clumps, of a Salicete formation, here consisting of *Salix Humboldtiana*, and of a Euphorbiaceous plant, *Alchornea castaneæfolia*, and partly of thickets of *Cecropia peltata* physiognomically characterized by its white bark, squarrose branches, and large-lobed, green glittering leaves with white hairs beneath. The Caa-ygapo is also included in this description. The following trees are here mentioned as a supplement to the earlier description of this primitive forest: Euphorbiaceæ (*Hura, Sapium, Pera*); *Hippocratea*; Laurineæ (*Nectandra*); Myrtaceæ (*Psidium, Eugenia*); Bombaceæ (*Pachira*); Leguminosæ (*Phellocarpus, Pterocarpus*); Palmæ (*Bactris Maraja, Astrocaryum vulgare* and *acaule*); also climbers Nandhirobeæ (*Feuillea*); Cucurbitaceæ (*Elaterium, Melothria, Anguria, Convolvulus, Bignonia*. The water plants of the Amazon present nothing peculiar; they are almost all distributed through the whole of tropical America, as *Pistia, Limnanthemum Humboldtianum, Cabomba, Azolla microphylla*. Plate 18 is a supplement to plates 1 and 11. It represents the vegetation of the banks of the Itahype, in Bahia, which is distinguished by the greatest variety of character in its forms. A social Aroideous plant (*Arum liniferum*), a sedge-like Gramineous plant (*Gynerium*), a *Rapatea*, forming a large-leaved turf, and the Marantaceous *Thalia* are next figured in their usual localities. Then follow the trees of the primitive forest with their climbers, in the first place a *Sterculia*, a *Zanthoxylon*, and the Palm, *Euterpe edulis*.

The "Catinga" (Tab. 10) is a forest formation of the trade-wind Flora of Bahia, which loses its leaves during the dry season. The trees here are generally only 20-40′ high, and stand more apart than in the primitive forest. Should the rainy season fail, which frequently occurs in the interior of Brazil, there is no vegetation to be seen, except the Cacteæ, during the whole time. Compared with the woods of Europe, those of the Catinga, with much physiognomical similarity, yet present a much greater number of forms. When the fall of the leaf commences, succulent plants, and others better protected by the texture of down on the leaves, remain green, such as the Bromeliaceæ, the Capparideæ, *Colicodendron*, and species of *Croton*. Some trees regain their leaves much more easily than others when the moisture is greater, as the Euphorbiacea *Cnidoscolus*. The woods of the Catinga are also distinguished from those of temperate zones by the multitude of the parasites and climbers. To the first belong here particularly the Bromeliaceæ, Cacteæ, and Loranthaceæ, rarely the Aroideæ, Orchideæ, or Ferns. In no formation of Brazil are the Cacteæ so numerous and various as here; they thrive well also on the thin poor soil of these woods. The Bombaceæ, *Cavanillesia*, also *Bursera*, *Spondias*, *Cnidoscolus*, and the Palm *Cocos coronata*, are examples of the trees constituting the Catinga.

The other plates represent landscapes in the provinces of Rio and S. Paulo, they are principally intended to show the forms of plants, as that of the Rhizophoræ (Tab. 12), *Rhizophora Mangle*, which, with two Avicenniæ and several Combretaceæ, forms the mangrove woods of Brazil; the Tree-ferns (Tab. 14) are represented by *Alsophila paleolata;* the arborescent grasses (Tab. 15), by *Guadua Tacoara*, and in Tab. 13 are the parasites of the primitive forest, which have been treated of most copiously by Martius, and the results published partly here and partly in the 'Münch. gelehrt. Anzeigen' (1842, Nr. 44-9.) This work is of much physiological interest. The true parasites of Brazil belong mostly to the following families: Fungi, Balanophoreæ, Cytineæ, Rafflessiaceæ, Burmanniaceæ (*Gonyanthus*), Orchideæ, Aroideæ (*Philodendron*, *Anthurium*), Laurineæ (*Cassytha*), Convolvulaceæ (*Cuscuta*), Orobancheæ, Ericeæ, Loranthaceæ, Marcgraaviaceæ, Guttiferæ. *Voyra*, however, should not be in the list of these plants, as Martius does not hold it to be a true parasite, since it resembles Orobanche.

The systematic portion of the Cyperaceæ by Nees v. Esenbeck, and the Smilaceæ and Dioscoreæ by myself, are contained in the three Nos. of the 'Flora Brasiliensis,' which have appeared in 1842.

St Hilaire, Tulasne, and Naudin, have begun to publish supplements to the 'Flora Brasili meridionalis,' of the former. (Ann. Sc. Nat. 17, pp. 129-43, and 18, pp. 24-54 and 209-13.) This work extends from the Ranunculaceæ to the conclusion of the Malvaceæ, and contains a considerable number of new species.

Gardner, upon whose recent collections from Minas Geraes, Sir W. Hooker has made a report (Journ. of Bot. 1842, p. 295), has begun to work at a catalogue of the plants found by him. (Ibid. pp. 158-93 and 528-48.) A summary of his herbarium collected from 1836-41 :— 400 species from Rio; 600 species from the first journey to the Organ Mountains; 500 species from Pernambuco (Oct. 1837—Jan. 1838); 200 species from Alagoas (Feb.—April, 1838); 600 species from Crato, in Ciara (Sept. 1838 —Jan. 1839); 400 species from Oeiras, in Piauhy (April—July, 1839); 500 species from Piauhy and Goyaz (Aug.—Sept.); 1400 species from Goyaz (Oct. 1839—April, 1840); a considerable collection from Minas (May—Oct.); and from a second journey to the Organ Mountains in the spring of 1841. Three or four hundred species have been already enumerated in the catalogue in geographical order.

An interesting paper on the Paraguay tea by Sir W. Hooker, illustrated by plates, is to be found in his Journal (Journ. of Bot. 1842, pp. 30-42.) The author confirms the opinion of St. Hilaire, that the *Ilex Paraguayensis* of Paraguay is identical with that indigenous to Brazil.

Hinds remarks on the equatorial limits of the Peruvian Flora (l. c.) that the woods of Guayaquil commence at 4° S. L., and are here distinctly separated from the coast vegetation of Peru; in this neighbourhood also lie the equatorial limits of the Peruvian Mist, the "Garuas," for whilst at Guayaquil heavy showers fall, half a degree south at Tumbez there is no rain during the year. The "Garuas" extend southwards to 36° S. L., at Valparaiso they cease to be regular.

Bridges has made a report on an excursion in the Andes near Valparaiso (Journ of Bot. 1842, pp. 258-63.) He remarks, that a third of the whole vegetation in the upper region consists of Synanthereæ.

Steudel has published the Cyperaceæ collected by Bertero in Chili and Juan Fernandez. (Regensb. Flora, 1842, pp. 599-605). Miers has described the new genus of Irideæ *Solenomelus* from Chili at a meeting of the Linnæan Society. (Ann. Nat. Hist. ix, p. 244.)

VI.—AUSTRALIA.

HINDS describes only about 500 plants as indigenous to the Society Islands. (The Regions, &c. p. 382.) The Marquesas, and Harvey's and Gambier's Archipelago have the same vegetation. On the Pomotu's, or Dangerous Islands, Hinds has collected 47 species, and terms their Flora very poor.

He (ibid. p. 384) includes in the Flora of New Guinea that of the Archipelago situated to the east as far as Tonga, thus including the Navigator and Friendly Islands. In this region are observed anomalies in the division of the seasons; most distinctly at New Guinea, but much less so at a greater distance in the Pacific Ocean; whilst in the Indian Ocean, for example at Celebes, where, agreeably to theory, the S. E. monsoon blowing from May to October, brings the dry season, and the N. W. wind prevailing in the other months, the rainy season, we observe the reverse in the Pacific.

During the S. E. monsoon frequent heavy rains occur. This wind begins in March or April, and lasts six months; the heat and moisture are much greater than in the central regions of the Great Ocean. The N. W. monsoon succeeds the rainy season, which blows till the following March, and here produces a dry season. (Hinds in Jour. of Bot., 1842, p. 670.) The farther eastward we proceed in the Pacific, the less are the seasons developed. Hinds has collected Herbaria on the Fidji islands, Tanna, New Ireland, and New Guinea, which Bentham has begun to work at. The vegetation of the Fidji Islands is, according to Hinds's observation, much more copious than that of the Society Islands; Leguminosæ are abundant, Mangrove woods appear, and also a leafless *Acacia*, *Chamærops*, and *Passiflora*.

New Ireland, like New Guinea, is densely wooded, and its climate very moist. The forest trees are very high, but almost without underwood, or other shade plants. The Palms here become more various, Hinds mentions the genera *Areca* and *Caryota;* a Cycadaceous plant (?) *Pandanus*, *Myristica*, and *Ficus*, are also characteristic; Ferns and Orchideæ are likewise numerous.

Drummond has continued the communication of his researches at Swan River. (Journ. of Bot.) Preiss has made known some information on the extent of the Herbaria collected by him in the same country. (Linnæa, 1842, p. 384.) Colenso has made a report on several New Zealand plants. (Journ. of Bot. 1842, pp. 298-305.)

REPORT

ON THE CONTRIBUTIONS TO

BOTANICAL GEOGRAPHY,

DURING THE YEAR 1843,

BY PROFESSOR GRISEBACH.

TRANSLATED BY GEORGE BUSK, F.R.C.S.

BOTANICAL GEOGRAPHY.

The most important work of the past year, in the department of general climatology, is Humboldt's 'Central Asia,' (Asie centrale. Recherches sur les chaines de montagnes et la climatologie comparée. Paris, 1843, 3 vols. 8vo.) In the first two volumes the relations of that part of Asia lying between the Altai and Himalayas, as to position and elevation, are deduced from a renewed analysis of all known sources. Particularly is it proved that the hitherto received notions with regard to the elevation and extent of the high lands of central Asia have been very much exaggerated. It had been already shown that the Chinese province of Thian-schan-pelu, or the land between the Altai and Thian-schan, belongs to the depression of the Caspio-Siberian steppes. But in the same way, also, the province of Thian-schan-nanlu, between Thian-schan and Kuenlün, has been excluded from the high land, because here, under the latitude of Italy, the cotton-tree flourishes, whilst in Jarkand the grape-vine thrives, and in Khotan the breeding of the silkworm is carried on successfully. (iii, p. 20.) The desert of Gobi, according to the measurements of Fuss and Bunge, in their journey to Pekin, has a mean elevation of 4000′ and is therefore on a level with the plateau of Persia. (i, p. 9.) The celebrated table land of Lesser Thibet alone, attains the level of the lake of Titicaca (12,000′), and its mean elevation is probably lower. (Vid. last Report, p. 403.) In the third volume, some of Humboldt's most important treatises on general climatology, have been again discussed, and enriched by new measurements, partly there published for the first time. Among these are included the researches on the causes of isothermal curves, and on the snow-line.

Extract from a table of all the measurements of the snow-limit in *toises :*

I. NORTHERN HEMISPHERE.					
Mageröe . .		71¼°	=	370 T.	
Norway . .	70°	70¼°	=	550	(v. Buch)
	67°	67½°	=	650	(Wahlenb.)
	60°	62°	=	800	
Iceland . .		65°	=	480	(Morcks and Olafsen)
The Aldan Chain in Siberia . .	60° 55′		=	700	
Ural . . .	59° 40′		=	750 ?	
Kamschatka .	56° 40′		=	820	(A. Erman.)
Unalaschka . .	53° 44′		=	550	(Lütke)
Altai . . .	49¼°	51°	=	1100	(Ledeb. and Bunge)
Alps . . .	45¾°	46°	=	1390	
Caucasus . .	43° 21′		=	1730	(Kupfer)
	42° 42′		=	1660	(Dubois)
Ararat . .	39° 42′		=	2216 ?	(Parrot)
Argaeus . .	38° 33′		=	1674	(Hamilton)
Bolor . .		37½°	=	2660	(Wood)
Hindu-Kho .		34½°	=	2030	(Burnes)
Himalayas					
Northern decliv.	30¾°	31°	=	2600	
Southern decliv.	30¾°	31°	=	2030	
Pyrenees . .	42½°	43°	=	1400	
Sierra Nevada .	37° 10′		=	1750 ?	
Etna . .	37½°		=	1490	
Abyssinia . .	13° 10′		=	2200	(Rüppel)
Mexico . .	19°	19¼°	=	2310	(Humboldt)
South America .	8° 5′		=	2335	(Codazzi)
	4° 46′		=	2397	(Humboldt)
	2° 18′		=	2405	(Boussingault)
II. EQUATOR.					
Quito			=	2475 T.	(Humboldt)
III. SOUTHERN HEMISPHERE.					
Quito . .	0°	— 1½°	=	2470 T.	(Humboldt)
Chili					
Eastern Cord. .	14½°		=	2490 T.	(Pentland)

Western Cord. .	18°		=	2897	(Pentland)
Chili . .	33°		=	2300	(Gillies)
	41°	44°	=	940	(Darwin)
Straits of Magellan	53°	54°	=	580	(King)

The tables which accompanied Humboldt's celebrated 'Treatise on the Isothermal Lines,' have also been filled up with all the more recent measurements, and have been arranged by Mahlmann for Humboldt's work. They embrace 315 places, the mean temperature of which, the temperature of the four seasons, and of the warmest and coldest months, is given. In the latter particulars therefore, these tables are more copious than the immediately preceding work of Mahlmann, (Dove's Repertorium, Bd. iv, 1841,) in which of 700 to 800 places the mean temperature only is given and, where it is possible, the summer and winter temperature. Humboldt, resting upon data which, in comparison with his Treatise of 1817, are now increased fivefold, divides the surface of the earth into eight zones of temperature, the extent of each of which is determined by the following limits of mean temperature:

I.—18° to 0° C. e. g.	Melville Island,—18° 7 (74° 8′ N. L.), Nain in Labrador,—3° 6 (57° 2 N. L.)
II.+0° 1 to 5° C.	Uleaborg, + 0° 7′ (65° N. L.), Quebec, 3° 1 (46° 8′ N. L., and 300′ alt.)
III.—5° 1 to 7° 5 C.	Upsala, 5° 3 (59° 9 N. L.), Utica 7° 4 (43° 1 N. L., and 450′ alt.)
IV.—7° 6 to 10° C.	Orkney Isles 8° (58° 9′ N. L.), Berlin 8° 6 (52° 5′ N. L. and 108′ alt.), Fort Providence 8° 5 (41° 8′ N. L.)
V.—10° 1 to 15° C.	Metz 10° 3 (49° N. L.), St. Louis 12° 9 (38° 6 N. L.)
VI.—15° 1 to 20° C.	Florence 15° 2 (43° 8′ N. L. and 200′ alt.), New Orleans 19° 4 (30° N. L.)
VII.—20° 1 to 25° C.	Cairo 22° 3 (30° N. L.), Macao 22° 5 (22° 2′ N. L.)
VIII.—25° 1 to 31° C.	Calcutta 25° 7 (22° 6′ (N. L.), Guayaquil 26° (2° 2′ N.L.), Pondicherry 29° 6 (11° 9′ N. L.), Massahua 31° 5 (15° 6′ N. L.)

Observations on the periodical phenomena of vegetation are now arranged under the direction of Quetelet, according to a connected plan in England, France, Germany, Italy, Switzerland, Belgium, and Holland, and published since 1843 in the 'Mémoires de l'Acad. de Bruxelles.'

E. Meyer has proposed a simple method of signs, in order to distinguish, in a list of the plants of any floral district, those which reach their areal limits somewhere in it. (Bot. Zeit. 1843, p. 209.)

The signs selected are the following :—

|*| The endemic plants of the Flora; ‾*‾ Plants which reach their northern limit therein; |*, *|, _*_, in the same way stand for the western, eastern, and southern limits respectively.

With respect to the numerical proportion of Monocotyledons to Dicotyledons, E. Meyer asserts (Drege's Dokumente, s. u. s. 28), that the law developed by Schouw of the decrease of Monocotyledons towards mean latitudes (35°-45° N. L.) does not hold good as regards mountains, where the Dicotyledons increase in the neighbourhood of the snow-limit. The hygrometrical conditions of the atmosphere may perhaps explain these phenomena, and the alpine region which lies above the clouds, in the heat of the summer corresponds with the Mediterranean basin, where the Monocotyledons decrease in the most marked degree.

The geographical relations of several families of plants have been monographically treated in the past year, by Watson as respects the Ranunculaceæ, Nymphæaceæ, and Papaveraceæ (the Geographical Distribution of British Plants); the Malpighiaceæ, by A. Jussieu (Monographie des Malpighiacées, Paris, 1843); the Rosaceæ, by Frankenheim; the Piperaceæ, by Miguel (Systema Piperacearum, Roterod. 1843, 8vo.) As the numerical relations obtained by such researches are extremely variable, I quote only some general results.

Ranunculaceæ. In Steudel's 'Nomenclator' 830 species are enumerated. Met with in all the polar expeditions, the number of species diminishes in the temperate zone towards the tropic, or they retreat into the higher regions of the mountains. Compared with the sum of the phanerogamia, they are most numerous in the polar circle, but the absolute number of species is greatest in the north temperate zone; 22 species are found in arctic America; Hooker enumerates 74 in British North America; Pursch 73 in the United States; Wahlenberg 44 in Sweden; Koch 109 in Germany; Sibthorp 60 in Greece; Desfontaines 30 in North Africa; and Humboldt 20 species on the Andes.

Nymphæaceæ. By Steudel 57 species, of which Asia possesses 20, North America 14, South America 9, Europe 8, Africa 7, the West Indies 2, Madagascar and Java 1 or 2. But to this distribution Watson opposes, that Torrey and Gray are only acquainted with 5 species in the United States, and Hooker with only as many in British America.

Papaveraceæ. There are distinguished of this family, including the Fumariaceæ, about 170 species. They are distributed in the arctic zone, and are found also within the tropics, though rare. They are most numerous in the warmer parts of the north temperate zone.

Malpighiaceæ. Of this family America possesses 528 species, viz., Brazil 290, Mexico 61, the West Indies 56, Columbia 45, Guiana 42, Peru 31; the Old World, on the contrary, presents only 55 species, of which 14 occur in India, 11 Madagascar, 9 West Africa, 9 in the Island of Sunda, 5 East Africa, 3 Australia, 2 Arabia, 2 China. There are but few instances of the Malpighiaceæ passing beyond the tropics; in North America *Hiræa septentrionalis* does not occur beyond 26° N. L.; in Nepal, *Hiptage* not beyond 28°, but in the southern hemisphere one *Acridocarpus* is found near Port Natal (30°), and *Higmaphyllon litorale* extends to Buenos Ayres. In the Mexican Andes the family does not ascend above 6000′, or scarcely passes beyond the limit of tropical vegetation. It is also met with at an equal elevation near the equator. In New Holland it is at present entirely unknown.

Rosaceæ. The author enumerates about 1100 species.

Of these 175 occur in central Europe, and about an equal number in North America, 92 in southern Europe, 74 in the Himalayas, 61 in the Alps, 85 in the tropical Andes; including, however, the Chrysobalaneæ.

Piperaceæ. This family is richest in species in tropical America; about a fourth part of that number are found in Asia, and isolated species in the South Sea Islands, and only a few in Africa. In the northern hemisphere, with few exceptions, scarcely any species pass beyond the tropic. In Africa only to 14° N. L. on the Senegal; from Arabia one species only, *Peperomia arabica* (22°) is known; on the Himalayas there are some at 30·5°; in China at 22·5°; in America, the only one, *Enckea Californica*, grows at Monterey up to 38°.

In Quito, *Piper peploides* extends to the altitude of 1590 *toises*. In the southern hemisphere, the Piperaceæ pass beyond the tropic to the greatest distance; they flourish at the Cape at 35° S. L., and one *Macropiper* as far as 45° S. L. in New Zealand.

I.—EUROPE.

The new data concerning the climate of European Russia contained in Humboldt's work on Central Asia, differ materially from the earlier less accurate accounts. A comprehensive idea of the climatic relations of eastern Europe is given, founded on observations of temperature at Petersburg, Moscow, and Casan.

Petersburg. (As. Centr. 3, p. 56). The measurements are by Wisniewsky, and were already known, though not accurately computed.

		MEAN TEMP.			MEAN TEMP.
December	=	− 5·2° C.	June	=	+ 15° C.
January	=	− 9·5	July	=	+ 17·3
February	=	− 7·5	August	=	+ 15·8
Winter	=	− 7·4° C.	Summer	=	16° C.
March	=	− 3·7°	September	=	+ 10·5°
April	+	+ 2·6	October	=	+ 5·1
May	=	+ 15·4	November	=	− 0·8
Spring	=	+ 2·5° C.	Autumn	=	+ 4·8° C.

An. Temp. = 3·9° C.

Moscow. (Ib. iii, p. 554.) The observations are by Spaski, and contained in the Bullet. Mosc. 1842.

Sea level	=	400′			
Winter	=	− 9·5° C.	Summer	=	+ 17·4° C.
Spring	=	+ 4·5	Autumn	=	+ 4·1

An. Temp. = 1·9° C.

Casan. (Ib. iii, p. 555.) The observations are by Knorre, and published in the same place.

Height above the Black Sea	= 240′		
Winter	= — 14·3° C.	Summer	= + 16·2° C.
Spring	= + 3·2	Autumn	= + 2·7
An. Temp.	= 1·9° C.		

Blasius has given an excellent exposition of the distribution of organic nature in European Russia, which, with regard to botany, contains a general determination and characterization of the provinces proposed by Ledebour, and mentioned in the Report for 1841. (Reise im Europ. Russland in den Jahren 1840 und 1841; 2 vols. 8vo; Brunswick.) In Northern Russia the author has especially investigated the districts on Lake Onega, and the southern part of the government of Wologda. In the Central province he has explored an extensive region from Jareslaw on the Volga, across the districts on the Oka as far as the Dwina and the Dnieper; and in the south he travelled across the Ukraine as far as the Steppes.

Northern Russia is chiefly distinguished from the Central province by its dense forests, in which *Pinus sylvestris*, L., and *P. Abies*, L., are the predominant species, and whose vast extent is only broken by swamps, or where, in the neighbourhood of the fluvial valleys, the trees have been thinned and destroyed by man. Amongst the pines and firs are intermingled here and there, *Alnus incana*, L., and *Betula pubescens*, Ehrb., which in some parts constitute by themselves large forests. The limits between cultivation and the wilderness are everywhere indicated, especially by alder bushes. Besides which, the only forms of leaf-trees are *Populus tremula*, L., *Sorbus Aucuparia*, L., and *Prunus Padus*, L. The pines and firs form two distinct forest formations, differing in the proportion of the argillaceous constituent of the soil. The clayey, often marshy low lands of the old red sand-stone are covered by thick fir woods, among which occur the *aspen* and *alder;* the sandy diluvial hillocks bear *Pinus sylvestris*, L., and *Betula pubescens*, Ehrb., and represent the forest character of the North German plain, the soil of which has been formed at the same time. On this diluvium, where the soil is deficient in clay, are met with also heaths of *Calluna* (Bd. 1, p. 102), which do not occur in the Silurian plains and trap formations. However, the diluvium is not altogether free from bogs, where *Ledum* and *Andromeda calyculata*, L., flourish, but even here also, the fir (*Tanne*) does not grow, but only the pine (*Kiefer*), which does not shun the water, and requires only a light sandy soil. (p. 161.)

The characteristic plants of the coniferous woods of North Russia, are *Rubus arcticus*, L., *saxatilis*, L., *Chamæmorus*, L., *Vaccinium Myrtillus* L., *uliginosum*, L., *Oxycoccus*, L., *Rubus idæus*, L., *Rosa canina*, L., *cinnamomea*, L., *Linnaea borealis*, L.

In the pine and birch forests, principally *Cetrariæ* or *Antennaria dioica*, Br. The forest meadows are filled with *Ranunculus reptans*, L. On the mountain limestone grow *Peristylus albidus*, Bl. and *viridis*, Bl., and on the Lake Onega, *Aconitum septentrionale*, Mart. (*A. Napellus*, Blas.), most luxuriantly.

In the North Russian bogs of the argillaceous lowlands, Blasius distinguishes two plant formations.

1. "The dwarf-birch formation." The uncertain depth is covered by a dense shaking turf of *Sphagnum* with *Vaccinium Oxycoccus*, L., from which bushes of *Betula nana*, L., and *fruticosa*, Pall., from three to five feet high, spring up everywhere. In common with these grow several Ericeæ, northern *Rubi* and *Salices*: *Ledum palustre*, L., *Andromeda polifolia*, L., and *calyculata*, L., *Arctostaphylos Uva ursi*, Spr., *Vaccinium Vitis Idæa*, L., and *uliginosum*, L., *Rubus arcticus*, L., *Chamæmorus*, L., and *saxatilis*, L., *Salix bicolor*, Ehrb., *limosa*, Wahl., *glauca*, L., *myrtilloides*, L., and *rosmarinifolia*, L.

2. "Formation of the reed grasses and Carices." The soil is covered with water, but the bottom is firmer and more clayey than it is under the birch bushes, and without any covering of *Sphagnum*. Tufts of reed grasses are placed

on the surface close together. About twenty species of *Carex* are enumerated, and above these project the crowded white heads of *Eriophorum*. (Bd. 1, p, 43.) Ligneous plants are wanting, but *Calla* and *Pedicularis* partly supply their place. The open pools and lakes which occur in these swamps, present almost the same forms as in Germany: *Nymphaea alba*, L., *Nuphar luteum*, Sm., and *pumilum*, Sm., *Stratiotes aloides*, L., *Hydrocharis*, white flowered *Ranunculi* and *Caltha*. (p. 252.)

The cultivated spaces form only oases in these boundless plains, which, from the White Sea, as far as the watershed towards the district of the Volga, are everywhere covered with these four formations. The country is intersected only by the river valleys, in a peculiar way. These, with their broad irregular water-courses, form deep ravines in the great plain, which is elsewhere only slightly undulating. Thus, Ustjug-weliki on the Dwina, is 330′ above the sea, and the highest plateau of the forest plain, in its neighbourhood, in general, 600′. It is on the broad ridges of land forming the declivities especially, that the swamps extend for many miles. Towards the rivers the plain is suddenly depressed, and below the forest forms two terraces, which constitute the spacious valley. The inferior terrace is quite horizontal, and is reached by the overflowing of the stream. It is uninhabited, and contains fertile meadows or wastes, banks bare of vegetation, and islands. The water-course lies throughout, on the right hand, close at the base of the steep upper terrace. (Bd. 1, p. 238.) On the desolate sandy banks throughout all Russia, even to the southern Steppes, *Salix acutifolia*, W., grows, whose roots, from 40′-60′ long, are closely interlaced in the loose soil. The meadows are formed in the first instance from clay and marl deposited from the river, and being annually irrigated and supplied with fresh marl from it, possess the most luxuriant turf. The dunes on Lake Onega bear, on the contrary, *Calluna* with *Empetrum*. The upper terrace lies about 40′-60′ above the bottom of the valley. It is undulating, and extends as far as the base of the wooded diluvium. It is inhabited, and the greater part of it cultivated, and contains dry sloping meadows, blooming with Orchideæ, Labiatæ, and Synanthereæ, which give place lower down to bogs; all the hollows also of the ground, especially along the margin of the forest, are occupied by marshy meadows.

As far as the condition of the soil is concerned, the land is everywhere adapted to the cultivation of all the central European Cerealia, but the climate is opposed to agriculture. The destruction of the forests, which has been so ruinous in Central Russia, has, in these regions, effected but little alteration in the character of the country, and that only in the neighbourhood of the river valleys; nevertheless, since the memory of man, two of the noblest and most useful trees have almost entirely disappeared from these districts. In regions where Pallas still saw large forest ranges of *Pinus Larix*, L., Blasius counted scarcely half-a-dozen trees in a distance of 60-80 miles. In the same way *P. Cembra*, L., the Russian cedar, which, at a former period extended further to the west, at present is first met with in central Witschegda, east of the Dwina. Blasius met with the finest forests along the course of the Suchona, in the government of Wologda. Here the stems of the fir and aspen rise to a height of 100′ to 150′; and the birch not unfrequently attains more than 100 feet. (Bd. 1, p. 164.)

Blasius has indicated more accurately the natural boundaries of North and Central Russia. They are accurately defined by the ridge of the Waldai, that is, the line of the watershed between the northern and southern streams. Its level lies only 200′ above the highest elevations of the north; it may be assumed to have an average elevation of 800′ (for example, near Grjansowez, between Wologda and Jareslaw, the mean altitude above the sea is 760′); and yet this low range everywhere distinctly divides two extensive botanical districts. It is the southern limit of *Alnus incana*, D.C., and the northern limit of orchards and of many leaf-trees, for instance, of *Betula corticifraga*, which, however, at first occurs mixed with *B. pubescens*, Ehrb., but further south it composes the birch woods exclusively. The Coniferæ decrease, *Populus tremula*, L., becomes more abundant, and forms dense forests. The birch and aspen contend for the mastery with the pine until the oak appears, and from this point the forests of leaf-trees predominate. *Fraxinus excelsior*, L., *Tilia*, and *Quercus pedunculata*, Ehrb., first make their appearance near Jareslaw. *Q. Robur*, L., on the contrary, is exotic to Central Russia, and eastward does not appear to reach even the Dnieper. The underwood consists of *Corylus Avellana*, L., mixed occasionally with *Evonymus europæus*, L., and *verrucosus*, Scop., *Rhamnus frangula*, L., and *cathartica*, L. Jareslaw is, besides these, the northern boundary for the following plants: *Berteroa incana*, D. C., *Lunaria rediviva*, L., *Lavatera thuringiaca*, L., *Chærophyllum aromaticum*, L., *Eryngium planum*, L., *Scrophularia vernalis*, L., &c.

The northern marsh willows are replaced by *Salix fusca*, L., *cinerea*, L., *Caprea*, L., and *Alnus incana*, D. C., is represented by *Alnus glutinosa*, G. Thus almost all the plant formations assume another character, but the physiognomy of the whole country is much more strikingly altered by the increased extent of cultivation. The cultivated land and forest in Central Russia are in equal proportions; in this district, or that constituting Great Russia, the forests have been cleared. On the Oka, where the woods are formed of oaks mixed with the aspen and birch, they are for the most part limited to the neighbourhood of the rivers, and the adjacent valleys and ravines, indicating the gradual commencement of the treeless steppes. Here is already seen on dry elevations a thick vegetation of Artemisieæ (*A. scoparia*, Kit., *vulgaris*, L., *campestris*, L., and *Absinthium*, L.), which extends to the willows on the bank of the river, where now *Salix acutifolia* grows mixed with other species, such as *S. alba*, L., *fragilis*, L., *viminalis*, L., &c.

Central Russia is geognostically defined, on the north, by the predominance of dolomite on the old red sandstone; further on its natural character is marked by the marly soil of the new red sandstone and mountain limestone, or by the chalk marl, which present themselves tolerably free on the surface in long tracts. Northern Russia, on the contrary, presents the sandy and argillaceous strata of the old red sandstone, and thicker diluvial formations. On the Osero, the central region of vegetation encroaches to some extent upon the northern, owing to the chalky soil; on the other hand, between the Dwina and the Dnieper the northern botanical region extends further to the south, in consequence of the opposite geological conditions which there obtain.

South Russia commences where extensive diluvial deposits cover the chalk, and tertiary formations, and are again themselves covered by the humose soil termed *black earth*, or "Tschernon Sem." On the Dnieper, its northern limit lies near Tschernigoff, whence it passes through the southern part of the government of Kursk, and reaches the Volga in the neighbourhood of Simbirsk; at which point the arenaceous covering of the chalk is immediately contiguous to the new red sandstone of the north. From these geognostic relations, it is evident that the vegetation of the steppes is as distinctly defined from the district of the leaf-trees, as those are from the northern Coniferæ. On the Desna, which falls into the Dnieper near Kiew, first appear the wild fruit trees, *Pyrus communis*, L., and *Malus*, L., together with *Prunus Cerasus*, L., and with these commences the Southern region of vegetation. These trees are distinguished, even at a distance, from the other leaf-trees, by their crooked, crowded branches, and dark-coloured bark; the apple trees have a stem about the height of a man, above which they spread out into equal-sized branches. (Bd. 2, p. 221.) But the whole surface of the country is entirely treeless. It is only in the swampy hollows, and in the depths of the river valleys, the only places which in the north have been cleared, that an arboreal vegetation flourishes; but even here there are nowhere continuous woods as far as the diluvial deposit on the surface extends. The Coniferæ have long altogether disappeared, and of the leaf-trees, the birch soon retires. The oak is the most abundant tree, and is always associated with the fruit trees; in this way narrow strips of wood are formed which, in proportion to the size of the steppe, are very inconsiderable. Cultivation is confined to the "black earth," on the border of the steppe. This narrow strip of land scarcely reaches to Krementschug, on the Dnieper, where Blasius found the northern limit of the culture of the vine. Close to this point the steppe commences with lofty shrubs, species of *Artemisia*, *Verbascum*, *Achillea*, *Euphorbia*, and *Cynara*, which are mixed with the tall dry grass, and as they are used for firing, have received the name of "Burian," fuel. In the spring these plains are covered with a flowery carpet, but which, after a few months, is again scorched up and withered by the burning sun. In the short autumn the atmosphere is again foggy, causing a renewed verdure, but snow-storms soon succeed, and the waste surface remains covered with deep snow through the long winter.

Ukraine Proper, or the government of Charkow, forms a peculiar transition between the Steppes and Central Russia. It is a hilly country, in consequence of the chalk projecting from the diluvial sand. Hence forests are produced, which cover a considerable part of this fertile country. On passing from the plain of Poltawa towards Charkow, the "black earth" is observed to diminish in thickness on the watershed of the district of the Dnieper and the Don near Walki, and here the forests first appear. They consist of oak, lime, aspen, poplar, ash, and *Acer Tataricum*, L., but always mixed with the wild pear. The underwood consists principally of *Corylus*. The unwooded surface is here thickly covered with steppe-shrubs, two to three feet high, viz. *Cytisus supinus*, *Caragana*, and the dwarf cherry (*Prunus Chamæcerasus*, Jacq.) The Flora of this province is distinctly that of South Russia, and this renders it probable that the climate exercises a more general influence than the soil, which in the Ukraine is calcareous, like that of Central Russia.

On the southern declivity of the Taurian mountain ridge, M. Wagner found the forests from Alupka as far as Ajuga-Dagh composed of *P. Laricio*, M.B., the region occupied by which extends from 600′ to 3000′. On the northern side, where the winter cold is much greater, they are replaced by the beech. *Arbutus Andrachne*, L., occurs only on the south side from the coast, as high as 1200′, though usually solitary, and its seeds appear to have been carried thither by birds of passage from Anatolia. (Augsburg Zeitung, 1843, Nos. 47-8.)

Of Ledebour's 'Flora Rossica' (vide Report for 1841, p. 416), the third and fourth parts appeared in 1843, and the fifth in 1844. (Vol. i, fasc. iii, vol. ii, fasc. iv, v.) The statistical relations of those families which have been treated of since the former Report are Balsamineæ 3; Oxalideæ 2; Zygophylleæ 10—in the European steppes, however, only *Zyg. Tabago*, L., and at the mouth of the Ural, *Zyg. Eichwaldii*, C. A. M.; Biebersteineæ 2; Rutaceæ 14—under which are included two species of *Tetradictis*, a genus probably belonging to the Crassulaceæ; Diosmeæ 1; Celastrineæ 6, and 1 Staphylea; 10 Rhamneæ, and 1 *Nitraria;* 2 Juglandeæ, both indigenous to the Caucasus; Anacardiaceæ 3; Papilionaceæ 568, among which is *Astragalus* with 168, *Oxytropis* with 61 species—genera confined to Asia are only *Thermopsis*, *Leobordea*, *Güldenstadtia*, *Halimodendron*, *Sphærophysa*, *Eremosparton*, *Lespedeza*, *Ammodendron*, *Gleditschia*, all with a single or few species; Mimoseæ 2, viz. *Lagonychium stephanianum*, M.B., and *Acacia fulibrissia*, W.—both only in the Caucasian provinces; Amygdaleæ 18; Rosaceæ 155—among which are *Spiræa* with 18 species, *Potentilla* with 60 species, 16 distinct species of *Rubus*, and 17 of *Rosa*—the Asiatic forms are *Coluria*, *Drya*-

danthe, Chamærhodos, Hulthemia; Pomaceæ 42, chiefly 19 species of *Pyrus* and *Sorbus, Punica* 1; Onagrariæ 23; Halorageæ 2; Hippurideæ 3; Callitrichineæ 5; Cratophylleæ 3: Lythrareæ 15, viz. two species of *Peplis* and *Middendorfia,* e. g. on the Dnieper, 2 *Ammanniæ* and *Ameletia* in Caucasia—the rest are *Lythra;* Tamariscineæ 15, for the most part Asiatic, although there are five species in the steppes of South Russia; Reaumuriaceæ 3, viz. *Reaumuria,* from the Caucasus to the Sea of Azof, *Eichwaldia* on the east side of the Caspian, and *Hololachna* in Zungaria; Philadelpheæ 1; Cucurbitaceæ 9, viz. on the Caucasus single representatives of *Lagenaria, Cucumis, Cucurbita,* and *Sicyas angulatus,* L., from thence westward as far as Podolia; Portulaceæ 16, of which 11 species of *Claytonia* occur in Eastern Siberia; Scleranthеæ 2; Paronychieæ 17; Crassulaceæ 59, e. g. 12 species *Umbilicus,* for the most part from the Caucasus and Ural; Grossulariæ 13, mostly Siberian; Saxifrageæ 70, besides 57 *Saxifragæ,* and 6 *Chrysosplenia*—in East Asia there are single species of *Leptarhena, Mitella, Tellina, Tiarella,* and *Heuchera;* Umbelliferæ 331, most numerous in Caucasia, almost disappearing in Eastern Siberia, yet there are 92 species in the Altai. The genera with most numerous species in Russia are *Heracleum* 23, *Peucedanum* 21, *Seseli* 18, *Bupleurum* 18, and *Ferula* 15; Araliaceæ 2, viz. *Hedera* and *Panax horridus* in the Kodjak Islands; Hamamelideæ 1—*Parrotia* in Talüsch; Corneæ 5; Loranthaceæ 3; Caprifoliaceæ 23; Rubiaceæ 77—among which, in the Caucasus, is the Hedyotideous, *Karamyschewia,* and the Spermacoceous *Gaillonia,* both with a single species; Valerianeæ 41—among which in Siberia were 4 *Patrineæ,* in Armenia 1 *Dufresnea;* Dipsaceæ 36, with *Morina parviflora,* Kar., in the Alatau.

Works on the Flora of Finland have been commenced by Nylander (Spicilegium plantarum Fennicarum; Helsingf. 1843. Centur. I. 31 pp. 8vo, 1844. Cent. II. 38 pp. 8vo.) Further (Stirpes cotyledoneæ paroeciæ Pojo—ib. 1844, 22 pp. 8vo,) and Wirzén (Prodromus Floræ Fennicæ—ib. 1843, 32 pp. 8vo.) The 'Spicilegium' contains critical remarks upon doubtful species, particularly on the *Carices*. Wirzén's work follows the sexual system, and extends at present only to the grasses.

Nylander, in 1842, travelled over Russian Lapland, from Uleaborg to Kola, on the Arctic Sea, and in 1843, East Finland and the governments between the Ladoga and the White Sea. Catalogues of the curiosities collected on the first journey are given in Lindblom's Zeitschrift. (Botaniske Notiser, 1842, 1844.)

Lund has described his botanical travels in Nordland and Finmark. (Reise ig jennem Nordlandene og Vestfinmarken i Sommaren, 1841; Christiania, 1842, 8vo.) He visited Tromsöe, where the birch was in flower at the end of August, and also Alten, Hammerfest, Mageröe, as far as the North Cape, and some other points. His review of the Finmark Flora contains 402 phanerogamia, in 50 families, whilst, in the whole of Norway, following Blytt's statement, he enumerates 84 families, with about 1100 phanerogamia. The families most rich in species in Finmark, are the following: Cyperaceæ 51; Gramineæ 42; Synanthereæ 33; Caryophylleæ 27; Cruciferæ 29; Rosaceæ 18; Junceæ 17; Ranunculaceæ 16; Ericeæ 15; Scrophularineæ 15; Saliceæ 15. Then follow 12 Leguminosæ, and 12 Orchideæ. The more interesting plants are: *Viola epipsila*, Led., nearly to the North Cape, *Lychnis affinis*, Vahl., *Potentilla nivea*, L., near Tromsöe, *Conioselinum tataricum*, Blytt., (Fisch?) near Alta, *Galium triflorum*, Mich.

The observed polar limits of the ligneous plants are, (1) near Alta, *Rubus idæus*, L., *Ribes rubrum*, L., *Myricaria germanica*, Desv., *Menziesia cærulea*, Sm., *Andromeda tetragona*, L., *Arctostaphylos Uva ursi*, Spr., *Rhododendron lapponicum*, Wahl., *Ledum palustre*, L., *Salix pentandra*, L., *arbuscula*, L., *hastato-herbacea*, Laestad., *Populus tremula*, L., *Alnus incana*, D. C. (2) Near Hammerfest, *Prunus Padus*, L. (3) *Pinus sylvestris*, L., as far north as 70°, that is, within one mile and a half south-east of Kistrand, on the Persanger Fjord. (4.) At Mageröe itself are still found *Sorbus Aucuparia*, L., *Calluna*, *Andromeda hypnoides*, L., *A. polifolia*, L., *Arctostaphylos alpina*, Spr., *Azalea procumbens*, L., *Vaccinium Myrtillus*, L., *V. uliginosum*, L., *Vitis idæa*, L., *Empetrum nigrum*, L., *Diapensia lapponica*, L., *Salix glauca*, L., *S. lapponum*, Wahl., *S. Myrsinites*, L., *S. reticulata*, L., *S. herbacea*, L., *Betula pubescens*, Ehrb., (*glutinosa*, Ld.,) *B. nana*, L., *Juniperus communis*, L.

Beurling, who, at the meeting of Scandinavian naturalists, in the year 1842, described the physiognomy of the neighbourhood of Stockholm, has travelled through Sweden in 1843, and the botanical results of his journey have been given in the 'Memoirs of the Stockholm Academy.' (Verhandelungen der Stockholmer Akademie.)

Zetterstedt's botanical tour through Jemtland, in the year 1840, has been translated in the 'Botan. Zeitung for 1844.' This Report contains lists of the localities, although without a more general characterizing of the vegetation of this province of Sweden. V. Düben has described an excursion in Bohuslan, made in 1841. (Lindblom's Botaniske Aviser, 1843. s. 75.) The first livraisons of Gaymard's 'Voyages en Scandinavie' have appeared. The plates give a graphic representation of the natural character of the north, but the explanatory text connected with them has not yet been published.

The fourth edition of Hartmann's Scandinavian Flora had been already published. (Handbok i Skandinavien's Flora, innefattende Sveriges och Norrige's Vexter, till och med Messorna; Stock. 1843.) Högberg's 'Svensk Flora, (Oerebro, 1843) is an inconsiderable compilation. Anderson's 'Observationes stirpium circa Christinehamn provenientium' (Upsala, 1842, 4to) contains some new localities for plants. Kröningsvärd has written a 'Flora dalekarlica.' (Fahlun, 1843, 8vo, 66 pp.) Torssel has published a catalogue of the Scandinavian Lichenes (343), and Byssaceæ (43). (Enumeratio Lichenum et Byssacearum Scandinaviæ hucusque cognitorum; Upsal. 1843, 12mo.) The eighth Century of Fries' 'Normalherbarium (vide Report for 1841) has appeared, and the fortieth part of the 'Flora Danica.'

The statistical relations of the British Flora have afforded a subject for new labours to Watson. The first part of a great work on this subject (The Geographical Distribution of British Plants, London, 1843, 8vo), though extending only to the Ranunculaceæ, Nympheaceæ, and Papaveraceæ, contains not fewer than 259 pages. This is the most copious collection of localities which has perhaps ever been made.

The horizontal and vertical distribution of each individual species is displayed in a table, which is even repeated forty times in this volume. Bielschmied has given a summary view of these special results in the Regensburg Flora. (1843, s. 641.) The only observations of more general interest are those illustrating the distribution of the three above-named families over the whole earth, of which we have spoken before.

The vegetation of the rocky island of St. Kilda, lying westward of the Hebrides in the Atlantic (58° N.L.), has been described by M'Gillivray. (Edinb. N. Philos. Journ. 1842, pp. 47-70, and 178-80. Also extracted by Bielschmied in Regensb. Flora, 1843, s. 455.) This island, about half a German mile in length, and scarcely half as wide, constitutes a rock 1380 feet high, consisting of trap and syenite, and presents in parts pasture land with Scottish vegetation; there are, however, only fifty indigenous phanerogamia. The characteristic species are *Cochlearia danica*, L., *Silene maritima*, Wilh., *Sedum anglicum*, Huds., *Rhodiola rosea*, L., *Ligusticum scoticum*, L., *Anagallis tenella*, L., *Salix herbacea*, L., *Carex rigida*, Good.; *Salix herbacea*, L., occurs here at a lower level than in Scotland, where Watson has not met with it below 1850 feet. The winter is very mild. Barley and oats are cultivated.

Dickie has investigated the geographical relations of the vegetation in Aberdeenshire. (Notes on the distribution of the plants of Aberdeenshire, in Hooker's London Journal of Botany, ii, pp. 131-35, and 355-58.) This is a supplement to Watson's work on the Grampians, mentioned in the last year's Report, and from it are derived the following corrections and additions to the altitudinal limits of the ligneous plants:

Quercus Robur, L.	0′ — 1500′
Lonicera Periclymenum, L.	0 — 1500
Rosa canina, L.	0 — 1860
spinosissima, L.	0 — 2000

Besides these, the extreme limit in altitude of a considerable number of plants belonging to a lower region is determined.

The author makes the following corrections in the list of alpine plants:

Arabis petræa, Hook.	1740′ (also washed down to 800′.)
Cerastium latifolium, L.	1740
Rubus Chamæmorus, L.	1000
Saxifraga oppositifolia, L.	On the shore near Aberdour.
Cornus suecica, L.	1200
Veronica alpina, L.	2300
Salix reticulata, L.	2000
Juncus castaneus, Sm.	2300
triglumis, L.	1200
Carex rupestris, All.	2000— ?
lagopina, Wahl. (*leporina*, Ant.)	3560

Babington has published a British Flora on the plan of Koch's Synopsis. (Manual of British Botany, containing the flowering plants and ferns, arranged according to the natural orders; London, 1843, 8vo.) Of Withering's British Plants (corrected and condensed by M'Gillivray. Aberdeen, 1843), the fifth edition has appeared. Of dried collections of British plants, we have 'Salicetum Britannicum exsiccatum,' containing dried specimens of the British willows, edited by Leefe (Fasc. i, 1842, fol. with thirty-two forms), and Berkeley's 'British Fungi' (four fasc. of dried specimens; London, 1843).

The 'Flora Batava' (vide Report for 1841) has advanced in 1843 to the 130th part (aflevering). Dozy has given a supplement to his Catalogue (mentioned ib.) of the Jungermanniæ and Marchantiæ, found near Leyden. (In v. d. Hoeven's Tijdschrift, 1843, s. 108-14.) Kickx has given the first Century of the Flemish Cryptogamic Flora, in the 13th vol. of the 'Mémoires de l'Acad. de Bruxelles,' the greatest part of which consists of the Fungi. (Recherches pour servir à la Flore cryptogamique des Flandres; Bruxelles, 1840, p. 46, 4to.)

De la Fons has published some remarks upon the plants of the upper valley of the Maas, which possess only a local interest. (Ann. d. Sc. Nat. 19, pp. 317-19.)

The six last decades of the sixth Century of Reichenbach's 'Icones Floræ Germanicæ,' have appeared, which conclude the Caryophylleæ, and contain the Celastrineæ Liliaceæ, and part of the Lineæ. The 'Flora Germaniæ exsiccata' contains at present twenty-five Centuries. Of Sturm's 'Flora Deutschlands' the 21st and 22d parts of the third division have appeared, containing the Fungi by Rostkovius. The work of Schlechtendal and Schenk with figures, mentioned in the last year's Report, has advanced in 1843 to the tenth part of the fourth volume; and that upon Thuringia to the forty-seventh part; and a new edition of the former has also been commenced. The publications by Lincke, mentioned (ib.) have both advanced to the thirty-third part. D. Dietrich has begun a work with plates on the German Cryptogamia, of which the first part includes twenty-six illuminated plates of Ferns. (Deutschland's Kryptogamische Gewächse; Jena, 1843, 8vo.)

Koch has published a second edition of his celebrated Synopsis Floræ Germanicæ, (Frankfort, 1843,) which has been augmented with numerous special researches and additions. An abridged edition of this work appeared in 1844. (Taschenbuch der Deutschen und Schweizerischen Flora von Koch; Leipsig, 12mo.) A second edition also of Kittel's 'German Flora' has been prepared. Scheele has made critical remarks upon certain German plants, but without sufficient literary aid. (In Regensb. Flora, 1843, pp. 296, 421, 557.) Of Rabenhoorst's collection of dried Fungi of the German Flora, the fifth and sixth Centuries have appeared.

German provincial Floras and similar works :—Langethal, on the north of Germany (die Gewächse des. n. D. für Landwirthe, &c., Jena, 1843, 8vo.) Schmidt on the Prussian province (Preussens Pflanzen; Danzig, 1843, 8vo. Roeper on Mecklenburg (Zur Flora M.'s Th. 1, Rostock, 1843, 8vo), containing the vascular Cryptogamia, and valuable with respect to Morphology. Scholtz, Flora of the environs of Breslau; (Breslau, 1843, 8vo.) Döll, Rhenish Flora; (Frank. 1843, 8vo), including the vegetation of the Rhine district, from the lake of Boden as far as the Moselle and Lahn, and important as regards systematic Botany. Hackl, List of Plants in the southern division of the Leitmeritzer circle in Bohemia (in the Medic. Jahrb. des österr. Staats, 1843, p. 105, &c.) More special treatises: by John, on some Plants of the neighbourhood of Berlin—in the (Bot. Zeitung, 1843, pp. 689-92); by Preuss, upon some localities for Plants in the Oberlausitz,—in the (Regensb. Flora, 1843, pp. 671-72); by Wimmer, on the Silesian Hieracia in the (Uebersicht der Arbeit. der schles. Gesellsch. für 1843); by Hampe, the latest supplement to the Harz Flora—in (Linnæa, 1843, pp. 671-74); by Traunsteiner, on the *Salices* of the Tyrol—in the (Zeitschr. des Ferdinandeums, 1842.)

Among these works the Flora of Upper Silesia, by Grabowski, is distinguished by its giving the altitudinal limits .In the Gesenke (compare Report for 1840), according to Grabowski's measurements, the extreme limits in altitude of the ligneous plants are as follows:

1. In the Fir (*Tannen*) region (1500′-3600′, accordinp to Wimmer), *Pinus Abies*, L., and *Picea*, L. reach 4000′; *Juniperus nana*, W. 4500′; *Betula pubescens*, Ehrb. and *Sorbus Aucuparia*, L. 3900′; *Populus tremula*, L. 3800′; *Pinus Larix*, L. 3000′; *Juniperus communis*, L., 2600′; *Betula alba*, L., 2500′; *Acer Pseudoplatanus*, L., 2400′; *Prunus Padus*, L., 2300′; *Pyrus communis*, L., 2200′; *Fagus sylvatica*, L., 2000′; *Alnus glutinosa*, G., 1800′; *Prunus avium*, L., 1700.′

2. In the Oak and Pine (*Kiefer*) region, *Quercus robur*,

G., 1500′; *Fraxinus excelsior*, L., 1480′; *Ulmus campestris*, L., and *Pinus sylvestris*, L., 1300′; *Taxus baccata*, L., 1200′; *Populus alba*, L., 1000′. Wheat and barley are grown up to 1000′; rye to 1800′; and oats on the average up to 2000′.

I am not as yet acquainted with Reichenbach's Memoir on the Botanical relations of Saxony (contained in the Gäa von Sachsen.) A botanical sketch of the Kylfhäuser in Thuringia, by Ekart, is merely a collection of lists of plants in those localities, which are known from Wallroth's communications. (Regensb. Flora, 1843, pp. 169-82.) Kirschleger has compared the vegetation of the Black Forest, of the Jura and of the Vosges. (Congrés scientif, 1842, and translated in the Regensb. Flora, 1843, pp. 186-94.)

Since the more general influence of climate upon the vegetation of these three mountains is the same in each, and the more so as that portion of the Jura which lies to the south of Neufchatel is excluded, the author correctly attributes the varieties of the vegetation, described by him, to the nature of the soil. The mountain-region from 2400′ to 4800′ presents these contrasts in the most marked degree. The Jura at this elevation affords 116 Phanerogamia, which are not met with in the Black Forest, nor the Vosges, which, on the other hand, present fifty-two species wanting on the Jura. So much richer in plants is the calcareous Jura, but to this abundance the nearer proximity of the Alps also contributes. The following, together with many alpine plants, are characteristic of that region: *Erysimum ochroleucum*, D. C., *Thlaspi montanum*, L., *Saponaria acymoides*, L., *Arenaria grandiflora*, All., *Linum montanum*, Schl., *Hypericum Richeri*, Vill., *Acer opulifolium*, Vill., *Genista Halleri*, Regn., *Heracleum alpinum*, L., *Centranthus angustifolius*, D. C., *Hieracium rupestre*, All., *Prenanthes tenuifolia*, L., *Sideritis hyssopifolia*, L., *Fritillaria Meleagris*, L. The Vosges, again, present a much more peculiar vegetation than the Black Forest.

The following are characteristic forms of these two mountains, which are absent from the Jura, and are also not among plants widely distributed elsewhere; *Nasturtium pyrenaicum!* Br., *Brassica Cheiranthus*, Vill., *Hypericum elodes*, L., in Lotharingia, *Angelica pyrenæa*, Spr., *Galium tenerum*, Schl., *Carlina longifolia*, Rchb., *Hieracium longifolium*, Schl., *Sonchus Plumieri*, L., *Campanula hederacea*, L., *Pyrola media*, Scr., *Digitalis purpurea*, L., and its hybrid *Epipogium aphyllum!* Rich.; of these, however, only the two marked (!) occur in the Black Forest, the rest only on the Vosges. The vegetation of the lower region also presents a variety of contrasts, according to the geological formation. The Jura limestone, together with the basalt and trachyte of the "Kaiserstuhl" are, in this respect, exactly opposed to the sandstone and granite. The following are the plants of the Jura limestone in the valley of the Rhine and on the Vorberg, 2400′: e. g. *Thalictrum montanum*, Wallr., *Hutchinsia petræa*, Br., *Althæa hirsuta*, L., *Alsine fasciculata*, M. K., *Trinia vulgaris*, D. C., *Bunium Bulbocastanum*, L., *Artemisia camphorata*, Vill., *Crepis pulchra*, L., *Melittis melissophyllum*, L., *Euphorbia verrucosa*, Lam., *E. falcata*, L., *Gymnadenia odoratissima*, Rich., *Himantoglossum hircinum*, Spr., *Orchis simia*, Lam., *Ophrys aranifera*, Huds., *apifera*, Huds., *Aceras anthropophora*, Br., *Allium rotundum*, L. Plants of the granite and sandstone are, e. g. *Sisymbrium pannonicum*, Jaq., *Mænchia erecta*, G., *Potentilla recta*, L., *P. inclinata*, Vill., *Lactuca virosa*, L.

Heufler has endeavoured to characterize the plant regions of the Tyrol. (Tiroler Bote, 1842, Nos. 19-27.) The botanical part of the subject, however, has been treated too generally, and the altitudinal limits can only be considered as approximate estimates. An evergreen vegetation of *Quercus Ilex* and *Phillyrea media* occurs only in the Sarcathal. The vegetation of the Reichenauer and Flatnitzer Alps, on the borders of Styria and Carinthia, has been described by Pacher. (Regensburg Flora, 1843, s. 803-11); this paper is only of local interest.

In the geological work on the Venetian Alps, by Fuchs, (Solothurn, 1843, fol.) of which I have no further knowledge, a section treats of the limits of vegetation in the southern Alps. Mohl has communicated observations on the arboreal vegetation in the Swiss Alps. (Bot. Zeit. 1843, p. 409 et seq.) They form a sequel to the observations of Martius, mentioned in the last year's Report. The author corrects some statements of Wahlenberg, which apply indeed to northern Switzerland, though not to the central chain, which was imperfectly examined by him. In this country *P. Abies* decreases in the higher forest region, and is replaced by an abundance of *P. Larix* and *P. Cembra.*

Near Zermatten, where the red pine does not attain the altitude of 5000′, the arboreal limit, formed by the two last-named Coniferæ, is placed as high as 7000′. The Beech and Oak also disappear on the central chain at a lower level than in northern Switzerland; the former in Oberhaslithal at 3000′, the latter at 2460′. Allowing that these and similar differences in the arboreal vegetation of the calcareous and slaty Alps, are to be referred to the geological substratum, the same explanation does not apply to the cultivated plants, in which similar relations are pointed out by V. Martius.

NORTH SWITZ.—ACCORDING TO WAHL:		CENTRAL CHAIN:
Cherry tree up to	2900′	4480′ in the Matterthal.
Apple	3000	3400
Walnut	2000	3600 in the Lauterbrunnenthal (Kastof)
Vine	1700	2500 near Stalden.
Cerealia	2700	Wheat 5400′ near Zermatten (Gaudin); Barley 6100 near Zermatten (Martius)

Mohl is inclined to refer these differences to climatic causes. He believes, that although the mean temperature of the seasons might be expected to produce a diametrically opposite effect, yet that, on the other hand, with reference to the amount of atmospheric deposit, at least to its increased quantity in the summer? as well as with regard to the hygrometrical condition of the air?

the greater elevation of the country in southern Switzerland possesses a more continental climate than the regions explored by Wahlenberg. It is certainly true that the central chain of the Alps, in its climatic relations, more nearly approaches the character of a *plateau* than do the steep, lesser, calcareous Alps; but it appears to me that the greater number of the phenomena adduced so prominently by V. Martius are explicable by the different conformation of the valleys in the slaty mountains, whilst the cultivation of the soil is limited by the form of the surface in the calcareous Alps and conglomerates.

The remarkable local differences in the altitudinal limits of the trees are also indicated in a paper by Heer, 'On the Forest Cultivation in the Swiss Alps.' (Schweiz. Zeitsch. für Land und Gartenbau, 1843.) The extremes are collected in the following table:

	NORTH SWITZ:	SOUTH SWITZ:
Fagus sylvatica	4250′	4660′ in Tessin.
On the North declivity	to 3900	
South	4550	
Acer Pseudoplatanus	4800	
On the North declivity	to 4700	
South	5000	
Pinus Picea, L.	5000	
Abies, L.	5500	5100 near Airolo.

In the Ober Engadin it ascends, on the other hand, as high as 6100′, in the Unter Engadin to 6600′.

Pinus Larix, L.	to 6000′	6500′ in Graubundten.

In the Engadin it also attains a greater elevation, and the greatest on the south side of the pass between Scarl and Münster; that near the Wormser Jochs as high as 7150′.

Pinus Cembra, L.		6500′

In the Engadin higher, and highest near Stelvio, where it attains 7280′

Pinus sylvestris, L.	to 5500′	6000′
Pumilio, H. K.	6200	6750 in Graubundten.
Betula		5000 in the Engadin. 6000 in the Albignathal.

These facts afford a scale of the influence of locality on the distribution of plants in Switzerland, an influence which causes the close approximation of so many various climates, determined by the position, inclination, and surface-formation of the valleys and heights. It is only through the complete analysis of all these relations that an isolated abnormal phenomenon can be here explained. But on the whole, these local conditions equalize each other, and the peculiarities of the Oberland and Valaise, described by Mohl, lose in general importance, when they are compared with the Engadin, a valley also appertaining to the system of the central chain, and running north-east.

Systematic works on the Flora of Switzerland, are: Hagenbach (Supplementum Floræ basileensis; Basel, 1843, 8vo.) J. B. Brown (Catalogue des Plantes qui croissent naturellement dans les environs de Thoune et dans la partie de l'Oberland Bernois qui est le plus souvent visitée par les voyageurs; Thun. 1843, 8vo: Catalogue of the Phanerogamia and Mosses, with their habitats.) Rapin (Le Guide du Botaniste dans le canton de Vaud, comprenant les descriptions de toutes les plantes vasculaires qui croissent spontanément dans ce Canton; Laus. 1843, 8vo.) Blanchet (Essai sur l'histoire naturelle des environs de Vevey, 1843, 8vo): a work with which I am unacquainted. Reuter (Supplément au Catalogue des Plantes vasculaires qui croissent naturellement aux environs de Genève; Genève, 1841, 8vo): fifty-one pages, with a figure of *Arabis hybrida*, R. The rarer plants of the neighbourhood of Pfäfers are enumerated by Kaiser. (Die Heilquelle zu. Pf. St. Gallen, 1843.) Schærer's 'Lichenes Helvetici exsiccati' have reached the 18th part, and contain 450 species. The last part is accompanied with the conclusion of the 'Lichenum helveticorum Spicilegium.'

Kirschlager gives a review of the botanical relations of the environs of Strasburg. (Congres scientif. l. c.) He enumerates on this, for the most part cultivated alluvium, 960 sp., which he divides into the following formations:—"in arvis" 290 sp.; "in pratis" 300 sp.; "in campis" (incultis, &c.) 120 sp.; "in sylvis" 280 sp.; "in paludibus" 80 sp.; "in aquis" 110 sp.; "in ripâ Rheni" 20 sp.

The meadow vegetation on the Orne, from the village of Louvigny (south of Caen) to the sea, has been described by several botanists in Normandy—Hardouin, Leclerc, Fourneaux, and Eudes-Deslongchamps. (Mém. de la Soc. Linnécne de Normandie, vol. 7.) This paper shows the influence of the soil upon the distribution of meadow plants. Where inundations occur regularly, *Agrostis vulgaris* replaces *Hordeum secalinum* and *Cynosurus*, which elsewhere are the chief constituents of the grass turf, or in places where the marine tides overflow twice a month, the *Agrostis* gives way to *Glyceria maritima* and *Festuca rubra*, var. *maritima*. Of Schultz's 'Flora Galliæ et Germ. exsiccata,' six Centuries have appeared up to the present time. The following works relate to the Flora of France: Cosson, Germain, and Weddel (Introduction à une Flore analytique et descriptive des environs de Paris; Paris, 1842, 12mo.) By the same authors, (Supplément au Catalogue raisonné des plantes de Paris; Paris, 1843, 12mo.) A new edition has appeared of Bautier (Tableau Analytique de la Flore Parisienne; Paris, 1843;) as also of Mérat entitled (Revue de la Flore Parisienne; Paris, 1843); the latter in opposition to the more exact work of Cosson, &c. Godron (Flore de Lorraine—includes the departments Meurthe, Moselle, Meuse, and Vosges; Nancy, 1843. 3 vols. 12mo.) By the same author (Monographie des Rubus, qui croissent naturellement aux environs de Nancy—Ibid. 1843, 8vo.) Desmaziéres (Dixieme notice sur quelques plantes cryptogames recemment découvertes en France—Ann. Sc. Nat. 19, pp. 335-73), contains new Fungi, especially *Pyrenomycetes*, and some *Pezizæ*.

Tulasne has described the subterranean Lycoperdaceæ of the neighbourhood of Paris, with several new species, and the new genera *Hydnobolites* and *Delastria*. (Ann. Sc. Nat. 19, pp. 373-81.)

Massot has published a table on the plant limits on the Canigou in the Pyrenees. (Comptes Rendus, v. 17; also printed in the Regensb. Flora, 1844, p. 84, and in the

Bot. Zeitung, 1844, p. 427.) These measurements are important as regards the alpine plants.

Descending from the summit, which rises to a height of 2785 met., the ligneous plants appear in the following order:

Rhododendron ferrugineum, L. (1322 m.)	2540 m.
Genista purgans, L.	—
Pinus Abies, L. (1500 m.)	2415
Sambucus racemosa, L.	2063
Betula alba	1987
Pinus Picea, L.	1950
Sorbus Aucuparia, L.	1838
Populus tremula, L.	1640
Amelanchier vulgaris, Mch.	—
Limits of cultivation of Potato and Rye, harvest in beginning of September	—
Fagus sylvatica, L.	1623 m.
Corylus Avellana, L.	—
Lonicera Xylosteum	—
Sorbus Aria, Cr.	1566
Rubus fruticosus, L.	1322
Cratægus Oxyacantha. L.	1250
Prunus spinosa, L.	1050
Ilex Aquifolium, L.	987
Cornus sanguinea, L.	—
Rye harvest middle of July	—
Castanea vesca, G.	800
Alnus glutinosa, G.	800
Sarothamnus scoparius, W. G.	—
Attempted cultivation of the vine	750
Acer monspessulanum	700
Euonymus Europæus, L.	—
Abundant cultivation of vine	550
Cultivation of olive	420

According to Bory, the indigenous oak of the mountains of Andalusia is the *Quercus bætica*, Webb., identical with *Q. Robur*, Desf., and widely distributed in Algeria. The former has named it *Q. Mirbeckii*. (Comptes Rendus, v. 17.)

Systematic remarks upon some South European Gramineæ have been communicated by Link. (Linnæa, 1843, pp. 385-407).

An interesting memoir on the character of the vegetation of New Castille has been read by Reuter before the Geneva Natural History Society (Essai sur la végétation de la Nouvelle Castille; Geneva, 1843, iv, 34 pp.) The plateau of Madrid, which is elevated more than 2000′, is bounded on the north by the Sierra of Guadarrama, (the mountains Carpétano-Vétoniques of Boissier), which are covered with snow for eight months in the year. The mean temperature of Madrid (2050′) amounts to 15° C. according to Humboldt, that of the summer to 24°·8, and of the winter to 6°·1 (Schouw); but the thermometer always falls in the winter below the freezing point, so that there is almost every year skating on the pond of the Retiro; it seldom sinks below 6°, although in 1830 it fell to 10°, and in 1802 to 11°·25 C. In summer, the thermometer occasionally rises in still air in the shade to from 37° to 41°. Rain falls only in winter and spring, with the prevailing north winds, which are cooled by passing over the mountains. In the spring these winds alternate with westerly and southerly breezes, which characterize the summer, and are accompanied with greater heat and drought. The autumn also is throughout warmer, till December. The epochs of vegetation appear to occur a month earlier than in Geneva. At the end of March, the trees were already in leaf, and the Cherry and Syringa in blossom. The vegetation of the herbaceous plants commences in the beginning of March, and is quite over by the end of June, excepting some shrubs which withstand the drought. (p. 12.)

The plateau, which presents undulating ridges of low hills, is, in the neighbourhood of the metropolis, covered for the most part with wheat and barley fields, and being destitute of wood or even of shrubs, presents the most uniform aspect, and is everywhere bounded by the same confined horizon. The plant formations are throughout dependent on the nature of the soil, and consequently fall under four classes: that of the clay, of the gypsum, of the sand, and of the granite. The argillaceous substratum stretches southwards from Madrid over the greater part of La Mancha. The hills, for example, from Aranjuez to Alcala, consist of saliferous gypsum, in the springs from which common salt effloresces and *Halophyta* flourish. To the northward and westward of Madrid as far as the mountains, the surface is composed of close-grained sand without stones, which, in consequence of the drought, acquires almost the same degree of cohesion as the clay. Lastly, the granite soil constitutes the Sierra of Guadarrama itself, and blocks of it are also scattered over the sandy surface. These mountains attain an altitude of 7-8000′, and the passes into Old Castille are about 4500′ to 5500′. Limestone is not found in the neighbourhood of Madrid; it first appears on the east towards Cuença, and together with it the extensive shrub formations of Catalonia commence, which are not found in the plateau of New Castille.

The corn on the sandy soil is but poor, on the clay it is perhaps 4′ high; "Garbanzos" (*Cicer arietinum* and "Algarrobas" (*Ervum monanthos*) are especially cultivated for food. The vine and olive occur only in sheltered places, but the latter is always small and poor. Meadows are altogether wanting; even the pastures (Kräuterwiesen) at Manzanares consist only of annual grasses and Leguminosæ, which at the approach of summer are soon choked by thorny plants; e. g. *Centaurea calcitrapa, Eryngium campestre, Ononis spinosa, Xanthium spinosum*, or where the ground is more marshy are replaced by large tufts of *Juncus acutus* and *Scirpus holoschœnus*. According to ancient chronicles, it would appear the elevated plain of Madrid was formerly wooded (p. 13), and remains of these woods, in the form of stunted, widely scattered *oaks*, especially *Q. Ilex*, are still visible on the sandy hills of the Casa de Campo, and of the Prado, mixed with leafless Genisteæ (*Retama sphærocarpa, Sarothamnus scoparius*), but these, together with the trees growing on the banks of the river (*Salix, Populus, Ulmus, Fraxinus angustifolia*, Vahl.), and some shrubs (*Tamarix gallica, Cratægus, Rosa, Rubus, Rhamnus, Osiris*), are the only ligneous plants of the plateau. It is evident that the want of wood is only the consequence of the aridity;

this is proved by the lofty growth of the plantations in the valley of the Tagus near Aranjuez, as well as of the more recently planted avenues in Madrid, which are maintained by irrigation.

Summary of the Plant formations:—(1) Argillaceous soil. In the fields the first plants which appear are *Brassica orientalis, Lathyrus erectus*, Læg., *Turgenia, Glaucium corniculatum, Polygonum Bellardi;* these soon become choked by thorny Synanthereæ; *Picnemon, Scolymus, Xanthium, Onopordon nervosum*, Boiss.; at the end of summer the only surviving plant is *Ecballion*, which at last develops its fruit, *Crozophora* also is abundant. The uncultivated plains and hills (campi) are covered with aromatic plants, a class which in Spanish is termed "Tomillares" from *tomillo* (Thymus). Here the vegetation consists of *Thymus tenuifolius, Teucrium capitatum*, and *Sideritis hirsuta*, with which various plants, characteristic of the country, are mixed, e. g. *Queria, Minuartia, Astragalus macrorhizus*, and *narbonensis, Echinops strigosus, Cynosurus Lima, Stipa barbata.*—Riparial plants are: *Althæa officinalis, Lavatera triloba, Cochlearia glastifolia, Gypsophila perfoliata, Sonchus crassifolius.*—Halophyta flourish most luxuriantly in the pool of Ontigola, near Aranjuez: *Spergularia marina, Frankenia pulverulenta, Erythræa spicata, Atriplex, Suæda setigera, fruticosa*, and *maritima, Salicornia, Hordeum maritimum*, and (cultivated) *Salsola Soda.*

(2) Gypsum. The vegetation peculiar to this substratum is, together with the soil, extended through the whole of Arragon. The steep declivities are covered with plots of *Frankenia thymifolia*, associated with *Peganum, Lepidium subulatum*, and *Cardamine, Helianthemum squamatum, Gypsophila struthium, Zollikoferia, Salsola vermiculata.*—Other characteristic plants are, *Vella Pseudocytisus, Iberis subvelutina*, Gass., *Herniaria fruticosa, Centaurea hyssopifolia, Statice dichotoma*, Cav. Extending from the south of Spain to Aranjuez, and clothing

the ridges of the downs, grows the social *Stipa tenacissima*, which is used for a variety of purposes; with this are associated several Cisteæ, *Pimpinella dichotoma, Rosmarinus, Fritillaria.* Many isolated thickets are formed of *Quercus coccifera*, with *Rhamnus lycioides, Retama sphærocarpa*, and *Bupleurum frutescens.*

(3) The sandy soil is characterized by numerous Cruciferæ, which perhaps nowhere present such a variety of species, nor grow individually so much associated together as here; and in spring they give a yellow colour to the cultivated plains. With this prevailing colour are also mingled blue Boragineæ and white Anthemideæ; *Diplotaxis catholica* and *virgata, Sisymbrium contortum* and *hirsutum*, Lag.; *Brassica lævigata* and *valentina, Sinapis heterophylla*, Lag.; *Anchusa undulata* and *italica, Echium violaceum; Anthemis mixta, pubescens,* and *arvensis;* and also *Malcolmia patula, Hypecoum grandiflorum* and *pendulum, Ræmeria hybrida, Cerastium dichotomum, Veronica digitata, Aphanes cornucopioides,* and several species of *Linaria*, particularly the extremely social *L. ramosissima*, Boiss., and *L. hirta* and *spartea.* When this rich vegetation has disappeared, the fields are overgrown with *Tanacetum microphyllum*, D.C. The "tomillares" occupy extensive tracts, and here consist of *Thymus tenuifolius* and *Mastichina, Santolina rosmarinifolia,* and *Lavandula pedunculata.* Among these, in the spring, is seen a multifarious vegetation of annual herbs and grasses; several Cisteæ, particularly *Helianth. sanguineum*, Lag., and *Ægyptiacum, Astrolobium durum, Campanula Loefflingii, Myosotis lutea, Pyrethrum pulverulentum, Prolongoa pectinata, Aira involucrata, minuta, lendigera,* and *articulata, Holcus setiglumis, Bromus ovatus, Psilurus anistatus, Hordeum crinitum.* After the disappearance of these, larger herbaceous plants spring up, especially Umbelliferæ: *Thapsia villosa, Margotia laserpitioides, Daucus crinitus, Magydaris panacina, Pimpinella villosa, Verbascum sinuatum* and *pulverulentum, Ruta montana, Onopordon illyricum, Centaurea ornata.*

(4) On the granite of the Sierra of Guadarrama, these "tomillares" extend up to about 4000′, becoming gradually mixed with other plants. The greater moisture of the soil produces here several central European plants. Extensive pasture grounds for horned cattle, which are protected by fences from the flocks of sheep (and termed "Dahesa"), are covered with bushes of *Quercus Toza* and *faginea;* on the rocks grow *Jasminum fruticans, Lonicera etrusca, Daphne Gnidium, Juniperus Oxycedrus.* Here also Rose-Cistuses first appear; *C. ladaniferus* and *laurifolius.* Several new species of plants were found by Reuter in this region, which for the rest differs but little from the plateau, e. g. *Ranunculus carpetanus, Pœonia Broteri, Silene Agrostemma, Hispidella;* and also are here found, *Caucalis hispanica,* Lam., *Digitalis thapsi, Dianthus lusitanicus, Antirrhinum hispanicum,* Chav., *Macrochloa arenaria;* several Orchideæ, Irideæ; under the shade of the oak bushes, *Arenaria montana, Bunium denudatum, Valeriana tuberosa, Scilla nutans.* The higher mountain region, above 4000′, is that of the Genistæ, since it is almost entirely covered with *Genista purgans.* Solitary shrubs of *Juniperus* and *Adenocarpus hispanicus* occur; upon the latter of which lives the true "Cantharis." In this shrub region are found *Arabis Boryi,* Bois., *Linaria delphinoides,* Lag., *saxatilis,* Chav., and *nivea,* Boiss., *Senecio Tournefortii* and *Duriæi,* Gay, *Narcissus apodanthos.* Some higher points rise above this Genista region, and bear a thick firm turf of *Festuca curvifolia,* Lag., mixed with *Armeria juniperifolia,* W. Of alpine plants there are only a few traces, such as *Saxifraga nervosa* and *hypnoides, Ledum hirsutum* and *brevifolium,* the annuals of the sandy plain of Madrid, however, flourish even here. In the neighbourhood of the mountain-rivulets the turf is composed of *Nardus stricta* with *Pedicularis sylvatica, Jasione carpetana* and *Veronica serpyllifolia.*

It is only on the northern declivity of the Sierra that forests of a bifoliate fir (*P. sylvestris*) occur, and here large tracts are covered with *Pteris.* The Sierra de

Gredos, the most westerly and highest elevation of this ridge, differs but little in its vegetation, and is in a still higher degree poor in plants, and of a uniform aspect.

Much more interesting appear to be the mountains south of Toledo, which were explored by Reuter at too late a season of the year. These extensive rounded hills belong to the vegetation form of the Monte Baxo, under which the Spaniard understands the oak bushes which grow in clumps. But the contrast presented by the Sierra Nevada is much greater, since all the plants which are common to this and that of Guadarrama, grow, without exception, also in Asturia and on the Pyrenees.

Reuter collected above 1250 species of plants in New Castille. The new species (about 50) are published by him, in concert with Boissier, in the 'Bibliothèque Universelle de Genève' (1840). The families most rich in species of this collection are the following: 143 Synanthereæ, 123 Gramineæ, 110 Leguminosæ, 76 Cruciferæ, 61 Caryophylleæ, 54 Labiatæ, 52 Scrophularineæ, 38 Rosaceæ, 33 Ranunculaceæ, 38 Boragineæ. The recurrence of a series of Castilian plants in the Crimea, without their being found in any of the intermediate countries is remarkable. Reuter explains this extraordinary fact by the analogy of the extreme climates, and of the geological substratum, which is especially evident in the heavy clayey soil and saliferous gypsum. The plants to which this explanation applies, are: *Lepidium perfoliatum*, *Menìocus linifolius*, *Mollugo cerviana*, *Minuartia dichotoma*, *Queria hispanica*, *Callipeltis*, *Campanula fastigiata*, *Veronica digitata*, *Acinos graveolens*, *Rochelia stellulata*, *Plantago Loefflingii*.

Contributions to the Flora of Italy. Of Bertoloni's 'Flora Italica' the fifth volume has appeared, containing the 11, 12, and 13 classes (Bologna, 8vo); and also the second volume of Moxis' 'Flora Lardoa,' an original work, indispensable in the systematic study of the plants of South Europe; this volume, in which De Candolle's arrangement of the families is followed, includes the Rosaceæ and the whole of the Ericeæ, from No. 411-779, together with Pl. 73 to 93—(Turin, 1840-43, 4to.) Puccinelli (Synopsis plantarum in agro Luccensi sponte nascentium Lucca, 1842.) Id. (Additamentum ad Synops. Lucc.—Giornale Bot. Ital. fasc. 1.) Gussone (Synopsis Floræ Siculæ, 1842:—a new working out of his Prodromus) Todaro (Orchideæ Siculæ, 1842.) Gasparrini (Nonnullarum plantarum descriptiones—Rendiconto, accad. Nap. 1842, extracted in the Botan. Zeitung, 1843, s. 643); 1 *Geranium*, and 1 *Fumaria* from Calabria, 1 *Cerinthe* from Naples, 1 *Sedum* from the Nebrodes.

Ball has published some remarks on his botanical tour in Sicily, and has taken occasion to give a very complete list of the Sicilian Gramineæ (240 sp.). (Ann. Nat. Hist. 11, pp. 338-51.)

The statement in the last year's Report, that Schouw had indicated *Opuntia* and *Agave* as occurring in Pompeii, appears, according to the Bot. Zeit. (1844, s. 581), to have originated only in an erroneous translation of his account.

On the vegetation around Pola, in Istria, are some remarks containing only what is known, by Von Heufler, (in the Regensb. Flora, 1843, s. 767.)

Zanardini, in a new systematic memoir, has completed his catalogue of the Dalmatian Algæ up to 272 species (Saggio di classificazione della Ficee; Venezia, 1843, 64 pp. 4.)

In Davy's work on the Ionian Islands (Notes on the Ionian Islands and Malta. London, 1842, 2 vols. 8vo,) are contained two years' observations on the climate of Constantinople, from which I extract what is most important as regards vegetation. (ii, p. 400.)

MEAN TEMPERATURE.

	1839.	1840.
January . . .	= + 2·2°	= + 4·8° C.
February . . .	= + 5·6	= + 4·1
March . . .	= + 4·4	= + 4·6
April . . .	= + 6·1	= + 7·7
May . . .	= + 11·1	= + 15·5
June . . .	= + 21·1	= + 20·6
Max. of temp. . .	+ 31·7°	= + 32·7° C.
Min. . .	— 1·7	= — 4·4

	1839.	1840.
July . . .	= + 22·2°	= + 24·5° C.
August . . .	= + 26·7	= + 22·9
September . .	= + 20·	= + 20·6
October . . .	= + 17·2	= + 15·6
November . .	= + 13·9	= + 12·7
December . .	= + 7·8	= + 3·2
Mean temp.	= + 13·3	= + 14·7 C.

Prevailing winds, N.E. (215 and 199 days), S.W. (99 and 113 days). Rain fell (102 and 122 days). Amount of rain, 1840=31·65″; May, June, July, and August, almost without rain; between 1″ and 2″ in November; between 2″ and 3″ in February and April; between 3″ and 5″ in May, September, October, December; above 6″ in January.

According to Davy's observations, the temperature of the springs in the Ionian Islands, at the level of the sea, fluctuates between 16° and 18° C.

The mean temperature of Malta (i, p. 261), equals 17·8° C.; the max. temp.=31·1°, and the min. temp.= +5° C.

The same work contains an important series of observations on the saline contents and temperature of the Mediterranean Sea. The common opinion that it is specifically lighter and warmer than the Atlantic, is in no way supported by these observations.

In Forbes's researches on the distribution of the lower animals in the Ægean Sea, the Algæ are also considered, though only in a general way. (Report on the Mollusca and Radiata of the Ægean Sea; from the Report of the

British Association, &c. for 1843.) In the eight regions admitted by Forbes, from 0° to 1380′ deep, the prevailing Algæ are distributed in the following relations:

(1) 0—12′.

a. Above low-water mark, *Dictyota dichotoma* and *Corallina officinalis.*

b. Below low-water mark. The characteristic Fucoid is *Padina pavonia.*

(2) 12′—60′. The mud is usually green from the presence of *Caulerpa prolifera.* The sandy bottom is rich in *Zostera oceanica.*

(3) 60′—120′. *Caulerpa* and *Zostera* gradually diminish in quantity.

(4) 120′—210′. Fucoids are abundant, especially *Dictyomenia volubilis, Sargassum satirifolium, Codium Bursa* and *flabelliforme, Cystosira.* Corallines increase. Nulliporæ and Spongiæ frequent.

(5) 210′—330′. Fucoids diminish in number; *Dictyomenia volubilis* is rare, *Rytiphlœa tinctoria* and *Chrysimenia uvaria,* more abundant. The bottom is constituted for the most part of Nulliporæ and shells.

(6) 330′—474′. Fucoids are extremely rare. The sea bottom consists of Nulliporæ. Although at this depth, the higher Algæ scarcely any longer exist, yet many phytophagous Testacea are met with, from which circumstance the opinion that the Nulliporæ are plants receives new and very important support.

(7) 474′—630′. The Algæ, except the Nulliporæ, which still usually constitute the sea bottom, entirely disappear.

(8) 630′—1380′. Here the Nulliporæ also appear to be wanting; as the sea bottom from this point onwards consists of yellow mud, with remains of Foraminifera.

Of my 'Spicilegium Floræ rumelicæ et bithynicæ,' in which about 2000 plants have been systematically studied, the first volume containing the Polypetala (almost the half of the whole), has appeared. (Brunswick, 8vo.) On the conclusion of this work I shall recur to it.

The Report on Koch's journey by the Danube to Constantinople, seems to have appeared without the knowledge of the author (Bot. Zeitung, 1843, s. 605), and must be passed over on account of the uncertainty of the names of plants (e. g. *Pinus Cembra* and *Ammodendron* on the Bosphorus).

Tenore has published remarks upon Sibthorp's 'Flora Græca,' which should not be overlooked in the comparison of the Italian and Greek Flora. (Rendiconto accad. Nap. 1842, extracted in Bot. Zeitung, 1843, s. 877.)

Schultz has proposed a considerable number of new Greek *Orobanchæ* (Reg. Flora, 1843, s. 125); but the descriptions are defective, and the species, without doubt, for the greater part untenable.

II.—ASIA.

Aucher-Eloy's oriental journals have been edited by Count Jaubert. (Relations de Voyages en Orient de 1830-38, par Aucher-Eloy, revues par le Cte. Jaubert; Paris, 1843, 2 vols. 8vo.) The scientific contents of this work are not considerable, but the importance of the author's collections, which have already for the most part been arranged, invests even a simple Itinerary, from which the locality and time of flowering of most of the plants can be determined, with a great degree of interest. Before entering upon the review of these travels, and as Aucher-Eloy has made no estimates of altitude, I will premise an observation of Ainsworth, which occurs in his last book of travels (Travels and Researches in Asia Minor, Mesopotamia, Chaldea, and Armenia. London, 1842, 2 vols. 8vo., ib. ii, p. 374), and in which the altitudinal relations of a part of the regions explored by Aucher-Eloy have been strikingly characterized from his own measurements. Asia Minor is a highland, encircled by a level or hilly littoral tract, to which on the north side, a second terrace of less elevated plains succeeds, e. g. that of Duzcha, E. of Nicomedia, 250′; of Boli, 570; of Vezir Köpri, above the mouth of the Kizil-Irmak, 800′, &c. Thence commences on the south, the elevated plateau, which, descending gradually from Persia towards the Ægean Sea, is near Angora, 2700′, and even near Kastamuni, close to the Black Sea, S.W. of Sinope, still 2400′ high, but rising near Erzerum to a height of 6000′. This plateau, with its scattered conical hills, the highest of which, that of Argäus, near Cæsarea, according to Hamilton, rises to 12809′, contains numerous basins, having no exit for the water; viz., Ak-Scher, 2300′; Konia, 2200′; the great salt lake, Koch-Hissar, south of Angora, 2800′; Erekli, on the northern base of the Taurus, 2600′; Kara-Hissar, near Cæsarea, 3420′; the lake Van, 5460′; and Urmia, 4300′. The Taurus, or southern border chain of this great highland, descends on the south abruptly, partly to the littoral tract and partly to the plains of Assyria and Mesopotamia, the latter of which are nowhere more than 700′ above the sea.

The first journey of Aucher-Eloy occupied from November 1830 to October 1831. It included Egypt, where he remained from December to March, and Syria, where he passed the months from April to July; August he devoted to a visit to Cyprus.

The imperfect journal of 1832 shows that Aucher-Eloy in this year explored Smyrna and Rhodes, whence he returned by way of Moylah and Guzel-Hissar. The third journey is comprehended in the year 1834. In May he arrived at Cæsarea from Constantinople, by way of Nicomedia and Angora; in April, at Scanderoon and Antioch, by way of Tarsus; in May he explored the country about Aleppo and Aintab: between Antioch and Aleppo he remarked the sudden transition from the Mediterranean to the Syrian vegetation (vol. i, p. 84); in June he crossed the passes of the Taurus to Malatia, on the Euphrates, and followed that stream downwards to the vicinity of Arabkir, and proceeded, in July, by Erzingan to Erzerum. Fourth journey in 1835. February, Constantinople, Brussa, Kutaja, Ophium, Kara-Hissar, Ak-Scher; March, Konia, Adana: *Crocus*, *Hyacinthus*, *Anemone coronaria*, and others, in flower on the 9th March on the southern declivity of the Taurus. Skanderoon: *Phœnix* abundant on the coast; groves of *Myrtus*, *Laurus*, *Styrax*, and *Arbutus Andrachne* towards Antioch. Aleppo: the period of vegetation of the steppe lasts from the end of February to June. (Ib. p. 177.) April: Bir, Mardin, Mossul: as prevailing steppe-plants between the two latter towns, are mentioned *Serratula cerinthefolia*, D. C., *Sinapis oliveriana*, *Avenæ* sp. (Ib. p. 191.) May: along the Tigris to Bagdad; banks of the river covered with *Tamarix gallica*, *Populus euphratica*, Oliv., *Capparis leucophylla*, *Sinapis lævigata;* below Dor (34° N.L.) the Date-palm becomes abundant; considerable palm groves near Hilla and Kerbela; prevailing plants of the saline steppes: *Tamarix pycnocarpa*, Decaisn., *gallica*, *Chenopodium fruticosum*, *Zygophyllum simplex*, *Peganum*, *Fagonia Bruguieri*, *Cucumis* sp., *Ajuga elongata*, M. B., *Savignya ægyptiaca.* (ib. p. 227). June: Kermanschah; limits of *Phœnix* towards Persia, near Hadschi-Kara-Khani, S.W. of Elluan (ib. p. 231), Hamadan, ascent of the Elvend. July: Scheschnau, Ispahan. August: excursion to Zerdaka, a mountain lying to the S.W. (32° N.L.), the height of which Aucher Eloy estimates at more than 10,000′; journey continued by Cashan to Teheran. September: excursion to Demavend, Kasbin, Tauris. The chain of the Elbruz presents no Coniferous region. The forests consist of *Quercus*, *Fagus*, *Ulmus*, *Celtis*, *Diospyros*, *Gleditschia caspica*, *Acacia Julibrissin*, *Platanus*, succeeded by bushes of *Paliurus* and *Juniperus hispanica*, A. E, in the alpine region, another *Juniperus*, *Rosa*, and *Berberis.* (Ib. p. 335.)

Fifth journey in 1836.—Smyrna, Chios, Syra, Athens, Parnassus, Eubœa, Thessaly, Olympus, Hajion-Oros, Skyros, Lemnos, Imbros, Hellespont, Brussa.

Sixth and last journey, 1837 and 1838.—March: Nicomedia, Angora. April: Tokat, Baibut. May: Erzerum, Koi, Lake Urmia. June: Tauris, Ardebil, coast of Ghilan, Rescht. July: Erzevil on the southern declivity of the Elbruz. August, September: exploration of that mountain, second ascent of the Demavend. September to December: remains in Teheran. January: Ispahan, Schiraz; spring vegetation commences in the middle of January with a *Bulbocodium* (*Colchicum crocifolium*, Boiss.), and in February the country is covered with flowers; the only rainy season is from the 15th January, to the 15th March Bushire on the Persian Gulf. February: Dscharun, Lar., *Mimosæ* become frequent; Bender-Abassi. March: passage to Muscat, the coast near Sohar is covered with palm groves (vol. ii, p. 545), excursion inland as far as the mountain Akadar (about 5000′ high). April: passage to Bender-Said, and back to Bender-Abassi. May: Forg, Darap, limits of palm vegetation between Darap and Fasa (ib. p. 600), Shiraz. June: returns to Ispahan, where he dies in October.

Ainsworth (l. c. et sup. vol. ii, p. 131) describes the annual course of vegetation in the environs of Mossul. During the moist February, the mean temperature of which = 10° C., the vernal plants, which constitute the only adornment of the steppe, bud forth. In the beginning of March, *Anemone* and *Narcissus* flower; in the second week of the same month, species of *Ranunculus*, the Fig, and Apricot shoot; in the third week, flowering Cruciferæ and Orchideæ, *Ranunculus Asiaticus* and *Traganth-Astragalus*. Towards April, about twenty Phanerogamia were in flower, viz., *Gladiolus*, *Sternbergia*, *Trollius asiaticus*, and a small Anthemideous plant; the almond trees blossomed, and the water-melon put forth buds. In the latter half of this month, the temperature = 15° C. With May commenced the dry season; to the spring grasses now succeeded other species of *Chrysurus*, *Dactylactenium*, &c.; the prevailing Phanerogamia were Euphorbiæ and Synanthereæ; the corn-harvest lasted from the middle to the end of the month, at which time the mean temperature = 30° C., now all the Phanerogamia began to wither, and only a white *Trifolium* and *Nigella damascena* continued in flower. Finally, no plant remained except the prevailing steppe-plants, species of *Artemisia* and *Mimosa*. In July the heat reaches 40° C., and from this time the hibernation of the vegetation continues till the following year.

As the most abundant plants of the Mesopotamian steppes, the light red soil of which, according to Aucher Eloy, rests upon a calcareous formation, with the rolled fragments of which it is mixed, Ainsworth enumerates (ib. p. 177) *Artemisia fragrans* and *Absinthium;* here and there are found other social plants, e. g. *Allium*, *Rœmeria*, *Silene*, *Erigeron*, (*Aster pulchellus*, Ains.), Anthemideæ, &c. Where the ground is less arid, an *Avena* prevails for miles together, together with some other Gramineæ and Synanthereæ, *Chrysanthemum*, *Gnaphalium*, *Crepis*, *Centaurea*. The steppe is nowhere altogether barren, but bare tracts are often only covered with lichens, especially with a gray *Lecidea* with black apothecia, a *Cetraria*, and some *Verrucariæ*.

The region of oak forests in the high mountains of Kurdistan, near Amadia, extends from 1500′-2500′, according to Ainsworth's measurements. (Ib. p. 194.)

On the Lake Urmia, the steppe-vegetation consists of almost the same plants as in the low-lying country of Mesopotamia and Babylon, although its level is almost 4000′ higher. (Ib. p. 301.) But the Artemiseæ are for the most part represented by species of *Traganth-Astragalus*, *A. verus*, and *tragacanthoides*. Where the steppe is free from salt, *Nigella damascena* grows, together with *Capparis spinosa* and *ovata*, as near Mossul, or the surface is covered with *Ononis* and a *Mesembryanthemum*, which flourishes as near Hilla. The vegetation of the saline steppe on the Lake Urmia consists of Chenopodeæ: *Salsola*, *Salicornia*.

M. Wagner ascended the Great Ararat, and found the arboreal limits to be constituted by some tufts of birch, at an elevation, estimated by Parrot, to be 7800′. The mountain declivities of Armenia, however, are almost as bare of trees as the elevated plains. The traveller was assured by the natives, that forests formerly existed in districts at present entirely bare. (Augsb. Zeit., 1843, No. 214.)

The systematic works connected with the Flora of Hither Asia, have made considerable progress. Of Boissier's 'Diagnoses Plantarum orientalium' (vid. last Report), the second and third parts have appeared, and this important work will be concluded in 1844 with the fourth and fifth parts. The new species described in it belong to the following families.—5 Rhamneæ from Persia, Kurdistan, and Cilicia; 1 *Rhus* from Muscat; about 180 Leguminosæ, of which 54 are Persian, for the most part *Astragali* (39), two species of *Taverniera,* 1 *Crotolaria* from Bender-Abassi, and 1 *Tephrosia,* the rest for the greater part from Asiatic Turkey; also about 10 *Astragali,* then follow *Trifolium* (11), *Trigonella* (10), *Onobrychis* (9); but many species are not as yet sufficiently determined, for comparison with those of Sibthorp and Willdenow; 10 Rosaceæ, mostly *Potentillæ* from Anatolia, 1 *Cotoneaster* from the Bithynian Olympus, found by Boissier, 2 *Amelanchier* species; 5 Paronychieæ with a new genus *Sclerocephalus* (*Paron. sclerocarpa,* Decaisn.), indigenous on Sinai and near Muscat (Mascate); 1 Reaumuriaceous plant; *Eichwaldia Persica* from the plateau of the Persian steppes. 6 Crassulaceæ, among which 3 *Umbilici* from Persia and Babylon; 6 *Saxifragæ* from Cadmus, Bithynian Olympus, Taygetus and Parnassus; the numerous Umbelliferæ have been published in the 'Ann. d. Sci. Nat.' for 1844; about 45 Rubiaceæ, many of which, however, must be reduced, the most remarkable are the *Wendlandia,* found by Kotschy in Kurdistan, and the new genus *Mericarpæa* from Mesopotamia; 8 Valerianeæ; 13 Dipsaceæ. Above 40 Synanthereæ, of which the most numerous are *Anthemis* (9) and *Centaurea* (8), though with several of the species untenable; a newly instituted genus *Cephalorrhynchus* with the habit of *Crepis pulchra,* found by Boissier in Lydia; 6 Campanulaceæ from Anatolia; 1 Primulaceæ; 2 Asclepiadeæ; 1 Convolvulaceæ; 17 Boragineæ; 47 Scrophularineæ, amongst the most numerous of which is *Verbascum* (18) mostly from Anatolia, *Scrophularia* (9), *Veronica* (9); what is remarkable, 1 *Gymnandra* near Erzerum, 1 *Wulferia* near Seleucis; 1 Acanthaceæ from Caria; 65 Labiatæ, among which are *Salvia* (7), characteristic of Persia, *Nepeta* (5), *Phlomis,* 2 *Otostegiæ,* 1 *Lagochilus,* and the two new genera *Zataria* and *Sestinia;* 3 Polygoneæ; 3 Santaleæ. 3 Aristolochiæ. 7 Euphorbiaceæ; 1 *Orchis.* 15

Liliaceæ, with the new genus *Chionodona* found by Boissier in the alpine region of the Tmolus, near Sardis; 4 Colchicaceæ: 13 Gramineæ, with the new genera *Rhizocephalus* from Mesopotamia, and *Nephelochloa* from Caria. In the appendix are contained: 1 Fumariaceæ from Spain (*Aplectrocapnos*), 5 Cruciferæ, 4 Caryophylleæ, 1 Lineæ, 2 Rutaceæ, 1 Leguminosæ, 1 Dipsaceæ, 3 Gentianeæ, among which is a *Swertia* from Persia, also published by me in De Candolle's 'Prodromus.'

Henzel's illustrated work, mentioned in the former annual Report, is entitled 'Illustrationes et descriptiones plantarum novarum Syriæ et Tauri occidentalis' (Stuttgard, 1843, fasc. i, with 14 lithographic plates, 4to.) This livraison contains, besides complete descriptions of the species published in the 'pugillus:' 12 Leguminosæ, with the new genus *Hammatolobium* from the Taurus; 2 Rosaceæ (*Potentilla*); 1 Geraniaceæ; 1 *Euphorbia*; 4 Hypericineæ; 18 Caryophylleæ, chiefly species of *Silene* and *Dianthus*; 4 Violarieæ; 7 Cruciferæ; 1 Ranunculaceæ; 3 Crassulaceæ; 10 Umbelliferæ.

The 'Illustrationes plantarum orientalium' of Comte Jaubert and Spach (vide last Report) make rapid progress. The first volume of 100 plates was completed in 1843, and the second is already commenced with the 12th livraison. The following genera have been completed: *Argyrolobium, Cicer, Hypericum, Gaillonia, Statice, Quercus*. I shall afterwards refer to this work more in detail. In the 'Ann. d. Sc. Nat.' Spach has at the same time discussed several oriental genera, particularly *Spartium, Leobordea, Argyrolobium, Ebenus, Amygdalus, Gaillonia,* and the section Armeriastrum of *Statice*.

Schlechtendal has described some plants collected by Kotschy in Kurdistan (Linnæa, 1843, pp. 124-28): 3 Umbelliferæ, with the new genus *Polycyrtus*, 1 *Fedia*, 1 *Althæa*, 1 *Hyosciamus*. 7 new Umbelliferæ from the same source have been described by Fenzel (Regensb. Flora, 1843, s. 457-63); among which are the new genera *Callistroma, Elæosticta, Anisopleura, Uloptera*.

The Flora of Cyprus has been composed by Pöch, and the work has been founded principally on an herbarium collected in that island by Kotschy in 1840. (Enumeratio plantarum, hucusque cognitarum ins. Cypri; Vindob. 1842, 8vo, pp. 42.)

In the whole 310 species are enumerated, of which four are given as new: *Pterocephalus multiflorus*, *Teucrium Kotschyanum*, *Quercus alnifolia*, *Crocus veneris*. The diagnoses of these have been given in the 'Regensb. Flora,' 1844, s. 454. Flotow has determined some lichens collected in Cyprus. (Linnæa, 1843, s. 18-20.)

I have, unfortunately, not yet obtained C. Koch's 'Travels in the Caucasus.' His list of Caucasian and Armenian plants, however, has been previously published. (Linnæa, 1843, s. 31-50, and s. 273-314.) The following families were treated of in the past year:—5 Caprifoliaceæ, 21 Rubiaceæ (new, 1 *Galium*); 7 Valerianeæ (new, 1 *Dufresnea*, 1 *Valerianella*); 16 Dipsaceæ (new, 2 *Scabiosæ*); 178 Synanthereæ (new, 1 *Centaurea*, 3 *Cirsia*, 1 *Carduus*, 1 *Anthemis*, 1 *Pyrethrum*, 2 *Senecio*, 1 *Antennaria*, 2 *Podosperma*, 1 *Scorzonera*, 1 *Lactuca*, 2 *Crepis* species, 2 *Mulgedia*); 16 Campanulaceæ, 2 Cucurbitaceæ, 7 Ericeæ, 1 *Diospyros*, 1 *Ilex*, 2 Oleineæ, 2 Asclepiadeæ, 2 Apocyneæ, 10 Gentianeæ, 3 Convolvulaceæ, 10 Solaneæ, 67 Scrophularineæ (new, 2 *Verbascum*, 1 *Celsia*, 2 *Scrophularia*, 1 *Linaria*, 3 *Veronica*, 1 *Gymnandra*, 1 *Odontites*, 1 *Pedicularis*); 10 Orobancheæ (new, 1 *Phelipæa*, 2 *Orobanche*-species); 1 *Sesamum*, 1 *Globularia*, 1 *Verbena*, 81 Labiatæ (new, 2 *Ziziphora*, 1 *Satureja*, 1 *Micromeria*, 1 *Lamium*); 43 Boragineæ (new, 1 *Omphalodes*, 1 *Caccinia*, 1 *Onosma*); 16 Primulaceæ, 5 Plantagineæ, 1 Laurineæ, 2 Thymeleæ, 3 Eleagneæ, 2 Santaleæ, 24 Chenopodeæ (new, 1 *Spinacia*, 1 *Halimocnemis*), and the new genus *Halanthium* from the Araxes.

Trigonometrical measurements of the altitude of the Caucasus above the level of the Black Sea, by Fuss, Sabler, and Sawitsch differ materially from the previous statements. For three of the most known mountains they have been communicated by Humboldt. (Asie Centr. ii, p. 57.) The western peak of the Elbruz measures 2882 toises (18493 English feet); the eastern 2880 toises; the Kasbeck 2585 toises; the Beschtau 710 toises.

Basiner gives a concise description of the autumnal vegetation on the sea of Aral, in his 'Journey from Orenburg to Khiva.' (Bull. Petersb. ii, pp. 199-204.) The steppe between the Caspian Sea and that of Aral is called "Ust-Jurt;" it was traversed by Basiner, and, according to the report of Tschihatscheff, forms a plateau lying 500′ above the plain of Orenburg. (Humb. Asie Cent. iii, p. 558.) The last-named officer, who accompanied the unfortunate expedition of the Russians against Khiva, has given an account of the extreme climate of this region, where the cold in winter descends to — 43·7° C., whilst in summer it may be observed to reach + 42·2° C. When Basiner travelled with an embassy from Orenburg to Khiva, by the same route, the steppes were already burnt up by the summer heats.

Between Orenburg and the Aral he observed in many places the plain covered for miles together with *Salsola arbuscula*, and *Atraphaxis spinosa*. On the rocky declivities of the "Ust Jurt," above the Aral, these were mixed with other Chenopodeæ. On the sand hills *Pterococcus aphyllus* was particularly abundant, easily distinguished by the slender leafless branches, and the fruit dependent on filiform peduncles.

Two shrubs vegetated among the testaceous tertiary rocks on the Aral, *Tamarix ramosissima*, Led., and the frequently mentioned "Saxaul" (*Anabasis Ammodendron*, C.A.M.), which resembles a bundle of green painted twigs. Further to the south near Aiburgir, N.W. of Kunä-Urgendsch, Basiner met with a large and moderately thick grove of "Saxaul," in which stems 15′ high occurred. This was the first wood after passing the Ileck, but a wood without leaves of any kind, although verdant and blooming.

The other characteristic plants of the "Ust-Jurt" coincide with the usual forms of the steppes of South Russia, and they extend also as far as Khiva. In Khiva *Karelinia caspia*, Led., and *Alhagi camelorum*, Fisch., are generally distributed, and *Salsola subaphylla*, C.A.M., and *Halimocnemis sclerosperma*, C.A.M., are not unfrequent. The saliferous loamy soil, however, of Khiva was in many places completely bare of plants. The meadows of the Kanat, so celebrated in the East, are indebted for their existence only to artificial irrigation, and in them *Poa pilosa*, *Setaria glauca*, *Melilotus*, and *Plantago*, contend with the Chenopodeæ, *Kochia hyssopifolia*, and *Atriplex Hermanni*. The embassy returned, in the middle of winter, to the western bank of the Amu-Deria, which presents a shrub formation of *Elæagnus angustifolia*, L., *Halimodendron argenteum*, D.C., *Tamarix ramosissima*, Led., and *Populus diversifolia*, Schrk. At the end 3 new species are described: 1 *Asperula*, 1 *Lepidium*, and the fruit of *Sium cyminosma*, which is cultivated in Khiva, supplies the place of *S. Sisarum*.

The remarkable journey of Middendorf in northernmost Siberia, almost to the promontory of Taimoor, may be said to have approached the limits of the next world. (Erman's Archiv für Russland, 1843. H. 3.) Descending the river of that name, the traveller did not turn back until he had attained the 76° N.L., when he had nearly reached the open Arctic Sea, under unspeakable difficulties. He then lay sick eighteen days, and forsaken by his companions during the month of September, buried in the snow on the Lake Taimoor, and was with difficulty saved. The last traveller in this region had been Laptiew (1739-1743), who advanced to 77° 29′, and traces of whose expedition were discovered by Middendorf. The whole peninsula on the Lake Taimoor is inhabited by only two Samoiede families, who pasture their herds of reindeer there in the summer, and drive them southwards in the winter. The collection of objects of natural history made under 74° N.L. is not yet arranged. Middendorf found arboreal vegetation even beyond 70° N.

At the meeting of Scandinavian naturalists at Stockholm (1842), Eichwald gave an account of an Alga of the Aleutian Isles, which is used for food, *Bromicolla aleutica*. At Unimah it forms a layer two feet thick, of a nostoc-like substance, which is covered with a gramineous vegetation. Whenever the provision of fish of the natives fails, these Algæ are collected and eaten.

Systematic works on the Flora of Northern Asia.

Schrenk has explored the regions on the Tschu, a river of the Zungarian steppes. The new species which he found have been already published. (Bullet. Petersb. 2. Nos. 32, 37.) They belong to the following genera: *Lepidium*, *Diplotaxis*, 3 species, *Silene*, *Zygophyllum*, *Euphorbia*, 5 species, *Astragalus*, *Oxytropis*, *Rosa*, 2 species, *Lythrum*, *Rubia*, *Microphysa* (nov. gen. Stellat.) *Cousinia*, *Apocynum*, *Pedicularis*, *Diploloma*, (nov. gen. Boragin.), *Solenanthus*, *Echinospermum*, *Plantago*, *Brachylepis*, *Rheum*, *Allium*, *Juncus*.

To these, besides, are added 9 Chenopodeæ (with both the new genera *Pterocalyx*, Schr., and *Halostachys*, C.A.M.), and 2 Staticeæ, which have been described in the Bull. de l'Acad. de Mosc. (Mars, 1843.) A monograph on the Siberian Rosacean genus *Chamærrhodos*, by Bunge, is given in the Ann. Sc. Nat. (Vol. xix. p. 176-178). A monograph by Besser on the *Artemisiæ*, which is only just printed, (Mém. Péters. Divers savans, v. 4, 1843), is highly important towards a knowledge of the steppe vegetation.

Kützing has given the characters of the Fucoideæ collected by Tilesius on the coast of Japan, which had been already admitted in his Phycologia generalis. (Bot. Zeit. 1843. s. 53-57.)

In the 'Souvenirs d'un Voyage dans l'Inde par Delessert' (Paris, 1843-4), are reports upon the climate of the Neilgherries, derived partly from his own, and partly from Baikie's measurements. The two English stations are named Kotagherry and Ootacamund, the former is situated 1983·5m. above the sea, the latter 2255m., both in. 11°-12° N.L.

	Mean Temperature.	Difference between Max. and Min.
Kotagherry	= 16·1	8°
Ootacamund	= 14·4	

An important systematic work has been commenced by Bentham, which is intended to embrace all the East Indian Leguminosæ, as well as those of tropical and Southern Africa. (Hook. Lond. Journ. of Bot. 1843. pp. 423-81, and 559-613.) This monograph relates principally to the collections of Wallich, Royle, Wight, Jaquemont, Griffith, Helfer, &c., from India; of Kotschy, Heudelot, and Vogel, from tropical Africa; of Burchell and other travellers at the Cape. Up to the present time, the Podalirieæ, the Liparieæ, and part of the Genisteæ, particularly the Crotalariæ, have been published, already about 300 species. Among these there are about 100 Genisteæ, 37 diadelphian Genisteæ (Liparieæ), and 27 Podalirieæ; about 80 Genisteæ, and 3 Podalirieæ, Indian, from the Himalayah; about 40 Genisteæ belong to tropical Africa.

Griffith has described the following new genera: *Jenkinsia* (Thymeleæ) from Assam, *Enkleia* (Thymeleæ) from Malacca, *Leptonium* from Assam, and *Champereia* from Malacca (both transition forms from the Santaleæ to the Olacineæ), *Plagiopteron* from Silhet (Euphorbiaceæ?), *Siphonodon* (Ilicineæ) from Malacca. (Calcutta, Journ. of Nat. Hist. vol. iv, 1843; also in the Regensb. Flora 1844, p. 432.) In the same Journal, which has not yet come to hand, Jack's botanical labours on Sumatra, &c., are also said to be collected.

The great illustrated work on the Flora of Java, which has been edited by Blume under the title of 'Rumphia' (Lugd. Batav. fol.), has advanced in 1843 to the end of the second volume, which relates principally to the Palms. A second work by Hasskarl, which has very little connexion with that mentioned in the last annual Report, is published in v. d. Hoeven's Tijdschrift (1843, pp. 115-50). It contains systematic observations upon Javanese plants, and descriptions of new species from the following families: 1 *Fern*, 2 Cyperaceæ of the new genus *Pandanophyllum* (near *Chrysitrix*), 1 Xyrideæ, 1 Commelineæ, 1 Melanthaceæ, 1 Amaryllideæ, 1 *Canna*, 1 *Artocarpus*, 4 Labiatæ, 1 *Begonia*, 1 Malvaceæ, 1 Meliaceæ, 4 Euphorbiaceæ, 1 *Connarus*, 1 *Rubus*, 2 Leguminosæ.

Junghuhn's 'Travels in Java' (vide Report for 1841), have been edited in more detail with the assistance of Nees v. Esenbeck. (Lüdde's Zeitschr. für vergleich. Erdkunde, Bd. 2, 3.) In the investigation of the mountain vegetation of Java, the traveller enjoyed great advantages from his residence at Djocjokarta, at the southern base of the volcano of Merapi, which is more than 8000′ high. He ascended this mountain repeatedly, and has described its vegetation. The forests of the lower region (vol. ii, p. 457), consist of hundreds of species of trees, but species of *Ficus* and other Urticeæ prevail, and after them Magnoliaceæ, with an undergrowth of Melastomaceæ and Scitamineæ.

To these succeed the oaks, especially *Quercus pruinosa*, Bl., with stems 100′ high, covered to the summit with Orchideæ and other parasites, and with *Usneæ* a foot long, and mosses. In these woods the Palmaceous forms are represented by *Areca humilis*, W., and the tree-ferns by *Chnoophora glauca*, Bl. A coniferous belt is wanting on the Merapi. Above the oak-region the forest consists of *Celtis*, which is called " Angring," and this affords shade to species of *Rubus* which, as in other mountains, are joined with *Podocarpus* (*Rub. javanicus*, Bl., *moluccanus* L., *lineatus*, Reinw.) In this region even, volcanic blocks occur, which throughout Java, above the altitude of 5000′, are clothed with *Polypodium vulcanicum*. On other declivities of the Merapi the *Celtis* is replaced by *Acacia montana* (vol. iii, p. 68), or the *Rubus* by *Gualtheria* and *Thibaudia*. These Ericeæ, together with other shrubs, here constitute an alpine region above the arboreal limits, a formation which reaches to the upper trachyte declivities.

The most abundant species is *Gualtheria punctata*, Bl., and a ligneous *Gnaphalium* (*G. javanicum*, Bl.) Mixed with these, grow *Thibaudia varingifolia*, Bl., *Rhododendron tubiflorum*, Bl., and other Ericeæ, besides *Hypericum javanicum*, *Polygonum paniculatum*. Junghuhn found: *Gualtheria repens*, with *Lycopodia*, some mosses, and *Polypodium vulcanicum*, up to the margin of the crater.

The views of the south coast of Java are not sufficiently definite to convey any precise ideas; but few travellers have as yet displayed the talent of being able to exhibit a luxuriant tropical vegetation. Junghuhn is especially acquainted with the *fungi*, of which family he has been the first to describe many Javanese forms. He treats of them in the description of the Znider Hills, a wooded range which runs along the Bay of Pashitan, on the south coast. At this part, thin groves of *Tectonia grandis*; *Emblica officinalis*, and low leguminose trees, alternate with the moist primitive forests; the open spaces in these groves are occupied by a dense growth of high grass, the "Allang-Allang" of the Javanese. It is, however, in the shades of the lofty primitive forests that the fungi are to be met with (ii, p. 358). In this equatorial Flora their appearance is not limited to any particular season of the year. The rains continue, at least in the mountains, all the year round, and the rich "humus" soil is constantly moist and spongy. Each particular species even is not limited to any special season, and the same species is continually making its reappearance. On the other hand, the larger *fungi* are not here so much associated together as in the temperate zone. They everywhere occur only solitary, a condition consequent upon their habitat on decaying trees; for in these forests the *Agarici* of the North are replaced by parasitic *Polypori*.

In the forestlike plantations of Batavia and Weltevreden the most abundant trees are the following (ii, p. 89): *Garcinia Mangostana*, *Mangifera indica*, *Artocarpus*, *Nephelium lappaceum*, *Citrus*, *Averrhoa*, *Morinda*, *Eugenia*, *Anona*, *Persea*, *Durio zibethinus*, *Carica*, *Cocos*, *Areca*, *Tamarindus*, *Canarium*, *Morus*, *Hibiscus tiliaceus*, *Musa paradisaica*, *Bambusa arundinacea*, *Bixa*. On the plain of Batavia there are no longer any primitive forests, and only thickets of *Psidium*, *Mussænda glabra*, and *Melastoma malabaricum*. The soil here consists of a reddish brown, rich clay, which, towards the sea-shore, acquires an admixture of "humus," until it finally passes into the pure "humus," or swamp of the Rhizophorous region. In these morasses the river water is mingled with that of the sea. True Rhizophori do not occur here, but *Bruguiera caryophylloides*, Bl., *B. Rhedii*, Bl., and species of *Ægiceras* with climbers of *Ipomæa maritima*, Br., *Verbesina*, and *Borassus*, with Loranthaceæ, or a jungle composed of *Nipa fruticosa* and *Acanthus ilicifolius*. (Ib. ii, p. 141.)

Botta (vide last Report) has given an account of his Travels in Arabia Felix, chiefly as an introduction to the description of the plants collected by him. (Archives du Muséum d'histoire nat. v. ii, pp. 63-88.)

The traveller started from Hodeida (15° N.L.) to Zebid, and explored the mountains in the district of Taas, particularly Mount Saber, celebrated from the time of Forskäl, on account of its botanical riches. It is a lofty precipitous mass of trachyte, at the northern base of which lies the city of Taas. The plain of Taas, which is situated at an elevation about half that of the mountain, is at present a waste, in consequence of the political disturbances of Yemen, and is covered with fleshy *Euphorbiæ*. On Mount Saber, on the other hand, which is easily defended, together with the cultivation of wheat and oats, the culture of *Celastrus edulis* (Cât.) flourishes; the buds of this plant and the unexpanded shoots are eaten without any other preparation, and produce a slight and pleasant excitement of the nerves. The trade in this production is in Yemen even more considerable than that in coffee. A single person may consume five francs' worth in the course of a day. Coffee plantations occur only on the south side of Mount Saber. In the country, the pulp only of the coffee-fruit is used; the infusion of the beans being but little esteemed. The hill is, besides these, rich in all varieties of fruits, both of the tropical and temperate zones, which are here cultivated: Banana, Anona, Vine, Almond, Pomaceæ. On ascending the summit, Botta, lastly, observed also European plants (*Rubus*, *Geranium*) succeeding the tropical region, which he states to be characterized by thorny Solaneæ and Orchideæ. At a considerable elevation woods occur of a tree-like *Juniperus*, under the shade of which, however, tropical Aroideæ (*Arisæma*) and Labiatæ (*Coleus*) are still met with. From the summit of the Saber, which appears to rise far above the other mountains of Yemen, Botta saw both the Red Sea and the Gulf of Aden. From thence he returned to the coast, and lay sick for a long time at Mecca. The plants collected are, in great part, different from those of Forskäl. As they were collected in the same region, but at another period of the year (October and November), and in part at higher altitudes, the author conceives that they so far complete the Flora of South Arabia that little more remains to be explored in that country. (p. 81.) We only wish that the materials may be completely worked out. In the sketch of the botanical regions, which Botta has appended to his account, the absence of systematic knowledge of the forms collected is to be regretted; the description, however, of the relations of cultivation is interesting. The low strip of country along the coast of Western Arabia, called by the natives "Téhama," and which is occasionally some miles in width, and sometimes very narrow, is not everywhere capable of cultivation, being sandy and barren; but the country is capable of being rendered extremely fertile by artificial irrigation. The usual crops are Maize, Doura and Indigo. Extensive plantations of the date-palm are also here met with. The woods consist entirely of various *Acaciæ*, and present many forms of plants common also to Sennaar: *Indigofera*, *Aristolochia indica*, *Capparis*, *Amyris*, *Cissus*, *Cadaba*, Asclepiadeæ and thorny Solaneæ. The Halophyta of the coast consist of *Salsola* and *Suæda*. The altitude of the mountains, according to Botta, is considerable, he estimates that of Saber as much above 8000′. The rainy season there occurs in the months of May, or July to October, whilst in "Téhama," where the heat is greater, the rainy season is limited to the winter months after December, and depends on the monsoon of the Gulf of Arabia.

Decaisne has begun to work upon the plants collected by Botta in Yemen, but at present only the Cryptogamia have appeared. (Loc. cit. p. 89-199, with seven plates.) The whole collection, however, according to the prefatory observations, contains only 500 sp. and more perhaps could not be obtained in two months. Whether the Algæ of the Red Sea are included in this or not, can only be learnt from the continuation of Decaisne's work, which at present is confined almost entirely to the Algæ, of which Botta has sent 53 sp., e. g. 7 sp. *Caulerpa,* 3 sp. *Dictyota,* 12 sp. *Sargassum,* &c., most perfectly figured by the author. To these succeed 13 *Ferns,* among which 5 are European and 2 new; lastly, 2 Lycopodiaceæ, edited by Spring.

III.—AFRICA.

Bory de St. Vincent has made a report to the French Academy on the Flora of Algiers, upon the return, and as an earnest of the results of the scientific expedition sent there in 1840-42. (Comptes rendus, t. 16.) The herbarium collected contained about 3000 species, of which only 60 are undescribed; for the most part they correspond with the productions of Spain and Portugal. The Cryptogamia collected amount to 400 species. The forests of the Lesser Atlas are laid waste. The chesnut, evergreen oak, and laurel, have become rare. The Syrian cedar occurs only on isolated declivities, and is said to be very abundant on the Great Atlas.

Bory distinguishes three botanical regions, the Numidian, Mauritanian, Tingitanian. The eastern, or Numidian, extends from Biserta to Collo; La Cala is situated in the centre of it; the country is well wooded, and contains many plants of central Europe. Algiers lies in the middle of the Mauritanian, or central region, and in its environs plants of the south of Europe prevail, and the Banana ripens its fruit. The Tingitanian, or western region, stretches from Cape Tanes to Morocco; it contains various African forms, among which, however, the *Stapelia* from Oran, adduced as an example, ought not to be included.

The 'Characteristik' of the Flora of Kordofan, mentioned in the last annual Report, is again enlarged and corrected by Brunner (Regensb. Flora, 1843, s. 473), and A. Braun (ib. s. 498). The former paper is unimportant, the latter relates only to two Alismaceæ, and contains valuable remarks upon that family.

A. Braun has also communicated a numerical review of the plants sent by Schimper from Abyssinia. (Ib. pp. 749-52.) These herbaria consist of 1250 species, two thirds of which are new. The first two parcels sent by Schimper are here included. The families are arranged in consecutive order, according to the number of species they respectively contain:—Gramineæ (141), Synanthereæ (140), Leguminosæ (116), Cyperaceæ (60), Acanthaceæ (46), Malvaceæ, including the Tiliaceæ (42), Labiatæ (40), Scrophularineæ (33), Rubiaceæ (26), Urticeæ (25), Euphorbiaceæ (24). Added to which are 18 species Cruciferæ and Boragineæ, 16 species Terebinthaceæ and Orchideæ, 15 species Amarantaceæ, 14 species Ranunculaceæ, 13 species Convolvulaceæ and Asclepiadeæ, 11 species Combretaceæ, Crassulaceæ, and Solaneæ, and 10 species Capparideæ and Verbenaceæ.

Included in the above number (1250 species) are about 100 Cryptogamia, viz. 27 Ferns, 50 Mosses, 17 Lichens, &c.

New Abyssinian plants collected by Feret and Galinier have been described by Raffeneau-Delile. (Ann. Sc. Nat. xx, pp. 88-95.) At present the number of species is only 16, but among them are several new genera: *Teclea* (Zanthoxyleæ), *Laneoma* and *Ozoroa* (Terebinthaceæ), *Feretia* and *Galiniera* (Rubiaceæ). Flotow has defined the lichens collected by Schimper (Linnæa, 1843, H. 1.); few of the species are new. Hochstetter has proposed the following new African genera (Regensb. Flora, 1843, ss. 69-83): *Xylotheca* from Port Natal (Bixineæ), *Candelabria* ib. (Samydeæ), *Diotocarpus* ib. (Rubiaceæ): *Kurria* of the former report. = *Hymenodictyon*, Wall., *Haplanthera*, *Monothecium*, and *Tyloglossa*, from Abyssinia and Nubia (Acanthaceæ), *Lachnopylis* from Abyssinia (Loganiaceæ?) *Pterygocarpus* ib. and *Apoxyanthera* from Natal (Asclepiadeæ).

E. Meyer has published a very important memoir on the Flora of the Cape, which is based upon the complete list of localities given by Drège, and which are printed together with it. (Zwei pflanzengeographische Dokumente von Drège nebst einer Einleitung von E. Meyer: als besondere Beigabe zur Regensburg Flora, 1843.) It contains 230 species and a chart. Drège's herbarium contains about 7000 different species (6595 Phanerogamia and 497 Cryptogamia), and was collected in a district of scarcely 4000 square miles. E. Meyer estimates the number of the Phanerogamia of the Cape, hitherto known, at 9000 species, and their whole number indigenous to the colony, chiefly in the districts explored by Drège, at 11500. He considers a very limited range of distribution for each species to be a fundamental feature of the Cape Flora, the areal range of most of them being five times more contracted than is the case in the Flora of Europe, where, according to Schouw, the average area extends over from 10° to 15° of latitude. Social plants form but a very small proportion of the mass of vegetation, and even those that are met with, are for the most part, much less numerously associated than the meadow grasses or forest trees of Europe. Among the social forms, Drège enumerates some Proteaceæ, small-flowered Ericeæ, *Elytropappus rhinocerotis* (Stœbe, Th.), which covers large tracts on the 'Karroo,' *Galenia*, and in the eastern plain of the 'Karroo' is found *Mesembryanthemum spinosum*, one of the most social plants of the country. Besides these, the *Cliffortiæ*, *Prosopis elephantina*, *Acacia horrida*, are tolerably abundant on the streams of the 'Karroo,' and some Bruniaceæ, Oxalideæ, Asclepiadeæ, and Aloes species; on the "Giftberge," on the west coast, *Toxicodendron capense;* near Port Natal, the Rhizophori and *Hyphæne coriacea;* lastly, the social water plant *Prionium serratum* (*Juncus*, Th.)

The Cape genera, as at present defined, contain on the average 6 to 8 species; on which account, the unusual number of species in some of the genera, characteristic of the Flora, is the more remarkable. Thus Drège collected

151 species of *Senecio*, 148 species *Pelargonium*, of *Erica* proportionately few, only 139 species; of *Helichrysum* 108 species; of *Aspalathus*, *Hermannia*, *Oxalis*, and *Restio*, between 80 and 90; of *Mesembryanthemum*, *Crassula*, *Euphorbia*, and *Indigofera*, between 60 and 70; of *Polygala*, *Muraltia*, *Rhus*, *Cliffortia*, *Anthericum*, and *Heliophila*, between 50 and 60, &c.

The statistical relations of the families are exhibited by E. Meyer with great precision, assuming Endlicher's genera as the basis of his conclusions. The Monocotyledons constitute 21, and the Dicotyledons 125 families. Of these, 38 appear to be wanting in New Holland, whilst, on the other hand, that continent presents 18 species not met with at the Cape. The families most rich in species form in Drège's collection the following series: 1110 Synanthereæ, i. e. almost 17 per cent., 510 Leguminosæ, 312 Gramineæ, 286 Irideæ, 264 Liliaceæ, 191 Restiaceæ, 184 Cyperaceæ, 170 Scrophularineæ, 169 Geraniaceæ, 167 Ericeæ, 157 Proteaceæ, 135 Euphorbiaceæ, 122 Orchideæ, 112 Polygaleæ, 108 Crassulaceæ, 104 Asclepiadeæ, 104 Umbelliferæ, 99 Byttneriaceæ, 88 Rubiaceæ, 87 Cruciferæ, 83 Oxalideæ, 79 Labiatæ, 75 Thymeleæ, 75 Campanulaceæ, 71 Rosaceæ, 69 Mesembryanthemeæ, 69 Selagineæ, 68 Malvaceæ, 66 Acanthaceæ, 65 Anacardiaceæ. Besides these, E. Meyer regards the following less numerous families as characteristic: Lobeliaceæ (56), Rhamneæ (56), Smilaceæ (51), Zygophylleæ, (44), Celastrineæ (40), Bruniaceæ (38), Hypoxideæ, (37), Cucurbitaceæ (35), Ebenaceæ (27), Penæaceæ (11), Cycadeæ (9), Stilbeæ (4). Some families range over only a portion of the colony: the Ericeæ, of which Bentham has already described 455 species from the Cape, were collected in smaller numbers by Drège, since the majority of that family are confined to the mountains of the extreme south; no Proteaceæ are found above thirty miles from the coast, but even within those limits the family does not extend to the borders of the colony. The Crassulaceæ occur principally in the great plain of the 'Karroo;' the *Her-*

manniæ are found in the northern districts; the species of *Heliophila* on the west coast, between 30° and 34° S. L., and the *Rhus* species on the east, as also the Hypoxideæ. Four families are endemic in the Cape Flora: the Selagineæ, Bruniaceæ, Penæaceæ, and Stilbeæ.

The Cape Flora is physiognomically characterized by the abundance of large flowered Monocotyledons with coloured perigon, by the succulent plants, and Erica-forms. Of the latter, at least single genera occur in most of the great families, e. g. *Stæbe* among the Synanthereæ, *Aspalathus* among the Leguminosæ, some *Proteæ*, and among the Rhamneæ *Phytica;* and to the same class, besides the Ericeæ themselves, belong most of the Diosmeæ, Bruniaceæ, Stilbeæ, Penæaceæ, Thymeleæ. Among the succulent forms, may be instanced the Crassulaceæ, Mesembryanthemeæ, the Stapeliæ, many Euphorbiaceæ, several Portulaceæ, and Aloes.

Lofty arboreal forms are notoriously wanting, and dense forests entirely so. Drège adduces the following list of ligneous plants above twenty feet high, some of which attain a height of fifty feet: 3 Coniferæ, (3 species *Podocarpus* = Geelhout); of the Urticeæ, *Ficus Lichtensteinii;* the Laurineæ, *Ocotea bullata;* 3 species of *Olea* (Yserhout, among which *O. exasperata* is the thickest tree of the colony, but only about 30′ in height); of the Araliaceæ *Cassonia paniculata;* certain Meliaceæ (*Trichilia*); 1 Tiliacea (*Grewia*); of the Celastrineæ, *Curtisia faginea; Ilex crocea*, the Rhamneæ, *Olinia acuminata;* the Diosmeæ, *Calodendron capense;* the Myrtaceæ, *Jambosa cymifera*; and Leguminosæ, *Virgilia grandis*. Of parasitic Dicotyledons, Drège has collected 42 species, among which are 17 Lorantheæ, 5 *Cassytæ*, 1 Cactus, 12 Orobancheæ, 3 Cytineæ, 1 Balanophoreæ, 3 Cuscuteæ.

The Monocotyledons of Drège's collection, are in proportion to the Dicotyledons as 1 to 3·2, as is the case also in the same latitude in New Holland. From the coast towards the elevated plains of the interior, the Monocotyledons at first increase, then decidedly diminish, and again increase on the most elevated terraces; but the proportionate number of these latter does not correspond with the above given statement of E. Meyer. To the lower terrace of the country he assigns a mean altitude of 500′, to the central, one of 2000′, and to the upper, one of 3500′, above which then, the mountains, where the Monocotyledons again increase in number, still rise to an altitude of more than 8000′ above the sea. Meyer endeavours to explain these differences in the distribution of the Monocotyledons, by the quantity of atmospheric deposit, an increase in which induces a corresponding increase in the Monocotyledons.

According to Drège, it nowhere rains more frequently or more copiously than on the south-west coast of the colony. From stage to stage in ascent the quantity of rain diminishes, in the same proportion that the Dicotyledons increase. Similar differences are also observable on the coast line. At the mouth of the Gariep, the winter rains of the Cape are said to be almost entirely wanting, and the summer rains seldom fall; on the east coast on the other hand the influence of the trade-wind is felt in the opposite condition of a dry winter, and a tropically moist summer, by which the peculiar vegetation of Port Natal is explained. The Verbenaceæ and Acanthaceæ begin to increase even at Algoa Bay. The following forms consequently are characteristic at Natal: tropical Leguminose genera, Myrtaceæ, Rubiaceæ, two Palmæ, and other plants of the torrid zone; although this settlement lies at 30° S. L., or more to the south than the mouth of the Gariep.

Bunbury has continued the reports of his botanical wanderings in the Cape country (vid. last Report.) (Hook. Lond. Journ. of Bot., ii, pp. 15-41.) He has described his journey from Cape Town to Graham's Town. In the coast region he found a distinct limit of vegetation at the mouth of the Gamtos river; from this point towards Algoa Bay commences a district which is characterized by fleshy *Euphorbiæ* and other succulent plants, as also by *Schotia speciosa* (Boerboontje.)

Rather further to the west as far as the River Kromme, the *Zamiæ* make their first appearance, with respect to which Meyer observes erroneously that they are first seen in Albany. For the rest, the whole journey occupied only seventeen days, and consequently little opportunity for observation was afforded, but a further supplement is to appear in 1844.

The systematic contributions to the Cape Flora, drawn principally from the herbaria of Krauss, have been continued by Meissner in the same journal (pp. 53-105 and 527-59.) This second part contains the following families: 2 Tiliaceæ, 1 *Aitonia*, 30 Oxalideæ, 7 Zygophylleæ, 1 Ochnaceæ from Natal, 1 Rhamneæ, 1 Bruniaceæ, 166 Leguminosæ, 10 Rosaceæ, 1 Portulaceæ, 1 Cunoniaceæ, 28 Umbelliferæ, 1 Hamamelideæ, 1 Corneæ, 3 Loranthaceæ, 5 Rubiaceæ, 1 Lobeliaceæ, 1 Jasmineæ, 1 Apocyneæ, 25 Asclepiadeæ, 1 Scrophularineæ, 1 Orobancheæ, 10 Amarantaceæ, 6 Chenopodeæ, 12 Polygoneæ, 28 Thymeleæ, 3 Penæaceæ, 4 Euphorbiaceæ. Bartling has given detailed descriptions of twenty-two new Diosmeæ, or which have been made known only by Ecklow; among which is the new genus *Gymnonychium*. (Linnæa., 1843, pp. 353-82.) Some new Cape plants have been published by Fenzel (ib. pp. 323-34); the new Amarantacean genus *Sericocoma* with three species; the newly proposed Asclepiadea, *Anisotoma;* and one *Veronica*, all from Drège's collection. Flotow has given definitions of fifty-five Cape Lichens, and descriptions of the new ones (ib. pp. 20-30); Berkeley has contributed thirty-one fungi from Zeyher's collections. (Journ. of Botan., pp. 507-24.)

Bojer has again, as in the last year, described new plants from the islands lying off the south-east of Africa. (Ann. d. Sc. Nat. xx, pp. 53-61, and 95-106.) Among which are 1 Anonacea, 2 Menispermeæ, 8 Cappardeæ, 4 Polygaleæ, 2 Pittosporeæ, 1 Lineæ, 6 Tiliaceæ, 2 Leguminosæ, with the new Dalbergiea *Chadsia*.

IV.—ISLANDS OF THE ATLANTIC.

I HAVE here merely to refer to the interesting memoir on the botanical characteristics of the Azores, by Seubert and Hochstetter, with which the present annual volume of these Reports commenced. Watson has, at the same time, given a report upon his botanical voyage to the Azores. (Hook. Lond. Journ. of Bot. 2. pp. 1-9, 125-31, and 394-408). The endemic vegetation was observed by Watson, beyond the cultivated district of Fayal, first between Horta and Flamingos, where the low hills on the strand are covered with *Myrica Faya* and *Myrsine retusa;* together with these grows *Erica azorica*, Hochst. (*E. arborea*, S. H. p. 21), which, however, according to Watson, is probably only a variety of *E. scoparia*, L. Near Flamingos, there are added to these, two European Ericeæ: *Menziesia Dabœci*, D.C., and *Calluna*. It appears to be probable, from this description, that the region of the Laurel Woods 1500′-2500′, which consists almost entirely of the same ligneous plants as the coast formation near Flamingos, originally extended everywhere to the sea. The forest above Flamingos is composed of *Erica scoparia*, *Myrica Faya*, *Myrsine retusa*, and *Juniperus Oxycedrus*, S.H., which is regarded by Watson as distinctly an endemic species; with these are mixed *Vaccinium maderense*, L.K. (a small flowered variety of which probably is *V. cylindraceum*, Sm., *V. longiflorum*, Wickstr., and *V. padifolium*, S.H.), besides *Rubus Hochstetterorum*, S., *Ilex Perado*, *Viburnum Tinus*, *Persea azorica*, S., *Laurus canariensis*, S.H.), and *Euphorbia stygiana*, W. (*E. mellifera*, S.) The margin of the crater of Fayal is situated 3170′ above the sea, and sinks down internally to an inclosed lake, the altitude of which is only 1670′. This moist hollow, the diameter of which is about a mile, is thickly covered with Ferns and the endemic evergreen shrubs. The Phanerogamia are for the most part the same as on the outside of the crater, but the endemic species are here much more densely crowded. The water-plants on the lake, however, are again European. The description of the Peak of Pico, agrees in all respects with that by Seubert and Hochstetter. The altitude of the peak, by barometrical measurement, amounted to 7616 feet Eng., and it would appear that the upper limits of some plants are placed higher than was supposed by Seubert and Hochstetter. At the summit the only plants are *Thymus micans*, and an undetermined species of *Agrostis*, with some mosses and lichens. Highest limit for *Calluna* 7000′, for *Erica scoparia* 6000′.

The younger Hooker, on his Antarctic voyage, explored the Cape de Verd Islands. (Journ. of Bot. p. 250.) The interior of St. Jago, of which island the coasts are completely barren, presents a luxuriant vegetation; on the mountains are forms of the Atlas and south of Europe, and in the valleys tropical genera. It is only now that a little is known of this Flora; in the opinion of the traveller, the mountains, immediately after the rainy season, would afford the richest booty. Any one who is desirous of exploring them must proceed directly from Porto Praya to St. Domingo, because, at that time, for several miles around the capital no plant is any longer visible. Foyo, the volcano of which is said to be about 7000′ feet high, might be more interesting than St. Jago. St. Antonio also is covered with wood, and Sal, a saliferous plain.

Hooker did not land on the island of St. Paul (0° 58′ N.L.), but Darwin, who explored it, remarks (Journ. of Research, p. 10), that although there are several indigenous insects and spiders, not a single plant, not even a lichen, is to be found, and only Algæ in the greatest variety.

St. Helena has already in great measure lost its endemic Flora, (ib. p. 582). The great forest of the elevated plain which existed at the commencement of the last century has been destroyed, and together with it, doubtless, many plants which, like the productions of a former world, have now disappeared from the earth. Darwin agrees with Beatson in ascribing this change to the introduction of the goat, which prevents the growth of the seedling trees. Instead of the endemic Flora, European plants have in great measure now become distributed over the soil of St. Helena. The most abundant tree at present is the Scotch Fir, but Hooker also observed (l. c. p. 252) *P. Dammara, Casuarina, Acaciæ*, and Pittosporeæ from New Zealand, *Eucalyptus* from New Holland, and Scitamineæ and Aroideæ from the East Indies.

V.—AMERICA.

Nuttall has continued the description of the plants collected on his journey through North America to the Sandwich Islands, (vid. Report for 1841, in the Transactions of the American Philosophical Society, 1843, p. 251.) This memoir contains the Campanulaceæ, Lobeliaceæ, Ericeæ, and allied families; several extensive genera have been divided by the author: e. g. *Vaccinium* and *Andromeda*. Engelman has published a distinguished monograph on the North American Cuscuteæ. (Silliman's American Journal of Science, vol. 43, pp. 333-45, 1842. Extracted in London Journ. of Bot. 1843, pp. 184-99.) In the same American Journal, has also appeared a continuation of Dewey's 'Caricographia.' (Vol. 43, pp. 90-2, with five figures.) Bruch and Schimper have examined Drummond's collection of Canadian mosses, and the results have been published by Shuttleworth. (Journal of Bot. pp. 663-70.)

An account of the botanical geography of the Mexican volcano Orizaba, was given by Liebmann at the meeting of Scandinavian Naturalists, at Stockholm, in 1840. (Also translated in the Botan. Zeitung, 1844, s. 688 et seq.)

(1) Hot Region. (0′ to 3000′.) The sloping savannahs to the west of Vera Cruz, beyond Santa Fé, and at an altitude of 200′, are interrupted by a forest, in which the characteristic trees are *Mimosa, Bombax, Citrus, Combretum*. Then follows an extremely fertile marly soil, derived from the disintegration of the porphyritic blocks of the Orizaba, the forests on which present magnificent groups

of the undescribed "*Palma real.*" Hence the sloping grass savannah again extends to an elevation of 3000′, with *Mimosa* bushes, and the Ternstræmiacea *Wittelsbachia*, a *Convolvulus* and a *Bignonia*.

(2) THE WARM, MOIST REGION. (3000′ to 6000′.) At 3000′ commence the moist mountain forests, in which the oak makes its appearance in numerous forms, and with it grow six species of *Chamædorea*, sometimes erect, sometimes creeping palms. This is the richest botanical region of Mexico, and in which with a mean temperature of 21° C., and a rainy season of eight or nine months, about 200 Orchideæ are indigenous. Here commences a ferruginous, hard clayey soil, which overlies the volcanic rock to a height of 11000′. The oak is most luxuriant between 4000′ and 5000′; about twenty species are met with, and several are limited to those altitudes. As is the case in Java, the oaks grow in a thick tropical forest of Laurineæ, Myrtaceæ, Terebinthaceæ, Malpighiaceæ, and Anonaceæ. The underwood is formed of *Melastoma*, *Treeferns*, *Mimosa*, the Monimiea *Citrosma*, *Bambusa*, *Yucca*, *Jatropha*, and *Croton*, *Triumfetta*, *Magnolia*, arboreal Synanthereæ, *Symplocos*, *Æsculus*, Araliaceæ, &c. The climbers are Smilaceæ, Sapindaceæ, *Cissus*, Apocyneæ, Asclepiadeæ, Bignoniaceæ, Passifloræ, Leguminosæ, and Cucurbitaceæ. In these forests the upper limit of the cultivation of coffee and cotton is attained at from 4000′ to 5000′, and that of sugar and the plantain at 5500′.

(3) REGION OF THE OAK FORESTS. (6000′ to 7800′.) At 6000′ the foot of the Cordilleras is reached, where another climate and other forms of plants commence. In the neighbourhood of the city of Coscomatepec, where, together with maize, the orchard trees of Europe and fruits of the south are cultivated, and where the fertile plains of the plateau begin, the most abundant trees are the following: *Yucca gloriosa*, *Cratægus pubescens*, *Sambucus bipinnata*, *Clethra tinifolia*, *Persea gratissima*, *Cornus*; the climbers are here composed of *Convolvulus*, *Vitis* and *Rubus*. The Palms have

already ceased at 5000′, but in the interior highland other species reappear up to 8000′. Tree-ferns are also wanting on the Cordillera, flourishing only between 2500′ and 5000′; and the last fruticose myrtles are seen at 4800′. The Orizaba itself is a more lofty peak, rising 1700′ above the border of the plateau. The traveller explored it in the month of September, in the middle of the rainy season. The lower forest belt (6000′ to 7800′), consists chiefly of species of *Quercus;* the other trees are *Lacepedea pinnata*, *Ulmus*, *Alnus*, *Clethra*, a Verbenacea, and an Araliacea; an underwood of *Cornus toluccensis*, *Viburnum*, *Triumfetta*, *Rubus*, with climbers of *Vitis*, *Ipomæa Purga*, a *Bidens*, and *Cuscuta*, Alstræmeriæ; parasitic Ferns, *Viscum*, Orchideæ, *Piper*, in three small forms, *Cereus flagelliformis*. The open spaces are covered with *Cassia* and *Mimosa* bushes, the herbaceous plants and grasses are rich in forms, and among the characteristic ones are *Ranunculus*, *Thalictrum*, *Anada*, *Hypericum*, *Drymaria*, *Oxalis*, *Geranium*, *Euphorbia*, *Desmodium*, *Rexia*, *Lopezia*, *Cuphea*, *Georgina*, *Lobelia*, *Salvia*, *Erythræa*, *Iresine*, *Cyperus*, *Panicum*, *Paspalus*, *Festuca*, *Vilfa*, *Lycopodium;* Ferns, Mosses, and Lichens are also tolerably abundant. Even at an elevation of 7000′ the vegetation is remarkably changed. *Vaccinium*, *Gualtheria*, *Andromeda*, become frequent, and particularly a new, tree-like *Arbutus*, *Fuchsia microphylla;* among the herbaceous plants: *Chimaphila*, *Dracocephalum*, *Tagetes*, *Carduus*, a Gentianea, several Orchideæ, *Ferraria*, and Commelineæ.

(4) CONIFEROUS REGION. (7800′ to 11000′.) The first Coniferæ appear at 6800′, *Pinus leiophylla*, but the oaks are not supplanted by the Coniferæ below 7800′. At this altitude vigorous trees of *Pinus Montezuma* predominate, with parasitic Tillandsiæ and Usneæ. At 9000′ commence the forests of the Oyamel pine (*Abies religiosa*), but *P. Montezuma* again constitutes the upper belt of the continuous pine forest at 11000′, solitary or situated individuals occur as high as 14,000′ on the N.W. side of

the peak. The traveller staid a fortnight in the Coniferous region, in a herdsman's hut in the 'Vaqueria del Jacal.' (10000'.) The mean temperature at that season was 11° C. At the end of autumn instead of rain, snow falls, which lies from November to March. The uniformity of the north does not prevail in these Coniferous forests. Leaf-trees are everywhere intermixed; such as the oak and alder; shade plants continue numerous; the ravines (barrancas) nourish a luxuriant vegetation; whole mountain sides are bare of trees, and covered with a high grass, together with alpine plants. The plants of the Coniferous region especially, present the greatest variety of forms, of which Liebmann furnishes a copious list. The following belong to the characteristic families: Leguminosæ (*Lupinus*), Umbelliferæ, Ericeæ (*Clethra, Vaccinium, Pyrola,* &c.), Synanthereæ (*Eupatorium, Stevia, Bidens, Baccharis, Aster,* &c.), Scrophularineæ (*Chelone, Lamouzouxia, Gerardia, Castilleja*), Labiatæ (*Salvia Stachys*), *Verbena,* Orchideæ (*Spiranthes, Serapias*), *Veratrum,* Irideæ (*Sisyrinchium*). Ferns, &c. Bushes of Laurineæ, Rhamneæ, *Tilia, Viburnum, Cornus,* Synanthereæ, *Salix* occur together with the Ericeæ. In one "barranca" Liebmann observed a thicket of bamboo, a form of plant that elsewhere disappeared at 3000'.

(5) Region of the Steviæ. (11000' to 13600'.) Low Synantherean shrubs (*Stevia purpurea, arbutifolia,* &c.) represent the sub-alpine Erica-forms, as they do on the Cordilleras of South America, where instead of *Stevia,* the genus *Baccharis* makes its appearance. Still they do not, as here, extend to the uppermost limits of vegetation. A more abundant shrub in the lower part of the region is *Spiræa argentea.* Besides these, alpine genera for the most part grow upon masses of volcanic rock, which now appears instead of the clayey soil. Characteristic forms are: Cruciferæ (*Draba, Nasturtium*), Alsineæ, *Viola, Lupinus,* Rosaceæ (*Alchemilla, Potentilla*), Umbelliferæ (*Eryngium, Seseli, Œnanthe*), *Tiarella, Pedicularis, Lithospermum, Stachys,* Synanthe-

reæ (*Erigeron*, *Hieracium*, *Hypochæris*), *Veratrum*, *Sisyrinchium*, *Serapias*, Junceæ, *Carex*.

(6) Alpine Mountain Plains. (13600′ to 14800′.) The soil of the highest parts of the surface below the crater consists of a mixture of volcanic sand with ashes; it bears a gramineous vegetation, the species of which correspond with those found by Humboldt on the Nevado of Tolucca: *Festuca toluccensis*, *Bromus lividus*, *Avena elongata*, *Deyeuxia recta*, *Crypsis stricta*, *Agrostis*, and other Festuca species. Instead of the *Steviæ*, are here seen thick-leaved, hoary shrubs of *Senecio*. The smaller craters are clothed with *Mahonia ilicina* and *Juniperus mexicana*. Under the Gramineæ grow several Synanthereæ (*Conyza*, *Helichrysum*, *Carduus*, *Saussurea*), *Gualtheria ciliata*, and of the other alpine genera, *Cerastium*, *Viola*, *Draba*, extend up to this height. The thawed snow affords growth to a formation of *Ranunculus* and *Potentilla*, associated with which are some Glumaceæ and *Veronica* (*Luzula*, *Carex*, *Phleum*, *Agrostis*.) Mosses and Lichens abound, and among the latter also, especially the northern Umbilicariæ (*U. pustulata*, 10000 to 14000′, *U. vellea*, 13000 to 14000′, *U. cylindrica* and *proboscidea*, 14000 to 14800′). The base of the great crater, which slopes at an angle of 30°, is situated at an altitude of 14300′, and is covered with broken rocks difficult of ascent. Here grow the last phanerogamous plants, which have, for the most part, not been observed by Schiede: 1 Hydrophyllea (*Phacelia lactea*, Liebm.), 1 *Castilleja*, *Saussurea*, *Carduus nivalis*, *Arenaria*, *Cherleria*, *Draba vulcanica*, Liebm., one of the fruticose Senecios, and most of the above-mentioned Gramineæ. The traveller observed the last Phanerogamia at the elevation of 14600′. The large rocks continue to be covered with Cryptogamia from this point up to 14800′; these are, besides the Umbilicariæ, *Tortula ruralis*, *Parmelia Ehrharti*, *Lecidea atro-alba*, *citrina geographica*, *Cenomyce pixidata*, and, as the last of all, 50′ higher than the rest, *Parmelia elegans*, a lichen which Agassiz also

found among the highest on the Jungfrau in Switzerland. (Vide last Report, p. 389.) The snow-line on the Orizaba may probably be taken at 15000′.

Much may be anticipated for systematic botany, as relates to the Flora of Mexico, when Liebmann's collections are fully studied, and these expectations have been raised to a greater height, among other things, by the essays already read by that traveller at the meeting of Scandinavian naturalists, held at Christiania in 1843, after his prosperous return. In the meanwhile other contributions to the knowledge of the Flora of Central America have been simultaneously made public in England and Belgium. Bentham has published a second and last part of his 'Plantæ Hartwegeanæ.' (London, 1842, 8vo.) This extends from Nos. 518-631, the greater part of which have been collected not in Mexico, but in Guatemala. The new genera are: *Hemichæna* (Scrophularineæ), *Lindenia* (Rubiaceæ), *Oxylepis* (Heliantheæ), *Caloseris* (Trixideæ), *Lampra* (Commelineæ). Very copious is the 'Enumeratio synoptica plantarum a Galeotti in Mexico lectarum,' which was commenced by Martens and Galeotti, and which is already tolerably far advanced. This work is contained in the 'Bullet. de l'Acad. de Bruxelles' (1843, vol. x. P. i, pp. 110, 208, 341; P. ii, pp. 31, 178, 302. 1844, vol. xi, P. i, pp. 121, 227, 355.) The families at present discussed, with numerous new and copiously described species, are the following: 7 Irideæ, 1 Hæmodoraceæ, 2 Hypoxideæ, 14 Amaryllideæ, 10 Bromeliaceæ, 4 Scitamineæ, 1 *Najada*, 4 Aroideæ, 1 Typhacea, 3 Palmæ, 11 Coniferæ, 24 Piperaceæ, 2 Myriaceæ, 35 Cupuliferæ, 2 Betulineæ, 2 Plataneæ, 8 Saliceæ, 5 Chenopodiaceæ, 14 Amarantaceæ, 12 Polygoneæ, 10 Nyctagineæ, with the new genera *Tinantia*, 4 Laurineæ, 2 Thymeleæ, 13 Valerianeæ, 83 Rubiaceæ, 5 Caprifoliaceæ, with the new genus *Vetalea*, 15 Apocyneæ, 40 Asclepiadeæ, 17 Gentianeæ, with the genus *Arembergia*, considered new, and for the most part new species, 8 Spigeliaceæ, and 205 Leguminosæ, with the new genera

Mikelertia and *Robynsia*. Besides these, there had previously appeared the Ericeæ and Vaccineæ, under the title of 'Notice sur les plantes des familles des Vacciniées et des Ericacées, recueillies au Mexique par Galeotti, et publiées par Martens et Galeotti.' (Ib. 1842. p. 526.) Schlechtendal's recent communications on the Mexican Flora (vide Report for 1840) relate to the Burseraceæ, especially *Elaphrium* (Linnæa, 1842. H. 6, and 1843, s. 245), and also to the Dioscoreæ. (Ib. s. 602.)

E. Otto has now collected the results of his American travels (vide Report for 1840). (Reis erinnerungen an Cuba, Nord und Südamerika, 1838-41; Berlin, 1843, 8vo.) Starting from Caraccas, he explored the district of the Orinoco.

Jameson's observations on the Flora of the Ecuador (Lond. Journ. of Bot. 2, pp. 643-61) are at present too fragmentary to allow of their being more closely considered; they will not certainly, however, be unimportant when continued, as is promised by the author. Of Bentham's work on the plants collected by Schomburgh in Guiana, the following families have appeared: Euphorbiaceæ, by Klotzsch (32 species, with the new genera *Schismatopera*, *Dactylostemon*, *Traganthus*, *Brachystachys*, *Geiseleria*, *Discocarpus*, the two penultimate separated from *Croton*); by Bentham himself, the Dilleniaceæ (1 sp.), Nymphæaceæ (1 sp.), Cabombeæ (1 sp.), Sarraceniaceæ (1 sp.), Ternstræmiaceæ (10 sp., with the two anomalous new genera *Catostemma* and *Ochthocosmos*), Guttiferæ (8 sp.), Marcgraviaceæ (1 sp.), Hypericineæ (3 sp.), Erythroxyleæ (6 sp.), Trigoniaceæ (3 sp.), Humiriaceæ (4 sp.), Olacineæ (3 sp.), with which Bentham places the new genus *Ptychopetalum* from Cayenne, Rhizoboleæ, (1 sp.); by Lindley, the Orchideæ (66 sp.) The number of species at present published amounts to 846. (Hooker, London Journ. of Bot. 1843, pp. 42-52, 359-78, 670-74.)

Miquel has published in several journals concerning new plants from Surinam, especially from the herbarium of Focke; in the first part of the 'Annals of Nat. Hist.

for 1843,' which has accidentally not reached us from the bookseller; and further in the 'Linnæa,' and in b. d. Hoeven's 'Tijdschrift.' The continuation in the 'Linnæa' (1843, s. 58-74) contains species from various families, and little that is new; viz. 1 Cyperaceæ, 1 Xyrideæ, 2 Pontedereæ, 1 Smilaceæ, 1 Hæmodoreæ, 1 Aroideæ, 4 Synanthereæ, 4 Rubiaceæ (among which is the new genus *Bruinsmania*). The 'Animadversiones in herbarium Surinamense, quod in colonia Surin. legit H. C. Focke, auct. Miquel,' (Tijdschr. voor natuurlijke Geschiedenis, 1843, pp. 75-93,) include the following families: Cacteæ (without any new sp.), 2 Portulaceæ (1 n. sp.), 1 Phytolacceæ, 7 Malvaceæ (2 n. sp.), 1 new Byttneriaceæ, 3 Guttiferæ (1 n. sp.), 1 new Marcgraaviaceæ, 1 Hypericineæ, 6 Malpighiaceæ (1 n. sp.), 1 new Erythroxyleæ, 2 new Sapindaceæ, 1 Polygaleæ, 1 Euphorbiaceæ, 1 Anacardiaceæ, 1 Myrtaceæ, 16 Leguminosæ.

Focke, in Paramaribo, has caused to be published by Miquel, a systematic catalogue of all the plants cultivated in Surinam. (Hoeven's Tijdschrift, l. c. pp. 373-85.) The following is an abstract of the Dutch names of the most important tropical products: *Anona muricata*, L. (Zuurzak); *A. squamosa*, L. (Kaneelappel); *Terminalia latifolia* (Amandelboom, Tafelboom); *Eugenia pimenta*, D. C. (Bayberry tree); *Jambosa vulgaris*, D. C. (Pomme de Rose); *J. malaccensis*, D. C. (Schambo); *Passiflora quadrangularis*, L. (Marquisade, Grenadille); *Mammea americana*, L. (Mammi); *Caryocar tomentosum*, W. (Bokkenoot); *Hibiscus esculentus*, L. (Okro); *H. Rosa sinensis*, L. (Engelsche Roos); *H. Sabdariffa*, L. (Roode Zuring); *Spondias dulcis*, Forst. (Pomme de Cythère); *Ricinus communis*, L. (Krapatta); *Janipha Loefflingii*, Kth. (Zoete Cassave); *J. Manihot*, Kth. (Bittere Cassave); *Malpighia glabra*, L. (Sure Kers); *Averrhoa Bilimbi*, L. (Bilambi); *Abrus precatorius*, L. (Weesboontje); *Erythrina corallodendron*, L. (Koffij-mama); *Arachis hypogæa*, L. (Pienda); *Poinciana pulcherrima*, L. (Sabinabloem); *Parkinsonia aculeata*, L. (Jerusalemsdoren); *Anacardium* *occidentale*, L. (Cachou); *Mangifera indica*, L. (Manja); *Artocarpus incisa*, L. (Broodboom); *Persea gratissima*, G. (Advocaat); *Coccoloba uvifera*, L. (Zeedruif); *Achras Sapota*, L. (Sapotilla); *Chrysophyllum Cainito*, L. (Starappel); *Sesamum orientale*, L. (Abonjera); *Crescentia Cujete*, L. (Kalebasboom); *Justicia picta*, L. (Portretboom); *Lycopersicum esculentum*, Dun. (Tomati); *Solanum ovigerum*, Dun. (Antroeri); *Plumeria rubra*, L. (Frangipane); *Cycas revoluta*, Th. (Sayo); *Amomum granum paradisi*, L. (Malaguetsche Peper); *Musa paradisiaca*, L. (Banane); *M. humilis*, L. (Dwerg-Banane); *M. sapientum*, L. (Bakove, Bakoeba); *Agave fœtida*, L. (Ingi-sopo); *Yucca stricta*, Ker. (Bajonet); *Bambusa arundinacea*, W. (Guinea-Gras).

Steudel has commenced the determination of the plants in Hoffman's herbarium from Surinam, mentioned in last year's Report. (Regensb. Flora, 1843, pp. 753-65.) The species described as new belong to the following families: Anonaceæ (3 sp.), Sterculiaceæ (2), Tiliaceæ (2), Sapindaceæ (1), Homalineæ (1), Leguminosæ (21), Rosaceæ (5), Combretaceæ (2), Myrtaceæ (3), Paronychieæ (1), Umbelliferæ (1), Rubiaceæ (2), Solaneæ (2); Verbenaceæ (1); Spigeliaceæ (2), Gentianeæ (2). The diagnoses are short, and descriptions are not added.

Of Pöppig's illustrated work upon the plants collected by him on his South American travels, (Nova genera, &c., Lips. 1843-4), the 5th and 6th Decades of the third vol. have appeared. Orbigny's 'Travels' have appeared regularly up to the 74th livraison. Casaretto has published 8 Decades of Brazilian plants, a work which has not yet come under my notice. (Novarum Stirpium Braziliensium Decades. Genuæ, 1842-44, 8vo, 72 pp.)

Meyen's collection of dried plants, made on his voyage round the world, has been subjected to the united labours of several botanists, and been published in the Transactions of the Leopoldine Academy. (Nov. Act. Nat. Curioser. vol. xvi. Supplem. secund.; Vratisl. 1843.) This collection contains about 1500 species, but the number of new ones is proportionately not great. The Leguminosæ were submitted to the late Vogel, Nees v. Esenbeck undertook the Glumaceæ, Philydreæ, Acanthaceæ, Solaneæ, and in conjunction with Lindenberg and Gottsche, the Lycopodiaceæ; Meyen himself, with Flotow, the Lichens; Klotzsch the Euphorbiaceæ and Fungi; Schauer the Myrtaceæ, Apocyneæ, Asclepiadeæ, and the rest of the Monocotyledons; I took the Gentianeæ; Walpers the rest of the Dicotyledons, and Goldmann the Ferns.

The greater number of the plants collected are from South America, especially from Chili and Peru, but more interest attaches to the herbaria from Manilla (about 200 species) and Macao (about 220 species).

Gardner's publication on the Flora of Brazil (vid. last Report) has been continued. He has described four new genera from the Organ Mountains at Rio: *Bowmania* (Nassauviæ), *Leucopholis* (id.), *Hockinia* (Gentianeæ), *Napeanthus* (Cyrtandreæ). (Hooker, Lond. Journ. of Bot. ii, pp. 9-15.) The continuation of the list of his collection, which is arranged geographically, contains 125 species from the Organ Mountains, among which are many new species, and the new genera, *Isodesmia* (Hedysareæ). (Ib. pp. 329-55.) 39 *Fungi*, collected by Gardner, have been determined and described by Berkeley. (Ib. pp. 629-43.)

Darwin, whose spirited descriptions of the natural relations of South America and the South Sea Islands, presents such a variety of interest, has occupied himself with the problem of determining the reason of the absence of forests from Monte Video to Patagonia. (Journ. of Researches, p. 53.) On the banks of the large streams in Monte Video willows occur, and report speaks of a palm forest near Arroyo-Tapes. The traveller observed a solitary palm at 35° S.L. But these are the only exceptions to the treelessness of a country in which the orchard trees of Europe flourish extremely well. Plains, such as the Pampas of Buenos Ayres, are entirely treeless, a circumstance that appears to depend upon the prevailing winds, and the consequent hygrometrical conditions of the air. But these conditions do not obtain in Monte Video, where the hilly rocky surface presents the utmost variety of soils, including clay, and where there is no want of water. Here there is, in winter, a regular rainy season, and even the summer is not inordinately dry. New Holland, south of the tropic, is much drier, and yet it is always well wooded on the coasts. Consequently, the author is of opinion that the absence of trees at Monte Video can only be referred to geological causes, to an original peculiarity in this centre of creation. If on that occasion the larger ligneous plants were omitted, they could not readily extend themselves to this region from other centres of creation, for the trees of Brazil require a tropical climate, and there is no other forest country adjacent to this coast. South America generally presents forests, only in much moister regions, as on the west coast, southwards from 38° S.L., where the west winds of the Pacific prevail, and in Brazil as far as the trade wind extends. Thus, the districts on either side of the Cordilleras, which interrupt the course of the winds and deprive them of moisture, as well within as without the tropical zone, are in opposite conditions. Opposite to the primitive forests of Brazil lies the west coast, which from 4° to 30° S.L. is barren and treeless, and the wooded coasts from Chiloe to Tierra del Fuego are in the same way opposed to the scanty vegetation of Patagonia. Thence it might be concluded that Monte Video, as regards the arboreal vegetation of South America, possesses a too dry climate although not so in comparison with other wooded parts of the globe. The Falkland Islands also are barren of trees, although, with respect to climatic and geognostic relations, they are placed under precisely the same conditions as the forests of Tierra del Fuego.

The Rio Colorado constitutes the southern limits of the Pampas vegetation; its mouth lies at 40° S.L. (Ib. p. 87.) Here the nature of the soil of the steppe is changed, and with it the character of the vegetation. Between the Rio Negro and the Colorado, the gravelly surface bears a turf of grass with low thorny bushes, and this continues to be the type of the vegetation along the whole of the shores of Patagonia. The entire surface of the country, in like manner, from the Straits of Magellan to the Colorado, consists of a gravelly soil, which is for the most part composed of porphyry, derived from the Cordilleras. North of the Colorado the gravel becomes gradually smaller, till it finally passes into the calcareous argillaceous soil of the Pampas, which sort of soil, without stones, occupies a large basin, extending to the granite of Monte Video. The climate north of the Colorado continues to be no less arid and sterile, but the soil produces a variety of herbaceous plants and grasses, whilst the thorny shrubs are lost, together with the gravel. The vegetation of the Pampas of Bahia Blanca was still in its winter sleep at the beginning of September, around the White Bay (p. 115), but in the middle of this month the plains were covered with bloom; just as in all steppes, both of the Old World and New, the abundant blossoms of spring usually burst out suddenly. Previously to the bursting of the flowers the mean diurnal temperature had been 10°·6 C., but it then rose to 14°·4 C., that is to say, to a height at which the hibernation still continues at Monte Video. Hence it might be supposed that a different degree of irritability existed in the two floras separated by the Rio de la Plata; but probably in this problem the moisture of the atmosphere is concerned, which at Monte Video, longer than in the hot Pampas, prevents the evaporation of the plants, the cause of the rise of their sap in the spring. The steppe vegetation of the Pampas, from the Rio Salado to Buenos Ayres, is much more luxuriant than it is in these southern border districts, but probably only in consequence of the greater use of pasture. (p. 137.) In common with the wild horses and other domestic animals, which, since the first colonization of these countries in the year 1535, have spread themselves widely over the steppes European plants have also been introduced, and having completely supplanted the endemic vegetation over extensive tracts, have given the country, in many districts, from the Plata to the Cordilleras, its present natural character, in the same manner as the Opuntiæ and Agave have become characteristic on the shores of the Mediterranean. In this region, where at the present time horses of European origin only exist, Darwin has discovered the remains of a fossil indigenous horse of the latest geological period, and exactly in the same way, together with an endemic thistle which covers extensive tracts on the Rio de la Plata, has the European *Cynara Cardunculus* obtained possession of the soil over much wider districts.

This lofty growth of thistles is, on account of its extreme density, quite impenetrable by man or beast. Darwin is acquainted with no instance of an introduced plant occurring in such enormous quantity, and found on prolonged land journeys the same growth frequently recurring; he even observed it beyond the Plata, and saw many square miles in Monte Video thickly covered with the same thistle.

In South Patagonia, after having already explored a series of points on the coast, Darwin ascended the St. Cruz (50° S. L.) up to the foot of the Cordillera. The whole of Patagonia consists of a tertiary plain, gradually rising in a succession of terraces up to the Andes, and precipitous towards the sea from a height of 1200 feet. The rounded gravel which covers this plain, reposes upon a whitish soil, the argillaceous porphyritic detritus, in which the plants are rooted. Amongst the few productions of this soil, *Opuntia Darwinii*, Hensl., is characteristic. The terraces are frequently cut across by level valleys, but without water, and in these, the thorny shrubs abound. The climate is so dry that one may travel many days together without meeting with a drop of water.

The most striking contrast to these steppes is afforded by the clay-slate mountains of Tierra del Fuego, which are, however, very closely contiguous to them; these mountains are everywhere, down to the sea-shore, covered with a continuous gloomy forest. (p. 227.) The valleys of this mountainous region, like those in Norway, are lower than the sea-level, and constitute "Fjorde." The forest consists principally of *Fagus betuloides*, Mirb., (*Betula antarctica*, Forst.,) the other species of *Beech* and *Drimys* occurring only in inconsiderable numbers. The forest extends on the steep declivities, where there is scarcely anywhere a speck of earth, up to the altitude of 1000′ to 1500′, to this succeeds the region of alpine plants, which grow on a boggy soil, and reach to the line of perpetual snow (3500′.) A turf formation is also frequent in the forest region, in a wilderness of fallen and still vegetating trees. On this account, and owing to the yellowish, brown-green of the beech leaves, which do not fall in winter, the landscape acquires a gloomy character, which is also not often enlivened by sunshine. The peat formation (p. 349), which extends on the north as far as the Chonos Archipelago (45°), and is no longer met with in Chiloe, is constituted, in open situations, principally of the social *Astelia pumila*, Br., (*Anthericum trifarium*, Sol.,) a genus allied to the Junceæ, and which consequently here represents the *Narthecium* of the "Emsmoore," which is systematically placed immediately next to it. Together with the *Astelia*, grow *Myrtus nummularia*, *Empetrum rubrum*, and *Juncus grandiflorus*, which take a part in the formation of the peat. In the Falkland Islands, in a corresponding soil, all the plants are converted into peat, especially the Gramineæ. At the eastern entrance of the Straits of Magellan, the Patagonian steppes pass over into the shores of Tierra del Fuego; in the interior, the strait separates the one Flora from the other rather abruptly (p. 263), a condition with which may be compared the analogous contrast between Jutland and Norway. The cause of this remarkable contrast in the southern extremity of America, is to be sought, according to Darwin, in the amount of atmospheric deposit. At first sight such a difference in the character of the landscape, within a distance of four geographical miles, appears almost wonderful, but the climate itself presents the same degree of contrast; on the one side are the rounded mountains of Port Famine, continually drenched with showers and mists, which are collected by the stormy movement of the atmosphere, and at a distance of twelve miles, on "Gregory Bay," are dry barren plains, under a hot and cloudless azure sky. The mean temperature of Port Famine is probably = 5°·3 C., that of summer = 10°, in winter = + 0°·6. (King and Darwin.)

Dr. Hooker has described his stay in the Falkland Islands during the winter. (Journ. of Bot. ii, pp. 280-305.)

Urville enumerates, in his 'Flora' of these islands, 217 species. Hooker has added to the list, especially in the Cryptogamia. The only shrubs are *Chiliotrichum amelloides*, *Empetrum rubrum* and *Pernettia empetrifolia*, and on the western island, *Veronica decussata*. The famous "Tussac grass" (*Dactylis cæspitosa*, Forst., = *Festuca flabellata*, Lam.,) which grows to a height of six feet, and forms extensive patches of turf upon the peaty substratum, and the naturalization of which in Ireland, on account of its great nutritious properties, has been thought of, is limited, however, only to peculiar localities, and yields in importance as a food for cattle to the much more generally distributed and also very nutritious *Festuca Alopecurus*, Urv., with which every peat bog is covered.

"Hermit Island" lying to the west of Cape Horn, is the southernmost point at which Hooker, on his antarctic voyage, observed any arboreal vegetation. (Ib. p. 365.) An herbarium of eighty-four phanerogamous plants, corresponds with the forms of Tierra del Fuego, and the Falkland Islands; the tree is Darwin's evergreen *Beech*, to which, besides the synonyms given above, Hooker has applied as probable ones, those of *Fagus Forsteri*, Hook., and *F. dubia*, Mirb.

Darwin compares the forests of Chiloe for their luxuriant vegetation with those of the tropics. Various evergreen species, particularly Laurineæ and *Drimys*, are intermixed, and loaded with parasitic Monocotyledons, and under their shade grow various large *ferns* and tree-grasses. This vegetation, on the west coast of the continent at 45° S. L., borders on the uniform forest which extends from hence on the west side of the Andes as far as Tierra del Fuego. Its existence in such a high latitude, is owing to the extraordinary moisture of the climate. In Chiloe it rains both winter and summer, and Darwin believes that no other country in either temperate zone is subject to so much atmospheric deposit. The winds are usually violent, and the sky almost constantly covered with clouds. Even in Valdivia the forest character becomes remarkably changed (46°), the evergreen trees decrease, and at Valparaiso (33°), where, during the summer, rainless south winds prevail, and the atmospheric deposits take place almost only in the three winter months, there is scarcely a tree.

VI.—AUSTRALIA AND SOUTH SEA ISLANDS.

Darwin has given a general description of the botanical characters of the Gallapagos, the endemic Flora of which is still almost entirely unknown. (Ib. p. 453.) Covered with innumerable craters, these islands rise to the altitude of 3000′—4000′, and possess, on account of the low temperature proper to the surrounding ocean, a not very hot climate. On the coasts it seldom rains, but on the mountains the clouds hang low, and consequently at the altitude of about 1000′ a tolerably luxuriant vegetation makes its appearance, instead of the barren aspect presented by the littoral region. The modern lavas, however, spread over the declivities are entirely bare. Both animals and plants indicate for the most part an endemic creation. The plants are characterized by the sparing development of the leaves, and cannot be at all referred to the equatorial position of the islands. Ligneous plants are rare: amongst the most abundant in the lower region is a fruticose Euphorbiaceous plant, with small brownish leaves, together with an *Acacia* and the treelike *Opuntia galopagea*, with large, oval, compressed joints springing from the cylindrical stem; in the mountain region is an arboreal Synantherous plant, as well as ferns and grasses, but no tree-fern, and no palms.

Bentham has continued his investigation of the Flora of the Fidji Islands, &c. (vide last Report), from the collection of Hinds and Barclay. (Journal of Bot. pp. 211-40.) This list of not quite 200 species, appears now to be closed; it contains the new genera *Vavæa* from the Friendly Isles (allied to the doubtful Cedrelaceous plant, *Ixio-*

nanthes), *Cardiophora* from New Ireland (Terebinthiaceæ), *Lasiostoma* from New Guinea (Rubiaceæ), *Chætosus*, ib. (Apocyneæ), *Leucosmia* from the Fidji Islands (Aquilarineæ).

Lhotsky has endeavoured to characterize certain districts on the east coast of Australia by their productions. (Some data towards the Botanical Geography of New Holland, ib. pp. 135-41.) He distinguishes the following formations:

(1) "The coast vegetation" from Sydney southwards to the Illawarra. Quicksands or sandstone rocks with a scanty soil; numerous lagunes with salt or brackish water. The only tree, a *Eucalyptus;* thick bush of Epacrideæ, Proteaceæ, Podaliriæ, *Boronia* and *Comesperma*, social Xanthorrhoeæ and *Xerotes*. These shrubs constitute an almost impenetrable growth, and are of no economical use.

(2) "Watered rocky valleys along the coast." This appears to be the only locality for both the palms of New South Wales: *Corypha australis* and *Seaforthia elegans*. Here grow also the arboreal Amaryllideous plant, *Doryanthes*, a tree-fern (*Alsophila*), the Magnoliaceous *Tasmania*, besides some Malvaceæ, Rubiaceæ, and *Callicoma*.

(3) "Vegetation of the clayey soil." Extensive tracts of this formation are covered by the thin Eucalyptus forest, well known from R. Brown's celebrated sketch; it contains little underwood, but excellent pasture ground, with the greatest variety of herbaceous plants.

(4) "The vegetation of the Minero-Downs" includes the large tracts of pasture along the foot of the Blue Mountains. Excepting *Hakea* and *Brunonia*, ligneous plants are entirely wanting on this plain. In November it is clothed with a luxuriant vernal vegetation, which withers up under the heats of summer, and after April it presents only the aspect of a yellow-coloured steppe; the plants, however, consist chiefly of Gramineæ and Cyperaceæ. On these downs, between which and the argillaceous district there is no very marked line of demarcation,

the breeding of cattle is carried on, the wealth of the colony.

(5) "Vegetation of the Blue Mountains." The upper declivities of "Mount William the Fourth," which was ascended by Lhotsky, and on the summit of which the boiling point=196° F. were found by him to be covered with *Eucalyptus* trees 12′ to 20′ in height.

The Australian grasses in Lindley's collection have been determined by Nees v. Esenbeck, and besides several new species, the genera *Gamelythrum* and *Amphibromus* have on this occasion been instituted by him. (Journ. of Bot. ii, pp. 409-20.) Schauer has given a report on the Myrtaceæ collected by Preiss on the Swan River (178 species.) (Regensburg Flora, 1843, s. 405-10.) A. Braun has described 8 New Holland *Charæ*, for the most part collected by Preiss; they are all without an external cellular layer. (Linnæa, 1843, pp. 113-19.)

In Van Diemen's Land, a journal has appeared since 1842, (The Tasmanian Journal of Natural Science, Agriculture, &c.,) with botanical contributions by Gunn and Colenso. According to an extract from the first volume (Bot. Zeit. 1844, p. 140), the former has communicated remarks upon the Flora of Geelong, Port Philip; and the latter described some ferns from New Zealand.

Dieffenbach in his 'New Zealand Travels' speaks of the statistical relations of the indigenous Flora. (Travels in New Zealand, London, 1843, i, pp. 419-31.) Up to the present time, only about 630 species from New Zealand have been made known, and this paucity is to be referred, in the traveller's opinion, not to an incomplete exploration, but to the actual poverty of the Flora, the greater part of which appears to him to be already known. Principal families are: ninety-four Ferns, which constitute the distinguishing characteristic of the Flora, not simply in consequence of the variety of forms, but chiefly from the quantity of the individual plants, since enormous tracts of open country are covered with them, as representatives of the grasses in other Floras; three Tree-ferns (*Cyathea medul-*

laris and *dealbata*, *Dicsonia squarrosa*) attain a height of from 30′ to 40′, and grow in even greater numbers together, deep in the forest; 24 Gramineæ; 20 Cyperaceæ; representatives of the Junceæ, among which the European social *Juncus filiformis*, widely distributed, is said to indicate a thin layer of fertile soil, above the sterile argillaceous deposit; of Palms only *Areca sapida*, but which is seldom wanting in the denser forests; certain Liliaceous forms, characteristic of the open regions; *Phormium* almost everywhere; *Dracæna australis* forming a jungle on the river banks; of the Smilaceæ, *Ripogonum parviflorum*, Br., together with a Pandanea (*Freycinetia Banksii*), which is the most abundant climber of the forest; Orchideæ rare, however 3 Epiphyta are met with; *Typha angustifolia* usually covers the swamps, as in Europe; 2 Piperaceæ, common; 11 Coniferæ, among which the most important the Kawri Pine (*Dammara australis*) is confined to the northern extremity of the north island, and the others (*Dacrydium*, *Podocarpus*, *Phyllocladus*) do not occur associated, but dispersed about in the forests; 9 Epacrideæ; some Araliaceæ of curious forms (*Panax*, *Aralia Schefferi*, &c.); several Cunoniaceæ, amongst which *Leiospermum racemosum* constitutes large forests in all parts of New Zealand; 20 Onagrariæ; 13 Myrtaceæ, including some widely-distributed forest trees (2 species *Leptospermum*, 9 *Metrosideros*, *Eugenia*, and *Myrtus bullata*, indigenous also in Chili); 6 Pimelea-species, but only 2 Proteaceæ (*Persoonia tora* and *Knightia excelsa*); 3 Laurineæ, 2 of which are extensively distributed, and constitute a riparial growth; *Laurus tawa* covers the upper region of the mountains on Cook's Strait; of the Atherospermeæ, *Laurelia*, a bulky tree; 12 Scrophularineæ, with 9 Veronica-species, some of which are fruticose; of the Cyrtandraceæ, only *Rhabdothamnus Solandri;* of the Myoporineæ, *Avicennia tomentosa*, which forms the mangrove woods of New Zealand; of the Verbenaceæ, the important tree *Vitex littoralis*, the "New Zealand oak" of the settlers.

"Lord Auckland's Islands," lying to the south of New Zealand (51° S. L.), were explored by Dr. Hooker, during several weeks in the most favorable season (Nov. Dec.), and afforded him, without reckoning the Algæ, an herbarium of 120 species. The Flora, as stated by Dieffenbach, is probably not endemic, but introduced from New Zealand. This opinion is supported by the circumstance, that even in this high latitude true tree-ferns are met with, though here forming only a low stem. The surface of this mountainous Archipelago, is pretty equally covered with forest—bush and open pasture ground. From the sea-shore to the forest, European genera especially are found, together with the prevailing ferns which are also very numerous in the woods. The forest trees cover a thick undergrowth; the more lofty trees consist of a *Veronica,* an Araliaceous plant, some Myrtaceæ, and Epacrideæ, and these trees are often placed so thick, that they completely shade the ground. The tree-ferns belong to *Aspidium.* To this forest succeeds a region of shrubs, in which the Veronica tree is wanting, and the constituents of the undergrowth become more and more dwarfish. Above the fruticose region is one, consisting of the Gramineæ, where the mountain-meadows consist of *Bromus,* and one *Hierochloa,* together with some herbaceous plants, e. g. two Umbelliferæ; and strongly defined by a different vegetation, an alpine region occupies the summit of the mountain, with European genera and *Acæna.* Characteristic forms: a very social *Asphodelus,* with gold yellow flowers, *Veronica, Gentiana, Coprosma, Dracophyllum, Astelia,* &c. With the Flora of the "Lord Auckland's Archipelago," that of the neighbouring Campbell Island corresponds, even in the two arboreal ferns (52½° S. L.), only the south-west or windward side of the island is wholly without ligneous plants.

On "Keelings Islands," which have become celebrated through Darwin's 'Researches on the Coral Islands' (12° S. L.), and which, from the introduced Cocoa Palms, have also received the name of Cocoa Islands, that traveller collected about 20 plants, to which the indigenous Flora is confined. (Journal, p. 541.) According to Henslow's examination, 20 species belong to 19 different genera, and 16 natural families; and as these have all been washed from Java or New Holland, there is not a single endemic species produced by the coral reefs.

Kerguelen's Land (50° S. L. in the Indian Ocean) was a long winter station on Dr. Hooker's voyage. (Journ. of Bot. ii, pp. 257-63.) He there collected many Cryptogamia, and obtained an herbarium of 130 species, among which were 30 lichens, which cover the 2000′ high mountains in large quantities. The peculiar nature of the climate appears to have enabled Hooker to collect also the few Phanerogamia in a condition admitting of their determination. The following genera are met with: *Agrostis* and 4 other grasses, 1 *Juncus*, 1 *Ranunculus*, 1 *Callitriche*, 1 large cabbage-like Cruciferous plant, 1 social Umbellifer (probably *Bolax*,) 1 *Acæna*, 1 *Silene?* 1 Portulaceæ, Rubiaceæ, and Synanthereæ, and 3 Phanerogamia of uncertain relationship. Moreover of Cryptogamia, still 1 fern, 2 *Lycopodia*, 23 mosses, mostly corresponding to the Arctic forms, 10 *Jungermanniæ*, 1 *Marchantia*, 10 *Confervæ*, and 39 other Algæ, 1 Fungus. This great poverty of the Flora cannot be considered to be caused by the climate, which though indeed stormy, is otherwise not so very inclement, but is to be explained geologically.

The French works with figures which have been published, as a sequel to the Antarctic Voyage of Dumont d'Urville, as well as to the 'Expedition of the Venus,' contain botanical sections, but are as yet far from completion.

MEMOIR

ON THE

NUCLEI, FORMATION, AND GROWTH

OF

VEGETABLE CELLS.

BY CARL NÄGELI.

Pt. 1.

TRANSLATED FROM

SCHLEIDEN U. NÄGELI'S ZEITSCHRIFT F. WISSENSCHAFTLICHE BOTANIK, 1844.

BY ARTHUR HENFREY, F.L.S. &c.

For pt 2 see [illegible] (1849).

VEGETABLE CELLS.

I.—PRESENT CONDITION OF THE SUBJECT.

Robert Brown* first called attention to a peculiar body which he named the *nucleus*, situated on cell-walls. A cell commonly possesses but one such nucleus; very rarely two are present. Schleiden† pointed out the regular occurrence of the cell-nucleus in the 'Phanerogamia,' at least in the young cell. He discovered in it a certain denser corpuscule, the nucleolus, which, however, may also be wanting. The nucleus is solid, and consists of mucilage. (C. H. O. N.) It originates in the following manner: some larger corpuscules (nucleoli) first appear among the mucilage-granules, and around these corpuscules the granules accumulate, and thus become more or less blended together. According to Schleiden, also, the nucleolus is first formed, and the enveloping layer (*Rindenschicht*) of the nucleus originates from depositions upon the outer surface of it. The simple nucleus is in this way completed. Sometimes several young nuclei become united together and produce a compound nucleus, which then contains a number (2-3) of nucleoli; in its general function, however, it is exactly similar to the

* Vermischte bot. Schriften. v, p. 156 et seq. (Printed for distribution in English.—Tr.)

† Müller's Archiv, 1838, p. 1 et seq. Grundzüge der wissenschaftliche Botanik, 1842, i, § 23.

simple nucleus. Schleiden brought the nucleus into a peculiar relation to cell-formation, and hence gave it the name of cytoblast. It either adheres firmly to the cell-wall, or is inclosed in a duplicature of it. Endlicher and Unger* often find several nuclei in elongated cells. They leave the nucleus either free in the interior of the cell, or lying so loosely on the membrane, that it may be washed about by the circulating fluid of the cell. Mohl† also observed a free nucleus in the parent-cells of the spores of *Anthoceros;* and I‡ have shown that, in the young pollen grains, these free nuclei first originate in the already-formed cells.

The greatest discrepancy prevails among the views entertained of cell-formation. To arrange these, with what relates to them, according to their objective certainty, proceeding from the established to the problematical, and laying aside the wholly unfounded, we must go over them in the following order: The formation of the cell around the nucleus was pointed out by Schleiden. According to him § the nucleus exists first. It acts chemically over its whole periphery on the mucilaginous fluid in which it lies, and converts the layer in contact with it into firm jelly. This jelly forms a closed utricle, which grows larger by assimilating the fluid, and becomes the cell. The cytoblast, which does not grow, remains situated on one side of the wall. Schleiden observed the foregoing, step by step, in the fluid of the embryo-sac, and by analogy extends it to all the cells of Phanerogamia. I ‖ have confirmed the existence of this mode of cell-formation (around a nucleus) in many organs of Phanerogamia, and also taken it up as universally holding good throughout this class of plants.

I have endeavoured to refer to a second mode of cell-formation, coexisting with the first in Phanerogamia, but confined to a particular kind of cell, what takes place

* Grundzüge der Botanik, 1843, p. 22. † Linnæa, 1839, p. 273.
‡ Zur Entwickelungsgeschichte des Pollens, 1842, p. 21.
§ Loc. cit. ‖ Linnæa, 1842, p. 252.

in the special parent-cells of pollen.* The contents of the parent-cell separate into two or four portions, each of which incloses a free nucleus. From each of the portions originates a cell. The two or four cells are not free, but depend alike, at their first appearance, partly on the wall of the parent-cell, partly on one another, and thence look like septa.

A third kind of cell-formation is the division of the parent-cell by a septum. Mohl has adopted this view in regard to the Confervæ,† and the parent-cell of the spores of Anthoceros.‡ The septa grow inward from the membrane. Unger§ declares this mode of cell-formation to be universal. The partition walls are at first single, and afterwards become double. Meyen‖ also assumed the multiplication of cells by division to be a constant occurrence. According to him, it is sometimes an absolute division by a wall, at others it may be a constriction of the parent-cell, the membrane forming a circular fold, which grows inward, until it becomes continuous in the centre.

A fourth theory of cell-formation still remains to be mentioned, namely, the origination of cells as cavities in a homogeneous mass. Mirbel¶ endeavoured to establish this by his researches on the root of the date palm. Endlicher and Unger,** of late, assume this in regard to inferior plants, (Algæ, Lichens, &c.) This theory, which is partly refuted and partly existing as bare assertion devoid of practical demonstration, brings us to the remaining theories of cell-formation, old and new, which have been either set aside by direct refutation, or rendered untenable in an indirect manner by the progress of science. To the latter, for instance, belong the assumption of Sprengel, that cells form out of starch-

* Zur Entwick. des Pollens, p. 11.
† Ueber die Vermehrung der Pflanzenzellen durch Theilung, 1835.
‡ Linnæa, 1839, p. 273.
§ Linnæa, 1841, p. 385. Endlicher and Unger Grundzüge, s. 77.
‖ Physiologie ii, p. 336 et seq.
¶ Nouvelles notes sur le Cambium, 1839. ** Grundzüge, p. 33.

granules; Meyen's, that the membranes of the spores of Algæ, and the cells of the albumen of seeds, originate from the confluence (*colliquesciren*) of granules,* &c.

Opinions are equally divided as to the origin of cells in regard to their conditioning external relations. According to Schleiden,† the new cells only form *within* the parent-cells. According to Mirbel‡ and Unger,§ they originate on the *outside* of the cells, either on their surface, or in a space surrounded by cells.

As soon as the cell is actually formed it begins to grow. Schwann‖ first distinguished cell-formation from cell-growth, in indicating that the former takes place by the deposition of molecules in a radial direction, and that the latter progresses by the deposition of molecules in the tangent of the cell. The mode of formation of cells conditions an important distinction in their growth. If the cells originate by division, they possess from the first their subsequent form; but if they are formed free in the parent-cell (from cytoblasts), or on the outside of cells, they are originally spherical, and the various figures they afterwards assume must all be derived from unequal extension. It may hence be concluded, that cells either enlarge uniformly and retain their shape, or nutrition being unequally afforded in particular parts, their form is altered. From the unequal nutrition arise flat and elongated, conical, spongiform, star-shaped, and branched cells.

* Physiologie, ii, p. 336.

† Müller's Archiv, 1838, p. 1. Grundzüge i, s. 51.

‡ Sur le Marchantia polymorpha, 1831 and 1832. Nouv. notes sur le Cambium, 1839.

§ Aphorismen, 1838, pp. 6, 7. Endl. und Unger. Grundzüge, s. 74.

‖ Microscopische Untersuchungen, etc. 1839, p. 243 et seq.

II.—THE CELL-NUCLEUS.

a. Algæ.

In the class Algæ, cell-nuclei have hitherto been known only in *Spirogyra*. An accurate examination exhibits structures resembling nuclei in very many genera, and, in several, perfectly distinct and undoubted nuclei.

Among the Diatomaceæ,* *Arthrodesmus* possesses a small colourless corpuscule on the wall of the cell, which looks like a nucleolus. *Euastrum* frequently exhibits among the green contents, two obscure bodies resembling nuclei, always one in each half when the division through the middle takes place. These are not attached to the cell membrane, but lie free in the midst of the cavity; they appear to possess a dark centre (nucleolus?) and a clearer periphery (enveloping-layer? *Rindenschicht*). The two following instances, however, place beyond doubt the occurrence of nuclei in this order. *Gaillionella* sp.† (Pl. vi, fig. 1-3; Pl. vii, fig. 27, 28), is one of the

* I intend to set forth the grounds on which I hold this order to be vegetable, in the next part of this journal, by the definition of a plant and of the vegetable kingdom.

† I refer this Diatoma to the genus *Gaillionella*, although it does not wholly agree with Ehrenberg's generic diagnosis. The form is shortly cylindrical. The diameter of the circular plane is about ·014—·027 of a line, the axis varies from ·007—·009.

Both the terminal surfaces of the cylinder are flattened, so that when seen sideways, it appears rectangular with the angles rounded off. It is composed of one simple cell, the membrane and contents of which, in its perfect condition, exhibit the following character: The cell is filled with a transparent fluid. The solid contents consist of chlorophylle-granules, which lie upon the membrane in two circular bands. (Pl. ii, fig. 28, i, ii, b.) Each of these bands occupies one of the obtuse angles of the cylinder, and appears annular from above (fig. 28, ii), rectilinear from the side (fig. 28, i.) The chlorophylle-granules lie near together, and not one upon another, as they are each in contact with the membrane. The surface of the cylinder, where it is free from the deposit of chlorophylle, is surrounded by a band-like siliceous

Diatomaceæ, which frequently occurs upon marine Confervæ at Naples. It has the form of a very short cylinder, and appears therefore in one aspect of a circular (fig. 1),

plate. This lies outside the membrane (fig. 28 a), and must be regarded, from analogy to all other similar structures, as extra-cellular substance excreted from the cell. This siliceous shield is sometimes very evident, and easily to be distinguished from the membrane. Sometimes, indeed, it is thinner, and then it is difficult, or even impossible, to make it out clearly as separate from the membrane.

The propagation and development exhibit the following facts: The cylinder, which to this end becomes a little longer in proportion to its diameter, becomes divided by a septum into two similar cylinders of half the length. (Pl. i, 3.) I saw this division in individuals protected by a distinct shield, and still more frequently in those appearing to be without one. As soon as the division has taken place, the two halves part, and become two new perfect individuals. In younger individuals, where the chlorophylle is in course of formation, it lies spread over the whole of one terminal surface. (Pl. i, fig. 1.) It does not move to the corner of the cylinder until afterwards. The nascent chorophylle-granules are either spread equally over the circular surface, or, as is more frequently the case, arranged in radii from the nucleus present in the centre, they lie in the course of the currents streaming from this nucleus. (Pl. ii, fig. 27.) If we compare this *Gaillionella* with a cell of *Conferva*, or of *Spirogyra*, all three agree in the following points: they divide by forming a septum; they possess similar contents (transparent fluid and chlorophylle granules), and they deposit extra-cellular substance. *Gaillionella* resembles *Spirogyra* perfectly in having the chlorophylle deposited in bands, and in the presence of a nucleus with circulating fluid; *Conferva* in the formation of currents upon the wall, by the chlorophylle. *Gaillionella* differs from both, by the production of an individual from every cell, also by the chlorophylle forming two lateral bands, and the siliceous extra-cellular substance an intermediate one.

According to Ehrenberg's diagnosis of the section, the above described *Diatoma* should be placed, properly, with the Desmidiaceæ, and not with the Naviculaceæ, to which *Gaillionella* belongs, as the former have a single-valved, and the latter a bi- or multi-valved shield. It would then form a new genus of Desmidiaceæ, characterized by its cylindrical form, and its single, apparently circular, band-shaped shield. I cannot, however, make up my mind to add another to the already numerous genera. So far as my investigations go, *Gaillionella*, which according to Ehrenberg possesses a bi- or multi-valved shield, agrees with the above described plant in all essential particulars. The lines, for instance, which would intimate a division of the shield into two or more pieces, are the septa, by which the cell-division is effected. As in the filiform Algæ, these walls appear at first as delicate lines, then by an increase of thickness seem to become two clearly-defined lines, and at last present themselves as two lamellæ, separated by an intermediate third line. The perforations which Ehrenberg described and figured, I look upon as nothing more than intercellular spaces, formed between the two new-formed cells and the parent-cell. These so-called perforations are only visible therefore on the two lateral borders, where the wall abuts upon the membrane. The Confervoid Algæ exhibit a similar appearance.

On these grounds I must place the said *Diatoma* in the genus *Gaillionella*.

in the other of a rectangular figure (fig. 2.) Exactly in the centre of one circular surface, lies upon the membrane a little globule of uncoloured mucus (fig. 1, 2, n.) From this nucleolus stretch out several colourless threads of mucus (sap-currents, as in *Spirogyra*, &c.) on the wall, less frequently into the cavity; one of these threads, however, constantly goes across through the axis of the cell to the central point of the opposite over-lying circular surface. In propagation the cell divides by an intermediate wall, parallel to the two terminal surfaces (fig. 3.) Each of the new cells now exhibits a similar nucleolus with the thread of mucus passing through the axis; and, indeed, these nucleoli lie on the distal terminal surfaces of the young cells (fig. 3, n.) *Navicula* sp.* has in the centre (whether lying on the membrane or free, I know not) a nucleus with a nucleolus. I observed a pretty rapid circulation of the granular contents, the granules passing from the nucleus outwards along the edges, and back again to the former. In *Closterium*, a nucleus lies in the centre, which possesses a thick whitish nucleolus within a clear enveloping layer. It is coloured brown by iodine, and wholly resembles the nucleus in *Spirogyra*.

In few of the Nostochineæ can we perceive any distinct nucleus in the cells. *Protococcus* only has regularly an indistinct point in the centre. In *Palmella* this is

This genus is distinguished from the remaining genera of the Diatomaceæ thus: the cell, which each individual forms for itself, is cylindrical, and the division is effected by a wall perpendicular to the axis. The individuals generally remain attached together, forming longer or shorter chains. The species in question differs in this, that the young cells always separate from each by the division of the parent-cell, and further, that the individuals are universally cylindrical, with a shorter axis and flat ends. As to how and why they differ or agree with the other species in reference to the contents of the cell, its deposition and the formation of the excreted siliceous extra-cellular substance, no observations have hitherto thrown any light.

* This *Navicula* comes nearest to the variety of *Navicula striata Ehrenb.*, figured by Ehrenberg. (Tab. xxi, fig. 15.) I found it in brooks about Zürich. It exhibits no movement. The contained matter is brown, and fills the whole of the central cavity; both horns are free from it, and are transparent and uncoloured.

often clearly a little ring. Although in the permanent cells of *Undina* and *Rivularia,* I only perceived finely granular contents, the larger and clearer germinal cells several times presented two free nodules resembling nuclei, which appear to be forerunners of the formation of new cells.

The Confervaceæ usually present no trace of nuclei. A somewhat doubtful observation on germinating cells of *Oscillatoria,* showed two nucleoli near the centre, as in *Undina,* before the formation of the young cells. *Conferva glomerata* grows at the apex in such a manner that the cell formation takes place in the terminal joint. I could see no nuclei there. On the other hand, I found in older joints of a fresh-water form, that new cells also originated in old joints. These cells were closely filled with green substance, and had, in the midst of this, a free, transparent, and utricular nucleus. (Tab. vi, 10.) The same occurs in *Conferva bombycina,* Ag., where a free, perfectly transparent utricle lies in the centre of each cell. (Tab. vi, 13, 14.) That these utricles are nuclei is proved by their regular occurrence and their defined, circumscribed form. Each cell has one of these peculiar nuclei. In those individuals in which the articulations multiply by division, each new cell exhibits the central nucleus at its first origin. *Spirogyra,* however, is especially to be alluded to here, it being well known that it possesses in each cell a free nucleus, with thread-like currents flowing from it. This nucleus has a thin, enveloping layer, and a dense whitish nucleolus. Iodine colours them brown, the former slightly, the latter more deeply. *Ectocarpus* also must be mentioned, as also possessing a central nucleus in each cell. As this nucleus, as well as the cell contents generally, has exactly the same characters as that of the Fucoideæ, I refer to the description there given.

Among the Ulvaceæ, *Bangia** often possesses well-

* This genus, in all essential characters, belongs to the Ulvaceæ.

marked nuclei; they are hemispherical collections of mucus attached to the membrane. They become more or less coloured by the cell contents lying upon them, and send out many thread-like currents into the cavity of the cell. (Tab. vi, 29, 30.) A brighter and denser point, which may be seen in each nucleus, is not a nucleolus, but a current of sap seen endwise. (Fig. 29, *a*, *b*, *d*.) The other red Ulvæ also occasionally exhibit similar nuclei. In the Siphoneæ I have never seen any trace of nuclei.

The true Fucaceæ* also possess a free central nucleus. (Tab. vi, 15, 16. Tab. vii, 1-5.) It is universally round, usually composed of a homogeneous and uncoloured mucilage (*Sphacellaria scoparia*, *Padina Pavonia*, *Cystoseira*); sometimes it subsequently becomes granular (*Padina Pavonia*.) In young cells this nucleus is the central point of a circulatory system, threads of mucus passing out from it on all sides through the cell. (*Cystoseira*, Tab. i, 15.) Tincture of iodine produces in it the characteristic colour of mucus. (C, H, O, N.) By the time the transformative activity of the cell has ceased, the formerly granular mucilaginous contents have separated into a transparent fluid and cell-sap granules which are attached to the wall, the currents having disappeared; the nucleus also undergoes an important metamorphosis. It becomes hollow, and presents an utricle with more or less granular, solid contents. (Tab. vi, 16.) It increases in size also. While, originally, it scarcely measured ·002 of a line across, it has extended by this time to a diameter of ·003, and even of ·005, ·006 of a line. The utricle into which the nucleus has become converted, is either transparent and wholly without contents (Tab. vi, 16, *a*), or it contains a varying number of little granules, the nature of which is not made out. (16, *d*.) Or it may inclose larger granules, which may be few in number or completely filling the cavity. These larger granules are clearly starch-

* To make this order natural, *Sphacelaria* and *Cladostephos* must be included in it; some other genera, as *Lichina*, *Furcellaria*, and *Chordaria*, removed.

(16, b, c) and chlorophylle-granules (16, *e*, *f*, *g*.) These metamorphosed nuclei we may easily set free by tearing the cellular tissue, and thus be convinced that they consist of a membrane in the form of a round cellule, lying upon the inner surface of which the granules are found. The above-described various conditions I first observed in several species of *Cystoseira*, and indeed sometimes all in the same section; subsequently I have seen this transformation of the nucleus in other Fucaceæ, and also in *Ectocarpus* which is nearly related in regard to its vegetative life, Occasionally also (ex. gr. in *Dictyota dichotoma*), the nucleus-cellules contain yellowish-brown oil-globules of greater or smaller dimensions.

The observation teaches us also, that in the Fucoideæ the nuclei at a later period take on the character of utricles. This appears at first sight to be the consequence of a metamorphosis. We shall, however, become acquainted with many other nuclei which are composed of an utricle with various contained matters. Analogy, therefore, strongly urges us to admit that the nuclei of Fucoideæ are also really utricles at the earliest period, and that they cannot be recognized as such on account of the dense mucilage with which they are filled. Then the whole apparent metamorphosis depends on nothing more than the chemical transformation of the cell contents; and the course of existence of this nucleus presents phenomena similar to those belonging to the cell. The nucleus-cellule originally contains a homogeneous mucilage, this becomes granular, and is then converted into starch, chlorophylle, or oil, which lie in a transparent fluid.

b. Fungi.

Structures resembling nuclei may be detected here and there in the cells of Fungi. The fermentation fungus in the must of wine and in yeast often exhibits a little nucleus of whitish mucus, lying on the membrane, regularly in each cell. In several of the filiform Fungi a similar appearance is to be observed, in which cases a system of anastomosing currents is occasionally connected with the nucleal globules of mucilage. In young cells of filiform Fungi, only just formed and still containing merely homogeneous mucilage, the nucleus has the appearance of a transparent utricle with a little nucleolus. I have found a distinct nucleus in the theca of *Morchella esculenta,* before the commencement of the formation of the spores. (Tab. vi, 28.) It is a homogeneous translucent utricle, and contains a dense, whitish nucleolus. Iodine tinges the former slightly yellow, the latter brownish yellow. The nucleus is situated on the wall of the theca, the nucleolus on the periphery of the nucleus.

The spores of the lower and higher Fungi frequently contain structures which one is inclined to regard as nuclei. In most cases the observation is not clear. I give the two following as more certain examples. In several species of *Peziza* a little transparent, hemispherical nucleus lies on the wall of the spore cell, which is densely filled with granular, colourless matter. The spores of *Erysibe Coryli* contain a clear, round, nucleal utricle among the orange-yellow granular mass.

c. Lichenes.

I have never yet been able to see nuclei in this order; in the spores alone occur bodies which can at all be considered as such. I am certain only of the compound spores, where the two nuclei already present themselves in the single cell, and the division of the cell consequently follows.

*d. Florideæ.**

The Florideæ possess nuclei of various kinds. A small whitish nucleus occasionally lies upon the wall in vegetative cells. From this the thread-like currents flow out through the cells (various species of *Laurencia*, *Rhodomela pinastroides*, *Wrangelia penicellata*, Ag. &c.), or it is connected with a reticular system of currents. (Young hair of *Laurencia dasyphylla*, Tab. vi, 22, of *Rytiphloca tinctoria*, *Hutchinsia*, &c.) In very young cells, which are yet filled with homogeneous and colourless mucilage, these nuclei appear either merely as rings, or a denser point (nucleolus) is perceived in their interior. In this condition they either do not differ in consistence from the surrounding mucilage, or they are thinner and look like vesicles in it. The nuclei are most easily to be seen in the terminal cells of the filiform Florideæ (*Hutchinsia*, *Callithamnion*), and in the terminal cells of the hairs in process of formation of the larger species. (*Rytiphloca*, Tab. vi, 17, *Rhodomela*.) When the cells become larger, their mucilaginous contents divide into filiform currents, radiating from the nucleus. I have been able to observe the nucleus most clearly in this stage of development. It displays itself as a transparent utricle with a delicate membrane and a small point-like nucleolus. (Young hair of *Rytiphloca tinctoria*, Tab. vi, 18, and *Rhodomela pinastroides*.) In old cells these nuclei appear as before stated, like small whitish hemispherical bodies. Transverse sections through the point of vegetation of the larger Florideæ exhibit a tissue similar to that of the apex of the stem of Phanerogamia. A denser and more opaque nucleus is present in each cell. (*Laurencia*, Tab. vi, 24.) Analogy determines me to assume here also, that these

* To this order belong all Algæ, which, in the parent-cells of the spores, form four spore-cells, after the manner of the Mosses and Phanerogamia. (Heterocarpeæ Ktzg.) These include most of the Florideæ and Ceramiæ.

nuclei have been altered by injury of the tissue, and by endosmose of water. I shall refer to these alterations when speaking of the Phanerogamia.

The germinal or gemmulary cells* are densely filled with red granular substance. In the midst of it is suspended a bright transparent nucleal vesicle. (*Nitophyllum ocellatum*, *Rhodomela*.) Whether this vesicle merely incloses a homogeneous fluid, or contains also a nucleolus, is not to be ascertained in fully-formed gemmule-cells. In young cells, which contain little coloured and finely granular mucilage, I have distinctly seen a nucleolus, in *Rytiphloca* (Tab. vi, 20), and in *Hutchinsia*. In earlier stages, however, where the mucilaginous substance is yet colourless and uniform, the nuclei are very small. (Tab. vi, 19.)

The parent-cells, from which the four spores are produced, at first contain a little nucleus attached to the membrane, like other vegetative cells. (*Hutchinsia*, Tab. vi, 23, *a*.) After this is absorbed a free nucleus appears in the centre. (*Nitophyllum*, *Ceramium*, *Dasya*, &c.) I made it out most clearly in *Hutchinsia* (Tab. vi, 24, *a*), and in *Callithamnion versicolor*, where it consists of a transparent utricle with a whitish point (nucleolus). The granular contents of the cell then accumulate round this central nucleus, and radiating currents proceed in all directions toward the circumference. (Tab. vi, 25, a.) After that four new nuclei are formed in the spore parent-cell, and as the consequence of these, the origination of four special parent-cells, and subsequently of four spores, follows. They are round, formed of homogeneous mucilage, and slightly reddish, or almost colourless. In most I could perceive no nucleolus; once there appeared to be one. I have seen these nuclei best in *Ceramium diaphanum* and in *Hutchinsia*. Twice I observed them coloured intensely red. After the plants had remained some time in the room the contents of the special parent-cells, which were

* The Florideæ have double organs of fructification. Of these, the Cystocarpiæ (Ktzg.) in their morphological signification approximate to true gemmule-bearing organs (knoospenbehälter), like those of the *Marchantiæ*.

also originally red, became green. The four nuclei only, still retained their former colour, and now appeared as bright red globules. (*Callithamnion versicolor*, Tab. vi, 26.) From these four nuclei originate the four special parent-cells. When the spores are formed we perceive again in them a free central nucleus, an utricle with a nucleolus. (*Hutchinsia*.)

e. *Hepaticæ*.

Nuclei may be observed everywhere in this order, if the tissue be examined sufficiently early. They consist of a transparent utricle with a dense whitish nucleolus. I found them in this condition in the apex of the stem of *Jungermannia*, in young leaves of *Jungermannia* (*bicuspidata*, Tab. vii, 15, &c.), in the simple hairs which exist on the leaves of *Lunularia*, and in the articulated hairs which surround the sporangium of *Marchantia* and *Lunularia* (Tab. vii, 16), in the young cells of the root fibrils of *Jungermannia* and *Marchantia*, and in the parent-cells of the spores of *Marchantia*. The nuclei have a similar relation to the contents of the cells in these various parts of the plant. These contents are originally homogeneous and uncoloured; the nucleus appears therein as a cavity with a little point. As the cell extends itself actively in proportion to the quantity of the contained mucilage, this divides into filiform currents round the nucleus. If, on the contrary, the mucilaginous mass is relatively more abundant, it becomes granular and of a green colour, without any appearance of sap-currents in it. In both cases the nucleus is a transparent utricle with a delicate membrane and a small nucleolus; it is attached to the wall of the cell. In old cells either the nucleus has been absorbed or it has escaped me, on account of the smallness of its size. In the minute cellular tissue which fills the antheridia, every cell also possesses a little nucleus before it forms the spermatic filament. Cells and nuclei, however, are very small there (the former ·0020-·0025, the latter ·0006 of a line); the latter, therefore, are only to be recognized as whitish granules.

In addition to the nuclei attached to the walls, the liverworts, like the Florideæ, possess free nuclei in particular cells. Hugo Mohl made these known to us in his interesting treatise on the formation of the spores in Anthoceros.* I had an opportunity of examining these plants in the summer of 1842, at Naples. First, as Mohl declared, a nucleus with a nucleolus (Tab. vi, 31) appears in the parent-cell. I cannot, however, participate in his view, that this is originally situated on the wall of the cell, and afterwards moves into the centre, from which one might imagine that this nucleus was the cytoblast of the parent-cell, according to Schleiden's idea of cell formation. Before it makes its appearance the parent-cell possesses a small nucleus, placed on the wall, and this is subsequently absorbed. Then the larger nucleus appears, and indeed, according to my observations, always free, and more or less in the middle of the cell. It appears to maintain this position, for even under later circumstances it does not always lie in the centre, but frequently between the centre and the wall. When this nucleus appeared most distinctly, it was a transparent utricle with a homogeneous and whitish nucleolus, which was situated on the wall of the nucleal utricle. Sometimes I saw two nucleoli. (Tab. vi, 32.) Iodine coloured the nucleus slightly, the nucleolus intensely brownish-yellow. Two free nuclei are seldom formed in one parent-cell; such conditions do not appear susceptible of further development.

The scanty, almost homogeneous and mucilaginous contents that occur in the parent-cell, surround the nucleus as a thin layer, and send radiating sap-threads towards the cell-wall. (Tab. vi, 31.) In other cells, the mass enveloping the nucleus is greenish and finely granular, the filiform currents, on the contrary, are uncoloured, or merely greenish at their inner expanded base. (Tab. vi, 32.) The

* Linnæa, 1839.

former condition, with uncoloured contents, is certainly the earlier, and the formation of chlorophylle takes place in this circulating mucilaginous matter, in the same manner as chlorophylle and starch originate in other (*ex. gr.* Algæ) cells. The nucleus is now invested with a thin enveloping layer of green granular mucilage. This accumulates at one side of the nucleus (Tab. vi, 33-4), and then divides into two halves, which separate from each other. (Tab. vi, 35.) Each forms a longish streak lying upon the nucleus. In this stage both the masses of mingled chlorophylle and mucilage are as yet without definite shape, they lose themselves in the surrounding colourless mucilage. By degrees they become more precisely divided; they then appear as two oval sharply-defined green bodies at either side of the nucleus (Tab. vi, 36-7), and are, with the latter, imbedded in a mucilaginous envelope, which is connected with the cell-wall by filiform currents. Sometimes these oval bodies contain all the chlorophylle that lies in the parent-cell; at others this also occurs in the mucilaginous envelope. The former condition alone, where the mucilaginous envelope is uncoloured, permits an accurate observation of the successive changes.

The oval bodies themselves differ considerably in the amount of chlorophylle they contain. Some are slightly greenish, others dark green. When they are little coloured, and their contents very lax, they appear, in the almost homogeneous, dull whitish, mucilaginous mass, exactly like two excavated spaces; in these the chlorophylle lies. The cavities are transparent, and slightly reddish, and are immediately bounded by the overlying mucilage. Subsequently, a delicate membrane is seen inclosing the green granules; and thus a nucleus makes its appearance in the form of an utricle, containing chlorophylle and mucilage. These two oval nuclei each divide into two round green nuclei. These attain a size equal to half that of the parent-nucleus, and are, like it, more or less intensely coloured. They also are sharply defined, and it may be perceived that they possess a proper membrane.

The division of the two primary nuclei takes place in the following course. In the oval nucleal utricle, which incloses a slightly coloured and almost homogeneous mucilage, a septum makes its appearance, whereupon a little dark point (nucleolus ?) is usually to be perceived in each half. (Tab. vi, 38.) The two newly-formed utricles gradually separate, at the same time acquiring a rounded form. After this they withdraw from one another, and take up such a position that they are arranged round the central nucleus like the angles of a tetrahedron. I have seen this tetrahedral position produced several times in such a way that the diameters of the two primary nucleal utricles intersected at a right angle, as also the septa, by which they became divided. (Tab. vi, 39.)

During the formation of the nucleus, the mucilaginous contents of the parent-cell are distributed in flowing currents round the central nucleus. (Tab. vi, 35-39.) When the four new nuclei have attained their final tetrahedrally-disposed condition, the system of currents becomes wholly changed. They appear now as connecting threads between the four nuclei and as filaments, which radiate from each, and connect it with the cell-wall. (Tab. vi, 40.) The absorption of the central nucleus, and the formation of four special parent-cells, subsequently takes place.

I have in the foregoing exactly reported what observation presented to me. The interpretation must be undertaken with greater caution. In the first place, it appears to me certain that the nuclei are utricles or cellules. Observation, which demonstrates a membrane distinct from the contents, leaves no doubt on this point. Hugo Mohl is of the same opinion; he called them granule-cells (körnerzellen). He, however, holds the apparent membrane to be merely the bounding and thickened layer of the surrounding mucilage. The above quoted observation therefore seems to indicate that they appear at first merely as cavities in the mucilage. This *probability* is not conclusive. A delicate utricle with transparent contents may very easily be invisible in the midst of denser homogeneous substance. That the membrane is peculiar to the nuclei, and also constitutes in itself an organic part, is proved by its division. Throughout the latter process, no essential difference can be perceived from the formation of cells in *Palmella.* It must also be explained like these, provided an analogy be established between true cells and nuclei, which have all the physical and chemical characters of cells. But from this it follows then, that the four secondary nuclei at least possess a proper membrane, and since a second analogy between these and the primary oval nuclei becomes in turn involved, the same must also be assumed of the latter. I shall return to this point when treating of cell formation.

Observation seems further to yield that the green mucilaginous mass collects itself into two heaps, which by degrees assume a precisely defined form, and become invested with a membrane; also, that two utricles of a determinate size originate. That, however, is merely the limit beyond which experience is unable to proceed. The region of possibility, consistent with experience, is extensive enough here. We know that the two oval nuclei, and the four round nuclei, are cellules with a membrane; and yet they appear, when their true form is hidden by chlorophylle lying in the enveloping mucilage, as shapeless accumulations. It is therefore equally possible, that in the primary green-coloured mucilage, which lies upon the colourless nucleus, an utricle is already hidden; that this utricle parts into the two oval nuclei, and that with these the mucilaginous mass also simultaneously divides into two portions. It is possible also that these two oval nuclei originate independently in some manner invisible to us. However, no conclusion can be drawn from the phenomena as they lie before us, as to the primary mode of formation of the nucleus. It would involve the error of confounding the stage first accessible to our observation with the organic origin. I call attention therefore especially to this, that the formation of nucleal utricles in

Anthoceros is not at all held as an analogue of Schleiden's cell-formation round a cytoblast; as in that case it would be assumed that the mucilage, coloured green by chlorophylle, collects together and forms a membrane on its surface.

Consequently, in regard to the nuclei in the parent-cells of the spores of *Anthoceros*, we can declare with certainty, no more than that they are cells with proper membranes, which contain mucilage and chlorophylle. Hugo Mohl also observed starch in them. They add to the nuclei of the Fucoideæ, and the red nuclei in the parent-cells of the spores of the Florideæ, the third example, where nuclei contain, besides mucilage, unazotized assimilated matter within an utricle. The mucilage itself appears at last to be almost wholly wanting, since merely a transparent fluid occurs with the little chlorophylle granules.

f. Musci.

I have but very few observations to relate in this order. I found distinct nuclei (=·013 of a line) in the large parenchyma-cells, which lie beneath the epidermis-cells of the fruit capsule in *Philonotis fontana,* at a period before the formation of spores had commenced. (Tab. vii, 14.) These nuclei are hemispherical, and are fixed to the cell-wall. They possess a distinct membrane, finely-granular mucilaginous contents in small quantity, and on their wall a little white nucleolus, which is sometimes in the midst of a cavity. (Fig. 14, *b*.) In the cells of the Paraphyses of *Polytrichum commune* are parietal whitish nuclei with nucleoli, from these fine sap-threads flow out through the cell.

g. Characeæ.

All young cells of *Nitella* and *Chara*, possess parietal nuclei. I have observed them in the apex of the stem of *Nitella flexilis*, in the leaves of *N. flexilis*, of *Chara vulgaris*, *hispida*, and *gracilis*, in the sporangium, and in the partly-developed sporocarpium of *N. flexilis* (Tab. vii, 10, *d*), and in the wall of the antheridiæ of *N. flexilis* and *Ch. vulgaris*. These nuclei all agree in this, they consist of a nucleal utricle and a nucleolus. The membrane of the nucleal utricle is often distinctly to be perceived. Its contents are transparent or slightly mucilaginous, seldom finely granular. The nucleolus appears like a whitish shining point. When it is sufficiently large, a cavity may be perceived in it. The nuclei vary in size, from ·003 to ·008 of a line. They are visible in the cells until the formation of chlorophylle commences. When the contents have begun to rotate, I can no longer find them.

The nuclei just described also occur in the partly-developed cellular filaments, which lie in the interior of the Antheridiæ. They are homogeneously mucilaginous, and contain a nucleolus. Subsequently, a roundish elliptical cell, with a little nucleolus, is found in each articulation. This appears merely like a whitish point, and resembles the nucleolus of the earlier nucleus. (Tab. vii, 11, *a*.) By agitation in water or pressure, the cell is made to draw itself together into a little mucilaginous heap. (Tab. vii, 11, *b*.) The figures *a*, and *b*, in Tab. vii, fig. 11, represent the same fibre, *a*, as it originally was, directly after it had left the antheridium; *b*, as it became altered before my eyes by endosmose of water. The filaments were drawn in this condition by Fritzsche,* and by Meyen.† The spermatic filaments originate in the elliptical cells just described. If these are not to be represented as merely the nucleal utricles increased in size, but as new formations after the absorption of these, and to be actually regarded

* Ueber den Pollen, 1837. Tab. ii, fig. 10. † Physiologie, Tab. xii, fig. 20.

as cells, they possess nuclei of a different kind from those of the other cells of the Characeæ, and analogous to nucleoli.

h. Equisetaceæ.

Every cell of the young tissue of the stem and leaves regularly exhibits a nucleus. (Tab. vii, 6.) It is attached to the wall, and of a hemispherical form. The scanty mucilage forms a thin layer round the nucleus, and proceeds in filiform currents through the cell. In somewhat older cells, where the movement of the sap has ceased, the nuclei are distinctly to be observed. By tearing the cellular tissue they may be set free. (Tab. vii, 7.) They are utricles of ·006-·008 of a line in diameter, which inclose almost homogeneous, or very finely-granular, colourless, or slightly brownish contents. They contain from one to four nucleoli of different sizes (·0005-·002 of a line). By rolling over the nucleal utricles, I have often convinced myself that the nuclei floated free in the cell-contents. (Fig. *d*, *i*, and *ii*.) I never saw them lying on the wall. Once I observed a hollow space in the cell-contents, the nucleolus was in the midst of this. (Fig. *c*.) Tincture of iodine coloured the nuclei brown, the nucleoli more intensely. The membrane of the utricle becomes more distinct by this application. (Fig. *e*.)

The spores also possess nuclei; I know nothing of their characters. The parent-cells of the spores present nuclei, like those of the other tissues of the plant.

i. Lycopodiaceæ.

The cells of the apex of the stem and of the nascent leaves of *Lycopodium clavatum*, when not more than ·005 of a line in diameter, possess a whitish, apparently homogeneous nucleus of ·002 of a line. (Tab. vii, 8.) When it becomes larger we distinguish, first a nucleolus within it, afterwards an investing membrane. (Tab. vii, 9.) The contents of these nucleal utricles, when they are ·004 and ·005 of a line large, lie as a thin layer of mucilage on their wall, or as granules also on the wall (9, *b*, *c*), or they are wholly clear and transparent (9, *a*). I always see the nucleolus (9, *n*) attached to the membrane of the utricle.

The nuclei of the spores of *Lycopodium brasiliense* are small. They appear to lie in the centre.

k. Filices.

The nuclei of vegetative cells are to be observed here with peculiar distinctness in the germinal frond. (Tab. vii, 13.) In every cell a nucleus of tolerable size lies upon the wall. From above, it appears round (fig. *a-c*), from the side, hemispherical. (Fig. *d*). It regularly contains one nucleolus, more rarely two. The enveloping layer (Rindenschicht) and the nucleoli consist originally of a a homogeneous whitish mucilage. The former appears thin and dim, the latter denser and brighter. (Fig. *a.*) Subsequently the enveloping layer of the nucleus becomes slightly granular, and separate from a membrane inclosing it. (Fig. *b.*) Finally it is an utricle filled with transparent fluid. (Fig. *d.*) The membrane of the nucleus, however, is already present in the earliest stage. In Tab. vii, fig. 13, *c*, is represented a nucleus exactly like that in fig. *a*, but treated with tincture of iodine. The homogeneous enveloping layer has divided into two clearly distinct portions; into a delicate membrane of a pale yellow, or wholly colourless and finely-granular brownish contents. The nucleolus becomes coloured a dark brown. From this it follows that the contents of the nucleal utricle consist of mucilage and gum. Tincture of iodine colours the mucilage brown by the action of the iodine, and precipitates the granular gum by the alcohol. These nuclei occur in all the cells of the germinal frond, also in the hairs of the roots and the organs which inclose the moving spiral fibres. Nuclei are always present also in the growing ends of fronds, though not so easily seen there. In the young cells of hairs a circulation is frequently connected with them. (Tab. vii, 12.)

Those cellules also, in which the moving spiral filaments originate, possess a small parietal nucleus. This appears to be analogous to the little nuclei in those cellules in the antheridium of *Chara*, in which the spermatic filaments are formed. Possibly, therefore, it may correspond not to an actual nucleus, but a nucleolus.

The spores also possess nuclei; I had no opportunity to investigate them more closely.

l. Phanerogamia.

Every tissue in the Phanerogamia* exhibits nuclei, provided we examine it at a sufficiently early period. They lie on the wall of the cell. One nucleus only occurs in each cell. In it are to be distinguished more or less clearly, according to its age and to the particular tissue of the plant, three parts: 1. An enveloping membrane, the nucleal utricle. 2. The contents of the nucleal utricle. 3. One or more nucleus-corpuscules or nucleoli.

In quite young cells, which are as yet filled with homogeneous, uncoloured mucilage, the nucleus appears like a hollow, almost transparent, space in them. The membrane is not yet visible; the mucilage of the cell seems immediately to inclose the hollow space. A whitish, shining point is the nucleolus. In this stage the nucleus occupies a large portion (even half) of the cavity of the cell. This becomes larger, the formerly homogeneous, mucilaginous contents of the cell become granular and more dispersed.

* According to Schleiden's discoveries relative to the fructification (Grundzüge der wissenschaftl. Botanik, ii, p. 97), the Rhizocarpeæ also are to be referred here; of these I had an opportunity of examining *Pilularia* lately. I found nuclei in all the young tissues of it, as in the other Phanerogamia.

The nucleus meanwhile has grown but little. Its membrane begins to be visible. Its contents are homogeneous, mucilaginous, and opaque; the nucleolus becomes somewhat larger. Subsequently the homogeneous mucilage of the nucleal utricle becomes granular, and continues in this condition during the whole duration of its existence. More rarely it is absorbed, so that the nucleal utricle incloses, besides the nucleolus, only a transparent fluid. The membrane is most distinctly visible when the mucilage has become granular. It remains unaltered by the action of iodine, while the contents become coloured a yellowish, and the nucleolus a dark brown. These are the chief facts in the history of the growth of the nucleus. Remarkable individual differences occur, however, especially in their fully-formed condition.

The nuclei which lie upon the cell-wall are usually of a form hemispherical when viewed laterally. But one or other diameter may exceed in length, and thus the nucleus become semi-elliptical, in which case the base usually corresponds to the long diameter of the ellipse, rarely to the shorter. The nucleus adheres to the cell-wall by its whole basal surface. In the stem of *Orchis maculata* (Tab. vii, 17, *a-m*, represent the nuclei, *n-p* the nucleoli of this plant), I found nuclei which had extended themselves remarkably around the place of attachment. (Tab. vii, 17, *e;* the nucleus is seen from the side; the portion of the membrane, by which it was attached to the cell-wall, is left, the cell-membrane having been stripped off.) It is only thus, indeed, that we can prove that the nucleus was still developing, after the cell-membrane had begun to grow. The form of the nuclei, seen from above, is usually round, sometimes elliptical, rarely linear.

The nucleoli vary much in number and size. Most frequently there is one only in each nucleal vesicle; but two, three, four, or five may occur. They are free or attached to the wall indifferently, whether one or many are present; the parietal position, however, is the most usual. When several nucleoli occur in one nucleus, they may be placed either in a line (Tab. vii, 17, *e*, *h*; 19, *a*, *c*), on the same plane (Tab. vii, 19, *b*), or irregularly. They may also be of equal (19, *a*, *b*) or of different (17, *h*, *k*) size. The substance of the nucleolus is always much denser than the contents of the nucleal vesicle. While it is small it appears solid. Even after it has attained its full size, it is at first solid and homogeneous (17, *a-e*, *g-i*; 19). It then becomes hollow in the centre (17, *f*, *m*). This cavity may remain small, or become so large that merely a thin enveloping layer remains. There may be one, two, three, or many cavities, of various sizes and arrangement. Tab. vii, 17, *n*, *o*, *p*, represent such nucleoli from *Orchis maculata*, where the mucilage has many cavities, and may almost be called frothy. The nucleoli are spherical or ellipsoidal. Their substance is either homogeneous, vesiculose (with minute empty cavities), or slightly granular. Sometimes the circumference of the nucleoli presented to me double lines (Tab. vii, 17, *m*, *s*, *n*), in other cases merely a thin, dense, marginal layer, as if they were invested with a membrane. When the nucleoli are large, in very rare cases however, we may perceive a denser, shining point in each, which has apparently the same relation to it as a nucleolus to a nucleus of the same size. I have seen these granules even in the cavity of the nucleolus (17 *l*).

The contents of the nucleal vesicle are distributed in it in an equally varying manner. Sometimes the contained matter is deposited in a layer on the inner surface. More frequently, however, hollow spaces occur in it, each round a nucleolus (Tab. vii, 17, *b-m*; 19, *b*, *c*); this happens both when the contents are homogeneous and when they are granular. The hollow space is either concentrical with nucleus (17, *b*; 19, *b*); on one side (17, *f*, *i*, *k*), or on two sides (17 *l*). All the nucleoli of a nucleal vesicle are similarly situated in such cavities (19, *b*), or some, especially the smaller, are immediately inclosed by the contents of the vesicle (17, *e*, *k*). At first it appears as if these hollow spaces were immediately bounded by the contents of the nucleal vesicle (17, *b-l*); these soon become notably thickened on the border, so that they now surround the cavity in the form of a membrane (17, *m, q*). In this condition the nucleal vesicle bears very great resemblance to a cell in which granular or homogeneous contents and a hollow nucleal vesicle, with a nucleolus (77, *m*), are present.

According to Schleiden* the nuclei are sometimes devoid of nucleoli. I have not yet been able to convince myself of this by certain observation. Even where the nucleoli, in many nucleal vesicles, were indistinct on account of the granular or dense homogeneous contents, I have distinctly observed them in other nuclei of the same tissue. So that I am very much inclined to assume that nucleoli are present in all parietal nuclei of the Phanerogamia. In these investigations we have especially to bear in mind a delusive impression which is easily caused by the alteration of the cell-contents. The cells of a young tissue which are submitted to the action of water, particularly when this is facilitated by slicing or pressure, often take very quickly quite another appearance. In treating of cell-formation I shall recur once more to this point. The cell nuclei, which before the disturbing action of endosmose began, presented themselves as vesicles, with very thin homogeneous and colourless contents, and a perfectly distinct nucleolus contract, become denser by the coagulation of the mucilage, and acquire a yellow colour; so that the nucleoli, since the whole substance of the nucleus has become equal in solidity to them, are now no longer, or at most very indistinctly, to be perceived. Young organs, of which sections have been made, usually exhibit nuclei so altered, and are generally represented in this condition. Tab. vii, 21*a*, and *b*, are drawings of the ovulum of *Orchis maculata*, before and after alteration by the action of water. In *a*, the contents of the cell and the nucleus are of equal den-

* Grundzüge der wissenschaftl. Botanik, i, p. 192.

sity, almost homogeneous. In *b*, the nuclei have become smaller and firm; the cell contents have been deposited upon the walls.

Robert Brown says* that he has generally met with two nuclei in the cells of the stigma of *Bletia Tankervilliæ.* He adds, however, that these had an areola of a symmetrical appearance. According to Endlicher and Unger† it is not unusual, in elongated cells, for each to possess several nuclei. With the exception of the cells, which subsequently form new cells in their interior of the pollen-grains, the pollen-tube, and the embryo-sac, I have never been able to find more than one proper nucleus. I must therefore, in regard to this point, fully confirm the assertion of Schleiden. In tissue, the delusion very easily arises, since the nuclei of adjacent cells often lie upon the septum between the two, and thus from the little difference of their focal distances, they appear to be situated in the same cell. In the pollen grain, where I have seen two nuclei (*ex. gr.* in *Œnothera*, *Pancratium illyricum*, Tab. vii, 26, &c.), one is attached to the wall (*a*), the other free (*b*). It would be very interesting to make out which particular cells possess several nuclei,‡ their relation to each other in regard to the time of their origination, and whether they are free or parietal. Since Endlicher and Unger declare that the nuclei only lie loose upon the wall,

* Vermisch. Schriften, v, 157. † Grundzüge, p. 23.

‡ Unger, in the elongated cells, which are converted into the large porous vessels of the root of *Saccharum officinarum*, figures three cell-nuclei, of which he says, that they had all been formed together. (Linnæa, 1841, p. 393; Tab. v, fig. 6.) Numerous investigations in the roots of monocotyledons have never presented the like to me. Although these negative grounds are of no weight against such a positive representation, it still occurs to me; 1, that these nuclei appear to be, not nuclei, but cells with a parietal nucleal vesicle containing a nucleolus; 2, that exactly similar cells occur in the circumference of the fibrous bundles in the roots of *Phœnix dactylifera* (Mirbel, nouv. notes sur le cambium dans les Archiv du Muséum d'Hist. nat. 1839, Pl. xxi, 9 et 10; Unger, l. c. fig. 15, b.), and, according to my own researches, in the vicinity of the vascular bundles of *Musa;* and, 3, that Unger merely brings forward the simple facts, and notwithstanding their theoretical importance, makes no particular remark upon it, yet specially declares that these nuclei or cells actually lie within the vessel, and never merely external to it.

and may be carried about by the circulation of the fluids of the cell;* these must indeed be nuclei different from the original cytoblast of the cell. These I have always found firmly adherent to the wall of the cell, and only with difficulty to be detached from it. In pollen-tubes and embryo-sacs, where often several (transitory) cell-nuclei occur, they are free.

The nuclei just described are found in all the tissues of Phanerogamia. It may be taken as a rule, that in every cell *there is one proper nucleus attached to the wall.* Deviations from this condition occur in the parent-cells of pollen-grains, in special parent-cells, pollen-cells, the embryo-sac and in the pollen-tube. The parent-cells of pollen originally possess one parietal nucleus. This becomes absorbed; a larger free nucleus makes its appearance in the midst of the interior of the cell. In Tab. vii, 22, *a*, is figured a parent-cell of *Cobæa scandens* with its central nucleus; *b* and *c* are two separate nuclei; 23 is a parent-cell of *Cucurbita Pepo.* This free secondary nucleus consists of a nucleal vesicle filled with a transparent fluid and a dense nucleolus, which is homogeneous (fig. 22), or granular (fig. 23), solid (fig. 22, *a;* 23), or hollow (fig. 22, *b, c*). In the free nuclei of *Cucurbita, Cobæa,* and *Passiflora,* I was able to observe a distinct membrane, both to the nucleal vesicle and to the nucleolus. (Fig. 22, *d.*) Pressure and water altered them, as they do other nuclei. They become smaller, the fluid of the nucleal vesicle becomes dense and opaque, the nucleolus hard, and both acquire a yellowish colour. It also happens here that, when the contents of the nucleal vesicle consist of homogeneous mucilage, a transparent hollow space makes its appearance in it around the nucleolus (fig. 22, *e, c*); so that we imagine we have before us a cell with nucleus and nucleolus.

I especially remark in these secondary free nuclei of the parent-cells of pollen a new proof of agreement between the formation of spores and that of pollen. The

* See also Meyen, Physiologie ii, 243.

parent-cells of the spores of Florideæ (Tab. vi, 24, *a*), and Hepaticeæ (Tab. vi, 31), possess, as we have seen above, a perfectly similar nucleus, after their primary cytoblast has become absorbed.* Formerly I considered this as a transitory formation of cells, and declared that in *Lilium* and *Tradescantia* one or several such cells originated. I have since become convinced that only one such cell is present normally, and that from its whole structure it is the analogue of a nucleal vesicle. The occurrence of several nuclei in one parent-cell, as in *Anthoceros*, is possibly an abnormal condition, and one capable of no further development.

The special parent-cells of the pollen form an exception to all other cells of the Phanerogamia, in possessing primary nuclei free and lying more or less in the centre, These are spherical or ellipsoidal, of homogeneous mucilage, or transparent, with 1-3 nucleoli.†

The pollen-cells have a free central nucleus. This, however, is not the primary cytoblast, but originates subsequently. The nucleal vesicle, the proper membrane of which is often very distinct, possesses transparent or whitish, homogeneous or granular contents, and one or several nucleoli. The nucleoli, when they are large and isolated, appear solid or hollow, with one or more cavities, homogeneous or granular, sometimes inclosed in a distinct membrane. I have observed such free nucleal vesicles in many pollen grains, ex. gr. in *Œnothera*, *Cobæa*, *Passiflora*, *Cucurbita*, *Alcea*. In *Œnothera* I several times found a free nucleus in addition.‡ In *Œnothera* also, I found, near the central nucleus, another nucleus distinct from it, smaller, and attached to the wall. Schleiden§ describes the same in *Fritillaria*. Other pollen-grains possess merely a parietal nucleus. Therefore, since the subsequent origination of the *central* nucleal vesicle may

* Entwicklungsgeschichte des Pollens, p. 11.

† Nägeli Entw. des Pollens, tab. ii, 16-19, tab. iii, 53-57. The absence of nucleoli in *Lilium*, *Œnothera*, *Bryonia*, &c., is indeed only apparent, and caused by the density of the contents of the nucleal vesicle.

‡ Op. cit. Tab. ii, 42.

§ Grundzüge, ii, p. 300.

be observed with certainty in some cases (*Œnothera, Lilium, Pancratium*), this must be considered as a *secondary* formation, and the parietal nucleus as the *primary* cytoblast of the cell.

I formerly imagined that I had seen transitory formation of cells in young pollen-grains.* Meyen mentioned this as an usual occurrence; Schleiden also has done so since. I have carefully repeated the examination of the only case known to me (*Lilium*), and am now convinced that it has nothing to do with cell-formation, but that here, as elsewhere, merely a free nucleal vesicle is present. This is transparent, and has from one to four whitish nucleoli. In *uninjured* and *unaltered* pollen-grains, nothing else is to be seen. (Tab. vii, 25, *a*.) But as the contents of the cell are altered by the endosmose of water, the nucleal vesicle becomes somewhat smaller, and its mucilaginous contents clouded by coagulation; a space hollowed out in the cell-contents makes its appearance around it, which, from its well-defined outline, bears an illusive resemblance to a cell. (Fig. 25, *b*.) After longer continued action of water, the nucleus becomes still smaller and denser, the nucleoli can no longer be distinguished; the water-vesicle, on the contrary, becomes larger. (Fig. 25, *c*.) Tab. vii, 25, *a, b,* and *c*, represent the same pollen-grain of *Lilium bulbiferum*, which within five minutes changed from *a* to *c*. Two nucleal vesicles are found in one pollen-grain in rare instances, and then sometimes two cell-like spaces originate. So far as my present, tolerably extensive, investigations of pollen formation reach, therefore I know of no other new formation in the pollen-cell but this of one or two *free nucleal vesicles*.

This nucleal vesicle exhibits a peculiar character in *Amaryllis formosissima*. (Tab. vii, 24.) It has thin and finely granular contents, usually without nucleoli. It is, however, surrounded by a dense and dark granular mass,

* Op. cit. p. 20, Tab. ii, 26.

which is sharply defined and looks not unlike a cell. These granules surround the nucleal vesicle, uniformly as a round concentrical layer, or irregularly as a peculiar pointed appendage, whence the whole has the form of a straight or bent spindle (24, *a*, *b*), a triangle (24, *c*, *d*), or a quadrangle. (24, *e*.) As a rule here, only one nucleal vesicle is present in the same pollen-grain; in rare cases there are two. Of the history of development, and of the signification of the phenomena just described, I as yet know nothing. It appears to me probable, however, that, as elsewhere, the granular contents become accumulated round the nucleus during the circulation of the sap, especially round free nuclei, and even after the discontinuance of the circulation generally remain collected in a mass; here also the appendages round the nucleus are the remains of the now quiescent currents; very possibly the points correspond to the principal streams.

I have mentioned of *Œnothera* and *Lilium*, that in young pollen-grains two nuclei are visible at the same time; one smaller, situated on the wall, and the other larger, floating in the centre. I have also observed two nuclei in the pollen-cells of *Pancratium illyricum*. (Tab. vii, 26.) The smaller is attached to the middle of the long side-wall (fig. 26, *a*); the larger is situated almost in the centre, and adheres to the smaller nucleus. (Fig. 26, *b*.) Both are transparent vesicles with a dense nucleolus. The inner nucleus is invested on one side, rarely all round, with a dark granular mass. This either gradually loses itself in the thinner contents of the cell, or is sharply defined. This phenomenon is, undoubtedly, analogous to that just described in the pollen-grains of *Amaryllis formosissima*. Younger pollen-cells of *Pancratium* contain only one proper parietal nucleus.

I shall speak of the nuclei in the embryo-sac and in the pollen-tube, and of the origin of the nucleus in general, in the section on cell-formation. I will only mention here a particular point relating to the origination, or rather to the multiplication, of nuclei. I have said when treating on the formation of spores in *Anthoceros*, that the oval green nuclei divide, and that this division, like the formation of cells in the green Algæ, takes place through the production of a septum. I have observed the same in the hairs of the stamens of *Tradescantia*. Two new cells always originate in the end cell of the growing hair. A longish nucleal vesicle first makes its appearance. (Tab. vii, 20, *a*.) This becomes divided by a cross-wall into two vesicles (fig. 20, *b*.), which separate from each other. (Fig. 20, *c*, *d*.) I observed the like formerly in the formation of cells in the apex of the root of *Lilium tigrinum*, but I then spoke of the division of the nucleus merely conjecturally.* Since this observation is confirmed by that on the hairs of the stamens of *Tradescantia*, and consequently the nuclei have an identical character in cells of such different kinds; since the formation of cells, as we shall hereafter see, is the same in the vegetative cells of Phanerogamia, we may indeed with greater probability dare to express the conjecture, that the *parietal primary nuclei of the Phanerogamia are formed by the division of a new nucleus of the parent-cell.* That this latter is a new nucleus, and not the primary nucleus of the parent-cell become larger and free, I shall endeavour to demonstrate in treating of cell-formation. There also I shall first consider the import of the nucleus in regard to the origination of cell-membrane, and the relation of position of the parietal nucleus to the cell-wall, which is intimately connected with the formation of cells.

m. Comparative Review.

Cell-nuclei occur in all classes and orders of plants. The number of plants in which they have not yet been found, is comparatively very small. The deficiency, in these

* Linnæa, 1842, p. 252; Tab. ix, 27, 28, 29.

cases, may justly be attributed to insufficiency of observation, on account, partly of the minute size of the nascent cells (in Lichens, many fungi), partly of the extraordinary size of the cells (Siphoneæ), and partly of the opacity of the contents of the young cells (some Confervæ and Siphoneæ.) In no vegetable cells has it yet been, or probably ever will be, demonstrated, that the nucleus is absolutely wanting. On the contrary, wherever observation has been possible, it has enabled us to recognize one. If therefore it is ever permissible to draw a conclusion from analogy, it must be so here, and lead to the decision that the nucleus is an universal and unexceptional phenomenon in vegetable cells. This assumption is so much the more justifiable since it does not merely conclude from nine tenths as to the remaining tenth, but altogether from like to like. For there is no special kind of cell, in which an example of the nucleus has not already been demonstrated, while, in regard to all cells where it has not yet been seen, individuals of the same kind are known which possess it.

Cell-nuclei are *primary* or *secondary*, according to the epoch of their origination. They have a perfectly distinct relation to the vital process of the cell. The primary nuclei precede the cell; they make their appearance first in the parent-cell, and condition the formation of the progeny-cells. They exhibit two kinds of relation of position. That of the first is where the primary nucleus lies free, and more or less in the centre of the cell, which has been produced by its influence. This is the case in the vegetative cells of all true Fucoids and some green Algæ (*Conferva bombycina*, *Spirogyra*, *Closterium*, &c.), and in the special parent-cells of all plants which produce four spores or pollen-grains in one parent-cell (Florideæ, Hepaticæ, Musci, Filices, Lycopodiaceæ, and Phanerogamia). The second kind of primary nuclei are attached upon the wall of the cell which they produced. Such nuclei are possessed by all cells (with the exception of the special parent-cells) of those plants which produce four spores in a parent-cell (Phanerogamia, Lycopodiaceæ, Filices, Musci, Hepaticæ, and Florideæ); also the cells of Equisetaceæ and Characeæ; lastly, the cells of some Algæ (*Arthrodesmus, Gaillionella, Bangia*,) and numerous Fungi.

The secondary nuclei make their appearance in the cell at a later period; they do not serve to produce new cells, but are, apparently, at once the expression of an exalted vital activity of the cell, and the support of it. They lie free in the cavity of the cell, single or in large numbers, and appear with the primary nucleus, or not till after its absorption. The presence of secondary nuclei has only been determined, as yet, in cells with a parietal primary nucleus, not in such as have a free primary nucleus. Their presence is as yet restricted to the pollen-cells and and the pollen-tube, to the spores and the embryo-sac, to the parent-cells of pollen-grains, and those spores which originate in fours.

Where the nuclei were large enough to allow of an accurate microscopical examination, the following structure was perceived: the nucleal vesicle consists of a peculiar membrane, and incloses fluid and solid contents distinct from it, and, in addition to one or more dense mucilage corpuscules, a nucleolus. That the nuclei possess a membrane, and therefore are utricles, follows from the correspondence of the results of researches in Algæ, Fungi, Florideæ, Hepaticæ, Musci, Filices, Characeæ, Equisetaceæ, Lycopodiaceæ, and Phanerogamia. This structure is demonstrated both in the free and the parietal nuclei. Where the membrane cannot be seen, it is on account of the minute size of the nucleus, of its being densely filled with homogeneous substance, or of the opacity of the cell-contents. In larger nuclei, where a more certain examination is practicable, the absence of the membrane can never be demonstrated. Even where the membrane is overlooked in the natural condition, on account of the similarity of the contained matter, it may be made visible by the action of reagents

(Filices). There is no reason therefore against setting forth, as a general proposition, that *the nuclei are utricles.*

The nucleus is not merely universally an utricle, it also possesses a proper membrane, and a peculiar metamorphosis of its contents. It cannot be demonstrated by direct examination, that the membrane is not merely a deposit (distinct from the nucleus) from the surrounding fluids of the cell. That it constitutes in its totality a distinct organ, is shown by the power of the nucleus to propagate as an utricle. I have pointed out the division of the nucleal vesicle in the Hepaticæ (*Anthoceros*), and in the Phanerogamia (*Tradescantia*). The contents of the nucleal vesicle run through a series of alteration. These consist, morphologically, in this, from the amorphous mucilage, granules are formed which lie in a watery fluid; chemically, in this, from a mixture of mucilage and gum are produced mucilage, starch, and chlorophylle-granules, oil-globules, and colouring matter. The vital processes, the *fashioning* (Gestaltung), and the propagation of the nucleal vesicle, agree in general with those of the cell, and it must in like manner be regarded as an individual organism.

The nucleus, when fully developed, contains one or more nucleoli. This structure I have pointed out in free and parietal nuclei in the Algæ, Fungi, Florideæ, Hepaticæ, Musci, Characeæ, Equisetaceæ, Filices, Lycopodiaceæ, and Phanerogamia. In many nuclei, however, the nucleolus has not yet been detected. This is most striking in the Fucoideæ, where the nuclei are quite large, and can readily be set free. The investigation is rendered very difficult in these by the peculiarity of the cell-contents. Moreover, the nucleal vesicles are for a long time densely filled with mucilage, and in a condition that, even in the Phanerogamia, mostly renders the observation of the nucleoli impossible. All other nuclei without nucleoli (and to these belong only the nuclei of several Fungi and most Algæ) are small, or the opacity of the cell-contents renders an accurate examination im-practicable. At this time I know of no nucleus in which the absence of the nucleolus has been distinctly made out; I am inclined, therefore, to set forth generally, and to claim as an *essential character of the nucleal vesicle, that it contains one or more nucleoli.* Although the old and metamorphosed nuclei in *Cystoseira,* which sometimes possess merely a membrane with transparent contents, certainly no longer contain nucleoli, this does not argue against the assumption; since in old cells, in which the chemical changes of the contents are completed, the nucleus also is mostly absorbed.

The assumption that the nucleus has the complex structure above indicated, might indeed be an improbable one as to the small point-like nuclei of those cellules, in which the motile spiral threads, spermatic filaments, are formed in Florideæ, Hepaticæ, Musci, Characeæ, and Filices. I believe, however, that the cellules in that case have not the signification of *cells,* but of *nucleal vesicles,* and therefore that the nucleiform body is not a *nucleus,* but a *nucleolus.* This assumption is perfectly natural in the Characeæ, as there the cellules of the spermatic filaments are to be distinguished as special structures inside the actual cells. In other Cryptogamia, which possess the so-called spermatic animalcules, experience can offer proof neither for nor against, as at present we are altogether without facts as to the history of their development.

As to the structure of the nucleolus, in my opinion nothing universal or precise can as yet be said. In some cases they appear to be merely accumulations of mucilage. In others, a membrane which surrounds them is wholly unmistakeable. In every case it is certain that they always appear with a clearly defined margin. This circumstance speaks strongly in favour of the assumption that they, like the nuclei, are inclosed in an utricle. Since, if they were merely agglomerated mucilage, we should have nucleoli, the substance of which would pass gradually into the mucilage of the nucleal vesicle, and which would generally possess an irregular periphery. Or if they originated by the deposition of layers from without, this lamellar structure would be perceptible in large and perfect nucleoli. Not only is there nothing of the kind to be seen, but the facts of the appearance of hollow space, the whole mass becoming vesicular, and the change into a granular substance, testify against it. The presence of a membrane is now indeed indubitable in some nucleoli. It is, however, still a question whether this is not somewhat accidental, whether it does not represent merely the thickened outermost layer of mucilage; since also when a hollow space makes its appearance in the contents of the nucleal vesicle, around the nucleolus, this becomes hardened into a membranous structure on its bounding surface. (Tab. vii, 17, *q*.) So long, too, as the membrane of the nucleolus, from its vital history, does not appear to be anything essential (as that, for instance, in the nucleal vesicles resulting from propagation), I cannot, from its presence in individual cases, deduce a safe analogy applicable to all. The examination of the nucleolus alone therefore has given us hitherto no means of understanding its nature and signification. We must look around us for a more extended analogy. In a future number of this Journal, in researches into the structure of chlorophylle and starch granules, I shall recur to the nucleoli, and endeavour to render probable the utricular structure in these also.

III.—PARIETAL CELL-FORMATION AROUND THE WHOLE CELL-CONTENTS (PROTOPLASMA).

a. With a central nucleus.

I HAVE shown above that all true Fucoideæ possess, in every cell, a free central nucleus, which is the central point of a more or less radiating network of currents. It frequently lies concealed in a mass of granules, which surround it. *Sphacelaria scoparia* grows at the apex in such a manner that an oblique septum is formed in the end cell, dividing it into two unequal portions. (Tab. vii, 1.) The upper, pressed rather to one side (fig. 1, *a*), is small, semi-lenticular, densely filled with a black granular substance. The lower half (fig. i, *b*) is much larger, cylindrical, and almost wholly filled with dark, granular mucilage, which is arranged as a clear fine-meshed net at the base only of the cell. This cell (*b*) grows longitudinally, whereby the upper lenticular cell (*a*) is pushed wholly to one side, and then divides by means of a horizontal wall into two equal portions. The upper of these two cells is filled, at first, with dark granules. In it the same process is again repeated.

The lower of the two cells formed by the division of the cell *b* contains, in its upper part alone, a heap of granules crowded together near the axis, while the remainder of the cavity is almost transparent, and is clothed with a network of mucilaginous threads. This cell extends itself longitudinally, the heap of granules comes into the middle of the cell, and there lies as a longish, round, nucleus-like mass, with its long diameter in the longitudinal axis of the cell. (Tab. vii, *i*, *e*.) Around this the rest of the clear contents are so arranged, as mucilaginous threads, that the threads in the vicinity of the nucleus are stronger, and proceed from it like rays. These rays are either simple or branched, and connected here and there by delicate cross-threads. At some distance from the nucleus the mucilage threads become thinner, their radiate arrangement passes into a network of threads, with four, five, or six-cornered meshes. The oval dark granular mass (Fig. 1, *e*) divides, and forms two round heaps, only half the size of the former. (Fig. 2, *a*.) They retreat from each other, and take up such a position in the axis of the cell, that they are a little more distant from each other than they are from the upper and lower walls of the cell. The threads of circulation exhibit the same arrangement again here; at the periphery of the granular heap they are radiant, further off they become reticulated. The circulatory systems of the two nuclei pass uninterruptedly one into the other. While the matter contained in the cell is thus undergoing division, a delicate gelatinous septum suddenly makes its appearance in it midway between the two nucleal masses. We have thus two cells, of equal size and placed one above the other, each with a central nucleus. In this manner have been produced the cells *b* and *c* in Tab. ii, fig. 2, from a parent-cell, like *a* in the same figure.

The nucleus-like mass of granules divides into two smaller, which lie horizontally near together (Fig. *b*, *c*), and between these a perpendicular wall originates. This process is repeated in the same way by the division of the central nucleus and the formation of a more internal septum, till the stem has grown to its full thickness. In the first instance several perpendicular walls are formed, whence is produced a bundle of cells of equal length. Then in the peripheral cells originate these bundles of alternately horizontal and perpendicular walls. The nuclei are thence continually diminishing in size.

In a similar manner is effected the multiplication of cells in *Cladostephos Myriophyllum*. The horizontal wall of the end cell divides it into a smaller upper, and a larger lower cell. The former is dark and thickly filled with granules. The latter is clear, and contains a granular mucilage of little density. In the upper part of it lies a denser collection of granules which, by the growth of the cell, is brought down into the middle. It divides into two portions, an upper and an under; between these appears a septum. All subsequent cell-formation proceeds in the same manner, as the central granular heap in a cell divides into two halves, each of which is destined for a secondary cell. A nucleus is concealed in each granular heap.

I have further observed a similar mode of cell-formation in *Padina Pavonia*, *Gaillionella*, and in a species of *Cystoseira*. In germination, the spore and the first cell produced from it are full of black granular matter. In the middle of the granular mass is a round nucleus in each cell. This is absorbed, and in its place appear two nuclei. (Tab. vii, 4.) Then a gelatinous septum forms midway between the two nuclei, dividing the parent-cell into two portions. (Tab. vii, 5.) In this manner also the spore-cell itself divides, like the cells of the first generation, from it. The cells in the end of the frond, on the contrary (in *Padina Pavonia* and *Cystoseira*), possess sparing finely granular or homogeneous mucilaginous contents, which are distributed around the central nucleus as radiating sap-currents. (Tab. vi, 15; vii, 3.) When a cell becomes a parent-cell, in place of the single nucleus, two nuclei appear, each with a system of threads of circulation. (Tab. vii, 3; Tab. vi, 15.) They appear to me to be sometimes produced by the division of the original nucleus. (Tab. vii, 3, *b*.) They retreat from each other to a certain distance (*d*); and the septum makes its appearance between them in such a way that each is now the central nucleus of a secondary cell.

So much for the facts. How are these to be explained according to the views of cell-formation hitherto entertained? Cell-formation round a nucleus and the division of the cell stand in opposition to each other, as the principal theories. According to the former, it must be assumed that the cells originate as minute utricles in the midst of the contents of the parent-cell, and completely absorb this matter during their growth. They must be so delicate and invisible, that they cannot be perceived even by the assisted senses, until they have formed a septum where they have come in contact one with another. In contradiction to this assumption, it is true, there is the fact that the nuclei are here always free and situated in the middle, while, according to Schleiden's view, they are attached on the membrane. It becomes, however, quite incompatible with the phenomena, as is especially to be observed in *Sphacelaria*. There the granular heaps are at no period defined, they always pass gradually into the network of currents, and the septum makes its appearance without any visible disturbance of the circulation. Assuming now that two little cells are formed, and that their membrane is so delicate as to become first visible on their union as a septum, the presence of these cells must surely render itself perceptible by an interruption, or at all events by a modification of the circulation. In the course of numerous investigations I have never seen anything of the kind. The network always appears as one, perfectly continuous and regular. It never appeared distorted or interrupted. Hence it follows that the lamellæ of the septum are formed in no other situation than that where they first and last are seen, and that Schleiden's theory of cell-formation cannot be extended to the Fucoideæ.

If it be determined that the septum is formed in the parent-cells in the place where it subsequently becomes visible, it further becomes a question whether there occurs a folding inward of the membrane of the parent-cell, a growth inward of a septum distinct from it, or the formation of a cell *around* the whole contents. No peculiar phenomena speak in favour of the first, no construction is apparent here, as in many Confervæ; neither, as the septum becomes apparent, does the nature of it lead at all to such an assumption. Only if it were proved as regards Confervæ, a strong analogy would give it a value as regards Fucoideæ. When speaking of the formation of Conferva-cells I shall point out the falsity of the theory of in-folding, and consider it as set aside here.

There remain, therefore, two assumptions; either that a septum grows inward, and subsequently changes into a double membrane; or that two closed secondary cells are formed, each around a complete half of the cell-contents. My observations on the Fucoideæ themselves furnish me with no certain facts for the determination of this question. An analogy therefore must be sought for, and this we find in the special parent-cells of spores and pollen-grains.

In the section on the nucleus I have shown that in all plants, from the Florideæ upward, to the Phanerogamia, the primary nuclei lie upon the cell-wall, and that only the special parent-cells of spores and pollen-grains possess a free primary nucleus (with the preliminary exception of Equisetaceæ and Characeæ, in which the mode of origin of the spores is yet unknown.) In the Florideæ I can see no more than that, at first, four free nuclei lie in the parent-cell, and then four cells make their appearance, each of which has one of those nuclei in its centre. The same is to be observed in the Hepaticæ. The examination of *Anthoceros*, where the contents of the parent-cell are tolerably transparent, teaches, in addition, that the septum does not originate by a folding inward, and renders it in the highest degree probable that they are formed immediately in that situation where we first perceive them. In *Blasia*, also, and in various species of *Jungermannia*, in which the parent-cells of the spores are constricted, and thereby four-flapped, it is easy to see that the cell-formation does not take place by a cutting off, but by the formation of septa, which are quite distinct from the membrane of the parent-cell. The investigation of pollen-formation in Phanerogamia gives certain evidence as to the nature of septa, as there we have neither in-foldings of the membrane of the parent-cell, nor structures which ever undergo further development, but merely rest upon the wall of the parent-cell. But the septa are themselves formed by the union of the membranes of two perfect cells coming in contact, which may be observed, *perfectly formed, within the membrane of the parent-cell.**

In my Memoirs on the development of pollen, I have sought to demonstrate that the special parent-cells form around the whole cell-contents. As the grounds of this assumption I urged, against Mirbel and Meyen, that we cannot see the advancing borders of an in-growing structure, that these borders, moreover, persist at a later period in unaltered integrity, and distinct from the septum;—against Mohl, that the septum, as soon as it can be distinctly perceived, consists of nothing else than the membranes of two separate cells;—against Schleiden, that nothing is seen of the origination of small and free cells, and that the primary nucleus does not lie upon the wall, but is free. Schleiden† makes various objections to my representation of the development of pollen. After repeated investigations I must reject these as altogether unfounded. The question, however, is so important to the subject of cell-formation, which is perhaps nowhere so easily observed, that I will enter more closely into it.

Schleiden objects that he has often perceived the nucleus to be parietal in the parent-cell, special parent-cell and pollen-cell, that free cells with nuclei appear in the parent-cell before its division; and lastly, that the special parent-cells are perhaps no cells at all. What, in the first place, relates to the parietal nucleus of the *parent-cell* altogether agrees with my observations. The *primary* nucleus of the parent-cells (in the Florideæ, Tab. vi, 23, *a*, Hepaticæ, and Phanerogamia) is *parietal*. Subsequently,

* Nägeli Entwicklungsgeschichte des Pollens, Tab. iii, figs. 58-9.

† Grundzüge der wissenschaftl. Bot. ii, p. 299.

however, appears a *free secondary nucleus, distinct from the other*. (In Florideæ, Tab. vi, 24, *a*; Hepaticæ, Tab. vi, 31; Phanerogamia, Tab. vii, 22-3.) That the nuclei of *special parent-cells* sometimes lie upon the wall is also compatible with my statements.* The question, however, is not of this, but of whether cases occur in which these nuclei are free. And here I must repeat my former conclusions, that *usually the primary nuclei* of *special parent-cells are free*, and that, in most cases, they occur in the *centre*. (Florideæ, Tab. vii, 26; Hepaticæ, Phanerogamia.) A central position, however, is not a necessary attribute of them. They also lie between the centre and the periphery; and there is no reason why they should not also be situated here or there at the periphery itself. This difference of position does not affect the theory of cell-formation, since it bears merely upon a definite relation to the whole quarter or half of the contents of the parent-cell, not upon a relation to the nucleus. It agrees with Schleiden's view in another way; this enforces an absolute specific relation of position of the nucleus. According to the theory this lies upon the wall; experience shows no exception to this from Fucoideæ up to Phanerogamia. When, therefore, there is a *central* primary nucleus in a parent-cell, it is an evidence against the cell-formation round the nucleus. When, however, there is also a *parietal* primary nucleus, it is, on the contrary, no proof against cell-formation around the cell-contents.

Schleiden says further, that between the empty condition of the parent-cell and its regular division, he has observed another condition where free cytoblasts, or something like them, are present with young cells in the granular contents of the parent-cell. The nuclei may be very easily and clearly seen. If, however, they were the cytoblasts of the special parent-cells they would always occur in precise numbers. (Regularly two or four.) But

* Loc. cit. p. 17.

usually only one is present, and the seeming young cells, which I have already alluded to as transitory cell-formations, are, as I can now state with certainty, merely the results of alteration of the cell-contents through the absorption of water.* The formation of spores (especially in *Anthoceros*, and in some Florideæ) exhibits most distinctly the production of a secondary free nucleus in the parent-cell, the formation of four nuclei, the re-absorption of the first, and the division of the cell by septa, by which the same four nuclei in the compartments are brought into the condition of individual free nuclei. The same stages may be distinguished in the formation of pollen. The earliest conditions exhibit a lateral primary nucleus, subsequently a free secondary nucleus, considerably larger, which contains a larger nucleolus in a transparent nucleal utricle. After this four new nuclei appear, and then the septa between them. It is incomprehensible to me that Schleiden has not also distinguished these four stages. Since the arrangement of the steps of development do not seem to me to be at all so difficult as he has stated; it can only be that an attempt has been made to refer them to a preconceived and too circumscribed theory. Schleiden is inclined to assume that the condition of the parent-cell with free nuclei and young cells (nucleal utricles ?) is the passage to the formation of the special parent-cells. This is certainly wrong. The different conditions which are found coexistent in the same anther, always present the exact type of the series of stages of development. Now we never find the condition described by Schleiden, together with that where the septa are visible, although the former must be considered as the immediate precursor of the latter. In the same anther I find, without exception, only the following stages in connexion with each other, either, 1, only parent-cells,

* Compare with p. 242. The phenomenon is the same as in young pollen grains, where also only free nuclei occur, and where an apparent formation of cells arises from endosmose of water. (Tab. vii, 25, *a*, *b*, *c*.) The cause is this,—the absorbed water collects in vesicles round the nuclei.

with a parietal nucleus; 2, with a parietal nucleus and without a nucleus; 3, without a nucleus and with free larger nuclei; 4, with four nuclei; or 5, with four nuclei and others with septa and four nuclei. Since also these stages of development follow one another, as they are completed, in a series, as we gradually examine larger anthers in the same plant, there is no reason why we should not look upon them as successive periods in the process of development. I have done this in reference to the formation of pollen, and more recently found a confirmation of it in the spore-formation of Hepaticæ and Floridæ, already described. I have re-examined pollen-formation since I made the investigations in *Anthoceros*. This enables me to correct my former views on transitory cell-formation in the parent-cell; I found, however, that pollen and spore-formation differed in no important particular. Nothing was found in one which was not equally present in the other; they, however, served to complete each other, as, for instance, in *Anthoceros* the mode of formation of the four nuclei and their relation to the free secondary nucleus of the parent-cell is very distinct; in *Alcea* the nature of the septa. I will bring forward another fact against Schleiden, although this is superfluous, namely, the division of the parent-cell into two primary special parent-cells, and the division of the latter into two secondary special parent-cells. At one time the nucleus of the former is easily perceived to be *free* and *central*. Moreover, previously to their again dividing, nothing is visible in them of the process which takes place in the parent-cell before the four nuclei appear in it. It is certain that here the question can only be of the formation of two nuclei and a middle septum.

Finally, the third objection which Schleiden makes against cell-formation around the whole contents is this, that the special parent-cells are probably no cells at all, but merely condensed gelatinous matter, which is produced round the pollen-cells by the solution of the granular contents of the parent-cell. To this theory there are many objections. In the first place, the analogy of the primary and secondary special parent-cells, where they occur, is opposed to it. Unprejudiced observation must attribute to both a morphological signification and mode of origin altogether identical, since they appear perfectly similar, and exhibit in their origination the same behaviour to the cell-contents as well as to the nucleus. If one is merely an enveloping jelly, so also is the other. Then in both must be pointed out the cell which is inclosed. No such cell is to be seen in the primary special parent-cell; in the secondary special parent-cell it appears at a later epoch, and is then the pollen-cell. Analogy therefore absolutely requires that if we consider the primary special parent-cells to be cells, as Schleiden does, we must also allow the same value to the secondary. Other facts are altogether inconsistent with Schleiden's conjecture. The pollen-cells have, as Schleiden declares, and as I have also convinced myself, a parietal nucleus. But the special parent-cells possess a *free nucleus*. If the pollen-cells originated first, the nucleus, also, as soon as the special parent-cells are formed, must always lie upon their wall. This, however, is not the case either in the primary or secondary special parent-cells. It is certain, moreover, that free nuclei of the special parent-cells are the same which were in the parent-cell before its division. The examination of this in *Anthoceros*, and in the Phanerogamia, leaves no doubt upon the subject. The only alternative yet possible is wanting, namely, that the free nuclei of the special parent-cells are in fact the secondary free nuclei of the spore or pollen-cells, while these, from the delicacy of their membrane and their primary nuclei, from some other reason, are invisible.

I believe that in the foregoing I have refuted Schleiden's objections. I will now give a brief exposition of spore and pollen-formation, according to the laws by which, from my present investigations, I must consider them to be governed. The parent-cells originally contain a primary parietal nucleus. (*Hutchinsia*, *Anthoceros*, *Trades-*

cantia, &c.) Thereupon a new secondary nucleus is formed, which is free, and lies more or less in the centre of the cell. The primary nucleus apparently is previously absorbed. The secondary nucleus is composed of a clear nucleal utricle and a dense nucleolus. (Florideæ, *Anthoceros*, Phanerogamia.) In the Cryptogamia it is the centre of a circulatory system. In rare cases, and then apparently only abnormally, two (*Anthoceros*, *Lilium*) or more (*Lilium*, *Tradescantia*) free secondary nuclei appear in one parent-cell. In the next place four new free nuclei are formed in the parent-cell. The secondary nucleus is dissolved. The parent-cell acquires a gelatinous thickening. The contents divide into four parts, in such a manner that each incloses one of the four nuclei in its centre, around each of these four parts is formed a proper special parent-cell, which originally rests alike partly on the parent-cell and partly on the three other special parent-cells, and with these produces the septa. (Florideæ, Hepaticæ, Phanerogamia.) Sometimes only two nuclei are formed at first, and two primary special parent-cells around the two halves of the cell-contents; subsequently, in each of these, two new nuclei and two secondary special parent-cells. (Florideæ and Phanerogamia.)

The whole course, from the analogy with *Anthoceros*, may perhaps be thus completed. After the origination of the free secondary nucleus of the parent-cell, two new oval nuclei are formed during its presence, and under its influence. Each of these divides again into two round nuclei. They retreat from the central nucleus, and take up a tetrahedral position. The central nucleus is absorbed, and the formation of the special parent-cells proceeds. Or two new oval nuclei are also formed with the secondary nucleus of the parent-cell. These, however, do not divide again into two, in the same way, but the central nucleus of the parent-cell is absorbed, and in the latter are formed two primary special parent-cells, each with a free oval nucleus. Now, first, this nucleus divides into two round nuclei, and then the formation of the two secondary special parent-cell proceeds.

Various modifications present themselves in the formation of special parent-cells, on account of their different numbers. Sometimes only two special parent-cells are formed (*pollen binarium* of Phanerogamia). Usually there are four. In rare cases from five to eight occur in one parent-cell, and then they are always mingled with the regular number, four. (*Passiflora, Cobæa.*) In the first case the two oval nuclei and the special parent-cells divide no further. In the last, the four round nuclei divide once more (all, or only one); and the contents of the parent-cell divide into as many portions as there are nuclei, whence originate an equal number of special parent-cells.

After the special parent-cells are formed, each contains a free nucleus (Florideæ, *Anthoceros*, Phanerogamia). Then a pollen cell originates inside each of them; in what manner it has not yet been observed. As this, however, often subsequently possesses a parietal nucleus, it is highly probable that it is formed in the same manner as cells with parietal nuclei. Is it possible that the free nucleus of the special parent-cell becomes the cytoblast of the pollen-cell? A new secondary nucleus now appears sooner or later in the centre of the pollen-cell. Rarely, and as an exception, there are two; then they are either alike (*Lilium*, *Pancratium*), or one large and the other small (*Œnothera*).

If we now bring together all the facts as to cell-formation with a central nucleus, the observations on *Sphacelaria* and *Anthoceros* render it almost absolutely certain that the septa originate immediately in their place, and that they are not formed from cells which are small at first, and gradually grow larger. This certainty proceeds, as we have seen above, on one hand, from the behaviour of the cell-contents during the cell-formation; on the other, from the central position of the nucleus. The examination of *Alcea*, *Cucurbita*, &c., further teaches us that these septa are not peculiar organs, but that they consist of two membranes which are continuous on each side with the inner surface of the parent-cell, in a word, that they belong to two perfect cells. Both facts unite to prove that *cells with a central nucleus* (Fucoideæ and special parent-cells) *originate immediately in sitú, as they are subsequently seen filling the parent-cells,* also that they are not free in the interior of the parent-cells, but *are formed around a complete portion of the cell-contents, in contact with this and with the parent-cell.*

Cell-formation around the whole contents exhibits the peculiarity, that the place where the septum appears is denoted beforehand. In the gelatinously-thickened parent-cells of *Anthoceros* and the Phanerogamia, growing borders (four or six) are exhibited on the inner wall, exactly of the form and arrangement to fill the intercellular spaces of the subsequently originating special parent-cells. From these pre-existing borders false conclusions might be drawn of a growth inward of the septum. I merely remark the fact here; in the theoretical explanation of cell-formation, I shall endeavour to explain this appearance also. The parent-cells of the spores of many Hepaticæ are constricted in the middle, and so appear fourfold. The septa originate subsequently exactly in the place of constriction. It has hence been inferred, without reason, that the cell-formation was produced by fission.

In cell-formation around the whole contents there is the additional peculiarity, that the contents of the parent-cell become, immediately and unaltered, the contents of the secondary cell. In reference to this, it presents some remarkable modifications. The parent-cells are either densely filled with dark granular contents, in the midst of which lie two nuclei; this is the case in germinating Fucoideæ, and also in the terminal cells of *Sphacelaria* and *Cladostephos;* in the last two, however, the nuclei are not visible; or the cells possess more or less transparent, granular contents, which are denser near the two or four nuclei; this occurs in the parent-cells of pollen-grains. Or the scanty mucilaginous contents are arranged in radiant circulation threads around the two nuclei; in almost all the cells of Fucoideæ, and similarly in the parent-cells of the spores of *Anthoceros*. Or the circulating mucilaginous substance is arranged in lines in the immediate neighbourhood of the two nuclei, and in a reticulated manner at some distance (*Sphacelaria*.)

*b. Without a visible nucleus.**

In the lower green Algæ, microscopical examination so displays the multiplication of cells, that nothing more appears to be produced in the parent-cell but a halving septum. Some Confervæ exhibit the peculiarity in this process, that the parent-cell first receives a slight annular constriction in the place where the septum is subsequently formed. In some Diatomaceæ (*ex. gr.* in *Euastrum*) this constriction of the membrane is habitual. The originating wall also is situated, in division, on the angle formed by the folding inward.

Conferva glomerata produces new cells only in the terminal articulation of the stem and branches. Other articulations, situated behind the end cell, only regularly form new cells when they branch out at the side. The terminal cell grows to be a cylindrical utricle, almost twice as long as the next cell. In the apex of this cell lies a homogeneous, colourless mucilage. Lower down this mucilage becomes finely granular, then greenish, from the production of small chlorophylle-granules. Downward from here the cell is already coloured green by chlorophylle. In the middle of its length the cell becomes constricted by a ring-like channel, and suddenly a fine

* I have here brought together the observations on the green Algæ where the Conferva-cells devoid of nuclei present the type of cell-formation, and on those which, independently of the facts stated in the first section, indicate cell-formation around the whole contents. Some lower Algæ, with a central and with a lateral nucleus, which otherwise exhibit similar phenomena, are also brought forward on account of the great systematic affinity. They form the link by which the conclusion from analogy then unites cell-formation with and without a visible nucleus under *one* law.

line shows itself, which unites the two opposite indentations, the just formed septum. During these occurrences, I can notice no other situation of the contents of the cell. The same chlorophylle, which previously filled the parent-cell, now appears, through the separating wall, to become the immediate contents of the two secondary cells. The cell-formation occurs in a similar manner, when a cell grows out sideways from the stem, to produce a branch. (Tab. vi, 9.) The septum is then produced between the newly outgrown and the original portions of the cell. The cell-contents also remain unaltered here, while the septum is becoming apparent. The cell-formation in *Conferva Linum* exhibits the same appearances, the parent-cell becoming constricted in the same manner. There is here, however, no formation of branches. Other Confervæ only differ by the absence of any annular constriction of the parent-cell, a septum suddenly becoming visible in the midst of it. The latter kind of multiplication may be observed, moreover, in almost all green Algæ, for instance, in *Palmella*, *Undina*, *Oscillatoria*, &c., as well as in most Diatomaceæ.

Most Algæ, from the Diatomaceæ upward to the Confervæ, have this in common, in cell-formation,—the parent-cell contains assimilated matter, as chlorophylle and starch, and appears, without any thing more, to form a septum, and to divide the cavity of the cell with its unaltered contents into two. The formation of spores, however, is to be excepted from this; in the Diatomaceæ and Nostochineæ only is the division by a septum at once the propagation of the individual. Distinctions in this cell-formation by division arise from the arrangement of the contents. These either lie equally distributed in the cell (*Conferva*, *Oscillatoria*, &c.) Or they are condensed towards the central point; in the parent-cell two darker free accumulations occur, between these the septum originates (*Palmella*, *Euastrum*, &c.) Or the chlorophylle lies upon the cell-wall (branches of *Conferva; Gaillionella* sp. Tab. vi, 1-3.) Or the green contents merely form a roundish agglomerated mass, which swims freely in the transparent fluid, and divides into two halves before the division of the cell occurs (*Bacillaria* sp. Tab. vi, 4, 5, 6.)* The last two phenomena strongly remind us of the cell-formation with a central nucleus, where, in like manner, the latter frequently lies hidden in an accumulation of the granular contents. I have, however, already rendered

* The Diatomacean here represented inhabits ditches near Zurich. It comes nearest to *Bacillaria* and *Tessella* of Ehrenberg. It differs from both in the circumstance that the individuals are free, and only remain united together immediately after the division of the parent-cell; subsequently they are completely separated. As the free independence of the individual, or the union into an aggregate, and with regard to the latter, again, the peculiar manner in which the union occurs, are distinguishing generic characters in the Diatomaceæ, the plant in question should form a particular new genus. It has, however, such great internal and essential affinity to particular *Bacillariæ*, that in my opiuion it cannot naturally be separated from them.

The cell of which each individual consists has the form of a column, the bases of which are ellipses. (Tab. vi, 7.) The axis is rather shorter than the long diameter of the bases; hence the cell appears almost square (fig. 4) on the broad side, on the narrow side as a longish rectangle. On the bases are four ribs, parallel with the broad diameter of the ellipse. (Fig. 7.) The bases also present many slight indentations. The ribs are merely in the membrane, as may be ascertained by a side view. (Fig. 4-6.) They extend, however, a short distance on both sides over the lateral surfaces of the cylinder, and are gradually lost. The nature of the ribs is not to be made out in these plants. From analogy to the above-described *Gaillionella* nov. sp. (page 219) it becomes probable that they are formed by secreted extra-cellular substance, The cell contents consist of a colourless transparent fluid, and a free nucleus-like heap of chlorophylle mingled with mucilage. (Fig. iv, 7.) In propagation this green mass divides into two parts (fig. 5), between which the septum appears. (Fig. 6.)

At the first glance the plant just described appears to agree with the marine *Fragillaria unipunctata*, Lyngb., figured by Lyngbye in the *Hydrophytologia danica*. (Tab. lxii.) It differs from it, however, in the colour and form of the contents, which are there rose-coloured and transparent in the centre, and further, in the direction of the striation, which there runs parallel with the dividing surface upon the lateral border, while in the said Zurich Diatomacean it is situated on the lateral surface perpendicular to the dividing surface. Among the *Bacillariæ* figured by Ehrenburg, it exhibits the greatest affinity to *Bacillaria cuneata*. (Ehrenb. Tab. xv, fig. 5.) The latter is equally almost square, has bright green contents, and is also almost of the same size, ($\frac{1}{96}$ to $\frac{1}{100}$th of a line.) *Bacillaria cuneata*, however, is distinguished—1, by the alternating broader lateral borders; 2, by the individual cells remaining attached together at one angle after division; 3, by the striæ not being straight upon the dividing wall, and not parallel with the axis, but running at an oblique angle over the broad lateral surface; and, 4, by the additional existence on both sides of two striæ on the lateral margin (on the narrow lateral surface).

it probable from analogy, that all the cells of Algæ, and in general all cells, possess nuclei. For we often find perfectly distinct nuclei in allied species and genera (*Conferva bombycina*, *Spirogyra*, &c.)

In the green Algæ and also in some Fungi, another mode of formation of membrane occurs, which appears to me important to the explanation of cell-formation. In perfect cells where assimilation is completed, a thin, slightly granular, colourless layer of mucilage (which is coloured brown by iodine) is spread over the whole internal surface. To the interior of this (not to the cell-membrane) the chlorophylle and starch granules adhere. The whole remaining space of the cell is filled with a clear fluid. This is the character of the perfect cells of Confervaceæ, Siphoneæ, &c. If one of these cells is wounded in any place, or suffers from pressure or the abnormal endosmose or exosmose of water, the mucilage layer becomes detached from the membrane, and retracts from it. The separation takes place at the injured spot; but if the prejudicial external action continue, it may spread over a more or less extensive portion of the surface of the cell. Part of the mucilage-layer has thus become free; this is subsequently no longer bounded externally by the cell-membrane, but by the absorbed water. On the whole of this free surface of the mucilage-layer, a new membrane is formed exactly resembling the rest of the cell-membrane.

It frequently happens that a portion of the cell-contents is so much injured, that it is rendered incapable of performing further functions. Then that portion of the mucilage-layer which retains its vital power, contracts in its circumference into a new independent whole, and perfects its membrane. The decaying cell-contents lie outside this restored cell. In Tab. vi, 8, is figured the terminal joint of a *Conferva glomerata*, from the sea. It has formed the new partial membrane (*c*). The contents (*b*) thus shut off, are dissolving and decaying. The inclosed contents (*d*) are living; at first they were lying densely upon the membrane, and they had previously produced the new partial membrane (*c*). During examination, they became retracted from the membrane, so that the latter, from the water which had entered (*f*), and the mucilage-layer (*e*), could be plainly distinguished. The cell-contents in the older utricles of the Siphoneæ often decay in places; these portions become detached from the membrane, lie irregularly in the cavity of the cell, and are subsequently wholly or partially dissolved; at last, nothing remains but the membrane and a clear fluid, in which here and there lie brown masses of undissolved hard substance. In some places, on the contrary, the contents of the utricles remain unaltered, and retain their vitality; the mucilage-layer, with chlorophylle and starch, lies upon the internal surface of the membrane. Wherever the living portion of an utricle joined a decaying or dead part, the mucilage-layer becomes united into a continuous surface. As a membrane is formed on this spot, a closed cell is produced. When, therefore, in an old utricle of one of the Siphoneæ, which originally presented a simple cell, the contents decay in places, the intermediate vegetating spots become changed into separate cell cavities. In Tab. vi, 11 and 12, are figured parts of an old utricle of *Bryopsis Balbisiana*. In fig. 11, the contents have divided into two portions (*e* and *f*), which have become shut off by an as yet delicate newly-formed membrane (*b*). A transparent fluid (*c*) lies between. In (*d*) the mucilage-layer with the superincumbent contents has simply retracted from the membrane, and at the same time become invested with a new one. Between the two new membranes is water (*d*). In fig. 12, *g*, is the decayed portion of the utricle, filled with clear fluid; the mucilage-layer and other solid contents are absorbed. The living portion of the utricle (*f*), possesses a broad parietal layer of finely granular mucilage (*e*), and chorophylle-granules, which lie upon it. The mucilage-layer has united into one surface near (*g*), and produced the new membrane (*c*).

When the new membrane has become thick enough to allow of the examination of its characters, it appears not to be merely applied upon the cell-wall, but to pass continuously into the internal layer. In Tab. vi, 12, *c* continues into the inner part of *d*. This may perhaps be explained thus: wherever the mucilage lies upon the cell, it forms layers of increment; wherever it is free, it produces a membrane. This, like the cell-membranes of Algæ generally, does not differ chemically from the lignifying layers, but consists, like them, of gelatinous matter. It is therefore immediately continuous with the contemporaneously formed layers of deposition.

If the cell is sensibly injured, the whole mucilage-layer sometimes becomes detached, retracts, and produces a new cell on its surface; or the mucilage-layer separates with its superposed chlorophylle into several portions, which contract into distinct spheres or ellipses, form a new membrane on the surface, and thus produce several free cells within the original cell. It usually happens that one portion of the contents, probably that on which the external influence has most strongly acted, remains separated from the partitioned-off, sound and living mucilage-layer, breaks up into little dark granules, and then becomes dissolved. I have observed these various facts particularly in *Conferva glomerata*, in *Bryopsis* and *Codium*, and in *Achlya prolifera*. *Bangia purpurea* also offers a remarkable example. In the usual condition, the cell-membrane and the secreted gelatinous matter may be distinguished in the cell-wall; on the membrane lies a nucleus, with a circulation of sap. (Tab. vi, 29.) In the lower part of a filament, the whole, homogeneously fluid and very thin mucilaginous contents, have already become detached from the wall, and formed a new and as yet extremely delicate membrane on their surface. (Tab. vi, 30, *n*.) Thus there is a new smaller cellule in each cell; between the two we find water (*o*); the transparent fluid of the new cell refracts light somewhat differently from the water of the interspace (*o*). The new membrane (*n*) is by no means the original cell-membrane;

that is thicker, and may also be perceived here on the wall next the extra-cellular substance. The new cell has moreover formed around the whole contents, by no means around a parietal nucleus. The nucleus and the circulating sap are like those which appear in the upper part of the same filament, as the contents of the original cell. The only explanation possible therefore is that the whole cell-contents with nucleus and circulation-threads, have contracted somewhat and formed a new membrane over the whole periphery. This membrane grows downward, into a long thin continuation, which breaks through the walls and forms a radicle hair (fig. 30, *b-f*). The membrane and the contents of this filiform elongation are of equal delicacy with the cell itself.

I have already said that, the investment of the free mucilage-layer stands in an important relation to lignification. We must not, however, conclude from this that it is analogous to lignification, and different from proper cell-formation. The newly-forming gelatinous envelope has throughout the essential peculiarities of cell-membrane. As one instance of this, it absorbs and secretes matter in the cell like the cell-membrane. Older parts of such regenerated membranes become clothed with a layer of extra-cellular substance. That they are perfectly identical with cell-membrane, however, is shown by the circumstance that they are capable of growth, exactly like the cell. The extension of these portions of membrane may sometimes be observed in green Algæ. It is particularly striking in *Achlya prolifera*, where a newly-formed free membrane of this kind often grows into a long filament, which shoots out from the original cell, and forms another branch of the plant. We have become acquainted with a similar phenomenon also in *Bangia*, where the new membrane elongated into a radicle hair.

Finally, the fact in question is to be regarded in a threefold relation. In the first place, it is the distinct proof that cell-membrane may be formed on the surface of the contents. These contents, however, are at the same time of a special character; they are of a mucilaginous nature. Secondly, the fact teaches us that the new formation of membrane may occur, not merely as a complete and closed utricle, but also as a limited portion of a cell. It indicates, thirdly, reparative power, since it tends to restore, in a peculiar manner, the disturbed integrity of a cell.

It appears to me that particular importance must be attributed to the mucilage-layer, which lies densely upon the cell-membrane, inclosing the rest of the cell-contents, solid and fluid. In a normal condition, production of membrane only occurs, after the cell is perfected, in the deposition of new thickening-layers. The thickening of the cell-walls may be perceived very distinctly in many green Algæ, and also that it occurs in layers. The new layers are deposited on the internal surface of the cell-membrane, therefore, immediately on the outer surface of the mucilage-layer. The only conclusion we can draw from this is, that the gelatinous matter, which constitutes the new lignifying-layer, is secreted from the mucilage-layer. Should the latter retract from the cell-membrane, in consequence of the external application of water, and thus become free, the vital activity not being otherwise interrupted, the secretion of gelatine must continue. It does not, however, now serve as a *thickening-layer* upon the free surface, but forms a *new membrane*.

Kützing* has called the mucilage-layer the Amylid-zelle. This name, however, involves a double error, namely, in relation to the anatomical and to the chemical constitution. The amylide-cell is not a cell according to the idea with which this expression is usually connected, and in this very case, according to that even which Kützing attaches to it in the real cell (Gelinzelle.) It consists of granular mucilage, which was previously distributed throughout the whole cavity, and is now accu-

* Linnæa, 1841, p. 546.

mulated on the surface. It has nothing in common with a membrane, except that the mucilage here occurs as a thin layer in the form of a cell, and that, according to its general nature in the cells of all plants, it forms a tenacious coherent mass, which by the action of water separates with a smooth surface. Externally, the mucilage-layer has a well-defined and smooth border; in the interior, it is more or less irregular, forms elevations and depressions, and frequently loses itself by degrees in the fluid contents. Neither the structure, therefore, nor the name of a cell can be allowed it.

The chemical nature of the so-called Amylide-cell is declared by the appearances it presents with some reagents. Iodine colours it brown; with alcohol, weak acids, or water it contracts and coagulates. These are the characters of (nitrogenous) vegetable mucilage. It is not true, however, as Kützing stated, that it becomes changed into amylum by the action of potash. The whole cavity of the cell is, as I have already said above, filled with clear fluid, and all the solid contents (chlorophylle and amylum) with the mucilage are at the surface. If the starch is dissolved by caustic potash or sulphuric acid, and coloured by iodine, the blue colouring spreads over the whole mucilage-layer. When the latter is thin, therefore, it may appear as if it had become changed into starch; places, however, where the mucilage-layer has a sufficient thickness, or where it is free from starch-globules, it does not become blue, but brown, from the action of potash, or sulphuric acid and iodine.

Having now given the facts presented by the cell and membrane-formation in the green Algæ, I will endeavour to explain them. We have here again the choice between the four principal theories of cell-formation. Either, 1, the annular constriction effects a division of the cell, by advancing to the centre, and so producing two new perfect cells; 2, one distinct septum grows from the infolding toward the interior; 3, two new perfect cells are formed *free* in the contents of the parent-cell; or, 4, the two secondary cells originate parietally around the two halves of the contents of the parent-cell.

The annular furrow which precedes cell-formation in some Confervæ appears to favour the theory, principally maintained by Meyen, of a *division of the cell by constriction*. The furrow is looked upon as the commencement of the constriction. It is, however, always of the same depth, it merely forms a slight groove, and never appears deeper. But if it were protruded toward the centre, it must at least have been once observed in some stage of this. In the course of numerous investigations, I have never seen such an advance toward the middle. A thin wall always appears suddenly, attached to the infolded furrow. Not only are all observations on the growth inward of the infolding wanting; hitherto no permanent conditions have been ascertained which favour such a view. If, moreover, the septum were a constriction of the membrane, either an open pore should remain in the centre, or the annular folds grow together there. In either case, a point or a little circle, should become visible in the middle of the septum, indicating the opening or the place of the growing up. Nothing of the kind is ever seen. On the other hand, the two cells are subsequently completely shut off from each other by the septum. We must not, however, disregard the new events, as yet strange and unknown in the life of the cell, which would be required by an infolding, through the dissolution of a wall on one side, and the division on the other into two completely separated planes. Lastly, probability speaks against the theory of a constriction. While the infolding is broad and formed of a tolerably thick membrane, the septum is sensibly thinner, and appears merely to be in contact with the fold. The furrow does not pass into the wall, neither does any continuation of its double membrane into the latter occur.

The second theory, that a *septum* distinct from the membrane *grows inward* from it *toward the interior*, agrees much better with observation. But an objection is here first of all to be made against the form of the expression. The growth inward has not been seen by any one. Mohl* indeed explains a condition, which he figures as an annular septum, interrupted in the middle; but, according to the figure, the interpretation is evidently wrong. The septum is perfect; the contents have become retracted from the cell-wall; they are in contact only on the middle of the septum. Mohl mistakenly considers this point of contact as an opening. I have, in many cases, convinced myself of the accuracy of my explanation. We can even by compression, by acids, &c., easily change a normal condition where the wall is distinctly perfect into a diseased one, like that which Mohl has figured. The idea of a passage from without inward proceeds, moreover, especially from the false interpretation of the projecting borders on the inner surface of spore and pollen-cells, which I have shown above (p. 256). There is no reason here either to suppose a gradual (ungleichzeitige) formation of the septum. It becomes visible in all parts at once, in the middle as in the border. So that, since the false interpretations with regard to the folding inward in Conferva-cells, and in the parent-cells of the spores of Jungermanniæ, with regard to the projecting borders in the parent-cells of the spores and pollen in *Anthoceros* and the Phanerogamia, must be laid aside, no facts remain favouring the notion of a *growth inward* of the septum. The total want of continuous stages of development also opposes it. All the phenomena of cell-life exhibit such gradations of condition. If, then, the septum of Conferva-cells originated from without inward, surely in the many thousand cases that have been examined, one should have been found where the wall was not completely formed. Then the activity of a cell may at that time be modified or interrupted. Should this happen in the present case during the formation of the septum, this would remain imper-

* Vermehrung der Pflanzenzellen, p. 16, fig. 3, *a*.

fect, and somewhat like the broad ring of an annular fibrous cell of the Cacteæ. But I have said there is nothing of the kind to be seen. I therefore must consider this view, that the septum grows from without inward as false, and assert that it is formed *all at once.* I shall hereafter endeavour to solve the question, whether it exists independently, or only as part of two perfect cells,

The third theory of *free cell-formation round a nucleus* has not indeed been definitely applied to the Confervæ. Nevertheless we must examine whether the phenomena can be explained by it or not. It must be assumed that, during their origination and growth, the young cells are delicate even to invisibility; and that our instruments first enable us to detect them when, abutting upon one another, they form a septum. This theory would evidently agree better with the subsequent relation of the septum to the cell-membrane than the second; since, for instance, each of the two lamellæ of the wall is subsequently continuous with the membrane of its respective cell. But here the absence of permanent stages of development at once opposes free cell-formation, since a cell has never yet been found containing two smaller cells not united to a septum. To this negative reason is to be added a much more important positive one. The terminal joint of the axis of Confervæ, which forms new cells, contains, as was stated above, in its lower part chlorophylle, which lies with the granular mucilage upon the cell-wall. Assuming now that two little cells are formed in the interior, and gradually fill the cavity of the parent-cell, the whole contents of the latter must be dissolved, pass into the young cells, and there become reorganized. Even if the young cells were invisible on account of their delicacy, still an alteration of the cell-contents must somewhere be evident; which is not the case. This argument is particularly striking with regard to the cells of the stem, which branch out; these are larger; they contain transparent contents, and in the mucilage-layer upon the wall, tolerably large chlorophylle-globules which are arranged reticularly. (Tab. vi, 9, *b*.) The whole arrangement remains unaltered during the production of the septum, which parts the stem-cell (*b*) from the branch-cell (*c*). I could see nothing of a solution and new formation of chlorophylle. I thence conclude that it is impossible that the multiplication of cells in Confervæ can occur by the formation of small free cells in the interior; but that, without change of form of the contents, a septum must originate either independently, or in connexion with some process which takes place outside the contents.

The two species of Diatomaceæ above described especially support the assertion that, in the green Algæ, the septum originates in the parent-cell, at the place where it afterwards appears, and that it is not produced by two preceding small and free cells. In the *Bacillaria nov. sp.*, the only occurrence visible in the cell, is the separation into two portions of the free mass of mucilage, mingled with chlorophylle, and the appearance of a partition-wall. (Tab. vi, 4, 5, 6.) But *Gaillionella nov. sp.*, presents irrefutable evidence. This contains, in a cylindrical cell, a clear fluid and two bands of chlorophylle, which lie upon the membrane, in the two angles. (Tab. vi, 2). After division, the whole arrangement of the contents has undergone no other alteration, except that it has become divided into two parts by an interposed wall, and that in one of these portions a new parietal nucleus has been formed. (Tab. vi, 3.) The two chlorophylle-bands still remain unaltered in the two corresponding (distal) angles of the two secondary cells. The two other (proximal) angles contain no chlorophylle as yet; this is formed subsequently. If, according to Schleiden's views, two small free cells first originated here, in favour of which the parietal nuclei might be claimed, something of the solution of the chlorophylle and its re-formation in the new cells must necessarily be seen, since it exhibits such a characteristic relation of position, and the chlorophylle globules themselves are of sufficient size.

The division of the Conferva-cell, as we have now seen, cannot be explained, either by a free cell-formation, by a constriction of the cell, or by a gradual growth inward of a septum. But the *wall originates in all parts at once, it is distinct from the wall of the parent-cell, and it divides the contents of the latter into two parts.* The only question now remaining is whether the wall originates in perfect independence, or is produced by two cells which have been formed round either half of the contents. In the former case the new formation of membrane would occur only in the septum itself; in the latter case, in the septum and equally over the whole internal surface of the parent-cell. It may be settled *in limine*, that direct observation cannot decide between these two possible theories. The phenomenon, as it presents itself, may be interpreted as well by one as by the other. The requisition, that the septum must be perceived to be a double membrane, if produced by two cells, is of no force, since it is too thin to allow of a decision. From the same reason, it is as little to be demanded that we should see the continuation of the septum on to the inner surface of the parent-cell.

Unger* advances, as a proof of his view, that in *Achlya* merely a wall, and not a whole cell, originates; that the wall of the cell-utricle must become thickened by the new cell, which does not happen. Such refined reasoning, however, at once oversteps allowable bounds. Has Unger measured the thickness of the wall before and after the appearance of the septum? Or is it possible to determine the thickness of the latter itself, and thereby to draw a conclusion from the necessary increase of the wall of the parent-cell? From my own investigations in the same plant, I consider both impossible; I must also declare the same mode of determination impossible in Conferva. We have here to do with altogether immeasurable dimensions, and it therefore becomes necessary to have recourse to other grounds of analogy and probability.

In the first place, to speak of the cell-formation in

* Linnæa, 1843, p. 136.

Achlya in question; analogy proves even to demonstration, that the constriction of the clavate end as a sporangium is not the consequence of a formation of a wall, but of a cell-formation. I have observed cases where, in the terminal expansion of the branch, one, and sometimes two, little sporangium-cells are formed; other cases where these were larger and almost filled the expanded end of the utricle. These larger free sporangia form perfect cells, which are never in contact with the wall of the utricular expansion, but lie concentrically at a small distance from it in its interior. If we are taught in one place that the *sporangium* is *an undoubted cell*, why, in another place, in another branch of the same individual, is it not a special cell, but only a part cut off from the parent-cell by a wall, merely because the new cell completely fills the whole breadth of the parent-cell, and therefore is only visible at its free side as a septum? I think it probable that the free sporangium-cells in *Achlya* do not originate as little cellules, but in their subsequent dimensions around an accumulation of the contents; and believe therefore that the sporangium, though it merely appears as a constriction of the clavate end, is also produced by a formation of membrane round the whole contents. Unger says, that upon the appearance of the septum no thickening of the parent-cell is visible. This is correct, because the wall of the sporangium-cell has yet no appreciable thickness. But afterwards, as soon as the septum becomes stronger, we see that the whole sporangium, now distinct, possesses a thicker membrane, like the utricular formation under the septum. This fact, indeed, renders it probable that we have here the production, not merely of a wall, but of a perfect cell.

Since the history of development affords us no assistance, our opinion on the question, whether the division of the Conferva-cell results from the formation of a wall or of a perfect cell must be formed principally from consideration of three points: 1, the subsequent relation of the membrane and the septum; 2, analogy; and, 3, the agreement with other occurrences in cell-life. The wall, as I have already said, first appears as a deposition of a thin plate of membrane. It gradually becomes thicker, and we then perceive in it two distinct lamellæ. Each of these passes immediately into the side-wall of the cell. By the cell-theory this appearance would be simply explained thus: from the very beginning two perfect cells form around complete halves of the contents, but their integrity cannot be made out until their membranes become sufficiently thick, and the parent-cell at the same time becomes dissolved. This theory is immediately supported by fact in the later stage of the phenomenon; it merely presupposes that the mode of origin is identical from the beginning. The theory of division by a wall, on the contrary, needs several assisting theories to reconcile it with the later appearances. It must first be assumed that the originally homogeneous wall subsequently splits into two layers; secondly, that each of these lamellæ grows together with the wall of the parent-cell, into a continuous membrane; and, thirdly, that the membrane of the parent-cell undergoes an annular division into two separate portions. These three processes have never been hitherto pointed out in cell-life, and their hypothetical assumption is to be avoided so long as no fact of greater certainty necessarily requires it.

Moreover, if we now seek for analogies for the theories, we find no definite facts elsewhere in favour of the formation of a wall. On the contrary, I have shown previously that, without doubt, a complete cell, and not a wall, originated in *Achlya*. The division of the parent-cell of the pollen in *Alcea*, however, is indisputable, as I have pointed out above. There we have exactly the same appearances as in *Conferva;* at first, an individual cell, then a septum, and finally, separate cells. These, however, the parent-cell and the special parent-cell, may be clearly distinguished from each other, on account of the thickness of the membranes. We see that the septa by no means grow together with the wall of the parent-cell, and thus produce the secondary cells ; but that these are special cells, unattached to the parent-cell, and that the latter becomes completely absorbed. This analogy alone must determine us to assume a similar proceeding in the division of the Confervæ, consequently *the formation of a perfect cell around the whole contents.* This may happen so much the more readily that two observations on *Confervæ* themselves confirm it. In *Conferva glomerata lacustris* (Tab. vi, 10), I saw the lower articulations undergo division. Two clear nuclei appeared in the dark green contents, and between them a wall. This was continuous at the margin on both sides, with a membrane which lay inside the parent-cell, and was distinct from it. The place of the cell-formation is indeed abnormal, as, elsewhere, the terminal joints divide. For the general theory this is equally valid, and through that fact proves in both cases that in Confervæ also a perfect cell is formed, and not a mere wall. In *Conferva bombycina* (Tab. vi, 13, 14) all the articulations of the plant divide. They are of an elongated elliptical form. A wall originates in the middle. The two secondary articulations, which are now of a semi-elliptical form (fig. 14), extend longitudinally and become attenuated at the originally broader side, so as to reassume a symmetrical figure. Division then takes place again. Each secondary cell contains in its centre a round transparent space, a nucleal utricle. The cell-contents consist of almost homogeneous and colourless mucilage. After some days this acquires a green colour, and becomes granular, whence it also becomes plain that the septa did not proceed from the parent-cell, but were produced as portions of separate secondary cells in the interior of the parent-cell (fig. 14), which latter is absorbed during the growth of the secondary cells. (Fig. 13, *c.*) An incontestable fact is also afforded by *Palmella,* where, in the division of the larger cells, the two secondary cells, with their broad, gelatinous, concentrically striated membranes, are sometimes distinct in the interior of the always thick-walled parent-cell.

The question yet remains, finally, whether the processes of cell-life with which we are already acquainted lead to the assumption of the formation of a wall alone, or of perfect cells. The cells of Confervæ are invested on their inner surface with a layer of mucilage. This, as I have proved above, exercises the function of secreting gelatinous matter; the latter is applied to the lignification of the cell-membrane, and on a free surface, to the production of a new one. The deposition of gelatinous matter takes place continuously over the whole periphery; as we see that the new membrane formed on a free portion of the mucilage layer is a continuation of the most internal layer of lignification.

The same takes place when a Conferva-cell divides. During the production of the septum, the secretion of gelatinous matter continues over the whole surface of the cell-contents. The production of the septum itself, however, may be thus explained from analogy: gelatinous matter is deposited by both the halves of the cell-contents, separating from each other, and first appears in the form of a thin wall; in fact, however, it consists of two lamellæ from the very beginning, because it is derived from both sides. So that the division of a Conferva-cell may be explained in perfect accordance with known facts in this manner: its contents separate into two parts, and each of these becomes invested with a membrane. The formation of layers on the outer surface of the contents proceeds; those which are formed contemporaneously with the septum, are continuous with its lamellæ, and with them produce new cells.

All reasons therefore unite in favour of the conclusion that the division of cells without visible nucleus, in the green Algæ, essentially rests upon the same foundation as the division with a central nucleus in the Fucoideæ and in the parent-cells of spores and pollen; namely, the formation of a cell around the whole contents. Whether in general a more important distinction exists between the multiplication of cells in the green Algæ and the Fucoideæ remains yet to be discovered; but it is improbable, as several of the former possess a central nucleus. The division of old cells which I have observed in *Conferva glomerata, L. Var.* lacustris (Tab. vi, 10), appeared to me to agree perfectly with the division of the cells of germinating spores of the Fucoideæ (Tab. vii, 4, 5); as the cells in both were densely filled with dark granular contents, and possessed a bright central nucleus. When other green Algæ possess a real nucleus (*Spirogyra, Conferva bombycina*), or a structure generally resembling a nucleus (*Palmella, Euastrum,* &c.), these are always in the middle of the cell. We may not have recourse to another theory of cell-formation for the few exceptions *Arthrodesmus, Gaillionella*), which contain a lateral nucleus. We have seen, on the contrary, that the phenomena in *Gaillionella* can only be explained by the formation of a cell around the whole contents. As parietal nuclei occur here and there with free ones in the special parent-cells, so it is the case in the formation of cells round the whole contents in the Algæ. There it is merely an individual deviation from the rule; here, apparently, a specific peculiarity.

On Parietal Cell-formation around the Contents, as an Universal Law.

Having, in the foregoing pages, presented the particular facts relating to cell-formation round the whole contents with and without a visible nucleus, and demonstrated this mode of formation, independently, in each case, I will now briefly collect together the proofs, and make good the universal law; show, moreover, the identity of the various appearances, and notice some essential differences within the limits of this identity; and, lastly, seek to determine as far as is possible at present, the extent of this mode of cell-formation in the vegetable kingdom.

The evidence of cell-formation around the whole contents embraces three very distinct series of facts.—1. *A cell-membrane may be formed on a free surface of assimilated matter, with which mucilage* (*C. H. O. N.*) *is mingled.* 2. *By the so-called division of cells may be formed perfect secondary cells, which are independent of the parent-cell.* 3. *These secondary cells originate in the situation, and in the form in which they first become visible.*

We have learnt from several facts in the cells of Confervæ and Siphoneæ, that a membrane may be formed on the free surface of mucilaginous cell-contents. This formation of membrane takes place either merely as a *reparation of the interrupted continuity of the wall;* for instance, when the contents retract from the membrane through endosmose of water, they are devoid of a wall at the point which has become free; also, when the contents decay in places, in a long cell (*e.g.* in Siphoneæ), and the living contents thus become free at two circular surfaces bounding these spots. In each case, merely a piece of membrane is formed, larger or smaller, according to the exigencies of the case; or, this formation of membrane produces *perfect* cells. This takes place sometimes by the whole contents of a cell becoming detached from the wall, contracting and producing a new membrane over their whole exterior (*Bangia*). Sometimes the detached contents of an injured cell divided into several portions, and each of these becomes a cell. This series of facts demonstrates the *possibility of the origin of a membrane from the surface of mucilaginous cell-contents.*

The division of cells is not effected by a single septum, self-constituting, or produced from the membrane of the parent-cell, but always by complete cells. The special parent-cells of pollen grains exist as thick-walled, gelatinous, and *independent* cells, *inside* the parent-cell, equally possessed of a broad gelatinous membrane. The *independence of the secondary cells* of *the membrane of the* *parent-cell* is also clear in some *Confervæ* with a central nucleus, and in *Palmella*. In *Achlya prolifera*, the appearance of a *mere wall* alternates with that of a *perfect cell*. In this latter, and in all other cases, the circumstance of the side-walls of the secondary-cell remaining invisible, where they lie upon the membrane of the parent-cell, may be very naturally explained by the tenuity of their wall. That they do not subsequently appear as independent of the parent-cell, when they have become stronger, is merely because at that time the parent-cell is dissolved. But the septum then presents itself as *two plates, each of which passes continuously into the membrane of the corresponding cell*. On the other hand, we can, in no case, see either anything of the inward growth of a septum, or that this wall at any one period of its existence has an organic connexion with the membrane of the parent-cell. This second series of facts shows therefore, on one hand, that, in some cases, the secondary cells are visible as special cells in the interior of the parent-cell, from their very origin; and that in all others, the secondary cells appear as soon as we can see them as *perfect cells with uninterrupted, equal membrane;* on the other hand, they show a total absence of opposing phenomena. This series of facts proves therefore, that *in the so-called division of cells perfect secondary cells originate, which are distinct from the parent-cell.*

The secondary cells do not originate, in the division of cells, as small, round, and free cellules, but in the position where they first become visible, namely, on the inner surface of the parent-cell and as the septum. To prove this it is sufficient to show that the septum is produced in that place alone where it is generally seen. In no case has anything been observed of young, free cells, but merely the *production* of a wall. Moreover *no alteration* of the contents of the parent-cell has been noticed *during the division*. It takes place without the interruption or modification of reticular or radiating circulation (Fucoideæ), without solution of solid cell-contents, and without even the appearance of a change in the arrangement of solid contents (Diatomaceæ, Confervæ); all of which must occur if two small, free nuclei were formed, and absorbed the contents of the parent-cell by endosmosis. Lastly, we must observe that the secondary cells regularly possess *central nuclei* (special parent-cells, Fucoideæ, many Confervaceæ), while the primary nuclei of those cells which originate free in the parent-cell are without exception *parietal*. This third series of facts proves that, in the so-called division of cells, *the secondary cells do not originate free and as round utricles, but in that position and of that form in which they subsequently become visible.*

The three series of facts here brought forward prove the universal validity of the law that there is one specific kind of cells which *form around several divisions of the whole contents of the parent-cell.* The contents of the parent-cell become the *immediate* and *unaltered* contents of the secondary-cells. The membrane of the latter is not free, but lies, from its very origin, partly upon the (inner) *wall of the parent-cell*, and partly upon the (outer) wall of the contemporaneously originating secondary-cell (Schwesterzelle). The cells are not round, but have, from the beginning, the form which is produced by the division of the parent-cell.*

* This is naturally only valid in the so-called division of cells, not generally in all cases where a membrane is formed on the surface of the contents. We must, for instance, distinguish between that mode of cell-formation around entire portions of the contents, where all the contents and the whole cavity of the parent-cell are taken up by the secondary cells, and that where the production of membrane indeed takes place on the surface of assimilated cell-contents, but free (not resting on the cell-wall). The latter species of cell, or membrane formation, occurs generally as abnormal (from external interference with the life of the cell); also as sporadic (Sporangium of *Achlya*, spore-cells of *Spirogyra*). The cell-formation around the whole contents, on the contrary, which is connected with a division of the parent-cell, or *parietal* cell-formation, has a great extent, and takes place generally as the normal process. I shall hereafter, in the description of free cell-formation around a nucleus, also more closely examine the relation of *free cell-formation around entire portions of assimilated contents* to *parietal cell-formation around the whole contents*, on the one hand, and to *free cell-formation around a nucleus*, on the other.

The phenomena just described express the *identity* of the parietal formation of cells around the whole contents. Others, which at the same time prove a part of this identity, may probably be found in the chemical and morphological constitution of the contents. I believe I may assume, as an universal condition in regard to chemical composition, that the portion of the contents around which the new cell forms contains fluid *mucilage* (C. H. O. N.), at least in its peripheral layer. As an universal condition in relation to morphological constitution, analogy seems to indicate that a *nucleus* is present in the membrane-forming portion of the contents. In the chapter on the nucleus, I have concluded from analogy that all, at least of the young cells of plants, possess a nucleus. I have now equally to declare that it is never wanting in the young cells which originate around complete portions of the cell-contents. The question, however, yet remains whether this nucleus preceded the formation of the cell, or originated subsequently in the latter; also whether it is a *primary* or a *secondary* nucleus.

In the parent-cells of pollen-grains and of spores (Florideæ, *Anthoceros*), the nuclei are first produced. and next the special parent-cells. In the Fucoideæ the existence of two nuclei or two heaps of granules, which always conceal a nucleus (germinating spores of *Padina Pavonia* and *Cystoseira*, cells of the stem of *Sphacelaria*), precedes the appearance of the dividing septum. There is no reason why we should not equally assume the presence of a nucleus in the cells of other Fucoideæ, where the opaque contents preclude observation. It is thus proved that in special parent-cells and the cells of the Fucoideæ, that they only originate around *portions of the contents* of the parent-cell, *each of which portions includes a nucleus;* in other words, that their nuclei are *primary nuclei existing before the formation of the membrane.* I have not yet with certainty observed the nuclei before the formation of the cells in the green Algæ. Whether some phenomena (in *Protococcus*, in the germinal cells of *Undina*, *Rivularia*, &c.) are to be so explained, further investigations must decide. In some others (*Euastrum*, *Bacillaria* sp. &c.) two accumulations of granules exist previously to the division; from analogy to the cells of the Fucoideæ and the parent-cells of pollen, they probably always inclose a nucleus. Several exhibit a central nucleus in each secondary cell during or subsequently to division (*Conferva* sp., *Spirogyra*, *Closterium*). Others possess a parietal nucleus after division (*Arthrodesmus*, *Gaillionella* sp., *Bangia*). Finally, in the majority no nucleus is to be seen. We have two points to consider in the cases where a nucleus appears in the green Algæ. Firstly, that not a single appearance goes to prove that it was formed as a secondary nucleus subsequently to the origination of the secondary cell, and that the secondary nuclei are generally wanting in those cells which are produced around complete portions of the contents. Secondly, that the same phenomena occur in the cells of Fucoideæ and in the parent-cells of spores and pollen-grains, only that there it is possible to carry the examination further back, and to point out the nuclei of the secondary cells even in the undivided parent-cell. Analogy also favours the assumption that the nuclei of green Algæ are their *primary* nuclei. And indeed this assumption is equally valid either of central or parietal nuclei; as the primary nuclei of the special parent-cells, already to be observed in the undivided parent-cell, may be either free or parietal in cell-formation. The conclusion from the cells of Algæ, with nuclei as to those without, is so much the easier, since each family exhibits one or more examples with nuclei, and because these, so to speak, stand on the very limits of perception, on account partly of their peculiar, delicate structure, partly of the opacity and muddiness of their cell-contents. If, therefore, we may venture a conclusion from the certain cases to analogous cases, which are uncertain because hitherto inaccessible to experience, we must affirm that the *portions of cell-con-*

*fents which form a membrane upon their surface inclose a tree or, more rarely, a parietal nucleus.**

The identity of cell-formation around complete portions of the cell-contents depends upon the fact that the membrane of new cells originates on the *surface* of a mucilaginous layer, furnished with a nucleus, resting upon the parent-cell and the contemporary secondary cells (*Schwesterzellen*). *Differences*, within the limits of this identity, may occur either *in the nature of the membrane-forming contents*, or in *the relation of secondary cells to the parent-cell and to each other*. The membrane-forming contents differ very much, *chemically* and *morphologically*. They consist either merely of homogeneous or granular mucilage, filling the cell uniformly, or they include in addition other assimilated matter, such as chlorophylle and amylum; in the latter case they are either uniformly distributed throughout the cell, accumulated in the middle, or forming merely a superficial layer; this superficial layer, again, is either uniformly spread over the whole circumference, or the sap-globules in it form definite figures. Whether or how far these said relations make good abstract distinctions, I must yet leave undecided. The *situation of the nucleus* constitutes another distinction. In the special parent-cells of Phanerogamia this is often inessential, as the central and parietal position alternate with each other in the same anther. In the Algæ, on the contrary, it appears important, as particular genera *constantly possess a free nucleus* (*Spirogyra, Conferva, Closterium*); others *constantly a parietal nucleus* (*Bangia, Arthrodesmus, Gaillionella sp.*)

In regard to *the relation of the secondary cells to the parent-cell*, in *general*, an essential distinction occurs,

* I shall hereafter discuss the signification of the expression "parietal" (*wandständig*.) In this case it is important to understand, that the nucleus does not lie immediately upon the cell-membrane and grow to it, but that in fact it is merely in contact with the very thin layer of mucilage spread over the interior surface, and by endosmose separates with that from the cell-wall, very often moving very deep into the interior of the cavity (e. g. in *Gaillionella* sp.)

whether the secondary cells are *like* or *unlike* the parent-cell. They are *like*, when the parent-cell has equally originated by parietal cell-formation around the whole contents. In this case the formation of secondary cells is merely the *repetition* of the process by which the parent-cell had been produced. The phenomena which accompany this process are extremely simple in cells with a central nucleus. The nucleus of the parent-cell divides into two secondary nuclei which form the primary nuclei of the secondary cells. The similarity of parent and secondary cells occurs principally in the Algæ, and, further, between primary and secondary *special* parent-cells of pollen grains (when both are present); in the latter case therefore it can only result from the production of secondary special parent-cells. On the other hand, the parent-cell and secondary cells are *unlike*, when the former originate by a different mode of cell-formation, namely, free and around a nucleus. In this case no repetition of a former, but a *totally new and distinct process* occurs, in the formation of secondary cells. This is also accompanied by many complicated appearances. Thus the parietal nucleus of the parent-cell first becomes absorbed, then a new, more central, secondary nucleus, in the neighbourhood and under the influence of which the primary nuclei of the secondary cells are first formed. This relation between parent-cell and secondary cell exists between parent-cell and special parent-cell in the spore and pollen formation of four-spored plants.

Within the limits of the *similarity* which exists between parent-cell and secondary cells in *general*, in *reference to the mode of cell-formation*, a series of special *objections* present themselves. The secondary cells are either *perfectly identical* with the parent-cell, e. g. in the Diatomaceæ and in *Palmella;* the secondary cell is here, like the parent-cell, a perfect individual and capable of division. Or the secondary cells are not *identical* with the parent-cell; this is the case in all many-celled individuals. This difference of parent-cell and secondary cells presents, again, a number of modifications. The slightest differences arise from *time and place of origin*, or from *the number of cells produced* (*Generationszahl*), more important, from the *relation to the axis* of *parent-cell* and secondary cells; the most weighty are involved through the circumstance that the cells of one kind principally *form cells*, and, in regard to the whole organism, must be described as *temporary*, the others, on the contrary, *do not form cells*, and are *permanent structures*. As the characters just pointed out belong, not to one particular but to all kinds of cells, I shall hereafter investigate them more closely, in connexion, in all cells. Here refer also the *relations between the secondary cells themselves*, which are either alike, or differ in various degrees. The two secondary cells of *Palmella*, or the four special parent-cells are, for instance, *perfectly identical*, while the two cells formed in the terminal joint of a *Conferva glomerata* are *absolutely different*, since one, (the end-) cell becomes a parent-cell, the other a permanent cell.

A relation of parent-cell and secondary cells, and of these among themselves, which conditions further differences in cell-formation arises, on one hand, from the *form of the parent-cell*, and on the other, from the *number* of secondary cells. In the parietal cell-formation around complete portions of the contents, the originating cells have exactly the form which results from the division of the parent-cell. A number of differences also occur, according as two or four, or from five to eight, cells are produced; further, as the parent-cell becomes divided into equal or unequal parts; lastly, according to the form of the dividing parent-cell, whether spherical, ellipsoidal, cylindrical, parenchymal, &c. Whether these differences are essential, and whether they found specific characters in cell-formation around the whole contents, still require extended investigations to decide. It is at least worthy of remark that, while in *free* cell-formation *around a* nucleus, the young cell is always of a *roundish* form at the moment of origin, in *parietal* cell-formation around *complete portions of the contents* the originating cell is *never round,* but appears with *a flat surface,* at *one* side at least; also that the form of the originating cell is very *variable.* This form may be the segment of a sphere, a half, quarter, or third of a sphere, a cylinder, a half, or segment of a cylinder, a cone, a half-cone, a cube, a rectangular or triangular figure, &c., in other words, the form of the originating cell may be part of a sphere, ellipse, cylinder, cone, or any solid with regular or irregular faces.

The *extension* of parietal cell-formation around the whole contents throughout the vegetable kingdom is yet extremely problematical. However, I believe I may state the following as certain. It is the *only* mode of cell-formation in the *Diatomaceæ, Nostochineæ, Oscillatoriæ, Batrachospermeæ,* and *Fucaceæ.* It takes place in *all other cells of Confervæ,* with the *exception of the germinal* or *spore-cells.* It prevails *only in the special parent*-cells of four-spored plants, namely, the *Florideæ, Hepaticæ, Musci, Filices, Lycopodiaceæ,* and *Phanerogamia.* Whether, or in what degree, this cell-formation takes place in *Fungi* and *Lichens,* whether it occurs in the *Ulvaceæ,* or plays a part in the formation of spores in the *Characeæ* and *Equisetaceæ,* I am yet ignorant. On the other hand, I believe I may assert that, with the exception of the special parent-cells, it is wanting in all the other cells of the *Characeæ, Equisetaceæ, Florideæ, Hepaticeæ, Musci, Filices, Lycopodiaceæ,* and *Phanerogamia,* and that in these divisions of the vegetable kingdom, excepting in the case of special parent-cells, only free cell-formation round a nucleus takes place.

REPORT

ON THE PROGRESS OF

PHYSIOLOGICAL BOTANY,

FOR THE YEARS 1842 AND 1843.

BY H. F. LINK.

TRANSLATED BY J. HUDSON, M.B.

For Rept. for 1844-45
See [illegible] (1849)

PHYSIOLOGICAL BOTANY.

It does not happen undesignedly that two years are comprised in the present Report. Certain subjects, namely, the occurrence of Fungi in and upon animal bodies, were only just touched upon in the year 1842, but were submitted to a stricter and more detailed examination in 1843; and this was also the case with the appearance of Fungi in bodies in a state of decomposition. On the whole, the year 1842 was less rich in observations than that which succeeded it. I proceed at once to the detail of individual researches, upon which I shall subsequently found some general observations.

INTERNAL STRUCTURE OF PLANTS.

I commence with the discussion which has taken place in the Academy of Paris, between M. Mirbel and M. Gaudichaud. The treatise of Mirbel 'On the Date-Palm,' appeared in the 'Comptes rendus' for 1843, vol. i, p. 1214, and subsequently in the 'Annales des Sciences naturelles,' 2d series, vol. xx, p. 5. Immediately after its presentation, (Compt. rend., ibid. p. 1235,) Gaudichaud protested briefly against the theory of Mirbel, and two sessions later appeared his 'Premières Notes,' (Compt. rend., ibid. p. 1379.)

In the first place, as regards Mirbel's treatise. Mirbel was sent to Algiers in 1839, for the purpose of studying there the natural history of the Date-Palm. He wished to meet with a large date tree; but being unsuccessful, in order not to be unemployed, he commenced observations on the stem of the *Agave americana*. It occurred to him in the first place, to trace the descent of the fibres (filets, Holzbündel) in the stem (stipe). He commenced with the fibres at the base of the leaves which were on the right side of the stem; and he succeeded, after many fruitless attempts, in tracing them, in spite of their numerous windings, until they became attached on the left side in the peripheral portion, a little above the base of the stem. He saw then distinctly that they had no direct connexion with the root. Shortly after these observations, he was enabled by the Baron de Vialar, to make experiments on a large date tree, the only one in his garden. The inferior and hard part of the stem could be examined at home at Paris; but the upper and soft portion of the young shoot was then and there made the subject of microscopical examination. After the author has communicated so much of the origin of his labours, he proceeds to the history of this question, and mentions how a remark of Desfontaines, expressed by him with his usual modesty and circumspection, had been converted by his followers into the affirmation that the growth of Monocotyledons is internal, and that of Dicotyledons external, whence followed the division of plants generally into Exogens and Endogens. It is further stated how Moldenhawer first opposed this theory, and what the investigations of Mohl and of Meneghini have ascertained. After this he returns to his own observations on the date tree. Poiteau had remarked very early in a Palm tree of the Antilles, that the first or primitive root perishes, and that the tree is nourished only by the auxiliary or secondary roots, an observation which was established with regard to many other Monocotyledons. Mohl now proposed the astonishing assertion, that only in the early growth of the tree had these accessory roots any connexion with the fibres of the stem. Upon this subject, Mirbel makes the following communication: in the interior of the growing stem, not far from the periphery, between the bundles of woody fibres which are connected to the base of the leaves, may be observed here and there small hemispherical collections of numerous young cells. These are the commencements of the auxiliary roots, which have no organic connexion at all with the leaves. The plane surface, or as it may be called, the base of these masses of cells, is turned towards the interior of the stem, and consequently their convex surface towards the exterior or periphery. This latter surface becomes thicker, elongated, and makes its way from within outwards, whilst the other surface only becomes broader without any elongation, and sends diverging fibres into the stem. The fibres which proceed from the centre or its neighbourhood, take a direction to the interior of the stem, and insinuate themselves through the old fibres which terminate in the leaves, becoming thinner as they recede from their point of origin, and losing themselves in the mass of fibres, so that their termination cannot be ascertained. Those fibres which proceed from the peripheral parts of the hemispherical masses are soon curved, some to the upper part of the young tree, the others to its lower portion. It would seem that the latter contributed to the formation of the shoots, which are situated at the base of the stem in the Date Palm and *Chamærops*?

As regards the fibres which run directly upwards, in order to reach the parts near the surface, it is very likely they may in their youth have been in connexion with the leaves. "By these statements" adds Mirbel, "I do not wish to contradict the assertions of Mohl, but to confine them within their proper limits." The author next describes these auxiliary roots, as they usually occur in the Palm.

"When we examine a longitudinal section of the Date tree," continues the author, "we see such a confused multitude of fibres, that we cannot tell how they may be rightly unravelled. The first question is, whence come these fibres? Do they arise from the leaves and run to the roots, as De la Hire, Dupetit-Thouars, and Gaudichaud affirm, or do they spring from the roots, and proceed to the leaves according to the old idea? The author accepts neither of these opinions. In two longitudinal sections he readily perceived that numerous fibres were attached by their upper extremity to the base of the petiole; but do these fibres originate from the leaves, or from the lower part of the stem? In every section it could be observed, that the fibres in the cellular tissue were distributed in almost the same quantity, and that the stem might justly be described as cylindrical. But this condition is in the first place impossible, if we hold that all the fibres originate from below. For if all the fibres go directly to the leaves, then must all those which still run to the leaves, together with those which have passed to leaves now dead, when collected in the lower part of the stem, constitute a very considerable bundle, and thus thicken the stem. The same would also be the case if the fibres proceeded from the leaves to the root; for on this supposition equally, would a thick bundle be formed at the lower part of the stem from the existing and from the dead leaves conjointly, and thus the stem would be gradually enlarged. There are, on the contrary, palm stems which are of less size at their base, a fact which does not admit of explanation by the hitherto-received theory. According to the theory of the author it is readily accounted for. The fibres grow from below upwards everywhere, in the whole internal periphery of the stem. During the formation of the stem the vegetation was weak, and consequently the stem also; but as this grew, more fibres were formed in its interior, and the stem became thicker. To demonstrate this still further, the author endeavoured to ascertain the number of leaves which had grown upon the Date tree, which is easy, on account of the attachments of the petioles still remaining; and he found in the length of a metre 337 leaves, which gave for the whole tree about 6268 leaves. He then attempted to calculate the number of fibres which entered one petiole, which he found to be about 644. This would give for the entire stem, the gross sum of 4,036,592 fibres, if they all proceeded from the root, or entered into it; and moreover, if he measured the surface of one such fibre or bundle, a diameter of 2·01 metres, and circumference of 6·33 metres; but the stem at its base had actually a circumference of no more than of 25 centimetres. This does not agree with Mohl's theory, which makes the fibres extend from the leaves to the roots.

The author now proceeds to the consideration of the upper herbaceous portion of the stem, which he calls the "phyllophor." The summit of the stem, whence the young leaves spring, forms a depressed hemisphere; the young leaves are placed in the centre, the old ones at the circumference. Beneath the youngest leaves in the middle of the summit an extremely delicate cellular tissue is found. This cellular tissue is the central point of a continuous process of reproduction. Scarcely have the cells begun to develop themselves, ere they are replaced by other and younger cells, which in their turn yield to others of the same kind. They proceed, in virtue of a spiral, centrifugal, and upward impetus, towards the circumference, which is now in a state of growth, and to the apex which is consequently elevated. An innumerable quantity of fibres, scarcely to be distinguished by the (naked) eye, proceed from the whole internal periphery of the stem, and mount upwards to the central part of the phyllophor. They elongate themselves, and approach by their upper ends to the bases of the leaves, with which they shortly acquire an immediate connexion. Sometimes we detect these fibres in the tissue which limits the bottom of the depression as they pass into those delicate veins of the leaves, which can only be perceived by a powerful microscope. We then find in the cellular tissue, immediately under the depressed summit, two parallel and horizontal fissures, which divide the cellular tissue into two layers, lying compactly one over the other. Each layer is a commencing leaf. The upper is the older, and is also the first developed; then comes a second, and often a third. While these leaves are increasing in size and strength, others are springing up. What has been said of the growth of the first leaf, applies equally to all the rest. The cellular tissue from which the leaf originates rises in the form of a vesicle, and soon afterwards becomes almost completely separated from the subjacent cellular tissue by a circular fissure. That portion which remains attached to the phyllophor, becomes the petiole. In its early stage, the leaf is of a spatulate form, and undergoes many changes before it becomes a perfect and pinnate leaf. The author is of opinion that the (lacerated) sheath originates from the wound which the leaf makes when it separates from the phyllophor. According to him, the woody fibres grow from below, upwards; and it is only necessary to observe the young shoot of the Date tree, to perceive that the upper bundles are very soft and young, in comparison with the lower. Had they originated from the leaves, they must in that situation have been older and thicker. They arise, however, as was above stated, from the internal periphery of the younger portion of the stem, and when this portion grows old it loses the power of generating such fasciculi of ligneous fibres.

The author then considers the part immediately under the phyllophor. Here is already a great change; the former cellular tissue is no longer to be recognized, but in its place we find a number of simple cells (utricles) more or less spherical, slightly attached to each other at their points of contact. The cells remain in this condition several years; the stem goes on elongating at its apex. The new fibres, which arise from the lower part, make their way through the cells and push them aside in succession, so that these cells form a sort of cement which fills up all the interstices, and envelopes all the fibres of an origin more or less recent. After this follows a more minute description of the fibres, which are divided into fine and coarser ones; the latter contain vessels. The course of the fibres was investigated by means of maceration of portions which had been split from the stem. Many of these fibres have a direction almost vertical, and proceed, as stated, from the internal periphery of the stem. A more delicate fibre issues from one of the central fibres, and ascends obliquely in order to reach one of the leaves. The author calls these slender fibres "precursors" (précurseurs). In their course they are joined by several auxiliary fibres which wind around them, and accompany them to the leaves. These fibres constantly diminish in size the nearer they approach the leaves. Where the precursor detaches itself from the vertical fibre, it gives off one or more branches which take a vertical direction; the termination of these Mirbel did not ascertain. If we trace the precursor further down, we find, after it has traversed a small portion of the length of the central fasciculus, that it now proceeds in an obliquely descending line to the leaf at the opposite side of the stem. Where also these fasciculi cross each other in the middle of the central fasciculus, two cones are formed, one upright and the other inverted, which are applied to one another in the direction of the stem. In this manner the author explains the growth of the stem by the elongation of the precursors, and of the central fasciculus (which probably consists only of precursory fibres), and the enlargement of the cells.

When Mirbel had read this paper, Gaudichaud immediately requested to speak, with the intent, as he said, to protest against all the theoretical portions of this work, since he held these theories to be injurious (fâcheuses) to science. He protested moreover against all the theories which Mirbel had founded on the examination of the "cambium," and promised to read several papers on that subject. This protest was made at the meeting of the Academy, on June 12th, 1843. At the meeting of the 26th of June, Gaudichaud read on this subject his 'Premières Notes,' which were printed in the 'Comptes rendus' for 1843, vol. i, p. 1379, and also in the 'Annales des Sciences naturelles,' sér. 2, tom. xx, p. 33. He complains of certain expressions in the treatise of Mirbel, such as "préoccupations d'esprit, les influences d'idées préconçues, les fautes de mieux savoir, les observations novices, &c.," which might be especially directed to himself.

He then proceeds to state, that Mirbel has not refuted his theory in the 'Organographie végétale;' that he (Gaudichaud) had made his observations, in the first instance, on American plants, and subsequently on those of his own country, whilst Mirbel on the other hand, in his treatise had employed materials which had nothing in common with his own; and that he acted as though his (Gaudichaud's) theory, which had caused him so many sleepless nights, so many laborious researches, so many sacrifices, had not even deserved to be met by open opposition, but that he thought to set it aside without notice. "Whilst I defend myself, gentlemen," he exclaimed, "I will frankly attack the labours of M. Mirbel on the Organography and Physiology of Plants; I will point out their errors, and the dangers to science arising from them, and I will not desist until the truth has been decided either in his favour or in mine." He then stated Mirbel's theory in a few words, and very imperfectly, since he offered no reply to the grounds on which Mirbel proves that the base of the stem of the Palm ought to be extraordinarily thick, if all the vascular fasciculi from the leaves were collected there. He next stated his own theory. All organic bodies commence with a cell. The organized cell produces "un être rudimentaire," which afterwards takes on development. This is true of animals and plants. The animal individuals, with certain exceptions, remain isolated; vegetable bodies are ingrafted from their origin one upon another, and so constitute very complex communities. In Monocotyledons, the simplest embryo (l'embryon le plus réduit), the simplest *Phyton*, consists of a "merithalle* tigellaire"

* "Merithalle" = internode.

(Stamknotenstück), of a "merithalle petiolaire" (Stielknotenstück), and a "merithalle limbaire" (Saumknotenstück), which separate themselves from the vegetating growth so soon as they have fulfilled their functions. The "merithalle tigellaire" alone is left, and at its summit a bud is produced, and at its base a root; the bud consists of the rudimentary leaves (feuilles rudimentaires), which lie over one another, and which originate from a vitalized cell. In the process of germination, or in the development of the embryo, all the parts elongate themselves as in animals, which are developed in all directions. In some Monocotyledons (*Phœnix*, *Xanthorrhæa*, *Allium*, *Porrum*), the "merithalle tigellaire" remains very short; in the rest (*Flagellaria*, *Joinvillea*, *Calamus*, *Bambusa*, and the other Gramineæ) it is elongated; in the former the leaves are placed close together, in the latter they are wider apart. Since the first individual, the embryo, has a root, there is no reason apparent why the others, which are developed successively in the bud, should be destitute of one. The development of a Monocotyledon in height takes place by superadditions of "merithalles tigellaires," however small and variously formed they may be; and in breadth, by the addition of the radical tissue to the whole tissue of the plant, among which the laticiferous vessels also occur; and lastly, by the various forms of cellular tissue. When Gaudichaud had made this statement he vaunted his system on account of its simplicity, and said that he sought to simplify everything, and Mirbel on the other hand to complicate everything, and that since the two systems were in direct opposition, one of them must be erroneous. A third supposition, he observes, is possible, namely, that they are both so.

There is perhaps no doubt that Mirbel has, on the whole, demonstrated what he wished to prove. About the origin of the bundles of vessels from the internal periphery of the stem he is obscure. Do they spring from indefinite or from definite parts of other ligneous fasciculi which are branched, or do they arise primitively from the cellular tissue? Do they all pass over to the opposite side of the periphery, or not? It seems probable that the examination of a young stem would be quite as useful, if not more so, than that of an old one. At all events it would have much promoted his object to have examined a young stem as well.

In opposition to this, Gaudichaud, in his 'Premières Notes,' (Annales des Sciences naturelles, 2 sér. tom. xx, p. 32,) in place of any answer advances only his hypothesis, some statement of which he makes, as has been detailed above. It depends upon the following induction: that as the first individual of the embryo has a root, so there is no obvious reason why the other individuals which are developed subsequently in the bud should be destitute of one. That this conclusion is not valid is immediately apparent. He makes the thickening of the stem depend on these roots. However, it is desirable that we should glance at the 'Recherches générales sur la Physiologie et Organogénie des Végétaux,' 2me et 3me partie. (Comptes rendus, 1842, i, 973); the first part, which appeared in Paris in 1841, as an appendix to the Organographie of the author, was examined and commented upon in last year's Report, pp. 113 et seq. Of this second and third part an extract, with critical remarks, has appeared in the 'Botanische Zeitung' of Mohl and Schlechtendal, 1843, No. 17. In the introduction the author manifests very accurate and ingenious ideas. He compares the physiology of animals with that of plants. "Animals," says he, "have a heart, arteries, and veins for the circulation of the blood, lungs for respiration, stomach and bowels for digestion, &c. Is it the same with plants? Are we not always obliged to inquire what organs are in them, and what functions they perform? Can it be said that there are in plants physiological functions which are not at the same time organogenic, and consequently also organographic?" Very true.

I also have with respect to this certainly remarked, that in plants the *object* does not appear, but Gaudichaud in addition to this states more definitely and correctly, that each organ is also organogenic."

He comes then to the inquiry whether the various substances, such as Strychnine, Morphine, Jalapine, &c. are derived by the plant from the earth; and he justly comes to the conclusion that as they are found sometimes in the leaves, sometimes in the root, &c., they are produced by the special organization of the part. He proceeds further to the metamorphosis of plants, which is altogether different from that of animals, since in one place parts disappear, and in another new ones are formed, which are, as it were, ingrafted upon each other. He then proceeds to certain propositions (hypotheses, suppositions), and the first is that which has already been detailed, of a living cell. In this the earliest motions of the sap take place, and the globules which it contains are converted into cells. On the different currents of the sap depend the five classes of plants which, their fabulous origin excepted, are in my opinion very correct, and which I have distinguished as Cryptogamous plants, Mosses, Ferns, Monocotylæ, and Dicotylæ. To this hypothesis succeed a number of true, half-true, or false positions, which always display a certain fertility of genius, but for which there is no room here. He says, for instance, not very untruly, that Monocotyledons consist of one primordial plant or phyton, but Dicotyledons, on the other hand, of two or more, connected by the medulla. As a second proposition, the author says: "That in every part whence buds may arise, the vital principle will continue for a time, but will finally exhaust itself, unless some active organ be produced, or a cell be changed into a phyton, which then throws out leaves superiorly, and roots inferiorly, stretching out where they find the most nourishment; these new phytons are ingrafted, as it were, upon the old ones." In what he terms his third proposition, the author asks: "How does it happen that a cell is so vitalized as to be able to produce a phyton?"

Hereupon he adds, "The more I have meditated upon this, the more am I inclined to believe that in the different cases of the production of buds and of fruit, the phenomenon of the vitalization of cells is brought about only by an excessive endosmose or nutrition. The fourth proposition lastly, is, that the commencement of all plants is the vitalized cell adherent to the placenta, the embryo-sac. The author adds, that what he here anounces simply as an hypothesis, is in his own mind, an established truth.

In the 'Secondes Notes relatives à la protestation faite à l'Académie des Sciences dans la séance du 12 Juin, 1843' (Annal. d. Scienc. naturell. t. 20, p. 199), after briefly recapitulating his theory of the primitive vitalized cell, Gaudichaud goes more to the point itself. He would in the first place demonstrate that the vessels which form the leaves do not proceed from the stem. One observation we will relate in the words of the author, since it would occupy too much space to give them all. "I cut obliquely through a young stem of *Dracæna* below the leaves at its summit, but left the base in the ground. Fourteen or twenty days after, buds were formed near the summit of the divided stem, in the centre of the cicatrices of the detached leaves. I destroyed these buds with the exception of a very vigorous one, which very soon produced a young shoot. I cut off the upper part of this stem with its little lateral twig, and left it to macerate. The cartilaginous kind of bark which surrounded this stem broke up by means of certain longitudinal divisions; and the same was the case with the cellular tissue lying beneath it, and also subsequently with the cellular, but firm and thick layer of bark which immediately surrounds the wood, and bounds the inner surface of the bark in the family of the Dracenæ, and as is the case with all ligneous Monocotyledons, so far as I have observed. In a yet unpublished work on the anatomy of plants, I call this important layer the périxyle (perixylon.) This 'périxyle' of the stem surrounds the ascending vessels in all the internodes of the stem as well as the descending ones.

When they have arrived at the periphery, they expand themselves from above downwards, on the inner surface of this body. Under this last tunic is found the radical tissue of the bud. A soft brush of badger's hair sufficed to separate the radical vessels from the cellular tissue, and in this manner I obtained the specimen which I lay before the Academy." Here are then cited figures from the author's Organographie. Gaudichaud supposes that the Dracæna family would be very similar to the Dicotyledons; the branches, stem, and roots increase in diameter after the same manner. "When it is asserted," says he, "that the vessels, which I have called radical vessels, proceed from the stem to the bud, it follows necessarily, that those which appear later have a somewhat deeper origin, and so also all others which subsequently appear, for the stem grows in all its parts, particularly at the base. If then the stem grow in this manner, it must be thicker above than below." The author then proceeds secondly to show that the vessels are not thicker at the base than above. To prove this he states that we have merely to glance at a macerated stem of *Carludovica* to perceive that the bundles of vessels are thicker above than below. In a stem of *Chamærops humilis* we can see distinctly in the centre all the internodial terminations (tous les sommets merithalliens des faisceaux vasculaires) of the vascular bundles, and at the periphery all the radical bases (Wurzelbasen); the terminations in the centre are very thick, compared with the bases at the periphery, which assume a more and more capillary character. "The extremities also have their more delicate terminations," he adds, "but that arises from a reason which I will explain in my answers." Finally, he wishes to prove that the roots send no vessels into the stem, but receive them from it. This is easy for him, and Mirbel himself may possibly have had no doubt on this point; but I doubt much whether Mirbel has been convinced by Gaudichaud's opinion, and I must grant that I myself am not convinced. Whatever Gaudichaud may say, it is not possible to resolve the dispute without accurate anatomy; and whatever Mirbel may declare is also of no avail without the comparison of a younger with an old individual. For the rest, Gaudichaud gives us an extraordinary mixture of ingenious poetical conceptions, of preconceived, we might say, obstinate opinions, and of morbid irritability and violence, with which he receives every opposition, and by which he seeks to give weight to his opinions. He feels himself disregarded, and often becomes disagreeably assuming. His memoirs in consequence, however exciting they may be, can seldom prove instructive.

Of the Composition of the "Cambium," and the part which it plays in the Vegetable Organisation, by MM. de Mirbel and Payen, in the 'Compt. rend.' for 1843, i, 98, and in the 'Annal. d. Scienc. natur.' t. 19, p. 193. The spherical cell-material which precedes the appearance of the cells, and which is invariably present wherever vegetable matter is in a state of growth, namely the cambium, contains, according to its elementary constitution, substances analogous to those which constitute animal bodies; it thus contains azote. This, however, occurs together with other materials not azotised, consisting of carbon and water, such as Dextrine, Gum, Starch, Sugar, Glycose, Mannite, &c. At the moment when vegetation announces itself by the development of cells, the cellulose also appears, a new proximate principle, consisting of carbon and water. The cellulose increases by new layers, which resemble one another in their chemical constitution, and occasionally also other materials are added, such as those which form the ligneous tissue, or the lignose. From this thickening of the cellulose, the reason becomes manifest why the wood in the interior of thicker stems contains little azote, while the spongioles, the buds, and the growing ovula contain from ten to twenty times as much. Chemical analysis can follow the azotised constituent step by step in the different stages of growth, namely, from the periphery to the centre, in the alburnum, and in the wood, or also from within outwards in the liber and cortical layers. By the help of analysis we can determine the quantity of azotised matter; it diminishes from the distal end of a branch to the part where it becomes attached to the stem. A similar result is obtained by comparing the lower end of the root with its older portions. The surface of the leaves and of the young twigs which are in immediate contact with the atmosphere, is impregnated with an azotised material which extends over the stomata, and penetrates with the air into the air cells. The cambium is a quaternary compound, soft, moist, and fluid, of an elementary composition as various as the innumerable forms of vegetables; it occurs in small masses in the cavities of the cells and tubes, and lines their walls; it secretes not only the cellulose, mineral, and crystalline substances, but woody fibre also; sugar, the fatty and volatile oils, gum, resin, and the colouring matter, are the products of the vital power.

If these chemical statements be established, which is above all essential, they are very remarkable. But the word "cambium" is here evidently employed in so indefinite a manner, that one cannot ascertain what the author understands by it. The soft granular-celled cambium, external to the cells, has, according to the observations of myself and others, always resolved itself into cells, or it was an exuded sap, which did not change into cells. The cambium contained in the cells is of a very different nature; and what is here said about it, requires more accurate determination.

Formation of Cells in the extremities of the Roots; Nægeli, in the 'Linnæa,' vol. xvi, p. 252. The author says, "When at the 'punctum vegetationis,' where the different layers of the root meet as in a focus, the most delicate section is made, and a few cells are isolated by tearing them away, we find among them—1, Cells having one cytoblast; 2, Cells having two; 3, Cells having two cytoblasts with an intermediate partition. This I generally saw when I examined the spongioles of the lily, tulip, and iris, taken while actually in a growing state. I observed in this situation on one occasion a large elongated nucleus, which seemed as though it were undergoing the process of scission; another time, within a cell, two young cells each with a nucleus, which had not attained such a size as to produce a partition by the conjunction of the membranes. From these facts I feel myself justified in stating decidedly, that in the spongioles of these plants the process of growth is as follows: that the parent-cells contain two nuclei, and that each of these nuclei becomes a cell. Unger states generally, that "the common procedure in the formation of elementary organs is the formation of partitions in the cells, i. e. the splitting up of the cells themselves; that the production of new cells in the interior of those already existing is limited to a few cases, and that he was unable to observe the development of cells from nuclei." This is also my experience. I also saw transparent granules in each cell of the root, sometimes surrounded by an areola; but I can distinctly affirm, that true cells never originate from them.

De Cellâ Vitali, scripsit Dr. H. Karsten, Berol. s. a. 1843, 8vo. The author has instituted many accurate researches, not only on the cells of plants, but also of animals. He draws the following results from his inquiries:—1. Every cell originates within a living organism; one cell is never divided into two others by means of longitudinal or oblique partitions, nor by proliferation into two individuals. Experiments on *Phragmotrichum*, *Saccharomyces Cerevisiæ* and *Spirogyra* have shown this.

2. The development of a cell does not depend on the previous formation of a nucleus, but upon a homogeneous fluid.

3. The cell lives, that is, grows, by intussusception; and secretes various substances in its interior by its vital power.

4. The elementary cell (elementarzelle) is composed of a series of cells developed within it; the link, which sometimes intervenes, is a secretion-cell (secretionszelle).

5. The organism consists *potentially* of such a system of cells, of a reproduction-cell (reproductionszelle); and *actually* of a series of cells which are joined together, each of which may again be a reproduction-cell, but never of a single cell.

From the drawings it might be supposed that the author has looked upon the large globules, filled with minute nucleoli, as internal cells.

'Beiträge zur Entwickelungsgeschichte der Pflanzen.' Contributions to the Developmental History of Plants, by Dr. Th. Hartig, Berlin, 1843, 4to. First section, relating to the Formation of Simple Cells, and of the Cuticle of Plants. The author states that a cell consists of three structures differing from each other; of an external layer (Eustathe), which, however, belongs in common to two contiguous cells; of an internal membrane bounding the cavity of the cell (Ptychode); and, lastly, of a substance intermediate between these layers (Astathe). He regards the internal layer as the primitive cell-membrane. In order to distinguish well the three layers, he places thin sections in a very weak solution of iodine in alcohol; then puts them on a plate of glass, allows them to dry, and covers them with a thin slip of glass, allowing a few drops of dilute sulphuric acid to penetrate between the plates of glass. The "Astathe" now swells up, bursts the "Eustathe," and pushes the wrinkled-up internal membrane into the interior of the cell. There follows now an attempt at the developmental history of vegetable cells, of which the author himself says, that "it makes no claim to perfection, and is not without hypotheses." The cell originates in the interior of a parent-cell, and its life may be divided into four stages, the period of growth of the cells, of the consolidation of the cells, of the formation of the alburnum, and of the formation of wood. The "Astathe" is formed in the second period, and shortly after the first layer appears a plastic intervening substance of a different kind, the "Eustathe." The "Ptychodes" of neighbouring cells, as originally simple cell-membranes, are in immediate contact in their earliest youth, and are attached at certain points in a more or less unbroken spiral line. By the secretion and deposition of the "Astathe" and "Eustathe," the original cell-membranes are separated from one another, remaining, however, in connexion at the point of union; when the connexion in the spiral is limited to small circular points, dots and their canals are produced. When the canal of the dot forms a perfect cylinder, it exhibits in a bird's-eye view, a simple circle, a simple dot. When the canal of the dot is closed anteriorly to its mouth, two circles appear, the outer one making the circumference of the dot, the inner showing its constriction beyond the opening. This is the simple areolated dot.

If the spirally-placed dots are much extended, and the points of connexion of the Ptychodes in the spiral, long and narrow, we have the streaked spiral vessels, which are incapable of being unrolled. When the united surfaces are not so long, but broad, the reticular or scalariform vessels are produced. If the uniting surfaces are broad and long at the same time, the simple spiral or annular filament, not capable of being unrolled, is formed, which would be better described by the expression, of a simple membranous fold.

From the dot-canals with a contracted orifice, or, what means the same thing, from dot-canals which become wider at the base, is developed the series of so-called spiral vessels capable of being unrolled, simply in consequence of an unbroken succession of surfaces of union in the spiral, and a contemporaneously increasing expansion in breadth of these surfaces, till they are separated by a line.

The author has illustrated all this with figures. I have given his representation in his own words, and will only refer the reader to Mohl's observations thereon, in Part 15, of the 'Botanische Zeitung' for 1844.

Distinctions between the Membrane of Plants, and the Cuticle of Insects and Crustacea, by Payen, (Compt. rend. 1843, xi, 227.) The chemical differences are as follow:—1st. Sulphuric acid with 1·5 atoms of water dissolves instantaneously the covering of insects, but scarcely attacks the cuticle of plants in several hours. Sulphuric acid with 3 atoms of water destroys (disagrége) the animal tissue in a few hours, whilst the epidermis of plants resists it for more than fourteen days. 2d. Common nitric acid with 4 atoms of water dissolves immediately in the cold about an equal volume of insect integument; while it leaves to vegetable epidermis for more than a month its structure and outward form. 3d. Hydrochloric acid of 21 degrees, or with 6 atoms of water, penetrates in a few minutes the covering of insects, destroys and dissolves it, but acts very slowly on the epidermis of plants. 4th. All these solutions of animal structures, when neutralized by a soluble base, give an abundant precipitate with *tannic acid;* this precipitate, if washed and dried, gives alkaline vapours on calcination; none of these phenomena occur under the same circumstances with the membrane of plants. 5th. When an almost saturated solution of powdered chloride of lime, prepared in the cold, is brought into contact with each of these substances, and then boiled for a few seconds, it destroys and consumes rapidly the tunic of insects, whilst it acts on the epidermis of the *Cactus peruvianus* but slowly, and the cuticle remains longer unaffected than the subjacent cellular substance. An elementary analysis gave the following results:

Cuticle of the shell of the crab .	8·935	per cent. of azote.
Tunic of the silkworm . . .	9·050	,, ,,
Epidermis of potato . . .	2·531	,, ,,
Epidermis of *Cactus peruvianus* (one year old)	2·059	
(two years old)	·906	
Cuticle (cuticule) of ditto . .	2·551	,, ,,

The greater preponderance of azote in the animal kingdom, is also distinctly shown by these valuable researches.

On the Cuticle of Plants, by Hugo Mohl, (Linnæa, B. 16, s. 401.) This is an investigation conducted with the usual accuracy of the author. It is necessary that it should be read throughout, and in connexion, since it would be impossible to give a notice of it which would not be almost as large as the treatise itself. It will be sufficient here to introduce two passages, which will best explain the intention of the writer. When a transverse section of epidermis is treated with iodine, says the author, " in most cases, the walls of the epidermis-cells remain uncoloured; and only in particular cases, as in *Hakea pachyphylla*, do they assume a more or less intense yellow tinge. But on the other hand, in all cases, a thicker or thinner layer, lying on the surface of the epidermis, becomes stained by the iodine of a deep yellow or brown. In the epidermis of the stem of *Kleinia nerii-folia*, as also in *Hoya carnosa*, the internal unstained layer is absent, which is so readily taken for the whole epidermic cells, and the external, dense, iodine-stained membrane is very readily perceived to be composed of several superimposed layers, which are deposited on the external walls of the cells, in the cavities of the cells; and by means of which the continuation of the lateral walls of the epidermis extends to the outer surface, like a continuous membrane. The same phenomenon occurs in the leaves of *Hakea pachyphylla*, in which this inner layer is indeed present, but which takes the stain of iodine like the proper cuticle, and proves itself by its dots to be a (*secundäre substanz*) when the epidermis is treated with sulphuric acid, whilst at the same time a distinct lamination can be traced in the matter deposited in the interior of the cells. What the author here saw satisfactorily, he attempts to demonstrate in other cases which are less certain, and hence seeks to establish as universal what is here said of the cuticle; according to which it proceeds from the epidermic cells, the walls of which next the surface are thickened by the deposit of internal layers.

Herewith we subjoin Some Remarks on the Structure of Dotted Ducts, by Hugo Mohl, (Linnæa, t. xvi, p. 1.) A treatise which is also a pattern of accuracy. The author has made the differences of the dots according to the subjacent parts the subject of his inquiry. With this view he describes the following varieties:

A. The peculiar structure of dotted ducts is developed most completely in those plants in which the walls of the ducts present no differences; they may be in contact with other vessels or with cells, in which case they are furnished in the same proportion with dots, which are surrounded by an areola, e. gr. *Elæagnus acuminata, Clematis Vitalba, Broussonetia papyrifera.*

B. Herein are included the ducts, which have indeed those parts of their parietes that are in contact with prosenchymatous cells studded with dots provided with areolæ, exactly as is the case in those walls which impinge upon another vessel; but in which the influence exercised by the neighbouring cells manifests itself in the more scattered distribution of the dots upon the parietes bordering on the cells. Such ducts occur in *Bixa Orellana, Acacia lophantha, Sophora japonica.*

C. In cases of a more decided dependence of the vessels upon the cells, the walls impinging on other vessels are indeed very thickly covered with dots; but those which are applied to the prosenchymatous cells are provided with very scattered dots, or even, for a considerable part of their extent at least, are altogether destitute of them. The parts adjoining the medullary rays have dots without areola. Such vessels occur in *Sambucus niger, Betula alba,* and others.

D. In cases where the influence of the contiguous cells is still more strongly marked, which then in general possess the form of parenchymatous rather than of prosenchymatous cells, those parietes alone which are in contact with other vessels present dots, surrounded by areolæ; on the other hand, all the parietes adjoining upon cells have numerous and large dots without any areolæ, and are thence identical in form with the dots in parenchymatous cells; e. gr. *Cassyta glabella, Bombax rentandrum, Hernandia ovigera.*

E. A mere modification of this structure, which nevertheless has a very characteristic appearance, is the form in which the parietes contiguous to another vessel look like the steps of a ladder, because the dots are elongated into fissures, which include the whole breadth of the vascular parietes; whilst the walls in contact with cells have large dots without areola; ex. gr. *Chilianthus arboreus, Cynanchum obtusifolium.*

The ducts of which we have hitherto spoken, have smooth walls between the series of dots; but the following have spiral fibres traversing their internal wall. They may be reduced to the following divisions:

F. All the ducts are covered with dots which have an areola; the larger have smooth walls; spiral fibres run between the dots of the smaller ones, *Morus alba, Ulmus campestris, Clematis Vitalba.*

G. All the ducts are closely studded with dots; narrow fibres run between the series of dots, *Hakea oleifolia.*

H. The larger ducts are dotted, the smaller ones are without dots. The walls of both kinds of ducts are occupied on their inner surface by spiral fibres, *Daphne Mezereum* and others.

I. The vascular parietes which are contiguous to other ducts are dotted, those which are contiguous to cells are studded with dots at long intervals, or are entirely destitute of them; both kinds present fibres, *Samara pentandra, Tilia parvifolia,* and many others. To ascertain the actual relations of these dots, the author states that *Cassyta glabella* is especially adapted, since in it they are very large. In this plant we may convince ourselves with the greatest precision, by means of delicate transverse or longitudinal sections, that the areola of the dots proceeds from a hollow, situated between the adjacent walls of the vessels, and that the dot itself is a canal leading from the interior of the vessel towards this cavity, and that it is closed by a delicate membrane at its end. It is somewhat more difficult to recognize this structure in other plants; but it succeeds very well where the dots are not too small. To have, however, a correct idea of the formation of these dots, the treatise itself must be perused. As regards their production, observations are wanting upon these vessels, in relation to different ages of the part wherein they occur. The accurate knowledge of these dots, or so-called pores, which we especially owe to the author, shows to us that we know nothing of them as far as they are concerned in the organization of plants.

On Fibre, by Martin Barry, (Philosophical Transactions for 1842, Part I, p. 89.) The writer observes, "that we may often perceive in the mature blood-corpuscules a flattened filament or fibrilla, which is formed simultaneously with the corpuscule. In mammalia, including man, this filament is frequently annular; sometimes the ring is divided at a definite point, and sometimes has one end overlapping the other. In birds, amphibia, and fishes it is often so long that it appears coiled up. This filament is now generally denominated fibre. I subjected, he continues, to a microscopical inspection the root, stem, petiole, and leaves of plants, as well as different parts of the inflorescence, and in all parts where fibrous tissue existed I discovered the same kind of fibres. When I subsequently examined portions of Ferns, Mosses, Fungi, Lichens, and Marine Algæ, I found the same fibres distributed everywhere. It is known that the spiral form of this fibre occurs in the tissue of plants, but not, as far as is supposed in those of animals. I have, however, found such structures in the nerves, muscles, in the small blood-vessels, and crystalline lens. The greatest correspondence, not only in structure, but also in the manner of reproduction between animal and vegetable fibre, occurs in flax. We see here the same division of fibres into smaller ones, and of these again into others still smaller. We see also the growing together of spiral fibres, so as to constitute a membrane as in the muscles; the hairs of certain plants show the fibres remarkably distinct, as do the hairs of animals; I have found them in the pappus of several Compositæ. When I applied a solution of corrosive sublimate to the spiral fibres of the petiole of the strawberry, I found that after some time the fibres split into two, as happens in those of muscles which split into two and four by spontaneous division. The spiral fibres of plants appear often to intertwine, and by their contact to give rise to the transverse fissures, elliptic pores, and dots."

It is of little use to venture upon a new department with only a disconnected and partial view of the subject. I pass by the consideration of what the flat fibres are in animal tissues; the greater number of observers have not found them; in the vegetable kingdom such occur only in the spiral vessels and spiral cells; in Fungi, Lichens, and Algæ not at all. In flax, the vessels of the bark are unquestionably tubular; spiral vessels form no membrane, not even the commencement of one. Even the hairs of the pappus in the Compositæ consist of prosenchymatous cells. The drawings are very indistinct, and for 600 diameters of magnifying power very small. The author appears, previous to the writing of this paper, not to have employed himself at all with vegetable anatomy, and not even to have known what had been already written upon the subject.

It might be expected that this treatise would excite attention in England. In the 'Annals and Magazine of Natural History,' vol. ix, p. 448, is a paper by Dr. Willshire, 'Remarks on some Parts of Vegetable Structure,' which maintains the well-known bodies in the milk-sap of the Euphorbiæ to be the elementary bodies of the cellular substance, after the analogy of Barry's fibre; for he supposes that we cannot agree that fibre is always the primitive form of development in the vegetable kingdom. Many things indeed support Barry's theory, among which the writer quotes the spiral cells; but yet, not everything. He then speaks of the dottings of vessels, whereupon he confesses that Mohl's meaning was not very evident to him, on account of the foreign language. The whole is not very convincing. It is bad that when any one has said something new, another should forthwith fall upon it without sufficient examination, for the purpose of altering, correcting, or subverting something in it; and that in this manner science should be oppressed with useless materials.

Herewith is connected a paper by Dr. Griffith, Observations on the Formation of the Pitted Tissue of Plants, (Annals and Magazine of Natural History, vol. xi. p. 95). It is directed against the above-stated opinion of Dr. Barry, which derives the pores from the interlacement of the spiral fibres. Dr. Griffith states very correctly, when he is speaking of the vessels with apparent transverse fissures: "In all such pitted vessels, we see traces of a spiral formation or spiral fibres; the vessels admit of being unrolled in a spiral direction, and when we lacerate them, we find the pits like interstices between the projecting teeth of the fibres. The fibres never run in the long axis of the surrounding tube, but always in a spiral direction. Consequently, inasmuch as this is the case, the two fibres which interlace must leave interstices which will be nearly parallel to the axis of the vessel, the pits must also take this direction; but that this is not the case it is hardly necessary to state." The writer then gives his idea of the development of these vessels, by means of the compression of the surrounding cells and vessels. "When," says he, "a spiral vessel is formed in a young plant, the rapid growth of the stem causes a mutual compression of the parts; the convex portions of the surrounding cells or vessels, which are opposed to the spiral vessel, are strongly subjected to pressure, while the intercellular or intervascular spaces suffer a far less degree of compression. The fibre in the interior of a compressed spiral vessel is also inclined inwards, at the part which is in contact with a cell or vessel; opposite to the intercellular and intervascular spaces, i. e. where the inflection of the fibres takes place, these last are firmly adherent to the membrane, which becomes thickened, and united above and below to the fibre. These thickened portions give rise to the line which runs between the series of pittings, the pits themselves are formed by the interstices between the portions of fibres, which are situate opposite to the convexities of the surrounding cells and vessels." Whence comes it, however, that sometimes perfect spiral vessels and such pitted tissue lie close together, amid the same surrounding parts? How happens it that, in these cases, the parts press on one another, whereas, in other cases, where new parts have evidently arisen between the old, no such compression happens? The explanations of the author are far too mechanical. I pass over other statements of his, e. gr. that the appearance of double interlacing fibres arises from the application of powerful reagents; which cannot very well be the case, inasmuch as such reagents would not divide the fibres into others, unless they had previously existed as such, and merely been glued together.

Development of the Cells of Stomates, by D. Karl Nägeli, (Linnæa, b. xvi, s. 237.)

The author made his observations chiefly on *Fritillaria imperialis*, *Lilium tigrinum*, and *Allium Cepa*. In its earliest condition, the epidermis contains small quadrangular cells of uniform size, each occupied by a cytoblast. Whilst the other cells are in progress of growth some individual ones remain small, and increase only in breadth. From the nucleus which adheres to the wall of this parent gland-cell mostly proceed the currents of sap which appear like fibres or rings. Subsequently to this, cells may be observed containing two nuclei; the author, however, did not succeed in observing the mode of their origin, nevertheless he is certain that they do not result from any spontaneous division of the original nuclei. Shortly after the formation of the two nuclei of the cells, a septum appears, which, passing between them, divides the primitive cell into two halves. (?) This septum is nothing more than the membranes of two new individual cells applied to each other. Both these tegumental gland-cells now increase, and their cytoblasts become absorbed; the minutely granular contents are for the most part, collected towards the outer walls of the cells. In the middle, between the two cells, a bubble of gas is secreted, which, becoming larger, causes the production of the stomate. (?) After that there appears a uniform distribution of the contents of the cells, which undergo a conversion into starch and chlorophyll.

To this is subjoined, "The development of the epidermic gland-cells and stomata in *Marchantia polymorpha.*" (p. 241).

Investigations upon the appearance of the air-cells and epidermic glands revealed to the author, in a longitudinal section through the end of the growing frond, the existence of little systems, each consisting of three cells, which were stretched over hollow spaces. These hollow spaces are always separated from one another laterally by a cell; they rest on the parenchyma of the frond, and form the commencement of the air-passages. The central one of these three cells is larger than the rest, and becomes a parent-cell. This parent-cell subdivides itself into a greater or less number of cells, so that a group of cells is produced from it, which lie side by side horizontally, from three to six together, and are also ranged one upon the other vertically from three to six deep. They form conjointly the canal of the stomate, which in favorable circumstances is surrounded by thirty-six cells. When the number of gland-cells appropriate to the particular case have emanated from the parent-cell, they secrete in the centre a bubble of gas, and are thereby separated from each other so as to form an intercellular space. This space is surrounded by cells, and closed equally from the external air as from the air-passages, so that the gas which fills it cannot well have any other origin than in the secretion of the cells forming the sides of the cavity which contains it.

ON THE ASCENT OF THE SAP IN PLANTS;
MORE PARTICULARLY OF ITS MOVEMENT.

'Examen chimique de la Sève de quelques Végétaux', par M. Langlois, (Compt. rend. 1843, 11, 505.) Examination of the Sap of the Vine. It was taken on March 30th, 1843, from a vine in the botanical garden of the Military Hospital at Strasbourg. It was perfectly fluid, without colour or smell, of a slightly acid taste, and reddened tincture of litmus. It contained, according to chemical analysis, free carbonic acid, tartrate of lime, nitrate of potass, alkaline lactates, muriate of ammonia, sulphate of potass, and phosphate of lime. A kilogramme contained about 10 cubic centimeters of carbonic acid, 1·25 grammes of tartrate of lime, ·02 grammes of nitrate of potass, and a very small proportion of the other salts. From a vine which grew in the open air near Strasbourg were obtained afterwards, with difficulty and by degrees, 300 grammes of turbid sap, which restored the blue colour of reddened litmus paper. This sap contained no nitrate of potass, and the ammonia which was obtained by distillation unquestionably arose from the decomposition of the albumen. Examination of the sap of the nut-tree. The sap was collected from the stem at the end of April; it was without colour or smell, transparent, of a sweet and agreeable taste, slightly reddening litmus. It contained free carbonic acid, vegetable albumen, gum, fatty matter, lactates of lime, ammonia, and potass, malate of lime, muriate of ammonia, nitrate of potass; sulphate and phosphate of lime. Examination of the sap of the lime tree. The writer was unable to obtain the sap in the ordinary method; he therefore removed the bark of young twigs, and washed off the cambium with cold distilled water. He obtained a fermentable sugar, analogous to cane sugar, vegetable albumen, gum, several salts, especially muriate of ammonia, and acetate of potass, also free carbonic acid. Biot makes some remarks on these inquiries (ib. page 519), wherein he attempts to show that their discrepancy with his previous observations arose from the collection of the sap having been made at a different period; hence Langlois found no sugar in the sap of the nut tree, which Biot had done. The manner in which Langlois had collected the sap of the lime was by no means the most suitable.

Rainey (Proceedings of the Royal Society, 1842, 432, and also Annals of Natural History, vol. xi, 383) endeavours to prove that the vital power in plants is not the cause of the ascent of the sap. A twig of *Valeriana rubra,* placed in a solution of corrosive sublimate, died from below, and the highest twigs were green and flowering, whilst the lower part was quite dead. The writer concludes from this, that all the water which supplied the upper portions must have traversed without hindrance the dead part below. This is very correct; but might not the fluid in this case ascend, as in capillary tubes, in consequence of the vital processes going on above, somewhat as oil ascends in a wick when it is burning at the top. The sublimate was converted in the dead portions into calomel, chlorine, and water; in the living parts there was no sublimate. The author took thin sections of plants, soaked in a solution of bichloride of mercury, and added to them iodide of potassium. A microscopic examination showed that the insoluble biniodide had only been deposited in the intercellular and intervascular spaces, but not in the cells or vessels themselves. This is a very imperfect method of instituting such researches.

The observations of Rainey on the descending fluids of plants, and especially the cambium, contained in the 'Annals of Natural History,' vol. xi, 383, are related so imperfectly that nothing can be deduced from them.

Researches on the Course of the Sap in the Vessels, by C. L. Honninger, of Tübingen, (Botanische Zeitung, 1843.) A very interesting memoir. The author commenced with the examination of vine shoots in spring, and with a lens saw distinctly, in sections, the ascent of the sap in the vessels, without any air-bubbles, but when these appeared, they were only accidental. In summer he found most of the vessels empty; sap, however, was still present, but only in the most internal parts; the prosenchymatous cells of the wood also were still full of sap. By ferrocyanide of potassium and sulphate of iron he found in the shoots of *Lycium barbarum*, that the most external layers of vessels were for the most part stained blue, the middle ones empty, and the most internal blue throughout. The author has made many further experiments with numerous plants, which he first caused to absorb ferrocyanide of potassium, and of which he afterwards made sections, which he placed in a solution of sulphate of iron, because he found this more convenient and more certain than when he allowed them to imbibe the latter solution, as I myself had formerly done. He also employed much more dilute solutions than I had formerly employed, and very properly; but it must be borne in mind that I purposely selected dry and hard plants for experiment. The results which the author deduces from his inquiries are—1. That in cellular plants without a central series of elongated cells, there is no special organ for the transmission of sap. The author made his observations only on lichens, not on other cellular plants; but with these also I have not been able to succeed. 2. That in all vascular plants the sap is carried upwards solely through the vessels. The grounds for this last proposition are so conclusive, that we may look upon it as a settled question.

The experiments by Boucherie, of impregnating the stems of trees with colouring and conservative matters, of which a Report has already been given in the Summary for 1840,* have been repeated by Mohl, with pyrolignite of iron. (See Botanische Zeitung, 7 Stück.) "I employed," says the author, "for these investigations, the wood of the oak, birch, pine, black pine, and white

* By some quite incomprehensible and careless error of type or transcription, 'Braunkohlentheer,' brown coal-tar stands there in place of pyrolignite of iron; but luckily, "pyrolignite de fer" is added in brackets.

pine, (*Abies pectinata,*) which were saturated with the pyrolignite of iron, by causing the solution to be absorbed by the cut down though still living plant. The birch (the stem of 6 Paris inches in thickness) and the coniferous trees were completely stained; in the oak, only the eight external annual rings were permeated by the solution. The oak and the birch wood had become gray, the pines had assumed a black colour; in the first, especially the medullary rays, and part of the vessels had become dark brown, which arose from the coagulated matters that were present in them. When longitudinal or transverse sections of these woods were placed in a solution of prussiate of potass and a free acid added, the fluid contents of the cells and vessels became of a beautiful blue, as well as the substance of the cellular and vascular membranes, for the evident reason that the iron had penetrated the entire organic substance, and entered into combination with it." It is a matter of astonishment, that in all the French examinations of Boucherie's experiments, not a single accurate microscopical observation occurs. Still, it should be ascertained whether the permeating fluid penetrates directly to the cells, or whether it first takes its course through the vessels. To this end the portions of wood should be examined, after they have lain a very short time in the fluid with which the experiment is made.

Ueber den Milchsaft und seine Bewegung, &c. On the Milk-sap (latex), and its Motions, by Hugo Mohl, (Botanische Zeitung, Nos. 33, 34, 35.) Against the theory of C. H. Schultz. First, of the organisation of the milk-sap. The author has availed himself of microscopical chemistry in his inquiries, which have given quite a different result from those of H. Schultz. If a drop of ether is brought in contact with a drop of milk-sap, the globules of the latter become swollen; they also coalesce, and leave on evaporation a fibrous material. If a drop of ether be agitated with a drop of milk-sap, the milky colour vanishes, and after the evaporation of the ether there remains on the surface of the sap destitute of globules, a membrane which has altogether the properties of caoutchouc. Alcohol, on the other hand, mixes with the milk-sap, and immediately separates from it white films. As regards the motion of the milk-sap, the author believes that observations in dazzling sunshine are deceptive; the motion by daylight he conceives to arise from the escape of the sap from the cut surface. To prove this more accurately, he burnt the leaves of *Chelidonium* at the divided part, and even then observed a motion of the sap in the vessels; but this he ascribes to the pressure to which a leaf must be subjected when it is observed under the microscope. Lastly, of the comparison of the milk-sap with the blood, as a nutritive fluid. The author does not state decidedly whether he regards the motion of the milk-sap vessels, in whatever manner it may be displayed, as a vital action, or one entirely unconnected with vitality. The latter cannot, however, be the case, for then the currents could only flow towards the divided surface, and their wonderful circulation in indeterminate directions could not possibly take place. All that is seen, is what I have caused to be delineated after nature from the calyx of *Chelidonium*, in the 'Ausgewählten Anatom. Botan. Abbild.' A. 2, T. 8, F. 1, where the artist has represented by arrows, exactly as he saw it, the direction of the sap. It is astonishing how various and indefinite are the directions of the currents, so that they could not be derived solely from the escape of a stream, from the place where the sepal had been attached. It is not unusual, in the examination of a longitudinal section of the wood of *Acer platanoides* to find that in one of two vessels the sap is ascending, in the other descending, a fact which chiefly influenced Meyer in his statement of the circulation; a circumstance which does not accord with the escape of the sap in one direction, independently of vital movements. Mohl himself shows in this treatise that the sap possesses motion in plants, where no opening exists to allow of its escape from the surface. He ascribes this to the pressure exercised upon the leaf in microscopic manipulations. But of what sort were the motions? A purely mechanical movement, not the consequence of vital forces, must be very indistinct and momentary. It appears to me beyond doubt that the motion of the sap in plants is a vital action, and I am accustomed with this idea to compare it with the motions of the sap in the cells of *Vallisneria*. I have already circumstantially detailed my opinion on the 'Cyclosis' of H. Schultz, in the former Report for 1841, and also in my 'Vorlesungen über die Kräuterkunde,' p. 129.

Against this memoir the following is directed: 'Strictures on Hugo Mohl's Essay, on the Milk-sap and its Motions,' in the 'Berlin Botanische Zeitung,' 1843, Nos. 33, 34, and 35, by Professor C. H. Schultz, of Berlin, (Flora, 1843, p. 721.) This treatise needs no quotation, since the author merely details his previously published opinions, and endeavours to show that his theory had not been duly comprehended by Mohl. The author having employed many expressions, with which Mohl might have been justly offended, and having moreover sent a very hasty criticism of Mohl's paper to the journal for scientific discussions at Grätz, where Mohl had just been appointed president to the botanical section, a very strongly expressed reclamation by the latter has appeared in the 'Botanische Zeitung,' 1843, p. 48.

A very interesting Essay on the Capillary Activity of the External Integument of certain Plants, by J. J. F. Arendt, of Osnaburgh, appears in the 'Flora,' 1843, No. 10, and is translated in the 'Annales des Sciences naturelles, vol. 19. The property consists in this, that certain plants, by means of their external envelope, draw up the surrounding water on the surface of the stem, and distribute it to the neighbouring parts, the petioles and leaves, from the apices of which the accumulated fluid falls drop by drop. A stalk of *Urtica dioica* was cut off smoothly, above and below, leaving only two leaves on the separated portion; this was placed in water, so that the petioles formed an angle of 30° to 40° with the surface of the water, whilst the stem itself was at right angles. The water passed upwards in the grooves in the upper surface of the petiole, followed the ribs of the leaves, and then dropped from the apex of the leaves. In the *Urtica urens* the process was not so successful; the water expanded over the surface of the leaf, and there disappeared without dropping. A still greater capillary action than that of *Urtica dioica* was observed in *Ballota nigra*, in which the water not only passed upwards in the petiole and the leaf, but also in the grooves of the stem itself. Both plants, viz. *Urtica dioica* and *Ballota nigra*, were exceeded in capillary activity by a syngenesious plant, which the author took to be *Ageratum cœruleum* (probably *Cœlestina ageratoides*), both in rapidity of transmission, and in the amount of the ascending fluid. *Physalis Alkekengi* also exhibited the same capillary power, but for a short time only. *Clinopodium vulgare* and *Betonica stricta* Ait., exhibited a feeble capillarity; in *Galeobdolon luteum*, Smith, the water was rapidly lost in the centre of the lamina; in *Galeopsis ochroleuca*, Lam., the fluid scarcely reached the base of the leaves. "As regards the general explanation of this phenomenon," says the author, "it may be very conveniently derived from the theory of capillary tubes; since the hairs, more or less thickly set, and longer or shorter, curve towards each other, and by being filled with water, inasmuch as the parenchyma of the leaf is not at all, or but slightly hygrometric, approximate more closely to one another, and in these various ways leave extremely small interstices which form as it were narrow tubes, through which the water is drawn up and transmitted." For the cessation of the dropping, the author thinks a very simple reason may be assigned; that from the swelling and expansion of the parenchyma and the inclosing epidermis owing to absorption, all the parts are forced asunder, and the hairs, the medium of capillarity, are separated further from each other, whence follows a failure of capillary power.

With this I will conjoin L. F. Gärtner's Researches on Vegetable Physiology, especially on the Dropping from the Ends of the Leaves of *Calla æthiopica*, L. Pflanzen physiologische Untersuchungen, besonders über das Tropfen aus den Blattspitzen der Calla æthiopica, L., in 'Flora,' 1842, Beibl. 1, 1. After an historical introduction follows an accurate diary of this phenomenon in specimens of *Calla*, which the author had under his eye. He then gives a chemical examination of the distilled fluid, which contains scarcely any solid contents; the residue after evaporation showed principally mucus and hydrochloric acid. Further, with regard to the organization of the leaves, he states, that the vessels are not continued to the end of the awl-shaped prolongation at the apex of the leaf, but that here there is nothing but cellular tissue. The secretion takes place at the extreme end of this prolongation, in a length of 1 to 1·5 m. in a scarcely visible manner, until the fluid has collected into a drop. After the death of the prolongation, the margin of the extreme apex of the leaf itself takes on the same function. The special organ of the exudation of the moisture, seems to be the elongated pores of the cuticle; and the imbibition of the excreted fluid, which is sometimes observed, seems also to be owing to the same. Light has no perceptible influence on the dropping from the leaves. Warmth alone has no special action; though it has when it is combined with immersion in water. The excretion was feeblest in a morning; increased towards noon; was most copious in the afternoon, from two to five p.m., and declined again during the night; but this periodicity is not accurately determined. There can be no doubt that the dropping arises from an excess of fluid beyond that which is requisite for the nourishment of the plant. The dropping ceases with the development of the spathe and organs of reproduction. The necessity of the plant for water was greatest during the night, but especially on the development of the spathe.

A supplement (p. 88) gives a diary of the watery secretions of the leaves of *Canna angustifolia, indica,* and *latifolia*. The secretion of watery fluid takes place in

Canna, not from the apices of the leaves as in *Calla*, but from the apices of the parallel ribs, which terminate at the margin of the leaf; and generally more from those which are nearer the apex of the leaf, than from those which are situated nearer to its base. From these terminations of the principal veins of the leaves, close to the margin, where they lose themselves in a delicate network or anastomose (seldom in the middle of the surface of the leaf), towards evening and at night, imperceptibly exudes a clear watery fluid, which collects in drops and patches on the upper and on the under surface of the lamina; running from it sometimes, but rarely, in a quantity, as copious as from the apex of the *Calla æthiopica*. The temperature of the air stands at least in no near relation to this excretion. It is rather promoted than hindered by the growth of the leaves; but it is quite the reverse when the plant puts forth stalks and flowers. This secretion then generally ceases for ever. With such accuracy as in the present instance a subject in Vegetable Physiology is but seldom investigated.

Neue Beobachtungen über den Holzsaft und dessen Umbildung in Lebenssaft. New Observations on the Wood-sap, and its conversion into Vital-sap, by C. H. Schultz, Professor at Berlin. (Flora, 1842, p. 49.) The author made chemical experiments on the sap of the *Vine*, *Betula alba*, *Acer platanoides*, *Carpinus Betulus*, at different periods of spring. From these inquiries it results that the wood-sap at first contains gum, which is afterwards converted into sugar. This sugar is frequently grape-sugar; and even where cane-sugar is present, as in the maple tree, it is combined with grape-sugar. The gum resembles gum of starch, or dextrine. Of the alteration of the wood-sap into vital-sap, the author states: "It was very interesting to me to find that the gum and the sugar in the serum of the vital-sap, were in the same chemical condition as the gum and the sugar in the wood-sap. In the sap of the birch and of the maple, evaporated to the consistence of a syrup, the addition of caustic alkali produced ammonia."

STEM, ROOT, LEAVES.

An abstract of a larger memoir by Payer, on the Inclination of the Stem to the Light, appears in the 'Comptes rendus,' 1842, ii, p. 1194. When cress is sown upon cloth, and the light thrown upon it from one side, the young growing stalks incline directly to the light, without bending at all. Incurvation takes place when stalks which have hitherto grown in a completely vertical direction, are afterwards exposed to a side light. Neither is it necessary that the rays of light should fall upon the point of incurvation. These remarks are directed against the theories of Dutrochet and De Candolle. Both had invented a mechanical theory, as to how the incurvation of the stem was supposed to happen. They considered, however, only the incurvation of the stem, without remembering that this very frequently does not occur. The author states, that we may lay down as a general rule, that the inflection of the stem towards the light is greater in proportion as the light is less intensive, (intensir) or when it proceeds from below. When the growing seeds were inclosed in a box, which had two openings on the same side, through which the light penetrated, if the intensity of the light entering through both openings was equal, the stems followed the resultant of the two directions; but in other cases, always the more powerful light. If the openings were opposite to each other, and the intensity of the light from each side was equal, the stems did not alter their natural direction; if the lights were unequal, they followed the stronger. In the red, orange, yellow, and green rays, the stems conducted themselves as though in complete darkness; but, on the other hand, inclined themselves to the blue and violet; and, moreover, when these entered from different sides, they inclined more to the violet rays.

The Report on this Essay, by Mirbel, Dutrochet, and by Becquerel who drew it up, is to be found in the 'Comptes rendus,' 1843, i, p. 986. It is in terms of approbation, and even of thanks. They regret that Payer had not made experiments with the non-luminous rays on the margin of the spectrum, and advise him to continue his researches with the coloured rays under other circumstances, for instance, of transpiration, sleep, &c. It might be expected that Dutrochet would not be very much gratified with this report, and this is actually the case, as we find in the 'Comptes rendus,' 1843, i, p. 1120. He is sorry that Payer should have been in haste, to transfer the essay from him (Dutrochet) to Becquerel. This I should have done myself. Dutrochet refers to his own treatise on this subject, speaks of his "expériences exactes," and so forth; but there is nothing beyond this in his paper.

Of the Tendency of Roots to avoid the Light, by Payer, (Compt. rend., 1843, xi, 1043.) In the roots of cabbage and white mustard this tendency is very readily observed, when the seeds of these plants are sown in cotton wool, floating in a glass of water. As the stems incline to the light, so do the roots turn themselves away from it, so that the plant assumes the form of the letter S. There are, however, roots, such as those of *Sedum Telephium*, which, while they do not turn away from a diffused light, (lumière diffuse) do so from one which is direct. On the roots of cress, neither diffuse nor direct light has any influence. But where light does produce an effect upon roots, the angle of inclination is always less in the roots than in the stem. The stronger the light, the greater is the angle of inclination. Only the blue and violet rays of the spectrum (those between F and H) have any influence on the roots. There is, however, a point in the space included by these rays, where the influence appears most intense; this point is different in different plants, but is constant for the stem and root of the same plant.

On the Inclination of the Stem towards the Coloured Rays, by Dutrochet, (Compt. rend., 1843, xi, 1085.) He confirms. in the first place, the observation of Payer, that the red rays have no influence on the inclination of the stem; at least, not on the stem of cress, (*Lepidium sativum*). But he clearly ascertained that the stems of *Alsine media* incline to the red light, and he then found that this was the case with all young plants which have a thinner stem than that of cress. He justly ascribes this difference to the varying degrees of light transmitted through the coloured glasses; and he believes that if the blue and violet glasses were as dark as the red the stems would not incline to the light so transmitted.

Beobachtungen über das sogenannte Ueberwallen der Tannenstöcke. Observations on the so-called "Overgrowth" of the Fir Stump, addressed to Botanists and Foresters, by Professor Goeppert, of Breslau, Bonn, 1842. A small but interesting essay on a remarkable phenomenon in the formation of wood. When for instance a tree, as is usual, is cut down not very far from the ground, the stump occasionally throws out a fresh mass of wood and bark, which foresters call "overgrowth" (Ueberwallen). The author has observed the formation of this ligneous substance with accuracy. "Shortly after the stem has been cut down," says he, "there commences at the usual place, namely, between the wood and the bark, the deposit of a new layer of wood around the whole circumference of the root, and of the lower part of the stump. At first, the bark of the stump covers this new addition, and a long time often elapses before it is perceived; whilst from year to year a new ring of wood and bark is formed, each one reaching a little higher. Finally, on the surface of the stump there appears at its circumference a cylindriform elevation, consisting of young wood and young bark, which has a constant tendency to spread to the centre, and which advances in this direction year by year, till this has been accomplished. If the surface of the stump be uniform, the overgrowth is also uniform. In the opposite circumstances, it traverses all the inequalities of the surface, like a viscid extravasated fluid, so that these are obliterated by a thicker or a thinner deposit. Generally the stump is hollow superiorly; but now the new bark, and with it the new wood, which is always somewhat shorter, and in the form of rods (Stäben), bends inwards and stretches across; closing thereby the orifice of the cavity, and obliterating gradually the funnel-shaped hollow in the centre, so that it forms at last a complete convex covering, almost like a cupola over the old surface, and which is constantly rising with the longer continuance of growth. This overgrowth has been observed only in some firs, most frequently in *Abies pectinata;* more rarely in the common fir (*Picea excelsa*); very seldom in the common pine (*Pinus sylvestris*); and only once in a variety (*Pinus pumilio*), nearly related to the *Krummholzfichte* (*Pinus humilis?*) This observation shows distinctly that wood and bark under proper circumstances can grow in all directions.

On this subject an essay occurs in the 'Preussischen Provinzial-Blätter,' new series, 1843, 1, by E. Meyer. Since the growth of a tree is dependent on the descending fluids of the bark, the author believes that here the growth depends on some other tree, the roots of which have inosculated with the roots of the stump.

H. Mohl, in the 'Botanische Zeitung,' 1843, p. 13, agrees on the whole in this opinion, and only makes a few remarks. He had often observed the overgrowth in the white fir (*Abies pectinata*), and this tree must have the as yet inexplicable power of reversing the flow of the cambium, and causing it to ascend, when otherwise it commonly descends. He adds, that it not unfrequently happens that fir trees become forked; and when one stem was cut off one or two feet above the bifurcation, he remarked that the resulting stump, destitute of all leaf-bearing twigs, vegetated and deposited new layers of wood, in the case of the white fir; but that this did not take place in the red fir. The white fir also transmits the cambium upwards to the leafless stem much more readily than the red fir.

Recherches sur la croissance du Pin sylvestre dans le Nord de l'Europe, par A. Bravais and Ch. Martius; from 'Mémoires de l'Académie Royale de Bruxelles,' vol. xv, printed separately. When the writers were staying at Kaafiord, in Finmark, between 69° 57′ N.L.. and 20° 40′ E.L., they were struck by the thinness of the layers of wood in the pine stems which were cut down. They measured them in several trees, and undertook to compare them with similar observations in other places. This they did at Pello (66° 48′ N.L., 21° 40′ E.L.), a village on the banks of the Torneo river, where Maupertuis commenced his triangulation; at Gefle, in Sweden (60° 40′ N.L., 14° 50′ E.L.); at Halle (51° 30′ N.L., 9° 40′ E.L.), where they examined the stumps in the low valley of Giebichenstein; and, lastly, at Haguenau, on the Lower Rhine (48° 43′ N.L., 5° 27′ E.L.), where an intelligent forester, Herr Millott, was making similar observations. From these measurements tables are given, according to the age of the tree, and the thickness of the layers calculated in decimals. From these tables, again, the average thickness of a layer is determined, and annexed to the table. To survey the progress of growth more readily, curves are drawn, derived from the five places where the observations were made, whose ordinates correspond to every ten years of age, and their abscissæ to centimeters in increase of thickness of the stem. From these we find that the trees in warmer places increase much more quickly in thickness; the curve for Haguenau approaches almost to a straight line. For these curves the following equation may be assumed, $r = \frac{an}{1-bn}$ where r represents the (average) diameter of the tree, n the number of years; a is a constant quantity for each individual curve, but varying for the other curves. From a comparison of the formula with their observations, the writers find that the coefficient a nearly coincides with half the mean diameter of the woody layer of the first year. It is more difficult to determine the value of the coefficient b. It does not correspond to the climate; we must rather suppose that it depends on the soil. If we take the mean of the ascertained values of b, (for since it is the only unknown quantity in the formula, it is easily calculated,) we have $b = \cdot 005$. The differences of the ascertained mean thickness of the layers from those hereby calculated, are given in the table, and many researches instituted upon them. We must thank the author for these laborious observations, and for his valuable investigations; they indicate the fundamental principles which run through the various phases of nature. There are, moreover, some detached observations. The stems of pines are seldom perfectly symmetrical around the centre, as may also be remarked in other trees; in the case of greatest eccentricity, the smaller diameter was to the greater in the ratio of 9 : 19. The separation between the alburnum and the perfect wood is more distinctly marked in the stems of northern trees than in those of the temperate zone.

Some observations are made on the upward growth of trees. Trees form, in their upward growth, a cone; and it follows, from the observations, that the external surface of the layers of the tree always preserves the same angle of inclination to the axis of the stem. The pines of Norway are often forked, and this occurs when the apex of the tree is broken off, either by storm, or by the heathcock, which sits on the summit of the tree; and also it would seem when the *Tortrix buoliana*, Fabr., and *Tortrix turioniana* destroy the apex. Two opposite branches of the stem then grow independently, and thus in progress of development form a fork. As regards the geographical remarks, it must be borne in mind, that there are different species of pines approaching very nearly to *Pinus sylvestris*, and which are often confounded together. This renders the statements of the author very doubtful, on whose description we have to rely. In my essay on the Abietinæ 'Linnæa,' vol. xv, I have detailed the varieties, or rather species of *Pinus sylvestris*.

Observations on the Growth of Plants, by P. Hartingh, (Tydschrift voor natuurlyke geschiedeniss en Physiologie, t. ix, p. 296.) An accurate and elaborate treatise. The author states that, "he selected the hop (*Humulus lupulus*) for the subject of his investigations, for a threefold reason: 1st, on account of its rapid growth; 2dly, on account of the form of the terminal bud (gemma terminalis), which allows of the measurement of the length of the stem to a great nicety, viz., to half a millimetre; and, 3dly, on account of the lateness of its flowering, so that observations on its growth may be carried on during at least five months; to which may be added that the stem is divided into well-marked internodes. The observations themselves are arranged in tables, with circumstantial details, and with reference to meteorological conditions." We here give the results:

1. It is only the two or three uppermost internodes which increase in length: all the rest undergo no further growth, not even when by breaking off the terminal bud the formation of new internodes is prevented.

2. The influence of the terminal bud on the elongation of the stem, is confined solely to the formation of new internodes.

3. Each internode increases chiefly by its lower end.

4. The growth of distinct stems of one and the same

plant, although exposed to perfectly similar external influences, is not only not similar, but we can perceive no regular proportion in their daily elongation.

5. There occurs at the commencement of the growth, a daily increasing acceleration in its rate, which is independent of external influences: this acceleration attains its maximum about the beginning of June, and there then commences a daily increasing diminution of growth, which is particularly observable on the appearance of the flower buds: after the development of the flowers the growth diminishes more and more, and ceases altogether at the period of fructification.

6. If the twenty-four hours of the day, from seven in the morning to seven the next morning, be divided into three equal portions of time, the growth in the early period, during the eight hours from 7 a.m. to 3 p.m. exceeds the sum of the growth of the two other periods; but as the stem becomes longer, the growth increases during the latter, and diminishes during the former interval, so that ultimately at the commencement of June, the time of greatest growth falls in the second period, from 3 to 11 p.m.*

7. Of all external influences, that of the atmospheric temperature is by far the most marked upon growth. Other things being equal, the warmth of the air keeps pace with the growth, yet in such a manner, that the temperature promotes the growth not immediately, but mediately. At first the most rapid growth coincides with the highest temperature of the day; but as the stalk becomes longer, and the nutritive fluids have to travel a longer distance to the point of growth, the growth is constantly later and later after the period of warmth.

8. The influence of the atmospheric temperature stands in a definite ratio to the growth; so that for each degree of temperature a definite elongation of the stem occurs, and the quotient of the daily growth divided by

* By an error of the press it stands from 7 to 4.

the mean daily temperature, expresses the gross increase for each degree on that day.

9. By the comparison of the thus computed gross daily growth, it approaches to a certainty, that at least in the months of May and June, the true rate of growth forms an arithmetic series, whose difference shows the daily acceleration, and at a later time of year the daily retardation of growth. By means of the series of real growth, compared with the series of gross growth, we obtain a means of calculating what proportion, positive or negative, the other influences, beside atmospheric temperature, have on the growth. If we call the known temperature of the air, on a certain day t, and the growth on the same day a, and we wish to know the amount of the probable growth A, in a space of time, a certain number of days subsequent to the first-mentioned day, which number is expressed by d, and the mean temperature of which is t, it may be found by the formula $A = t\ (\frac{a}{t} \pm dr)$, where r expresses the daily increase of growth.

10. The acceleration of growth with the increase of atmospheric temperature is not, however, unlimited: there is a temperature which is the most propitious to the growth of plants, so that every higher degree of warmth, in place of acceleration, produces retardation. This temperature is for the hop about 20° Centigrade; but it appears that the point rises with a moist atmosphere, and sinks with a dry one.

11. The influence of the temperature of the root on the growth of the stem is not perceptible.

12. A dry atmosphere apparently contributes more to growth, in general than a moist one. It appears, however, that both a very dry and a very moist state of the atmosphere act injuriously upon growth.

13. Increased atmospheric pressure seems generally to have a favorable effect on growth.

14. On the influence of wind or a calm atmosphere, the observations afford no certain data.

15. Rain in any considerable quantity always diminishes the growth of the hop.

Observations on the Growth of different Parts of Plants, by F. Münter, (Botanische Zeitung, 1843, 5-8st). The author, who had previously been commendably engaged on this subject, (see Report for 1841, Archives for 1842, p. 121,) proceeds in the same inquiry. First, of the progress of growth of several contiguous internodes. The observations were made upon *Dahlia variabilis*. The law given in the former treatise for the growth of *Phaseolus* is confirmed. The author adds, that it is very surprising that the terminal internode does not absolutely present the greatest length, although it is almost always growing for the longest period. More internodes are continually being developed, the highest however grow the most; and in plants of a year old, as in branches, one portion as regards growth is at a standstill, while those which are above it are in full activity. The lower internodes exceed the succeeding ones in length; this is true, however, only of the internodes situated *above* the middle of the branch, or of the entire plant, since the internodes of the bud-scales, or of the cotyledons up to the middle (of the branch) are in exactly reversed conditions as regards length, i. e. they form a series gradually increasing in length, the others one, gradually decreasing. As regards the relation between internode and leaf, the author found that the development of the internode was not at all dependent on the leaf. Here follows a table on the development of the pinnate frond of *Aspidium molle*. The results are:

1. The petiole of the frond, and its prolongation as midrib, grow like the internode or the stem of dicotyledonous plants.

2. The pinnæ grow like the leaves of dicotyledons, and many monocotyledons; i. e. they cease to grow at the base and the apex sooner than in the middle.

3. The pinnulæ proceed like the lateral ribs of a simple leaf. The periphery, and thus also the apex, cease to grow

sooner than the base. The author thinks that this may confirm my statement, that the frond represents a plant by itself. This, however, I have never affirmed; but only that the frond of the Epiphyllosperms and some other Ferns, was a combination of leaf and flower stalk, as is distinctly seen: but combination is not mere growing together, as has been attributed to me.

On the growth of leaves in monocotyledons, the author has made observations on *Calla palustris* and *Arum viviparum*, and he incidentally corrects an error concerning the leaves of *Sagittaria sagittifolia*, in his dissertation, (Linnæa xv, p. 228), where it was said, "mediæ partes primum desunt crescere," &c. According to the present observations it is said, both with respect to duration, as well as to considerations of length which arise subsequent to its cessation, that the upper parts of the petiole, and the lower parts of the midrib exceed all the rest; also, that the maximum of duration and of length lies at the point of union of the leaf with the petiole, whilst the minimum occurs at the base of the petiole, and the apex of the leaf; from the maximum to the minimum the transition is gradual. On the growth of the leaves of dicotyledons he establishes what he had formerly found in the leaves of *Phaseolus;* namely, that—

1. The leaves expand in all their parts.
2. At different times, the portions thus produced, though originally of equal length, acquire different lengths.
3. That they cease to grow first at the apex, next at the periphery, and finally, at the base; whence it follows that cessation of growth is concentric.
4. The petioles, on the contrary, cease to grow, universally, in a centrifugal direction. There are some incidental remarks on the action of light on leaves; whence, it appears, that the attraction of light elongates the petiole, whilst the leaf itself does not advance equally. On the growth of the peduncle. In the "pedunculus communis," it is observed, that at first, the growth proceeds uniformly in every portion, and afterwards, while it advances more

vigorously in an upward direction, that it ceases gradually in the inferior portions. The pedicles are developed in the same manner as the common peduncle.

In the 'Botanische Zeitung,' Nos. 44-7, Dr. Münter furnishes his Third Contribution to the Knowledge of the Growth of Plants. In the first place, the author makes some remarks on the before-mentioned treatise of Hartingh, the results of which were translated in the 6th No. of the 'Botanische Zeitung.' He declares himself, especially against the third law laid down by Hartingh, viz., that each internode grows principally at its inferior extremity, and asserts that it is entirely opposed to his experience. As I was myself also convinced of the contrary by some observations of my own, I perused repeatedly the passage in question in Hartingh's memoir, but found no evident proof of this result. Then follow some observations on the growth of the internodes. It appeared, from observations on *Acer-Pseudo-Platanus*, *Vitis vinifera* and *Sambucus nigra*, that the extension of the internode, at first, goes on in every part of it, then, that the cessation of growth commences at the base, whilst the other portions of the internode continue to elongate, and that the stoppage of the extension gradually advancing upwards, finally reaches the uppermost portions. When the growth is disturbed, as, for instance, by a strong light, it may happen that the inferior portion of the internode appears to grow more than the upper, but the latter makes up for this by the longer continuance of its growth. Lastly, the author adduces observations on the growth of the leaves, of *Corylus Avellana*, *Vitis vinifera*, and *Ampelopsis quinquefolia*, from which it appears that the petiole in its growth, belongs to that system of vegetable organs whose growth ceases in a centrifugal direction, whilst the midrib and the lateral ribs, either of a simple leaf as in *Corylus*, or of a simple five-lobed leaf as in *Vitis*, cease to grow centripetally, as is the case also in the distinctly projecting lateral lobes of *Ampelopsis quinquefolia*. Observations on *Fraxinus excelsior* and *Rhus typhinum*, showed that as far as the midrib of a pinnate leaf extends, it follows a centrifugally ceasing direction of growth, and that as far as the terminal leaf reaches, that as well as the lateral leaflets, elongate themselves, according to the centripetally ceasing mode of growth. It appears, also, that the elongation of the lateral leaflet still continues quite independently of the midrib, at a time when the midrib has already ceased to grow at the point of insertion of the lateral leaflet. The secondary ribs of compound pinnate leaves, as those of *Acacia lophantha* likewise exhibit that mode of growth which ceases centrifugally.

An important paper occurs in these Archives for 1843 p. 267 : 'Observations on the Growth of the Organs of Plants, with regard to their Methodical Arrangement, by A. Grisebach. I shall only detail the conclusions which it contains, as it appears strange to me to review circumstantially another paper appearing in the same journal. The author refers first to an instrument by which a scale of divisional lines can be impressed on the plant, and which he calls "Auxanometer." His measurements show the following results: in certain plants the development of the stem-internode divides itself into four periods, which are normally distinct from each other. This division is authorized for example by observations on different Caryophylleæ. These periods are:

1. The stalk elongates itself equally through its whole extent. Period of uniform elongation (Incrementum continuum æquale).

2. The divisions of the scale increase towards the lower part of the internode; the growth is therefore greater in the lower than in the upper part. There is, in this case, no defined limit between the growing and the inactive portions. If we regard the terminal bud as the centre of vegetation of the stem, we may designate this period, "Incrementum continuum centrifugum."

3. The divisions of the scale increase towards the apex

of the internode, so that the upper parts first equal the development of the lower, and afterwards exceed them in length. The growth is, therefore, more vigorous in the upper than the lower part. This is the period of centripetal elongation. (Incrementum continuum centripetum).

4. A piece is intercalated between one of the two, generally between the lower node and the scale. This happens, however, although all the four modes of development are exhibited in the same plant, chiefly whilst the second or third period is still going on within the scale. Sometimes the periodicity is very exact, particularly if the fourth period follow immediately upon the first, as in *Polygonum orientale*. Period of intercalary growth (Incrementum intercalare). Uniform growth alone occurs in all families, as in *Azalea pontica*, *Scabiosa atropurpurea;* as also the form of development where the second stage is wanting, as in *Lupinus versicolor*, *Rosa centifolia;* the form of development where the first stage follows the second, and the second the third, may undoubtedly be observed in the Umbelliferæ, Caryophylleæ, Synanthereæ, and Cucurbitaceæ. Intercalary growth together with an unequal growth occurs in *Astrantia;* intercalary growth at the base of the stem internode, succeeding the uniform growth, and exhibited in a more marked degree, is met with in *Polygonum orientale*.

Lastly, on growth with reference to the cells he makes only a few observations. The author believes from other observations, that he is justified in concluding that the stage of unequal growth depends only on enlargement of the cells.

The Reporter has not been able to observe the uniform growth; it was always more or less centrifugal, as he would rather describe it, than by the author's term centripetal. The intercalary growth seems to him not to belong to this subject.

On the Growth of the Peduncle of *Littæa geminiflora*, some remarks are made by H. Gräfe, of Nymphenburg, in the 'Flora' for 1843, p. 35. The growth was very unequal on different days. The temperature to which the plant was exposed is not mentioned.

Although Morphology is not specially a subject of this year's Report, I will briefly refer to a few essays on that department of science.

Professor Wydler in Bern, on the Ramification of Caryophylleæ, in the 'Botanische Zeitung,' 1843, p. 13. The branches are situated, as we know, alternately in the angles of the opposite leaves, the uppermost pair of leaves excepted, where the branches likewise are opposite. The author, however, remarked opposite branches also in *Cerastium arvense, Stellaria graminea, Spergula nodosa,* but one of them was always more diminutive than the other. Also in the Caryophylleæ, the branch connected with the first is always less developed, but that of the second bract (vorblatt) is the stronger and more ramified. The author adds that though these may be the external appearances, their intimate nature remains a secret to us, but that it might be possible to discover it if we were to regard the plant, not as a complete, but as a progressive object. All physiologists have done this, and I know of none but descriptive botanists who regard the plant as complete, and are able to view it only in that light. The cause does not lie here, but in that we do not take into view the whole vegetable kingdom, and consider in all its extent the effort of nature to advance from the more diffuse vegetable life, to the more collected, concentrated animal life, and thus to consciousness.

The same writer on Accessory Branches, (Botanische Zeitung, 1843, p. 14.) The writer first remarks that the accessory branch situated nearest to the normal branch has its origin not from the principal axis but from the normal branch. "The arrangement," he continues, "of the accessory branches, as is known, is serial; but their direct growth continues only for a time. In the course of successive evolution they change their original situation, they are turned alternately right and left, and this is determined by the direction of the normal branch, which also inclines alternately to the right and left. This varying direction of the secondary branches springing from each other, stands in the closest relation with the direction of the spire of their leaves." The secondary branches have usually no radical leaves, which were, however, found by the author to exist in *Aristolochia Sipho*. In general, moreover, the secondary branches situate nearest to the normal branch, are the most perfectly formed. To this, however, there are exceptions in cases where a secondary leaf-branch (laubzwëig) is interposed among the blossoms, as was observed by the author in *Manulea oppositifolia*. Finally, is given a list of the plants having secondary branches, which were observed by the author.

Since Schimper a great deal has been written upon the position of the leaves and bracts on the stem and peduncle, although but few mathematical researches have appeared upon this subject, which is one well adapted to such inquiries. A natural philosopher of considerable merit in the department of mathematical crystallography, Herr Naumann, has just published an essay 'On the Quincunx as the fundamental basis of the arrangement of Leaves, in the Vegetable Kingdom,' (Ueber den Quincunx als Grundgesetz der Blattstellung im Pflanzenreiche, in Poggendorf. Annal. d. Physik. u. Chemie, 2 Reihe, b. 26, 1842, s. 1.) On this subject the author first adverts to the regular arrangement of the scars in fossil plants, the species of Lepidodendron and Sigillaria. He does not profess to be a botanist, and is also acquainted only with what Carl Schimper and Alex. Braun have done in this matter, and consequently gives only some general remarks, which are, however, of importance. Although it is true that nature, in organic bodies does not work accurately by square and compass, still probably her forms have always a geometrical basis. For the rest, no abridgment can be made of a paper of this nature, in which the subjects are arranged accurately and alphabetically, though the principal statements may be given.

"A quincunxial arrangement," says the author, "is always found where parallel series or rows (or also series radiating from a common point, and inclined at the same angle) of equidistant points are formed in such a manner, that the points of each individual series do not correspond with those of the neighbouring series, but are opposed to a defined part of the space intervening between two points. If we make the distance between the points of each series $= a$, the distance or interval of the individual parallel series $= b$, and if $\frac{n}{m}$ is a fraction whose numerator may at the farthest be half as great as the denominator, then the quincunx will be constituted from this, that all the points of the second series are removed from a direct parallelism with those of the first series by $\frac{n}{m} a$."

The author treats first of the quincunx of parallel series. The whole arrangement in this case will have completed a cycle in m series; and hence the numerator of the fraction $\frac{n}{m}$ is to be regarded as the proper cyclical number of the quincunx. To determine the oblique lines which Schimper called spirals (wendel), and which our author terms "Strophes," he draws two right-angled coordinates through a figure, which represents the superficies of a cylinder, with the quincunx projected on a plane. One side of the ordinates may be called the positive, the other the negative. If now we join any point in the line of the ordinates with the nearest point of the neighbouring series, $\frac{n}{m} a$, we obtain a line, by the production of which a complete series of points is constituted, and we have also a complete system of similar series parallel to each other. These series are the first and most important Strophes. The author calls them Archistrophes, and distinguishes them as first, second, and third Archistrophe, &c. If we now draw straight lines from the points of origin of the coordinates to all the points of the Archistrophes, we get the secondary Strophes, and the author calls the Strophes described through the points of the second Archistrophe, Protostrophes, as also those through the points of the third Archistrophe, Deuterostrophes, &c. They are also designated, according to the number of the point in each Archistrophe, Strophes of the first, second, third order, and so forth. The ordinal number of each Archistrophe, towards which any secondary strophe runs, when diminished by 1, thus determines the class, and the ordinal number the point in such Archistrophe points out the order of of the strophe. The author calls this the distinguishing point of the strophe, and if its coordinates x and y are represented in general by α and β, it readily follows that the pth point of the $(q-1)$th Archistrope will be determined by the coordinates, $\alpha = \frac{pn-qm}{m}\, a$, and $\beta = pb$.

These two equations form the groundwork of the investigation of quincunxes of parallel series. The application and further developement of them must be studied in the author himself. In the second division he treats of the circular or concentric quincunx, where, namely, the leaves or similar parts stand on a spherical disc, which, however, occurs but seldom in the vegetable kingdom.

I have (in my Grundlehre der Kräuterkunde, 2d edit., part i, pp. 446-47 et seq.) given a mathematical statement of the matter, which seems to me very simple, and which rests on the fact that leaves or bracts are drawn out into a spiral line from their circular position. To determine this change of position I have taken the angle at which the secondary series are inclined to a directly ascending primary series. Thus, from the angular distances of the whorls or strophes from the principal line, we may determine the number of revolutions which are made by the leaves or bracts, between any given leaf or bract and that which is situated in a straight line above it. This calculation has here, principally, only a general application to different cases; the enumeration and measurement must be made upon the plant itself, since organic digressions from the fundamental form do not admit of accurate measurement.

Remarks on certain opposite Leaves, which by Coherence become alternate, by Ad. Steinheil, (Annal. des Sciences Naturelles, 2d series, vol. xix, p. 321.) Ch. Bonnet first observed the coherence of two leaves, and after him De Candolle. The author observed such a monstrosity some time ago in *Salvia verbenaca,* and more recently in *Eucalyptus pulverulenta, Betonica stricta,* and *Urtica dioica.* The five-stem leaves of *Betonica* were alternate and in two rows; the lowest leaf was simple, the next three bifurcated, the fifth again simple; the leaves below the first whorl, however, were again opposite. The author applies these observations of monstrosity to morphology, as he had already previously done in an essay in the 'Annales' for 1835. He distinguishes between leaves which are alternate by means of coalescence, or by means of disunion (par la soudure ou par la dissociation); among those of the first form he has, in the treatise referred to, placed the leaves of *Epheus,* where the stem-leaves are always coherent. The leaves which are alternate (par dissociation) can be thus distinguished, that the lowest leaves indeed are opposite, but from the third leaf onwards their position becomes somewhat irregular, and that one leaf develops itself earlier than the other. The author allows that the distinction is not unfrequently difficult.

Observations on the Origin and Purpose of Stipules, by E. Regel, (Linnæa b. 17, p. 193.) The author employs this expression in a very peculiar sense, as will appear at once from the following: he sets forth twelve propositions, with which he premises the more circumstantial inquiry, and of which we will give the substance.

1. All leaf-like organs of phanerogamous plants divide into two widely distinct classes, viz. into the stipule, and the leaf-form.

2. The stipular form of leaf envelopes by growing over it from its base the whole of the papillary summit of the axis rising from the centre of the bud, presenting in the simplest forms a uniformly simple stipular sheath. The envelopment of the summit of the stem by these means, however, is never complete.

3. The perfect forms of stipules are produced, when, in the stipular sheath which grows over the summit of the axis, two, four, and occasionally even more longitudinal fissures are formed in place of one, whereby naturally a corresponding number of stipule leaflets are constituted.

4. Since the stipules grow from the base of the summit of the axis (Achsenspitze) they receive their vessels direct from the stem.

5. In all cases the stipules serve for an envelope of the summit of the axis, which grows under their protection.

6. In all parts where new portions are added to a plant, that is first to appear which constitutes the axis of the new individual, which is next covered over by the growth of one or more stipule sheaths. All organs in the vegetable world destined for envelopment belong not to the leaf but to the stipule system. To this belong the sheaths of buds with a few exceptions; the envelopes of the ovum, the cotyledons and the pericarp.

7. The stipules are, for this reason, to be so far regarded as a formation preceding the growth of leaves, inasmuch as in newly-developing individuals they are antecedent to the origin of the leaves.

8. With regard to the stipules and leaves belonging to one node, we find a double distinction, since in the first case the circle of the stipules is higher, and in the other lower than the leaf.

9. The stipules, which are situated internally, protect the growth of the succeeding node and leaf. At the time when the leaf of the next node begins to be developed from the summit of the axis, these stipules still constitute a complete envelope to the latter, so that the formation of the leaf proceeds entirely under their protection. On the other hand, the leaf of the same node, at whose inner base they stand, is developed a little earlier, or contemporaneously.

10. The production of the externally situated stipules again, precedes the development of the leaf of the same node.

11. As the stipules are restricted to the protection of a definite part, they can also have no axillary buds; only in those cases where no actual leaves exist is an axillary bud to be found at the base of the stipule.

12. The true leaf grows excentrically from one side of the base of the summit of the axis.

I have stated these propositions in the author's own words, only curtailing them here and there. I cannot perceive what justifies him in his strangely-conceived idea of stipules; nor, indeed, how any one can bring into the same class stipules, cotyledons, pericarps, sheaths, and leaflets. The summit of the axis in dicotyledons is always surrounded with rudimentary leaves, often in great numbers, which are afterwards developed into true leaves, besides this there is no other envelope.

INFLORESCENCE, FLOWERS, FRUCTIFICATION, FRUIT.

WHAT has appeared during the past year upon inflorescence and flowers belongs wholly to Morphology, which, as already stated, is not an especial object of consideration in this year's Report. However we will here give a short sketch of a few important papers.

On the Dichotomous Branching of the Flower-axis (cymose inflorescence) of Dicotyledonous Plants, by H. Wydler, professor at Berne, (Linnæa, part xvii, p. 113.) The author states that he has compared the observations of Schimper with those of Bravais, and thus conceived a series of propositions which he here communicates. We shall, in what follows, pay regard only to that which is less generally known.

As in the case of opposite stem leaves, a succession in their appearance is demonstrable, so is it also in opposite bracts; and consequently a first (lower) and a second (upper) bract are always to be assumed. The so-called opposite bracts are seldom really opposite, and seldom make with one another an angle of 180°; they commonly form between them two different divergents, of which the greater divergent is most frequently directed forwards towards the parent leaf of the flower stem, whilst the smaller inclines backwards towards the primitive axis of the branch. With the bracts commences the spiral series of leaves which extend along the flower stalk, and which includes the calyx, as the first whorl (cyclus) of the flower. Most frequently the calyx of dicotyledons presents $\frac{3}{5}$, $\frac{1}{2}$, $\frac{2}{3}$, as the fraction indicating the position of the leaves; the first case is most common, the last the least so. The spire of the calyx, which succeeds to the bracts, may, in respect of its position between the axis and the parent leaf, be stated to wind either in a backward or forward direction. In the former and more frequent case, the calyx being of five segments, the first sepal towards the front comes to stand somewhat to the right or left above the parent leaf (mutterblatt); the second odd one, situate in the middle, has, on the other hand, an inclination backwards towards the primitive axis. The relation of situation may be expressed by the formula $\frac{3}{2}$ ($\frac{\cdot}{\cdot\,\cdot}$). The axes of bracts are either fertile or sterile. In the former case a branch proceeds from the axil of each bract; if the branches advance equally the ramification acquires a forked appearance (cyma triflora of the author). If the same mode of branching is repeated many times from the bracts of the lateral branches, there is produced a dichotomous ramification, which continues to advance on each side, this is termed by Schimper a "dichasium;" and in it are to be distinguished axes (branches) and also bracts, of the second, third, &c., order. The remarkable law of all the branches springing from the axils of two bracts of the same order, is continued in the symmetrical opposition in the direction of the leaf (calyx) spiral, which always obtains in them, that is to say, the two branches are antidromous to each other. For instance, if the direction of the spiral in the one branch is to the right, it proceeds to the left in the other. Besides, in the two branches, the leaf-spiral of the one follows the same direction as the primary axis (the central flower branch), and that of the other is opposed to it. The author then proceeds to distinguish on the "dichasium" a superior and an inferior branch, and assigns the various relations of the position of the leaves, according as it coincides with the primary axis (homodromous branch), or is opposed to it (antidromous branch). If the homodromous branches of a "dichasium" are perfected, it is termed by Schimper a "screw," (Schraubel) (bostryx), and if only the antidromous branches are completed he calls it a "fan" (Wedel) (cincinnus cicinus). The author afterwards goes through the various natural orders which he has examined with reference to this inflorescence. We must express our obligations to him for the lucid review he has given of the obscurely expressed essays of Schimper and Bravais. Although the leaf-spiral may not be of the importance some morphologists ascribe to it, yet researches with regard to it are necessary to a complete knowledge of plants.

Examen Organographique des Nectaires par M. L. Bravais, (Ann. des Sc. Nat., t. xviii, p. 152.) Linnæus designated as nectaries those parts of the flower which secrete a sweet fluid; but he not only included many parts in which no such secretion can be perceived, but also described as nectaries whatsoever was neither calyx, flower, stamen, pistil, nor ovary. Science is in want of an expression, says the author, to distinguish a portion of the male apparatus (androceums) or even a circle of parts, which may or may not secrete a nectareous fluid. Most of the expressions employed do not answer their purpose. In the absence of better the author chooses the terms nectary and disc; the first according to the Linnæan definition, the second in the case where the nectaries form a circle, or ring (Wirtel). Then follow the divisions of the nectaries, and in fact according to the situations where they occur.

1. Calyx-nectaries. To this division belong the glands of the calyx in many Malpighiaceæ, some Euphorbiaceæ, the spur on *Impatiens Balsamina*, also the nectary which occurs at the base and within the sepals of the Malvaceæ, as in many kinds of *Malva*, in *Lavatera trimestris*, &c. It forms a whitish and rough swelling (bourrelet).

2. Hypopetalous nectaries. Only one example is known to the author; externally, and at the base of the flower of *Chironia decussata* is found a yellow, notched ring, which produces honey.

3. Corolla-nectaries. They occur in most flowers, es-

pecially in the lower portions of the petals, in the form of pits, channels, spurs, &c.

4. Hypostaminal nectaries (Hypostemone Nektarien), between the corolla and the stamens. The author observed them in sixteen natural orders: Capparideæ, Resedaceæ, Hippocastaneæ, Ampelideæ, Geraniaceæ, Oxalideæ, Sapindaceæ, Terebinthaceæ, Passifloreæ, where they constitute numerous filaments and cavities secreting honey; Loaseæ (in which I have called them 'Parastaminal,') Cucurbitaceæ, Asclepiadeæ, the corona of which they form (which I have named Paracorolla).

5. Staminal nectaries. The author describes here many such: e. gr. in a double Columbine, in the Violet, *Fumaria, Corydalis, Dianella,* the Laurineæ, *Vinca, Phaseolus, Alsine media.*

6. Nectaries inserted between the stamens, as in *Melianthus major* and *minor, Tropæolum,* several Cruciferæ, *Sibbaldia procumbens.*

7. Discs between the stamens and the ovary (the Perigynium of Link). Very frequent; occurring in almost one half of Dicotyledons.

8. Pistil-nectaries. Rare, in a few Euphorbiaceæ. Linnæus referred to this division the three glands at the apex of the ovary in the Hyacinth.

9. Nectaries on the receptacle. These belong for the most part to the preceding; but with regard to this subject the scales in the flowers of some Crassulaceæ need investigation. There are, however, many flowers which secrete a nectareous fluid, in which, nevertheless, no special nectary can be discovered. The microscopic examination of nectaries shows only cells of various kinds, often filled with sap, but no spiral vessels; they may however be seen in *Campanula Rapunculus,* but we cannot be certain here that something has not been cut off from the receptacle. Under the section, "On the symmetry of Nectaries," the author describes their situation in various flowers. He then distinguishes in each leaf of the "androceum" four portions, the "support,"

"nectary," "anther," and "limb," and applies this with much ingenuity to individual plants: the greater number of nectaries are parts which want anthers and limb. He applies this also to the pistillary members, where the ovary is compared with the support, the style with the nectary, and the stigma with the anther. He also considers in the last place the leaves of the stem, in which, according to our author, the base of the petiole, very often thickened, corresponds to the support; the petiole, often covered with glands, to the nectary, and the lamina to the anther. On the use of the secretion of the nectary the author has but little to say; he thinks that in many plants it becomes reabsorbed, and probably serves for the nutrition of the ovule.

The division into discus and nectary, according as they have a circular arrangement or not, is not much to the purpose, since there are undoubted nectaries, which stand in a circle, like the pits on the petals of *Fritillaria imperialis L*, and many others. That which the author also calls disc, includes parts so very various that they cannot be well designated by one and the same term. I adhere to the terminology which I formerly adopted, which is, at least, readily intelligible, where "Paracorolla," "Parapetala," "Parastemones," are readily distinguished as to their position and form. "Perigynium" expresses all the parts surrounding the pistil, whose variations are readily announced by the use of an adjective: "Perigynium disciforme" is the great disc which in many flowers surrounds the pistil; the only form for which the word disc is applicable. The word "glandulæ" may always remain in use, even when these parts secrete no fluid; first, because it is acknowledged by almost all descriptive botanists, and also, because even anatomists have retained this expression, where no secretion takes place, e. gr. "glandulæ conglobatæ." The word nectary may always be retained as a general name; but in descriptions it would be better to say fossæ nectariferæ, &c.

On the "Involucra" in *Cynosurus* and *Setaria*, by Dr. H. Koch, of Jever, (Botanische Zeitung, 1843, St. 15-17.) That the so-called involucrum of *Cynosurus* consists of sterile spikelets, is apparent to the eye, and has been already recognized by many. The so-called setæ of *Setaria* are peduncles, whose flowers have not attained to perfection. The author shows this in detail, and then adverts to the distinctions between *Setaria viridis, italica,* and *verticillata.* He states in conclusion that simple alternation, is confessedly in the grasses the fundamental arrangement, from the leaves up to the stamens, which are almost always arranged by threes. Our *Setariæ,* he continues, present the interesting fact, that the transition, the fluctuation between the two numerical proportions (the occurrence of twos or of threes), is not confined, as in the other grasses, to the contrast between flowers and leaves, but appears even in the distribution of the branches. Although the endeavour to give predominance to a divergence of one third is sufficiently well marked, yet it is never completely established; for not only, as frequently occurs, do the primary branches, at the commencement and end of the spike, revert to a divergence of one half; but all the secondary branches up to the last, the peduncle, again exhibit a transition from one third to one half, and the latter divergence continues thenceforward, as is usual in double flowers and their parts; so that the *Setariæ* change their order of arrangement twice, whilst other grasses do so for the most part but once.

In the leaves of most grasses we see indeed the arrangement in threes, for the alternating leaves are in general only a contracted whorl. There is also another circumstance connected with the inflorescence constituted by the peduncles, viz. the antecedence (Prolepsis), the earlier or later development, and of this the author has taken no notice. The expression divergence is very unsuitable, and the author himself speaks of the casual magnitude of the angle. Most morphologists interchange the terminology of descriptive with that of morphological botany, which has quite another field. "Involucrum" signifies the arrangement of parts, external and inferior to the floral sphere, either around a single flower, or around several. What is the character of these parts, considered morphologically, has not always been as yet inquired; and even where this has been done, it still remains doubtful, and frequently requires accurate anatomical investigation, which cannot be instituted by the descriptive botanist, or one who applies description to the recognition of species. On these principles the expression "Involucrum" for *Setaria* may be readily justified, and the addition "*setosum*" likewise, for the fibres themselves are stiff and bristly. What is a seta, is very differently defined by botanists, and the describer can only have regard to the filamentous form, and stiffness of the bristle of an animal. *Cynosurus* has no involucrum, as I have also stated, in 'Hort. Bot. Berol.'—"spiculæ fultæ bracteis pinnatifidis;" for these parts represent bracts, though they might also be glumes grown together.

Remarks on the Structure of the Pollen-grains, especially in regard to Classification, by Arthur Hill Hassall; in 'Annals and Magazine of Natural History,' vol. viii, p. 92. The author acknowledges that he knows nothing directly of the writings of Purkinje, (who has treated only of the spiral-cells of the anthers,) of Fritzsche and Mohl, except from Lindley's statement of their views. First, of the pollen-granule in general. The cylindrical, or nearly cylindrical granules, which, before being moistened with fluid, lie horizontally, erect themselves and increase in breadth, when moistened with a fluid less dense than the fovilla, and change their form into a triangular (or circular) one. The author believes that this takes place by endosmose, singularly enough, for here the principal conditions of endosmose, namely, two fluids, which traverse a membrane, in order to change their situations, are not fulfilled. It is known that the pollen-grains have for the most part two coats; to the number of those in which three have been observed, the author adds the pollen-grains of different species of *Banksia* and *Dryandra*, of *Fuchsia*, &c.; he believes, however, that in the last there may be a fourth covering, which Fritzsche found in many Onagrariæ, and the author himself in *Clarkia elegans*. The singular form of the pollen-grains of *Saponaria viscida* is described. The author speaks in detail of the furrows which are observable in many pollen-grains, and explains them as a deficiency in the outer membrane, by which the egress of the pollen-tubes is facilitated. The external membrane consists of cells for the most part, which are held together by an " organic mucus." Also in the grains furnished with spines this cellular coat may be distinguished. Sometimes the surface of the pollen-grain appears granular, but this arises only from granules in the fovilla, which shine through the external coat. The pollen-grains, especially those which are hispid or bristly, are surrounded by a thick tenacious matter, which the author does not regard as a secretion or exudation, but as derived from the cell in which the pollen-grain was first developed. The pollen-grains are often united, and either by means of a viscid material, or by filaments of lacerated cellular tissue, and thus the union is occasional, and for a time only, or permanent and organic. The former condition occurs in *Epilobium* (except *angustifolium*), the latter in the Ericaceæ. There are often a number of these grains connected together; twelve in *Acacia decipiens*, sixteen in *Acacia linearis*. The different sizes of the pollen-grains are stated; the author met with the smallest in *Myosotis palustris* and *Mimosa marginata*, the largest in *Cobœa stipularis*. The colour of the pollen grains is very various. The pollen-tubes are elongations of the internal membrane, and are filled with the fovilla; but since no membrane can be extended so greatly, as we find in many pollen-tubes, we must call them growths. The spontaneously moving molecules in the fovilla are regarded by the author as fluid, since their figure alters very much. The different actions of acids and saline solutions on the pollen-grains are stated. Then follows the different means which nature employs to assist the business of fecundation, which for the most part are sufficiently well known.

In the ninth volume of the same Journal, p. 544, this paper on pollen-grains is continued. The author describes the figure of those which he had examined, according to the natural orders, commencing with the Cyperaceæ and Gramineæ, and gives also 158 figures. He then makes some general observations on the shape of the pollen-grains. "The difference," he says, "between the pollen of Exogens and Endogens is so great, that it alone affords a character, by which the class to which a plant belongs may be at once specified. The pollen-grain of an endogen (Monocotyledon) may be characterized in the following manner: it is either spherical, oval, or elliptic; commonly, if not always, composed of two membranes, which seldom contain more than one pollen-tube, and with one single exception, never more than two. This exception occurs in *Limnocharis Humboldtii*, in which the pollen-grain is spherical, and the external membrane (extine) perforated by six or seven apertures, to admit the escape of the pollen-tubes. The elliptic figure of the grains is found most frequently in Monocotyledons; it was observed in 44 of the 73 genera which were subjected to microscopical inquiry. The pollen-grain of an Exogen (Dicotyledon) may be defined in the following manner: in general, it presents a more compound organization; the number of enveloping membranes is two, three, or four; the form various, for the most part either three-lobed, spherical, or triangular, with pollen-tubes whose number is very various, and indeed, with three exceptions, from three to fifty. Of these forms, the three-lobed occurs most frequently, and is, according to the experience of the author, characteristic of an exogen, since it occurred in 187 out of the 332 genera (of dicotyledons) examined. The exceptions referred to occur in the genera *Acanthus*, *Dryandra*, and

Magnolia; the last genus is so decidedly dicotyledonous, that there can be no doubt about it, though it has, strangely enough, a pollen-grain of the elliptic form, which is so common among Monocotyledons. The pollen-grain of *Dryandra,* although it has only two pollen-tubes, is curved, and has three distinct membranes." This might be expected, and is not a matter of astonishment, for, according to one of the three natural laws governing the multifarious forms of plants, every part runs through a series, from simple to compound, whilst another part continues stationary at the same degree of development. As far, however, as regards simplicity or complexity, coincident forms occur most frequently. The author places the Coniferæ and Taxus, according to his view, between Monocotyledons and Dicotyledons, although the pollen-grain is more complex than in Monocotyledons. This arrangement appears correct, since it applies to an entire order; but when he places *Nymphæa* among the Monocotyledons on account of its pollen-grains, this forms no distinction in the case of an individual genus, since, exactly in such, the combination of parts in very unequal stages of development may take place. Lastly, he refers to Mohl's statement that the figure of the pollen-grains is variable, and differs in the same family, the same genus, and even the same species. The author confirms the first, the second is, however, very seldom the case; and he is acquainted with only two exceptions to his statement, viz. in *Linum usitatissimum* and *Linum africanum;* also in *Viola tricolor* and *Viola montana,* or *Viola odorata.* The author denies the third *in toto,* and affirms that, where this appears to be the case, the pollen-grain is monstrous or imperfectly formed, either by subtraction or addition. The author adduces examples from numerous plants, and they occur with especial frequency in hybrid plants, e. gr. *Fuchsia Standishii;* and this may be the reason why hybrid plants are so frequently barren, a remark of the author's which deserves attention.

To this subject belong, Critical Observations on Mohl's Views of the Nature of Pollen-grains, by Arthur Hill Hassall, (Annals and Magazine of Natural History, vol. ix, p. 93.) "Mohl is of opinion," says the author, "that the cells in the external membrane of the pollen-grain secrete the oil which is found in the pollen." According to our author, this, as well as the gummy matter which covers the grain, proceeds from the original cells in which the pollen-grain is formed; for it occurs most abundantly in the pollen-grains which have just escaped from the anther. Mohl was in error when he affirmed that the pollen-grains with spines had no cells in their external membrane; and also Adolph Brogniart, when he stated that every cell is furnished with an excretory duct. The author further says, that he has asserted that the granular aspect of the surface of the pollen-grains arises from the active little granules which are seen through it; and in all cases he maintains the opinion that such a state exists merely in appearance. The spines and warty projections on the external membrane were not elongations of the granules of the external membrane, but projections of the inner membrane. From such a projection of the inner membrane, in conjunction with a fissure on the external one, arise the bands which may be seen in the furrowed pollen-grains when they swell up after being moistened.

On the Structure and Functions of the Pollen, by J. Aldridge, in Hooker's 'Journal of Botany,' vol. iv, p. 86. In the 'Report' for 1841, p. 128, I gave a notice on Aldridge's Researches on Pollen, contained in the 2d vol., p. 428, of 'Hooker's Journal,' and added very little on the above essay, as the writings of 1842 were not properly embraced in that year's Report. The author first defends himself against the objection that Fritzsche had anticipated him in his statements. Aldridge had, for instance, asserted in that treatise that the stigma secretes an acid, which causes the pollen to burst, and coagulates the fluid in it, which surrounds the fovilla. It was easy for him to show that Fritzsche was not aware of the acid on the stigma, as had been objected. The author now goes further. The fovilla consists of mucus, oil, and starch. The mucus swells in water, and this swelling is the reason of the pushing out of the pollen-tubes; it is coloured brown by iodine, and acids change it into a gray viscid substance. The other ingredient, which is never wanting, is oil; this is not coloured by iodine; but, on the other hand, the starch-granules, as is well known, are coloured blue by it. It is the granules in the oil-drops which are in motion in the pollen-tubes.

Extract from the Inaugural Dissertation on the Formation of the Embryo, and on the Sexuality of Plants, by Dr. Gelesnow, of Petersburg, (Botanische Zeitung, 1843, p. 49). "My observations," says the author, "confirm the main points in those of Schleiden, on the mode of origin of the embryo, namely, that this is formed from the pollen-tube, which reaches the cavity of the embryo-sac. Of the correctness of this phenomenon we may be most conclusively convinced in such plants as have the embryo-sac furnished with an operculum, and remaining a long time entire. This case I have most distinctly observed in the Peach. This occurrence of an operculum in the embryo-sac is not found in all plants; for example, in *Iberis amara* and *umbellata*, the micropyle extremity of the embryo-sac is very pointed, so that the diameter of its apex is not much greater than that of the pollen-tube. Here the formation of the embryo takes place in the following manner: when the pollen-tube comes in contact with the embryo, the part of this latter which is impinged upon dissolves, and the pollen-tube penetrates without change of shape into the cavity of the embryo-sac; in the plants referred to it even penetrates very deeply. Thus, the embryo, when formed, is not here encased by the inverted wall of the embryo-sac, as in the peach; but this, as well as the long suspensor, is formed from the proper membrane of the pollen-tube. In these circumstances it is often much more difficult to distinguish whether the embryo contained in the embryo sac, together with its suspensor, be simply a prolongation of the pollen-tube, or whether they are produced in any other way." It is to be desired that the author had given a complete translation of the essay, which he had written in Russian, or had, at least, repeated word for word the results which he had obtained. In this extract the author does not content himself, especially as regards *Iberis*, with simple observation, as in the original paper, but he passes beyond that into theory.

New Theory of the Fertilization of Plants, by Dr. Theodore Hartig, (Brunswick, 1842, 4to.) After the author has made some remarks on the present state of the doctrines with regard to Fertilization, he proceeds in the first section to endogenic impregnation, or to impregnation in the interior of the ovary. In this case, for instance, a pollen-tube, or tube of pollen-grain (Ballschlauch,) as the author says, reaches as far as the ovum, penetrates into the foramen of the ovule, grows through the cellular tissue of the nucleus (Befruchtungskegel) to the spot where the germ originates. According to the author, in the Coniferæ the pollen itself enters the micropyle of the naked ovum, attaches itself firmly to the ovule (Befruchtungsei), and sends a short tube into the cellular tissue, in consequence of which a series of remarkable formations commences, the last of which, after an interval of more than a year, in those coniferæ that are two years in maturing the seed is the commencing germ, as was previously quoted from the author's 'Lehrbuch,' in the former yearly Report, p. 133. The penetration of the tube into the ovule has been satisfactorily ascertained in many families; but it is the object of the author to show, that fertilization does not always take place in this manner. This is followed by the impregnation of the placenta. In a number of plants by no means insignificant, the pollen-tubes can be traced as far as the ovary, sometimes even to its base; while we seek for them in vain in the foramen of the ovum, as in many *Œnotheræ*. In all plants, continues the author, to which a deeper introduction of the tube is generally peculiar, the tube turns itself in the shortest way to the cellular tissue of the stigma, penetrates the cuticle, the superficial and the cortical cells, to the central bundle of vessels, and runs from thence parallel with this latter to the end of the style, where it passes from the cellular tissue of the stigma into the conducting fibres of the canal of the style. When the tube does not enter the cellular tissue of the stigma by the shortest course, but runs to a greater extent free on its surface, the penetration of the tube does not take place at all in most cases, as is seen in *Clarkia pulchella*. The author now considers the penetration of the pollen-tubes into the canal of the style, where they follow the conducting fibres. The conducting fibres of the canal of the style correspond, as the author says, in their structure to the absorbent hairs (Saughaaren) of the stigma; in most cases, the absorbent hair is nothing more than the most external cell of a series of conducting fibres, which latter is however destitute of cuticle. The conducting fibres consist always of two membranes lying one within the other, of a mucous membrane and a tubular membrane. The pollen-tubes, however, often perforate the outer membrane, in parts where an open canal occurs, and reach the interior. Although we can trace the tubes as far as the ovary, but no further, a transmission of the fertilizing matter from the tubes adjoining the placenta, into its cellular tissue, takes place; and it is forwarded to the ovule through the cells or fibres of the funiculus. The author attempts to prove thereby that in plants with many-seeded ovaries, the number of ova presents often a great disproportion to the number of tubes. In *Œnothera longiflora* for example, the ovary contained about 1000 ova, of which some 250-300 attained complete development.

The usual area of a transverse section of 300 tubes is ·00785 of a square line; but the canal of the style close above the ovary has only an area of ·00785 of a square line, so that even if it contained nothing but tubes, it would comprise only one fifth of those which are necessary to fructification; but in the lower part of the canal of the style of this plant not so many as 50 tubes can be counted at the most. The pollen-tubes also appear of greater duration when they enter the ovum; but here, namely, in *Œnothera longiflora*, the author has never found a tube in a single ovum. Since the tube is usually of such a size that it could not easily be contained in the pollen-granule from which it arises, the author considers it probable that the fertilizing material of the granules which have not advanced to the formation of tubes, being absorbed from the surface of the stigma and introduced into the cellular tissue, is taken up by the tubes, and conveyed in common with their proper contents to the spot where impregnation is effected.

In the second chapter, epigynous impregnation is treated of, under which the author includes those cases in which the style, the stigma, or the absorbent hairs of the stigma act as organs of ingestion in the process of fertilization. First, of fertilization by means of the style, especially by means of the curious hairs of the style in *Campanula*. The author saw pollen-globules or grains in the hairs of the style, sometimes in remarkable abundance. He regards it as decided that fertilization takes place by means of these hairs; even the retraction (Einstülpung) of these hairs could only serve to approximate the pollen to the elongated cells of the central bundle of spiral vessels. Although, after the separation of the lobes of the stigma (Narbenarme) pollen reaches the inner side of the lobes which are covered with hairs, and pollen-tubes become there developed, yet fertilization cannot take place by this means, since that condition is but seldom observed. Moreover, the author coated the stigma with a solution of gum, previous to the separation of the lobes from each other, and yet fertilization took place.

To impregnation of the stigma the author refers all cases in which the formation of tubes from pollen-grains upon a naked stigma, that is, one destitute of hairs, cannot be shown to occur, as in *Petunia*, *Nicotiana*, *Atropa*, &c. The pollen here falls on a mucous covering, which mucus is produced by peculiarly formed mucus-cells.

Impregnation of the absorbent hairs of the stigma, or of the papillæ upon it, takes place in many plants, as for instance, in *Matthiola annua*, and others. The papillæ consist of three membranes: the middle one is termed by the author the mucous membrane; it is covered with a delicate external membrane, and incloses an internal tube, whose granular contents are coloured brown by iodine. We must here distinguish the impregnation which takes place by penetration of the tubes into the middle membrane of the hair, since the cuticle is in that case wanting, as the author has shown with regard to *Matthiola annua*, in the third part of his elements. Further, impregnation of the absorbent hairs by penetration of the tubes into their cuticle, as in *Glaucium violaceum;* impregnation of the absorbent hairs by absorption, particularly in *Capsella Bursa pastoris*, a very frequent occurrence; impregnation of the absorbent hairs by contact, as in *Clarkia pulchella*. In all these cases a formation of tubes takes place. Frequently, and especially in those flowers which have the stigma covered with large masses of pollen, we see that only those granules succeed in forming tubes which are restrained by the deeper situated pollen-layers from coming in contact with the surface of the stigma or with the hairs; whilst those granules, which are in immediate apposition to the latter, yield their contents to the stigma, without developing the least trace of tubes: *Eschscholtzia cristata* affords an example. Lastly, to epigynous impregnation also belongs that form which occurs without the formation of tubes, of which the author consequently never found any example in the majority of Compositæ, Umbelliferæ, Lobeliaceæ, &c.

The third section treats of Perigynous impregnation. On the outside of the ovary of *Reseda odorata*, says the author, at the part to the inside of which the ovules are attached, and accurately corresponding to the course of the placenta, run narrow, pectiniform, elevated striæ of papilliform projecting external cells, running in a direct line from the upper point of union of the pistils, nearly to the base of the ovary. If we examine the flowers of this plant shortly after the successful shedding of the pollen, we find a quantity of pollen adhering to the striæ, which has partly discharged its contents without forming tubes, and not unfrequently penetrates the cuticle by means of a delicate tube, so that a perigynous impregnation in this plant can scarcely be questioned. "Hypogynous" impregnation is the subject of the fourth section. The coronet of *Passiflora* seems to be intended to assist in fertilization. It is covered with papillæ, like the stigma; the openings of the anthers are directed towards it, in the same way as they usually are towards the receptive organs. Lastly, the author remarks, that those are not always pollen-tubes, which appear to be such, even when they are hanging out from the ovule; as in the Cruciferæ, where they are prolongations of the conducting tissue, and in the Cupuliferæ, where they belong to the ovule. The former are present before the shedding of the pollen: they are even articulated, and the middle chamber is filled with a clear sap, containing green granules: the latter often originate long after the pollen-shedding, as is the case in *Quercus rubra*.

In the 'Contributions to the History of the Development of Plants,' see above, the author has defended himself against the attack which Schleiden, in his 'Outlines of Scientific Botany,' had made upon the just quoted work. The defence of the author had been already answered by Schleiden in a little pamphlet, 'More recent Objections to my doctrine of Fertilization, an answer to Dr. Th. Hartig's Contributions to the History of the Development of Plants,' Leipsic, 1844. From such discussions, especially when conducted with a degree of warmth, there results nothing beneficial to science. Herr Hartig is in error when he thinks that he is obliged, like a younger author, to earn a reputation by disputes. Since he has quoted me, I may be permitted to say, that when I, as a man certainly not of older standing, was attacked on many sides for my 'Principles of the Anatomy and Physiology of Plants,' I never allowed myself to be drawn into a discussion. The succeeding times did me justice, nearly all the propositions of that book are adopted, and much has transpired in science, without my name being mentioned, but which is a matter of no consequence.*

I have pointed out errors, being chiefly misled by the bad microscope, which alone could be procured in those days; I corrected them, some soon after, some at a later date; and I have also, with the intention of correcting, made worse many

* Thus, for instance, that starch already formed in the cells occurs in small granules. I myself did not pay any attention to it until I recently met by accident with a passage in the 'Contributions to the Physiology of Plants,' by Treviranus, Göttingen, 1811, p. 3. Treviranus says, "My opinion of the origin of the cells, which by their union constitute the cellular tissue, from the granules contained in the cells is according to Mirbel's judgment, a tissue of fancies. Link is more just, because he has doubts on the subject, and gives the reasons for his doubts (Grundlehren d. Anat. u. Physiol. d. Pfl. Götting. 1811, s. 29). Although these are by no means decisive, I am also little inclined to assign to the former opinion all the persuasive force of a truth; it is, and remains merely a very probable supposition." He then supposes that these granules might serve for the production of the cells, when in a state of solution as they are observed in germinating seeds. My reasons, which were decisive enough, are not refuted by Treviranus, who does not even cite them. In the Grundlehre, s. 8, p. 32, I have gone over the argument in detail, that these granules are starch, and even mentioned the solution in the germinating seed through which the nutrition of the young germ is effected. Not a word of this does Treviranus mention. I believe also that I was the first who made the statement that these granules consisted of starch. Iodine was not known at that time. To all this I have made no other reply than the following: (Supplement to the Grundlehre, &c. part ii, p. 8, Göttingen, 1812.) "I doubt not that the granules of starch contribute to the formation of the cells when they are previously dissolved and converted into a fluid. But that was not the question, but whether the granule of starch be the young cell." Compare Treviranus, Beiträge, p. 3.

portions, which thus required a second correction; but I have never been ashamed to announce my opinions openly, although it is often difficult to throw off previous notions which have once been regarded as correct. I do not wish to involve myself in the dispute of our two authors, since I do not think that I am possessed of a sufficient number of observations to be able to decide thereupon. However Hartig seems to me too hasty, especially in his conclusions; I have in many plants found no pollen-tubes, and when I did see them, but not passing over into the ovule, yet have I never ventured to affirm that the pollen-tubes were wanting, or that one might not at another time be able to observe their passage into the ovule; I have often seen the penetration of the pollen-grains into the hairs of the style in Campanula, probably before the author, but I have never ventured, and do not yet venture to assert, that fertilization takes place in this manner. This is not the result of my age. I could not in my youth neglect the observations of Hedwig: the fibre in the spiral vessels of plants must at least be a channel; so little confidence had I in myself.

In Hooker's 'London Botanical Journal,' 1842, 601, is a paper by Wilson on the hairs of the style in *Campanula.* He observed that pollen-grains had penetrated into the cavity of the hairs, and found traces of an opening at the extremity of the hair. They even penetrated further into the cavities of the style, in which the hairs terminate. Hassall had made some remarks on this paper, and believes that Wilson is speaking of pollen-tubes; this is refuted by the latter in the 'Annals of Natural History,' vol. xi, 182. For the rest there is nothing contained in this paper which was not previously known.

Remarks on the Formation of the Embryo in *Pinus Laricio* and *sylvestris, Thuja orientalis* and *occidentalis,* and *Taxus baccata,* by MM. de Mirbel and Spach, (Annales des Sciences naturelles, tom. xx, 1843, p. 257, also in the Compt. Rend. 1843, 11, 931.) The authors first speak of that which had previously been discovered regarding the development of the embryo of Cycadaceæ. "It was known," say they, "already previous to 1810, that the embryo of *Cycas* and *Zamia* lies in the axis of the seed in a thick albuminous body, that it is inverted, furnished with two Cotyledons, and that its radicle terminates not far from the apex of the ovule. But it was not known, and the information was first circulated in an essay in 1810, that this radicle of the embryo of *Cycas* terminates in a thin, tubular fibre, of twelve or fourteen centimeters in length, which is coiled up as it were into a ball; nor was it known how the male organ comes into conjunction with the nascent embryo; nor further, that between the radicle and the apex of the ovule there is a cavity in the mass of albumen, and that four or five oval utricles lie there, each of which ends in a coiled-up tubular fibre. These utricules and these tubes are regarded by the author of the former treatise (Mirbel) as abortive embryos, and this has been confirmed in the sequel. Brown's researches drew attention to the similarity between the Cycadaceæ and Coniferæ; and with this view the authors undertook an investigation of the cones of the Abietinæ. Two or three weeks after the commencement of May in the second year, the nucleus (nucelle) of the ovary ceases to be a perfectly homogeneous tissue. In the middle is now seen, provided this nucleus be transparent, a spherical vesicle, in which the commencement of cellular tissue may be observed. The vesicle enlarges, and the more it increases, the more does the mass of the nucleus diminish, till ultimately it is quite absorbed, without our knowing where it is gone to. The vesicle, which is nothing else than the embryo sac, now includes the whole, and becomes adherent below to the wall of the ovary; and it is now evident that the tissue which is present in this sac is no other than the albumen, which afterwards, at the period of germination, is liquefied into a milky fluid, for the purpose of nourishing the embryo. Hereupon follows another series of phenomena. In the interior of the albumen, near its top, appear certain vesicles of elongated form situated round the central axis. Their number varies in different species; it is three in *Abies alba* and *Pinus Laricio*, four in *Abies canadensis*, five in *Larix europæa*, and six in *Cedrus Libani;* they adhere but slightly to the albumen, and they represent, according to the idea of the authors, a second embryo sac for each bundle of embryos. They contain a yellowish, very delicate cellular tissue, which occupies three fourths of the whole cavity; the remaining fourth is taken up by five vesicles disposed in the form of a rose, which are nothing more than the rudiments of the suspensory filaments (suspenseurs.) At a later period the vesicles at the base break up, and liberate the suspensory filaments, which now elongate, and pass downwards into the cavity in the middle of the albumen. In their interior may be remarked granules varying in number. These tubular bands are sometimes distinct and independent of each other; sometimes they are collected and even firmly glued together in twos, threes, or more. They terminate in a little nodule, consisting of one or more cells, in which numerous granules are often present. The authors now describe specially the formation of the embryo of *Thuja orientalis*, and add the following: "At the apex of the ovule are seen little membranous swellings (boursoufflures membraneuses.)" Is the origin of these referrible to the pollen-tubes? We believe not; for whilst we are perfectly aware that in many species the tube penetrates into the interior of the ovary, and even of the ovule, yet it appears to us that this is not the case in the Coniferæ. The description of the formation of the embryo of *Taxus baccata* confirms the opinion of the authors with regard to the suspensory fibres. This treatise is of considerable importance, and especially for the elucidation of fertilization by the pollen-tubes which may very easily be confounded with the suspensory fibres, and which, as it appears, have already been so confounded.

Contributions to Vegetable Embryology, from Observations on the Origin and Development of the Embryo, in *Tropæolum majus*, by Herbert Giraud, in the 'Transactions of the Linnæan Society,' vol. xix, part 2, p. 161, 1843. Also in an Extract, in the 'Annals of Natural History,' vol. ix, p. 245, 1842. The author selected this plant for examination, because it has one-seeded fruit, and ovules large in proportion. In the first period, or shortly before the opening of the bud, a longitudinal section was made through the carpel, from the back towards the axis of the pistil. The section divided the ovule, and showed that this had already acquired an anatropous development. Firm and dense cellular tissue, including a bundle of vessels, passed downwards from the placenta, and after it had formed with it the raphe, it terminated in the base of the ovule. The nucleus has only one envelope, at the extremity of which the exostome or micropyle is found, close to the point of adhesion. The gubernacular cellular tissue of the canal of the style, can be traced through the cavity of the carpel, as far as the micropyle. In the second period, during which the bud expands, and the anthers open themselves, thus previous to fertilization, a small elliptic cavity appears near the apex of the nucleus, covered by a delicate membrane, which is formed by the parietes of the surrounding cells. This cavity is the embryo sac, and we observe a little canal proceeding from it to the micropyle. The apex of the embryo sac contains a quantity of mucus, in which numerous little corpuscules occur. In the third period, the apex of the nucleus and of its envelope, inclines a little towards the placenta. The embryo sac has become longer and wider; the mucus has disappeared, and given place to a long transparent cell, the "utricule primordiale" of Mirbel, in which there are a number of little globules. The primordial cell is developed in the embryo sac, from which it is clearly distinct. The fourth period comes after fertilization. The pollen-tubes do not extend into the carpellary cavity, but the fovilla with its granules is frequently found in its transit from the style to the micropyle. With the increased development of the embryo sac the primordial cell elongates, and becomes distinctly cellular, in consequence of the formation of little cells in its interior; it terminates near the base of the nucleus, in a spherical mass of globular cells. The primordial cell acquires at this time the character of the suspensory fibre (suspenseur of Mirbel), and the spherical end forms the first trace of the embryo. In the fifth period, the nucleus with its envelope inclines still more toward the placenta; the spherical end of the "suspenseur" becomes larger, and shows itself more distinctly to be the rudiment of the embryo. In the mean time the entire "suspenseur" becomes longer, in consequence of the multiplication of its contained cells; and its upper extremity perforates the apex of the embryo sac, the apex of the nucleus, and the micropyle. We may be allowed to pass over the remaining periods of development. The author draws the conclusion that, as the embryo sac, and also the primordial cell are visible before fertilization, they cannot arise from the pollen-tubes; and further that the fertilization probably is effected by means of the fovilla, inasmuch as the pollen-tubes do not reach the micropyle. This essay was presented, with numerous drawings, to the Linnæan Society, of London, and deserves the greatest attention.

William Griffith describes in a letter from Serampore, in the 'Annals of Natural History,' vol. ix, p. 243, the Ovule of *Santalum* and *Osyris*. The ovule of *Santalum* consists of a nucleus, and the embryo sac, which is prolonged over the apex and the base of the nucleus. The albumen and the embryo are developed in the parts which project over the septum; the substance of the embryo is developed immediately from the vesicle, which is the extremity of a pollen-tube; the albumen has no other envelope than the upper incorporated separable portion of the embryo sac. In *Osyris*, the ovule consists only of a nucleus and the embryo sac, which is elongated as in *Santalum*, yet not so much anteriorly; this anterior part is precisely similar to the unaltered part of the sac of *Santalum*, below the septum. The albumen and the embryo are formed external to the sac, and are quite naked; and whatever covering they have does not belong to the ovule.

On the Opposite Arrangement of the Divisions of the Stigma, and the Parietal Placenta in the Compound Ovarium in Plants, by Robert Brown, (Botan. Zeitung, st. 12, 1843.) This is an extract from R. Brown's account of the Cyrtandreæ in the second part of Horsfield's 'Plantæ Javanicæ Rariores,' London, 1840, the original of which is found in the 'Annals of Natural History,' vol. xi, p. 35. A few copies were published in 1839.

"We are at present," says the distinguished author, "generally agreed, to regard a many-seeded legume as the condition of the simple ovary, which best illustrates the commonly-received hypothetical view of the formation of this organ, namely, that it consists of the modification of a leaf which is folded inwards, and which has grown together by its margins, which in most cases are the only parts of the organ whence ovules proceed; and where this reproductive power is not altogether limited to the margins; yet, according to rule, it either commences in them, or otherwise includes them. The exceptions are of two kinds; either where the whole inner surface of the carpellary leaf produces ovules, or where the production of ovules is limited to the external angle of the cell, and thus to the axis of the carpellary leaf in question. The author considers particularly the latter case, and endeavours first to account for the exceptions in several species of *Mesembryanthemum*, and then those which Lindley had observed in the Orchideæ. As might be expected, the author attempts with much ingenuity to reduce the latter case to the commonly received general rule. But this general rule has always appeared to me not merely doubtful, but altogether incorrect. For when do buds proceed from the margin of true leaves? A bundle of vessels never runs to the margin, whence buds or young shoots might proceed, and which could present the only analogy to the bundle of vessels, from which the ovules in the pericarp arise. If *Bryophyllum calycinum* be quoted, it serves for a reply, that the buds do not grow from the margin, but only in its neighbourhood, in the angle of the notch, where numerous delicate nerves interlace. Or, if *Phyllanthus* be adduced, we can easily reply, that here the so-called leaves are only expanded petioles, as the little scale below them shows, which represents the real leaf. The supposition that the ovule originates from the midrib of a metamorphosed leaf is far more natural, and explains better the forms of the pericarp, if we only admit the reflection and slight coherence of the margins. Endlicher first advanced this opinion, and it has been adopted by Fenzl. On this subject I would direct attention to the recent excellent investigation of *Rhigozum dichotomum*, of Burchell, in the 'Denkschriften der K. Bayerischen Botanischen Gesellschaft zu Regensburg,' B. 3, p. 205; where an historical account of these views is given. But another theory, of which we shall speak immediately, appears to me to be preferable.

On certain hitherto unnoticed Peculiarities in the Structure of the Capsules of Papaveraceæ, and on the Nature of the Stigma of Cruciferæ, by J. W. Howell, (Annals of Natural History, vol. x, p. 248.) The peculiarity consists in that the rays of the stigma in the poppy are opposite to the dissepiments, whilst in the Nymphæaceæ, according to the general rule, they are alternate. When reminded that Kunth, in his accurate description of the poppy in the 'Flora Berolinensis,' had already paid attention to this circumstance, the author replies, in the 'Annals of Natural History,' vol. ii, p. 42, that he had made his observations as long ago as 1832, whilst on the other hand Kunth's 'Flora' first appeared in 1838. But it comes to this, who first made the observation public? even in this respect we are often unable to avoid errors of memory. He explains, or reduces to rule, the anomalous formation of Papaveraceæ, in the following manner: each stigmatic ray is double, formed by the stigmatic portion of the lateral halves of two contiguous carpels; the two stigmatic portions of each carpel are, in the more complex capsules of the higher species, divided by an intervening membrane; e. gr. *Argemone*, *Papaver*. As in the Cruciferæ an exception occurs, similar to that in the Papaveraceæ, he thus explains it: " it is very probable that the " siliqua" of the Cruciferæ is composed of two carpels, whose incurvated margins form two lateral placentæ, consisting of a double lamina; the apparently anomalous arrangement of the stigma, arises from its being formed of two lateral halves, each of which belongs to the corresponding carpel, situated below. It is highly probable that the seed, like all other parts, proceeds from the axis, and in the present case from the axis of the peduncle. This is never simple, but breaks up ultimately into many divisions, into lateral portions. These now, either remain in company, and traverse the fruit in a bundle, in which case the seeds are adherent to the axis, or the divisions separate from one another, before they penetrate into the fruit, and then the seeds are situated on the walls, or the axis ceases altogether, and only carpellary leaves remain, which bear the fruit on their midrib, as *Delphinium*, *Aconitum*, &c.

This form of fruit is, according to my opinion, by no means the normal form, but in fact the anomalous condition, and the capsule with a single free central placenta is the simple state. The carpellary leaves, if we may be allowed to call them leaves, of which the pericarp consists, spring up underneath the fruit; and either become adherent to each other by their margins; or they have their margins turned in, so as to contract an adhesion to the division of the axis; or even without this, becoming adherent among themselves only, as in *Aconitum*, *Delphinium*, all Multicapsulares and Leguminosæ. The dissepiments proceed normally from the midrib of the carpellary leaf, and inasmuch as every part in the flower is alternate, so the carpellary leaves alternate with the divisions of the axis, and with their continuation, the stigmata. Thence the general rule that the stigmata alternate with the dissepiments. The formation of the fruit of the poppy is very correctly explained by the author, of which we may be easily convinced, if we allow a young unripe capsule of *Papaver somniferum* to dry up, because the parts of the stigmata become then quite detached from one another. The fruit of the Cruciferæ, on the other hand, seems to me an intermediate form between those fruits in which the axis terminates, and those in which it is merely subdivided: it is, namely, a carpellary leaf with the midrib grown adherent to the division of the axis; and the dissepiment also is formed as usual between the midrib of the leaf and the opposite placenta, which now, however, lie in proximity to each other. The divisions of the style are a continuation of the divisions of the axis, as usual; and thus in this case they coincide with the dissepiment. The alternation of the carpellary leaves with the divisions of the axis is remarkably well seen in the poppy. By this explanation of the fruit no violence is done to nature, as in the hypothetical origin of the seed at the margin of the leaves.

On the Existence of Spiral Cells in the Seeds of Acanthaceæ, by Mr. Richard Kippis, (Tr. of the Linnæan Soc. vol. xix, p. 1, p. 65, 1842.) On the seeds of an *Acanthodium*, nearly allied to the *Acanthodium spicatum*, from Upper Egypt, may be seen close-set seeming hairs; but which, when immersed in water, swell out, become broader, and then evidently consist of tufts of from five to twenty, long, cylindrical, transparent tubes, which adhere to one another for one third of their length, and contain one, two, or sometimes three spiral fibres, which are strongly adherent to the membrane of the tubes. The fibres are sometimes interrupted by rings. In the lower part where the tubes are adherent together, the fibres are reticulated; towards the end the spirals lie asunder, and in the middle they are bound together by delicate filaments given off from the principal fibres. The development of the hair is connected with a considerable discharge of mucus. The cells of the testa are hexangular: similar cells, but more elongated, surround the base of the hair, and pass into it. In a similar condition are the hairs on the seeds of *Blepharis boerhaaviæfolia*, *Bl. molluginifolia*, and *Bl. rubifolia*. Solitary hairs with spiral or annular fibres are seen on the seeds of *Ruellia formosa*, and *R. repens*. Mucus flows in abundance from the ends of the tubes. In five species of *Hygrophila* the seeds had similar hairs, so also in *Dyschorista ceruna*, *D. littoralis*, and *Œchmanthera tomentosa*. On the seeds of *Strobilanthes*, *Stenosiphonium* and *Ætheilema*, similar hairs occur at the margins only of the seeds. But the hairs of the seeds of *Strobilanthes fimbriata* and *Strobilanthes Wallichii* have no spiral fibres; so also the hairs of the seeds of *Dipteracanthus patulus* and *D. erectus:* they pour out much mucus from the extremity. In the hairs of the seeds of *Dipteracanthus dejectus* a spiral fibre is present. The seeds of *Blechum Brownei* have a narrow whitish margin of cylindrical cells without fibres. The cells expand themselves in water, on account of the mucus which they contain, and acquire at length the form of broad, short, curved hairs, without fibres. The author, lastly, describes the various hairs and appendages to the seeds of the *Acanthaceæ*, which present no spiral fibre. On the mucus, which escapes with the spiral fibres from the seeds, see my Vorlesungen über die Kräuterkunde, pp. 94 et seq.

Complete Account of certain Degenerations observed in various Plants, by E. Von Berg; New Brandenburg, 1843. Vollständiger Bericht über einige bei verschiedenen Pflanzen beobachteten Ausartungen, von E. Von Berg, Neubrandenburg, 1843. Reprinted from the Practische Wochenblatte for Husbandry, Horticulture, Domestic Economy, and Trade. Just as, from time to time, a treatise on squaring the circle and perpetual motion is presented at the Academies, so, from time to time, some economist comes forward and states that he has brought about the transformation of rye-grass (*Trespe*) and oats into rye, of rye into wheat, and other similar transformations. Our author belongs to these economists. In the opening of this little pamphlet he details to us what he had already published about such transformations, at first anonymously, with the signature G, and afterwards in his own name. He affirms that rape may be converted into *Thlaspi arvense*, the latter plant into *Camelina sativa*, and this again into *Capsella Bursa Pastoris;* he even obtained from a seed of *Thlaspi* a plant similar to white mustard, which by repeated setting, became constantly more similar to the white mustard. All this the author has previously made known. He now informs us how he changed rye-grass (*Bromus secalinus*) into rye. In the year 1839 he procured a pound of the seed of rye-grass from Hamburgh: one portion of this was sown the same spring in an experimental garden, and the rest in the following autumn upon his land. Rye was first sown, and then rye-grass. The rye-grass, like the rye, came up shortly after the sowing; when it had remained so but a short time, the rye-grass acquired the appearance of rye, and produced also in the following year rye, and in fact so generally, that there was only a single stalk of rye-grass among it, &c. &c. See also Botan. Zeitung for 1843, p. 30.

Some further Observations on the Nature of the Ergot in the Grain, by Edwin J. Queckett, (Tr. of the Linnæan Society, vol. xix, part 2, p. 137, see also, Annals of Nat. Hist. vol. xi, p. 461.) The author has in an earlier paper (vol. xviii, part 3,) of these Transactions, endeavoured to show that ergot arises from a fungus. To prove this he has instituted researches. Grains of rye, wheat, and barley were made to germinate in a vessel of distilled water, and then granules from the outside of ergot were scraped off with a pencil into the same glass and water, and the whole set aside some time for the further growth of the grain; upon which the young plants were transplanted. Other grains were allowed at the same time to germinate, but without ergot. When the plants had grown up, the two plants of infected rye which arrived at maturity, each presented an ear with ergot, the plants from the uninfected seed none. But the infected seed of wheat and barley, had no ergot. The author opines that these experiments would have been conclusive, if the wheat and barley had also produced spurred grain; but too few of the rye plants attained maturity to furnish a sufficient demonstration. See also the Jahresbericht fur physiolog. Botanik, im Jahre 1840, p. 418.

Description of a Tetramerous Orchis Flower, by Dr. Moritz Seubert, (Linnæa, vol xvi, p. 389.) In a specimen of *Orchis palustris*, all the flowers were well-formed, till one of the lower ones immediately excited attention by its two labella. Below these two was an accessory perigonial leaf. The author believes that the flower had changed from a triple to a quadruple number, and he thus reckons: four external perigonial segments (Perigonienzipfel) by including the accessory one; and four internal segments with the two labella.

The following Monstrosities are quoted according to the natural orders; for this reason the preceding ones have been placed at the head.

Thesium intermedium. Contribution to the Teratology (Teratognosie) of the flowers of Thesium, by Siegfried Reissek, (Linnæa. vol. xvii, p. 641.) Only the results of this accurate and interesting paper are here given, whereas, for the sake of distinctness, the description ought to be copied entire. The monstrosity was observed in a specimen of *Thesium intermedium*, and in fact in a plant which was covered with the *Æcidium Thesii.* It showed the following deviations from the typical form. In the first place, alterations in the carpellary whorl, with normal formation of the other whorls; secondly, alterations in the whorls of both carpels and stamens, with normal or but slightly irregular arrangement of the perigonium; thirdly, alterations in all the whorls, with the formation of simple leaves; and fourthly, alterations in all the whorls, with progressive central restoration of flowers. From a comparison of monstrous plants in all their phases with the allied normal forms, their morphological interpretation is ascertained. It follows, that *Thesium intermedium* which is injured by *Æcidium* in the formation of the stem, attains a higher grade of development, and herein approaches nearest to the character of Osyris; and further, that it also, in regard to the production of flowers, stands partly upon a higher scale, and herein approaches to the New Holland forms. From the conformation of monstrous flowers it follows: 1. That the perigonium is capable of a gradual transformation into vegetative leaves; but that the whorls of stamens and carpels retain their characters with greater tenacity, and rather perish than become transformed into vegetative leaves. 2. That the disc disappears with the failure of the stamens, and does not remain like an expansion or margin round the bud generated in the interior of the perigonium; therefore, there is either no special expansion of the axis, or in case this takes place, the expansion is constantly merged in the elongation of the axis.

Plantago botryophylla, Kirschleger, Notice on some Facts in Vegetable Teratology, in 'Mém. de la Soc. du Muséum d'Histoire naturelle de Strasbourg,' tom. iii, p. 12. This paper is paged separately from the Memoirs. The bracts in *Plantago major* had grown into subspatulate leaves. A not unfrequent monstrosity in good soils.

Peucedanum Oreoselinum, Kirschleger (ibid, p. 8.) On the stem, at a certain height, were observed a quantity of umbelliferous rays, from thirty to forty, which surrounded the stem in a circle; the involucra were transformed into compound leaves. The elongated stem bore a many-lobed bract, from whose axil a single distinct umbel proceeded. The summit of the stem terminated in an ordinary compound umbel. The author therefore believed that in the umbel one ray always represents the axis.

Primula sinensis. Beschryving eener volledige Vergræning van Primula sinensis, Lindl. in the 'Tydscrhift voor natuurl. Geschieden. en Physiolog.' vol. x, p. 355. An accurate and circumstantial description of this remarkable monstrosity, which showed a gradually progressing transition of the floral organs into leaves. We cannot well give any extract from it. Every part of the flower had become green. The calyx in place of being ventricose (bauchig) below, was so only above; the corolla, in place of being deciduous, was adherent below to the receptacle, and its segments, besides the green colour, were in some flowers slightly notched; the filaments of the stamen were grown together; the anther fleshy and without pollen; the ovary seated on a stalk, and thickened at its upper part, so that it projected from the flower. The most astonishing were the changes which the seeds, and still more the placenta, had undergone; they were in some rudimentary fruits but little altered, only that the micropyle, in place of being situated near the point of attachment, lay opposite to it. In other fruits, the ovules were surrounded by fleshy leaflets, of from three to five lobes; some are completely covered by the leaflets; others still have at their base properly-formed ovules, and others again, beset with leaflets at the base, had at the summit ovules upon long stalks. The leaflets arising in place of the ovules were oval, decurrent upon the petiole, acute and hairy. The author did not observe the development of any ovule into a young plant.

Primula Auricula, Kirschleger, (ibid. p. 11.) This flower had, in place of the ovary, a very well-developed flower-bud.

Peloria of *Calceolaria crenatifolia*, described by E. Meyer, (Linnæa, vol. xvi, p. 26.) The Peloria of this plant presented a bell-shaped tube, and an inverted funnel-shaped, four-cleft limbus. The pistil was perfect, and developed without the slightest deviation from the normal standard; but the stamens were wanting altogether, without the slightest trace of the situation where they should have grown. The author proceeds to explain the Peloria in the following manner: in the natural corolla both stamens stand below the short upper lip; the lower lip on that account appears larger and more vividly coloured, because no stamens arise from it. Should the stamens now be taken completely away, the equilibrium between the two lips must be restored. The Peloria consists then of a whorl of leaves completely reduced (verschmolzene) to corolla; and exhibits spots all round the base, because all round no stamens have come to perfection. Neither of the Peloriæ was terminal. The stalk of one was even so much grown together for its whole length with the stalk of a completely normal neighbouring flower, that the calyx of each stood with its back to the other, and both the corollæ were extended almost horizontally.

Linaria vulgaris. Monstrous flowers described by E. Heufler, (Linnæa, vol. xvii, p. 10.) A very remarkable monstrosity, and deserving of notice because it is out of the usual routine of metamorphoses. The upper lip of the flower had nothing peculiar, beyond the rudiment of a spur on the dorsal surface. The lower lip was decidedly larger, and was increased by one or two mis-shapen lobes; the throat more swollen and excessively wrinkled. The four stamens were changed into trumpet-shaped tubes. Each individual tube stood out from the throat at a different inclination. The lowest part was like a spur; the middle was set with orange-coloured hairs; the uppermost part was again smooth, and opened in the most various ways. The margin was turned irregularly outwards, and in every single segment differently formed. The rudiment of the fifth stamen had become a similar tube-shaped leaf, which from the inner surface of the upper lip was free, and projected beyond the flowers. This metamorphosed fifth stamen was very delicately formed; quite naked and transparent, of a dilute sulphur-yellow tint. Very often were traces of a sixth and a seventh stamen present, either in the form of a transparent spiculum, or as a delicate pedicle, bearing a yellowish, leaf-like scale. Instead of the pistil, a second flower more or less developed was present. From the description of this Peloria, we see that it is no retrogradation from a normal flower, bnt an advance towards a more highly developed form of inflorescence.

Veronica sibirica fasciata. Kirschleger, (ibid. p. 10.) Description of one of those Veronicas with a flattened stem which divided superiorly into two portions. Of the internal structure the author merely states that the transverse section of the stem presented a single pith. A few words are added on the origin of this malformation, to the effect that two or more stems have grown together. This must, however, have been apparent from the internal structure.

Campanula persicifolia. Kirschleger, (ibid. p. 3.) The leaves of the plant constantly approximated more to the character of flowers as they reached the upper part. The leaves of the stem, from the ninth to the thirteenth, had their margins crisp and wavy; from the thirteenth to the eighteenth they had a blue colour; from the nineteenth to the twenty-third the leaves continually diminished in size, and were of a greenish-blue, very pale colour; some were coherent by their margins. A whorl of half-flower, half-leaf-like organs were developed, before the five verticillate stamens appeared. Each of these last bore at its upper and anterior part a two-celled well-developed anther, whose cells were filled with pollen not yet granular. Each cell belonged to a half of the leaf, and was divided from its fellow by the midrib. The pollen masses, both on the anterior and posterior surfaces, appeared to be covered by an epidermic membrane. Each cell was divided into two long chambers (Concamerations), which were bent inwards at the margin where the anther opened. At the extremity of the axis were three free carpellary leaves; no traces of ovules could be seen. The monstrosity appeared to be occasioned by the sting of an insect.

Tragopogon pratensis. Kirschleger, (ibid. p. 5.) The external florets, which were much larger than the internal, presented a calyx of five linear sepals; a corolla of a yellowish green, at the top slightly five-toothed, at one side cleft down to the base; five free stamens; two long, pointed, green pistils, and between them a new calathidium consisting of thirty florets. The conclusions are easily drawn.

Rosa gallica prolifera. Kirschleger, (ibid. p. 7.) The calyx presented five pinnate leaves; the terminal leaflet of some was three-lobed. The axis was continued through the calyx, of uniform thickness; then followed five naturally formed petals, but the axis was prolonged and now become naked. At this part a small leaf appeared, which could only be regarded as the terminal leaflet, and whose midrib between the two stipules had a rose colour. Both the stipules were of delicate consistence, and rose-coloured. At the apex stood a distended rosebud with many carpels.

Philadelphus coronarius of Schlechtendal, (Linnæa, vol. xvi, p. 463.) The calyx consisted of four petiolated leaves, of which the two lower were longer, the two upper smaller, and extremely inequilateral, since one half was wanting. Eight petals; the stamens quite normal. Pistil free, otherwise normal. In the axil of the upper little sepal stood two small and differently curved petals; and between these, two short stamens, of which one bore a well-formed anther, the other a malformed one. Another flower showed the transition of the normal floral structures into the irregular forms described above. A third flower had a normal calyx and four petals, with which alternated other four floral leaves which evidently consisted of stamens. A fourth flower had its calyx divided into four segments, of which two were normal, the third presented a petiolated leaf, the fourth was much smaller, almost unilateral, and twisted spirally. An imperfect flower was present in the axil of each upper segment of the calyx. "Here is," says the author, "a union of the floral development with the inflorescence.

Berberis articulata Loiseleur, Kirschleger, (ibid. p. 1.) The author found a monstrous specimen of *Berberis vulgaris*, with leaves whose petioles were articulated at the apex. He concludes thence that the leaves of *Berberis* are properly only the terminal leaves of a pinnate leaf, as the allied species show. Willemet, in his 'Flore de Nancy,' says that he saw this monstrosity, and as he found no other *Berberis* in Linnæus than *B. vulgaris* and *B. cretica*, he concluded that it must be *B. cretica*. His nephew Soyer Willemet perceived this error, and called the plant *B. vulgaris monstruosa-petiolata*.

Loiseleur (Dictionn. des Sc. nat., vol lvi, p. 318), recognized clearly that this was not *B. cretica*, but yet he described it as a new species under the name *B. articulata*. Here belongs also *B. provincialis* Audib., the characters of which are given in the 'Reliquiæ Schraderianæ' (Linnæa, 1838, p. 381); Steudel has not made the correction in his botanical nomenclature, as we are reminded by Kirschleger. But when he, as it were, censoriously states that the expression "*spine*" should always be employed in the description, he is very incorrect, for in description the position of a part indeed must be specified, but morphological views, which may be very various, ought not to determine the name of the part.

Delphinium Consolida, Kirschleger, (ibid. p. 4.) The Corolla (the nectary of Linnæus) was protruded of five petals, and almost regular; the upper petals elongated into spur-shaped appendages, and these petals alternated with the sepals. This flower forms a proof of the views of Jussieu. But indeed they are generally received.'

I append here the notice of a paper, since it equally refers to transformations and monstrosities: 'On the Essential Nature of the Germinal Bud,' by Siegfried Reissek, (Linnæa, vol. xvii, p. 657.) "If the germinal bud," says the author, "be a true bud, then the nucleus corresponds to the nucleus of the leaf-bud, and the integument to its external leaves. In ordinary leaf-buds it holds good as a law, that the external and respectively inferior leaves are the oldest; and the internal leaves, which compose the nucleus, are the youngest; therefore, the nucleus itself is the youngest part. In the germinal bud the nucleus is always the oldest, the external integument the youngest part. There is here, therefore, a reversed condition. From this condition it is evident, that the germinal bud, since it deviates so decidedly, can in its vegetation be no bud. But the deposition of new parts in the leaf, normally proceeds in an outward and downward direction. Consequently, the germinal bud is a leaf. Just like the formation of lobes on a leaf, so the formation of the integument of the germinal bud proceeds outwards." I must, directly, contradict this. The nucleus of the leaf-bud is in no way composed of leaves; it is the rounded extremity of a branch, and is the first and oldest part of the bud, being formed by the protrusion of the medulla. I could show the author many drawings of this, one, or several of which, I shall shortly produce in my 'Anatomia Plantarum.' This new nucleus shoots out new leaves, but does not at all resolve itself into leaves. The development of new parts in an outward and downward direction is a normal process in the leaf-bud, and not in the leaf, which expands itself in all directions. The germinal bud is thus no leaf, but admits of comparison with the leaf-bud. It would be too diffuse for me to express my opinion on the succeeding individual propositions of the author, since I have almost always come to the opposite results.

With these general considerations of Monstrosities, (the preceding only refer to individual cases) are connected the "Malformations" collected by Professor von Schlechtendal, in the 'Botan. Zeitung,' part 29, p. 492. "The four-cleft margin of the Corolla of *Syringa vulgaris*," says the author, "frequently presents an additional lobe, which is generally not of corresponding size to the rest. In such cases, the number of stamens is also increased by one, and this in consequence of the division of one of them, whose filament curves itself, and on this incurvation appears a little spot which developes pollen. More rarely flowers are observed, and this happens especially in the white-flowered variety, the corollar limbus of which is divided into a number of lobes; from thirteen to twenty-five are sometimes noticed. The stamens are also more numerous in this case; two pistils standing near each other at the base of the flower show that the coalescence of at least two flowers has laid the foundation of this peculiar structure. In *Arctotheca repens*, the author observed three florets of the disc which were united together."

"Very frequently," says Von Schlechtendal, "we may notice the spiral twisting of the stem of the plant, and also of the leaves, commonly when their development has been interrupted in any way. This twisting often coincides with flattening. In *Triticum repens*, the author also remarked a twisting of the uppermost leaf, which he here accurately describes. In roots I have also frequently seen such a twisting.

DESCRIPTION OF PLANTS, WITH REFERENCE TO THEIR INTERNAL STRUCTURE.

1. *Phanerogamæ.*

Monographia Cycadearum, scripsit, F. A. G. Miquel, (Traj. ad Rhen, 1842, fol.) An excellent monograph. It commences with an examination of the internal structure of these plants, historically, and according to peculiar views. First, an accurate description of the internal structure of the roots, such as has not hitherto been given; and it would have been very desirable that the author should have given figures of them. The "gemmæ radicales" are remarkable, which the author justly compares with bulbs. But we may also regard the entire stem with its scales as a bulb above ground. The author quotes the observations of Faldermann, in the Imperial Botanical Garden of St. Petersburg, who produced young plants from the scales of dead stems. The scales are the leaves from which, as from the leaves of the varieties of Aloe, so long as they are still moderately fresh, we can rear young plants. The so called leaves are designated by the author, with Linnæus, "fronds;" and the individual leaflets, not in accordance with that term, he calls "foliola." They are branches, (as I have shown in a paper, not yet published, but which was read before the Academy in 1842, and of which a notice has appeared,) and as the author himself explains at p. 11. He says here, "that the female 'spadices' of *Cycas* were manifestly fronds, the ovaries transformed leaves; whence it follows, that we may regard the fronds as branches. The scales under the fronds are a much more convincing proof that they are branches. The leaflets of the American Cycadeæ, are attached to the rachis by a tumid base, almost articulated; those of the Indian and African varieties pass directly into it. The ovary of *Cycas revoluta* is minutely described; it is elongated, and terminates in a pointed tube. It consists, externally, of a cellular layer, made up of small dense and firm cells, filled with a yellow colouring matter, and of gum ducts (Gummigängen.) Then follows a hard woody layer of spiral vessels, which are coalesced below; and, lastly, there is an internal membrane of brown flocculent cellular tissue, which the author regards as the cellular portion of the funiculus, or as the placenta. The author considers these three parts as the pericarp, in which the ovule lies. It has a distinctly patulous micropyle. The testa consists of a thick strong cellular tissue, and its cavity before fertilization is filled for one third or one fourth with cellular tissue, the external portion of which appears membranous; the internal portion, on the contrary, is dense and spherical, and represents the nucleus. In progress of time this nucleus grows and forms the albumen; the testa coalesces with the flocculent cellular tissue. After impregnation, several embryos appear in one stock (Stamme), but only one is developed, which lies in the axis of the albumen. The radicle projects a little from the apex. It is united by a suspensory filament to the membrane, which covers the apex of the albumen, and is there free; but inferiorly it is for the most part adherent to the placenta and to the endocarp. The nut or putamen, is covered internally by the testa, and connected thereby to the tissue of the placenta, which presents as it were a smooth and dry membrane, with ramifying bundles of vessels, which diverge from the base (raphe). In the *Zamiæ*, the intermediate placentar tissue is almost entirely wanting, and we then see distinctly how the base of the testa is closely connected by vascular fibres with the base of the nut. The author, lastly, explains Bauer's drawings of the fruit of *Cycas media*, and subjoins some remarks on the fruit of the Japanese variety of *Cycas circinalis*.

He also describes the male organs. He saw the fruit of *Encephalartus spinulosus* germinating in the Amsterdam gardens; he compares his observations with the description given by Dupetit Thouars of the germination of a *Cycas madagascariensis*, and briefly points out the difference. In conclusion, the alliances of the Cycadeæ are referred to; he states their points of dissimilarity to all the families in whose proximity they have been placed. "Though Richard considered their habit as palmaceous," says the author, "yet is the difference very great. The internal structure of the caudex is quitė different, and like that of a dicotyledon; the leaves are not sheathing, but distinct from each other, and there is no resemblance in the formation of their sexual organs." But the structure of the sexual organs in the Palms is extremely various; the scales of Cycadeæ are the true leaves and are sheathing; the internal structure of the stem is exactly as in *Phœnix* and allied palms, which as Cocoideæ, I have for a long time in my lectures distinguished from the Arecaceæ. But more on this subject in the sequel. Then follows the description of the individual genera and species.

De *Encephalarto Lehmanni*, scripsit G. H. de Vriese, (Tydschrift voor naturl. Geschied, vol x, part 1, p. 59.) This is a letter in very good Latin, (an unusual thing with botanists of the present day,) addressed to Miquel, and containing a minute description of the just mentioned plant, and its history. The author remarked that in autumn, after the plant had flowered, new leaves arose near the remaining peduncles, whereby the cicatrix of the peduncle was pushed on one side. There was thus in the flowering cones a terminal evolution, to which a lateral evolution of the leaves succeeded, and the author supposes that the irregular bränching (Verästelung) of the Cycadeæ, which we sometimes see in old stems, happens in this way. A letter, written in equally good Latin, from Miquel to De Vriese, in the same periodical, p. 68, treats of Loddige's Cycadeæ.

Les Observations sur les Musacées, Scitaminées, les Cannées et les Orchidées, par M. Thém. Lestiboudois, in the 'Ann. des Scienc. naturel.' vol. xvii, pp. 205 et 257, contain only descriptions, in which the author has paid but little regard to the views of others.

Literary Researches on the Lily of St. Jaques (Jacobæa Lily), followed by Observations on the Anatomy and Physiology of that Flower, by Ch Morren, (Bulletin de l'Académie Royale des Sciences, vol. ix, part 1, p. 302.) This is an account of the *Amaryllis formosissima*, Linn., which is now called *Sprekelia formosissima*, a name, as the author justly remarks, to which no reminiscences are attached, and which a rational etymology would not even have permitted. Simon de Tovar, physician at Seville, in the year 1595 received bulbs of this plant from Mexico, from which he obtained flowers, some of which he sent to the Count von Aremberg, through whom they came into the 'Gärten der Liebhaber.' Linnæus supposed he had made the observation in this plant that the stigma secretes periodically a fluid which it again absorbs; but the author found that this fluid proceeds not from the stigma, but from the bottom of the perianth; that this did not take place periodically, and that the fluid was not reabsorbed, but dripped off. The author next considers the metallic lustre of the flower. It proceeds from the dermis, which has a peculiar structure, the cells being filled by a transparent red fluid, and also from the innumerable air vesicles which occur in the intercellular passages beneath the dermis; these little air cushions present a mirror, in which the ruby red of the cells of the dermis is reflected. Both the dermic layers, the upper and the under, are formed of cellular tissue with conical cells, which some anatomists falsely (why ?) have called papillæ. The conical cells are short, hexangular at the base, and present a conical elevation in the middle. Opposite this cone, in the cavity of the cell a large granular cytoblast, of a whitish yellow colour, rises, and the remainder of the cell is filled with a beautiful red fluid. In the air this fluid changes its colour, and becomes of a blueish green. On the upper surface the conical elevations are more marked than on the lower." The air bladders mentioned seem to me not to contribute to the lustre. I have long ago stated, that the peculiar velvety lustre of the leaves of flowers and mosses arises from papillæ, namely, these conical elevations of the cells; the larger the papillæ, the greater the lustre. If the papillæ be wanting, the flower appears altogether lustreless, as in *Plantago*. The author adds some remarks on the wavering (Schwanken) of the anthers, and on the form of the pollen-grains. According to Mohl, the external membrane may be without cells; the granules in the interior are seen through it. The large pollen-tubes run into the elongated cells of the stigma, and traverse the middle of the style, where a number of them may be seen.

Researches on the Vegetable Ivory, by M. Charles Morren, (Bulletin de l'Académie Royale des Sciences de Bruxelles, vol. ix, part 2, p. 362.) The Vegetable ivory is the dense albumen of a nut from which numerous elegant articles may be turned; an application of it first made in England. This nut has been known a long time, and comes from a tree which is nearly allied to the Palms, or, according to Endlicher, to the Pandaneæ; Ruiz and Pavon call it *Phytelephas*, Willdenow terms it *Elephantusia*. It grows, according to Humboldt, in the interior of South America, on the Magdalen river, and near Ibague, in South America, and not on the Mascara Islands, as stated by Morren. Hereupon we have a minute anatomical examination of the nut. It consists externally of four envelopes of differently formed parenchyma; then follows the albumen, the proper so-called vegetable ivory, which is externally dense and white, and of a remarkable structure. We find, namely, towards the circumference cavities of irregular form; they then become six-sided, and when seen in section short straight canals run out from each angle. The cavities have a quincunxial arrangement. All the rest appears, when strongly magnified, a dense substance. But when a drop of Canada balsam is added, we see distinctly that the dense substance consists of parenchyma, and that the cavities communicate by the broader extremities of their branches. The internal structure resembles that of water-plants, and the different density and firmness might probably arise from the delicacy of the compressed parenchyma.

Systema Piperacearum, exposuit F. A. Guil. Miquel, (Roterod. 1843, 8vo. Fasc. 1.) A valuable book. The introduction treats of the internal and external structure of the Piperaceæ. Only a few of the author's statements can be quoted here. The stem of all the Piperaceæ, according to the author, has a swollen node, and is thereby articulated, but the origin of this node is various. In the Peperomiæ there is a terminal bud, which is the continuation of the stem, besides many lateral buds, whence the branches proceed; but in the Piperaceæ the process of elongation is interrupted at each node, and is carried on by a lateral bud. Such a lateral axis is with its first leaf surrounded by a "stipula oppositifolia," which, morphologically considered, is an abortive leaf of the axis. (?) The axis in these plants terminates in the amentum; consequently, at first the amenta are quite erect, but afterwards inclined to one side, as the lateral axis grows. The representations of the author are very correct. This kind of inflorescence occurs also in many umbelliferous plants, where I have called it "inflorescentia axillaris;" as in *Sium angustifolium* and *Sium nodiflorum*, whilst *Sium latifolium* retains the ordinary infloresence. The Piperaceæ are placed intermediately between Monocotyledons and Dicotyledons in all respects; and we may regard the stipule as the rudiment of a sheathing petiole, or a "ligula bipartita." The author further says that the stem has the internal structure of the Dicotyledons, wherein all botanists are agreed; but the wood is not disposed in perfectly concentric layers, but only cleft into sections by the medullary rays, and scattered woody fibres run without order through the pith. In a two-year old branch of *Peperomia magnoliæfolia*, we can distinguish neither pith nor woody layers, but only about twenty-five vascular bundles, irregularly disposed, and scarcely in circles, of which the outer nine are thicker, the inner gradually becoming thinner; and in the middle they stand so closely together, that no pith can be distinguished. In the older branches the pith is quite distinct from the wood, and contains scattered woody fibres; but the yet soft wood is by no means disposed in concentric layers, but only divided in a radiate manner by broad medullary rays. In several herbaceous species the woody fibres are so irregularly distributed, that no medullary rays can be distinguished. This form also stands intermediate to the Monocotyledons and Dicotyledons. Besides the Piperaceæ, it also occurs in the Amaranthaceæ, many Chenopodeæ, Nyctagineæ, &c. We must not, however, confound this form with that which occurs in Cucurbitaceæ, Umbelliferæ, and many other herbaceous plants, as has often been done, where only the woody layer with medullary rays is divided into numerous segments by cellular tissue. Upon the leaves the author remarks, that they only acquire an opposite arrangement in consequence of the contraction of the nodes, by which means both leaves are approximated; but that only one leaf occurs on each member: the two leaves also do not arise simultaneously, but one is developed subsequently to the other. He lastly assigns the Piperaceæ to the Dicotyledons, only because the embryo-sac has a lateral projection, and the embryo is developed from it. But since the embryo is but very small, and appears only, as the author says, like a "gemma bilota," the germination might very well stand intermediate to Monocotyledons and Dicotyledons.

Observations, Anatomical and Organogenic, on *Lathræa clandestina*, L., by M. P. Duchartre, (Compt. rend. de l'Académie des Sc. à Paris, 1843, part 2, p. 1328.) We will only quote the termination of this anatomical description of the plant, where mention is made of the fruit and the seed. This plant is remarkable, because the capsule when ripe opens suddenly, and the two valves roll up with such an elasticity, that the large seeds are projected from 60 to 90 centimetres. The cause of this phenomenon depends, according to the author, on the existence of two layers in the pericarp; the external one thick, almost fleshy, formed by large cells, which are elongated from within outwards, and which generally become wider at the end which is turned away from the centre of the fruit; the internal thin, almost leathery, consisting of small oval cells, whose greater axis is parallel with the surface of the capsule. The swelling out of the cells in the first layer causes each one to press on those which are adjacent; whence the result of the whole in each valve is that they acquire a disposition to curve inwards. The author has here, probably, wished to give an explanation after the fashion of Dutrochet. The double layer of cellular tissue occurs in nearly all pericarps, which do not however forcibly spring open. Moreover, a swelling up of cells in the vegetable kingdom never takes place suddenly, and consequently a sudden action could not very easily be conceived to depend upon it. The seed, continues the author, is, in the growing state, invested by a very thin testa, or spermoderm, which consists of three layers of fibro-cellular tissue between two layers of simple cells. Internal to these there follows a large, white, dense albumen with large cells, which are remarkable for the thickness of their walls, and the depth of their dots (ponctuation). Lastly, there is the very small embryo, which lies in, and completely fills up, a cavity in the albumen; this cavity is toward the margin of the seed, and near the umbilicus. The embryo has the form of a little ball, on the outer surface of which a little papilla, the radicle (mamelon radiculaire) is situated; opposite are the two somewhat unequal cotyledons, and between these a little elevation, the commencement of a gemmule.

Report on a Memoir by M. Payer, entitled Morphological Studies on Anomalous Inflorescence; and on a Memoir by M. Naudin, entitled Studies on the Vegetation of the Solaneæ, the Disposition of their Leaves and their Infloresence. (Compt. rend. 1842, part 2, p. 147.) In some natural orders the branches do not always arise from the axil of a leaf or of a bract, but stand free. St. Hilaire explains this anomaly by a growing together of the base of the leaf and the stem. This hasty explanation has now been carefully analysed and adopted by Naudin and Payer. Naudin speaks only of the Solaneæ, Payer of the Crassulaceæ, Borragineæ, and Cistineæ. Besides the growing together, both, however, assume a cessation of growth in the main stem, instead whereof the branches acquire or usurp its place, and are hence called "rameaux usurpateurs."

The Anatomical Observations on the Structure of the the Melocactæ, by P. F. A. W. Miquel, (Linnæa, vol. xvi, p. 465), contain only the confirmation of earlier observations, together with some corrections, and are without figures.

Contributions to the Anatomy of the Cacteæ, by P. Hartingh, (Tydschrift voor natuurlyke Geschiedn., vol. ix, p. 181. See also 'Botanische Zeitung,' part 6, p. 97.) As this paper contains only the confirmation of earlier observations, and the refutation of others, we may conveniently refer to what has been said in the 'Bot. Zeitung.'

Cereus Napoleonis, or, Observations on the Anatomy and Physiology of that Flower, by M. Ch. Morren, (Bulletin de l'Acad. Roy. de Sciences des Bruxelles, vol. ix, part 2, p. 210.) The *Cereus Napoleonis* is commonly distinguished in the garden as the largest variety of *Cereus triangularis*. The author first gives an external description of this plant and of its beautiful flower, which is rarely seen. He then speaks principally of the stigma canal. Whilst he is on the subject of its scent, he quotes two experiments, in which he immersed under water a spike of *Orchis bifolia*, so that it could only give out its odour through the water; nevertheless, during the night a delicious odour expanded itself, proving that the reason why plants give out their odour only at night, is not in consequence of the exhalation being more condensed by the coolness of the night.

Studies on the Anatomy of the Grape, and the Colouring of Wines, by Ch. Morren, (Bulletin de l'Acad. Roy. des Sciences de Bruxelles, vol. ix, part 2, p. 511.) The author examined the grapes which are principally cultivated about Liege; but he also paid attention to those from Italy and Portugal. The epicarp, or external membrane of the berry, consists of two layers; the external is composed of prismatic or octohedral colourless cells, without nuclei or cytoblasts, and in the Italian, Spanish, and Portuguese grapes is remarkably thick; the internal layer consists of similar cells of a red colour, which contain a small whitish cytoblast, surrounded by a red fluid, in which little globules occur. The sarcocarp, or flesh of the berry, is red at the part where it borders on the epicarp, but elsewhere colourless; its cells are oval, or sometimes prismatic. It is traversed by vessels, which constitute two systems, a central, and a peripheral one, which forms an elegant network within the external membrane. The cells of the sarcocarp have a radiate direction from the centre to the circumference. The most remarkable part of the sarcocarp is that which extends from the network of vessels to the epicarp, which contains on its outer surface red, then green, and lastly, white cells, filled with little globules and a cytoblast or chlorophyll. But we find, moreover, under the epicarp, a great number of dark red, broad, discoid bodies, which the author calls "coreses," from the Greek κόρη, (pupilla.) Careful observation shows that they lie external to the cells, and not within them. If they be detached from the cells, it may be readily seen that they consist, like chlorophyll of rounded granules, with little granules in their interior, and that they secrete a red, violet, or blueish fluid, which surrounds them like a cloud. Such a regular secretion between the cells has not been hitherto observed. Are not these granules inclosed in a dense membrane, like raphides?

On the Anatomical Structure of some Magnoliaceæ, by H. R. Goeppert, (Linnæa, vol. xvi, p. 135.) We will here state only the result of these inquiries, namely, that on more accurate examination the, perhaps merely conjectured correspondence between the species of *Tasmannia* and *Drimys*, and the Coniferæ, is found to have no existence whatever; and that it is limited to a very singular resemblance, depending on apparent uniformity of construction of the woody substance from porous parenchymatous cells: but even in this particular, passing over the difference in the form of the medullary rays, there are so many discrepancies that they cannot be confounded with the Coniferæ.

2. *Ferns.*

On the Dotted Vessels of Ferns, by J. W. Griffith, (Annals of Natural History, vol. x, p. 169.) The author describes the dotted vessels of Ferns, which in reality are not different from the dotted vessels of Phanerogamous plants. By means of laceration we can often recognize the remains of a membrane, which filled up the dots; proving that the vessels consist of two coats, one very delicate, and the other formed by the united fibres. We have been long agreed on this subject in Germany. The tubes are not real sap-conveying ducts, since they uncoil without breaking, and contain air; neither can they be regarded as a form of woody tissue, for the last-named reason, and because the dots are spirally arranged. [They are not scalariform vessels, as their markings do not extend across the tube, nor are they angular.] The author is of opinion that they are altered spiral vessels, and have the same function. They are porous vessels, which very often tear in a spiral direction, and have a spiral arrangement of the apparent pores, and also often contain air, but at other times the nutritive fluid; they belong undoubtedly to the woody tissue. The author believes that spiral vessels may have more than one mode of origin, and adduces the mucoid secretion containing spiral fibres, afforded by the seeds of the Acanthaceæ. We see from this statement that the author does not neglect his subject.

Observations on Hybrid Ferns, by E. Regel, (Botanische Zeitung, 1843, part 32, pp. 537, 538.) The author enumerates the different forms which are brought up in our gardens as hybrids, without however giving any more accurate description, or explaining their origin. They occur only in the genus *Gymnogramma*, and indeed only in the sub-genus or section which I have named *Ceropteris*. Vide "Filicum species" in (Hort. Reg. Botanic: Berolin, 1841.) The forms known to the author are as follow:

1. Between *Gymnogramma chrysophylla* and *G. peruviana* is *G. L'Herminieri* (Filic. sp. p. 164.)
2. Between *G. chrysophylla* and *G. distans*, a form (*C. Massoni*, Filic. sp. p. 143.)
3. Between *G. chrysophylla* and *G. dealbata*, stands *G. Martensii*.
4. Between *G. chrysophylla* and *G. calomelanos*, two forms. (One is *G. Martensii*, Filic. sp. p. 143.)
5. Between *G. calomelanos* and *G. distans*, one form.
6. Between *G. dealbata* (*G. tartarea*) and *G. calomelanos*, also one form.

There is no doubt that these intermediate forms must be reckoned not as hybrids, but as varieties. It is known that there are many genera, and among these many species more liable than others to variety; as, for instance, in the willow tribe, among which *Salix aurita* is much more subject to variety than *Salix pentandra*. In the genus *Ceropteris* the variable waxy excretion is superadded, which is sometimes yellow, and sometimes white, and even both white and yellow in one and the same plant. However numerous at the present time are artificially-produced hybrids, yet they are seldom produced by nature, or rather in nature, and least of all can we expect them among cryptogamous plants, where the male pollen is so concealed, that it cannot be widely distributed, although it may be generally present.

3. *Algæ.*

F. T. Kützing. The Conversion of the lower Forms of Algæ into higher, as also into Genera of altogether different families and classes, of higher cellular Cryptogamous Plants, (in Natuurkundige Verhandelingen van de Hollandsch. Maatschappy d. Wetensch. Tweed. Verzamel. 1 D. Haarlem, 1841, p. 1.) It is necessary to refer to this prize essay, which forms nearly the entire volume, since the author appeals to it in the subsequent work. It is the development of Algæ, of Lichens, and of Hepaticæ, from the *Protococcus*. It would be very unjust, if we were altogether to reject these accurate and careful observations, and should wish to explain as false the conclusions which are founded upon them. The author regards the *Protococcus* as a primary form, proceeding either from original or equivocal generation. He then describes the transition of Protococcus-granules into many Algæ, and through *Conferva tenerrima* into Mosses; also the development of Lichens from granules of this kind. On account of his adoption of original generation, he will not please those who regard the atmosphere as an accumulation of germs of all kinds. They will say that the spores are by no means the seed, but that they only inclose them, and in this they may very often be right. But the analogy with Phanerogamous plants is in fact entirely hypothetical, and probability is much more in favour of the author than against him. But on the other hand we may ask, how can we explain the difference of the species of Lichens met with upon a single stone, or a single trunk of a tree; or, if the author would deny these to be different species, how are the different species of Mosses, which not unfrequently grow intermixed with one another, to be explained as arising from one and the same species of *Protococcus*, or from one and the same *Conferva tenerrima?* Will the author convince us that two granules of *Protococcus*, from which proceed different species of *Algæ*, *Lichens*, or *Mosses*, or that the delicate *Confervæ* producing a variety of mosses, do not differ, although they show no difference even to our aided vision? Do we find differences in the embryo of the hen's egg, after but a few days of incubation? But nevertheless we are convinced that the rudiment must already possess distinctive characters corresponding to those of the particular variety, for that particular variety of the hen becomes developed. If this happens in animals of so high a scale of development, how much more will it be the case with the more feebly developed cryptogamous plants. If even we do not rigorously insist upon some præformation, as was formerly assumed by Bonnet and his followers, yet we must assume that the foundations are determined, or have determinate tendencies, since otherwise the constancy of species and even of varities could not be accounted for. As for the rest we would regard the observations of the author as affording a foundation to be built upon subsequently, and the first question to be solved might be, to investigate the difference, or the similarity and identity of the Protococcus-granules, and their varied development, with reference to the different species and varieties arising from them. The multiplicity of scientific terms makes the perusal of this treatise disagreeable.

'Phycologia generalis,' or the Anatomy, Physiology, and Systematic Arrangement of the Algæ, by Dr. Fried.

Aug. Kützing, (Leipz. 1843, 4to. p. 458, eighty coloured engravings.) A work which constitutes an epoch in the knowledge of Algæ, and is a considerable advance in science. It was necessary to condense the particular facts, in order to arrive at a general view of the subject; and it is here especially, on account of his own researches, which were not, however, made without regard to the inquiries of others, that we have to thank the author for his labours. We cannot give any abstract of the entire work, a few notices must suffice. The author states justly, that there are creatures manifestly intermediate between plants and animals, and I should not at all object to many of such creations being referred equally to either kingdom. Others might be arranged in that division to which the greater proportion of the vegetable and animal properties might entitle them to belong. To the true intermediate forms belong the Diatomeæ. In a division of the Diatomeæ, namely, the Desmidiæ, the author discovered starch, which he holds to be characteristic of the vegetable kingdom. We may look upon this as a collateral argument, but not as a fundamental axiom. The author believes that some species of *Hygrocrocis* are probably collections of Monads; the *Oscillatoriæ* and Corallineæ are correctly referred to the Algæ, and *Alcyonidium* restored to the animal kingdom. The including of the Sponge, by the author, among animals, does not seem altogether appropriate; the genus might be referred to either kingdom equally.

The first book treats of the constituents of the Algæ. In the chapter on the inorganic constituents of the Algæ the colouring matter is specially treated of, and the author distinguishes besides Chlorophyll, Phycokyan, Phycoerythrin, and Phycohæmatin. Phycokyan, occurs in *Lemania torulosa, Thorea ramosissima*, several *Oscillatoriæ*, especially *Oscillatoria princeps*, and some *Vaucheriæ;* it is produced by a kind of fermentation in the plants mentioned, when they are laid thickly together, and are kept constantly moistened; an accumulation of blue fluid being the result. Alkalies viz., potash, soda, caustic ammonia, cause an immediate change of colour, but it is restored by acids. Phycoerythrin is contained in *Callithamnion* and *Griffithia*, principally in the Delesserieæ, and appears during desiccation as a red fluid. Water, alcohol, ether, oils, and acids do not extract the red colour from the dried Algæ; but it is removed by ammonia, and the Algæ acquire a dingy violet, or violet-green colour. Acids restore the original red colour. If the Algæ treated with ammonia be digested in absolute alcohol or ether, they colour these fluids green, and chlorophyll remains on evaporation. Sunlight bleaches Phycoerythrin, and the colour can in no way be restored. Phycohæmatin has hitherto been found only in *Rhytiphlæa tinctoria;* it is dissolved by digestion in water, and precipitated by pure alcohol. Among the organic components of these plants he enumerates first, the mucus, or the intercellular substance, according to Mohl, as is added between brackets; also the Phytogelin, which by boiling in water is changed into vegetable jelly. The author distinguishes gelatinous, cartilaginous, and corneous gelatine (gelin). "In many palmelliform species," says he, "the soft gelatine-cells are so united together, that they appear to constitute only a single homogeneous substance." Lastly, the Amylid, and the cell-globules (Gonidia of Walroth; Chromatidium of Link).

In the second book is contained the Anatomy of the Algæ. First, of the gelatine-cells, which consist of a double membrane; and then of the starch-cells. Most of the gelatine-cells inclose, according to the author, another extremely delicate cell, whose substance differs from the gelatine, and which is called Amylid. In it are developed the fine nucleoli, which are contained in the cell. Sometimes this substance cannot be distinguished from the nucleus of the cell, as in the genera *Nostoc*, *Palmella*, several *Oscillariæ*, &c., but sometimes it is distinctly different, and can be well observed in the larger Confervæ, the various species of *Spirogyræ*, and many others. Then follows an account of the "gonimic" cell-contents, of the cryptogonimic, monogonimic, and polygonimic cell-contents; as the cells contain, respectively, merely a fluid, or one nucleus, or several nuclei. In the cellular fluid of many Algæ we find small, freely-swimming Gonidia, which have a lively spontaneous motion; they are seen especially in *Œdogonium vesicatum* and *capillare*. There follows now the developmental history of the elementary organs, in which it is perplexing that the author does not draw a marked distinction between the cells and their contents, the Amylid-cells, for instance, or his "Exenchyma," and what he calls gonimic tissue or Parenchyma, but treats of the whole conjointly. The cells are a quite distinct and more defined structure than the membranous or granular substance found in their interior. We will now only quote his observations on the proper cellular tissue, or algal-tissue (tanggewebe), as the author calls it. The development of this tissue takes place:

1. By division of the cells.

2. By conjugation of already complete cells.

3. By interstitial deposit; when new individual cells appear between cells previously existing and partially connected.

4. By the growth of interstitial fibres in previously existing cellular tissue.

5. By a growth, not like the last, from the periphery to the centre, but proceeding from the centre to the periphery.

6. By apposition; where the commencement of formation originates in a globule, or minute cell, which grows on the outer surface of an older cell, increases in size, and remains in connexion with it; this appears especially in the verticillate ramifications. It is readily perceived that these varieties in development differ very widely from each other in their nature. The work itself must be consulted for the description of the different forms of the algal-tissue. The compound organs are next treated of; and first the Phycoma, or body of the Algæ (Algen-

körper). Why has not the author retained the expression "thallus," which very suitably represents the fundamental portion of the whole plant, and groups together three families which are very nearly allied, and to which it is difficult to assign accurate distinctive characters, viz. the Algæ, Lichens, and Fungi? The term "Phycoma" is again subdivided into "Trichoma," "Phylloma," &c. The author now goes through the forms of the "thallus," the "phylloma," and "cauloma," which, however, differ but little from each other, and then speaks of the external integuments, of the mucous vessels, the air cavities, and the flocculent conceptacles. Many Algæ have also roots (but these do not differ in their internal structure from the remainder of the thallus). "The most essential part of the fruit of the Algæ," says the author, "is the seed," (seme), (spermatium, spermatidium.) Many fruits consist of this only, and these he calls naked fruits, "gymnocarpia;" others are surrounded by a special envelope, and are then termed "angiocarpia;" the envelope itself "spermangium." It always incloses several seeds. Where, moreover, several "angiocarpia" are united together, a "carpoma," or fruit body is formed (Frucht-lager, Frucht-körper.) Thus again, as was done by Acharius, has he invented new scientific terms for one individual family, which might very readily be placed with others. But the following classification not being a classification of special organs, but of species, is much more to the purpose. The author, for instance, goes on to say, "All fruits are alike in the form and structure of their seeds, as well as in the kind and manner of their development; but certain differences are presented in the coverings of the fruit, and in the arrangement of the seeds as to form and number. In one half of the Algæ the fruit is produced in one and the same manner, and is similarly developed in every individual; these Algæ are called "isocarpeæ." In the other half of the Algæ, on the contrary, it always appears in a twofold manner on different individuals, and these are called "heterocarpeæ."

The true, ripe seeds," adds our author, "are free, hologonimic Amylid-cells, which are commonly surrounded by a more or less thick, sometimes single, sometimes double gelatine membrane." In an appendix the author collects the different scientific terms for the organs of Algæ, whieh ought to have made him cautious in inventing new ones. We shall shortly have some one else who will reduce his unnecessary terms in turn, to synonyms, which is to be regretted in so excellent a work. The propagation of the Algæ in the different forms is minutely described from his own observations; it consists, generally speaking, in a very simple development. The propagation from original generation is also here assumed. The nutrition of the Algæ is a subject as yet but little known, but on which some appropriate remarks are made. In the second part of the systematic arrangement, all the known genera and species of Algæ are mentioned, and the number of new species is very astonishing, our acquaintance with which we owe to the author.

Plants observed at the Moment of their Transition into Animals, by Dr. Fr. Unger. (Vienna, 1843, 8vo, 98 pages, and a plate.) With that amiable enthusiasm which reminds us of the pleasant times of the observation of nature, when observers were attracted by the wonderful instincts displayed by the minute animals, does the author relate, in a letter to Endlicher, a singular phenomenon which he had observed in one of the Algæ, in *Vaucheria clavata* (*Ectosperma clavata*, Vaucher). This little plant consists of a branched unarticulated tube, which derives its green colour as usual, from granules of chlorophyll. At the apex of the terminal shoot there appears in the normal condition a transverse septum, and in the upper division, resulting from this arrangement, from a colourless, slimy, and granular substance proceeds the formation of a pouch, adhering closely to the primitive membrane, and constituted of ciliated epithelium.

In the sacculus itself, or in the interior of the so-called "sporidium," only a slight trace of organization can be perceived. By the swelling of the ripening sporidium simultaneously with the thinning of the apex of the parent sacculus by absorption (elongation), this latter bursts, and the sporidium spontaneously forces itself through the narrow opening, and finally even with a rotatory motion. This process lasts several minutes. The sporidium is an oval or elliptic body which, when liberated from the parent sacculus, moves freely in water in all directions, with a rotatory movement from left to right, progressing at the same time. An epithelium uniformly furnished with vibratory cilia gives rise to these motions. Periods of rest alternate voluntarily with those of motion, and the motions are sustained on the whole for about two hours. With the cessation of the movements, the ellipsoid acquires a spherical form, the green colour becomes distributed more uniformly, and the glassy transparency of the epithelium is transformed into a delicate homogeneous vegetable membrane. In less than twelve hours the vesicle elongates by a direct bulging out in one or two places at once, and this is accompanied by the phenomena of germination. The development of the sacculus advances rapidly. On one side is formed a root whereby the little plant fastens itself; whilst the other process increases in length, and becomes branched, and within fourteen days arrives at a similar formation of spores. This is the course of the wonderful phenomenon described partly in the author's own words. In the commencement of the letter he says, "The motility of the sporidia of the Algæ, and especially of those of *Vaucheria*, was not regarded as a very peculiar phenomenon, or, at least, as an animal one. Link, Oken, Schlechtendal, Meyen, R. Brown, Valentin, Ehrenberg, and many others, have expressed this opinion. Although I find myself in good company, I must nevertheless quote a passage from the 'Propyläen der Naturgeschichte,' which belongs to this subject, see page 279. "It is a remarkable phenomenon that the ova of many animals possess spontaneous motion, and even of those animals which themselves are not locomotive. Grant observed this in the Sponges, in *Gorgonia verrucosa*, *Caryophyllæa calycularis*, *Plumularia falcata*, and others. If these were the young just escaped, as the ciliary motion in the ova of *Campanularia dichotoma* seems to show, it is still very astonishing, that the young individual of this kind in its earliest condition can move from place to place, while the adult animal is fixed. Such motions have also been observed in the germinal granules of some Algæ, a fact which has given room for many hypotheses. The vitality of a plant is enhanced at the time of fertilization, and we might thence readily expect, that exactly in the transition from the animal to the plant, the highest advance in the seed and in the ovum would take place." In another place it is said, that a more animal development occurs even in the leaf than in the stem; the leaf is developed like a part of an animal, since it appears from the very commencement in outline; but not so the stem. Lastly, the author puts a question to the point, and says, "That a plant may assume an animal mode of development is certain; and if it can do this, what hinders me from saying that it has done, and is doing it very frequently? what hinders me from supposing that originally the whole animal kingdom, and even man himself, may be a production of the vegetable world?" But the plant can give to its seeds only a very transient animality, and not a permanent one. Everything in nature proceeds by a gradual development, and the object of this mode of development is the creating of that manifold variety which at last reaches to consciousness, the highest aim of nature. Such I have represented to be my belief in the 'Propyläen der Naturgeschichte.'"

Researches on the Locomotive Organs of the Spores of Algæ, by M. Gustave Thuret, (Annal. des Scienc. naturell. 2d series, vol. xix, p. 266.) This treatise is annexed to, and refers to, the letter of Unger. In the first place, we have observations on the spores of *Conferva glomerata* and *rivularis*. They are perfectly alike in these two species; their figure is top-shaped (kräuselförmig); the attenuated colourless extremity, the beak, has two filamentous tentacula which are longer than the spores, and by which they move themselves. In this motion the beak sweeps out in front, and the spore rotates in the water with a kind of tremulous motion. From time to time it starts backwards, and turns upon its axis. A small quantity of extract of opium suffices to stop at once this motion; the tentacula are then better seen, as also when a little diluted tincture of iodine is added, and the spores allowed to dry between two plates of glass. *Chætophora elegans*, variety *pisiformis;* the spores, which are smaller, and difficult to observe, have four tentacles. *Prolifera rivularis* and *Candollii*, Leclerc (Mém. du Mus. tom. iii, p. 462), have oval spores; the beak is rounded, and has a crown of filamentous tentacula, by means of which they move rapidly. When the spores begin to germinate, they fasten themselves by the beak to anything that floats in the water, and send out root-like processes or hooks, with which they adhere very firmly. This adhesion is often formed upon the filaments of the Alga itself, and this misunderstood phenomenon has given rise to the name *prolifera*. The author now comes to *Vaucheria clavata*, speaks of Unger's observations on this Alga, and appends his own. The green matter is condensed in the club-shaped extremity of the filament, so that it assumes a blackish appearance. An empty space then appears at the base of the club, as if the mucus were also condensed, and had thrust back the green globules upwards and downwards (Unger's "septum.)" When a little carmine is added to the water, we see the currents which the ciliæ make in the water. Water which has stood over iodine stops the motion very quickly; the tincture of iodine must be very dilute. For the rest, the observations of the author correspond very nearly with those of Unger. "The plant," he adds, "possesses in all its parts the power of reproduction. Sometimes the liberation of the spores does not take place, and they germinate on the parent plant, giving rise to extraordinary forms. In the chlorophyll granules of the Alga he perceived no motion, except when a filament is ruptured, on which the granules come out by gushes.

Observations by Hassall on Algæ, *Enteromorpha intestinalis*, (Annals of Nat. Hist. vol. xi, p. 233.) In its youth this Alga consists of a series of cells. Each of these cells becomes bisected by a longitudinal line, to which many parallel lines succeed, so that the original cells are divided into several, each of which in its turn enlarges, and is again subdivided. They ultimately lose their confervoid character, and become hollow and cylindrical. He further observed that in the cells of this Alga, while they are still very small, a nucleus frequently originates, which germinates while still in the parent-cell, and produces articulated filaments, so that when the parent-cell breaks, parasitic confervæ appear to be attached to it.

On the Branched Fresh-water Confervæ, (ibid., p. 359.) The cells are developed not only in length, but in time also in breadth, so that the filaments decrease from base to apex. The reproductive cells are expanded. The author also says something about the Zoospores, with which we are now better acquainted. The genera *Bulbochæte* and *Microspora*, new genera, are characterized. (See also page 463.) The septa are said to be formed by a rent in the walls of the cells, and a folding in of the margins, and their subsequent coalescence; and not, as Morren thought, by a separation of the contents into two parts.

Observations on some Points in the Anatomy and Physiology of the Fresh-water Algæ, by Arthur Hill Hassall, (Annals of Nat. Hist. vol. xii, p. 20.) First, on cytoblasts in the Algæ. The cytoblasts in the genera *Zygnema* and *Vesiculifera* are the central organ, which Meyen had discovered in the genus *Spirogyra*, and which Schleiden calls a "cytoblast;" an accidental coincidence, since our author does not know Meyen, nor on this subject Schleiden, at least he makes no reference to them. He states that the structure of *Zygnema* is very complex. Each cytoblast is solitary, and commonly occupies the centre of the cell. It consists of two, sometimes of three membranes; the internal one represents the nucleus; the two exterior are separated from each other by a fluid. The external sends out many tubular processes which terminate in spiral filaments. The author regards the cytoblast as the stomach, which transmits the materials taken up and digested, through the processes to the organs, by which it is assimilated. When the cell has attained its full growth, these tubular processes disappear; but the body still grows, and the author believes that it serves for the fertilization of the transparent granules which are observed in the spiral filaments. Hypothesis!

Observations on the genus *Zygnema*. He divides the species of this genus into two sections; in the one are the cells which have attained their maturity implanted in each other, and in the other those where this is not the case. Of this adhesion Mohl has already treated, and the author refers to this, and adds an unimportant remark.

Observations on the genus *Vesiculifera*. Some cells are in part surrounded by regular rings. The author is of opinion that these rings contribute to the escape of the seeds, the membrane of the cells being ruptured by their approximation.

Observations on the genus *Mougeotia*, on two new genera of fresh-water *Algæ*, and on *Tyndaridea*, with description of species, by A. H. Hassall, (ibid., p. 180.) In the general remarks on *Mougeotia*, he says, "the species in which the filaments do not conjoin furnish a proof that the conjunction of two cells is not necessary to propagate the species." He then describes *Mougeotia ericetorum*, which very certainly does not belong to this genus; he also mentions even the distinctions, without regarding them as sufficient, which they certainly are. The rest belongs to descriptive botany.

In the same journal (p. 188) is inserted a note from Ed. Forbes, in reply to Hassall, and relating chiefly to Zoophytes and the occurrence of Fungi on living bodies, as Hassall had not made himself acquainted with what had been already written on the subject. Hassall is certainly a good observer, but he is seldom acquainted, and never accurately, with what others, especially foreigners, have already made known upon a subject.

History of the Development of *Chætophora tuberculosa*. Karl Müller, (Flora, 1842, 513.) Remarkable, and also already recommended by Hassall to repeated observation. This Alga has distinct sexes on the same plant. The male capsule is sessile, lateral, round, red, and having distinctly developed pollen-grains. The female is terminal, pedunculated, round, large, at first filled with transparent globules, then cellular. In fertilization the nearest male capsule approaches the female, and at the same time elongates, grows together as it were with the female, empties the pollen-grains into it, and is then thrown off. The female capsule contains distinctly, at first colourless pollen-grains; it then becomes green, and the green granules pack themselves together into little masses, generally into five. The capsule swells up, the contained granules become coloured, and are forced out of the lacerated capsule in all directions. From each of the emerging granules proceeds a clear transparent filament which propagates the Alga.

Batrachospermum moniliforme, observed by Naegeli, (Linnæa, T. xvi, p. 264.) An accurate description of this Alga, which does not admit of extracts. Especially remarkable is the formation of cells, not, however, in all parts of the filaments, which is given as the characteristic of the genus.

Spirogyra Hornschuchi is described by Hermann Karsten in the 'Archiv. d. Naturgesch.' Jahrg. 9, s. 338.

First, some observations on the structure of this Alga. The filament consists of three different membranes. The external one covers uniformly the entire plant, and incloses the close packed series of cells formed in its interior by the second membrane, whose contiguous walls form the transverse septa. In each of these cells is found the third, most internal membrane, a cell with very delicate parietes, which is everywhere uniformly applied to the parent-cell. Roth had already pointed out the first two membranes in most Algæ with transverse septa. The author now unites, as others have already done, *Spirogyra quinina* and *princeps*, but distinguishes a species discovered by him at Berlin, called *Sp. Hornschuchi*, "dissepimentis patelliformibus."

Note relative to the Distinctive Characters which separate Plants from Animals, and to the Mineral Secretions of Plants, (Compt. rend. 1843, P. ii, p. 16.) Properly only concerning the Corallines. The author shows first, that the calcareous deposit is only external; he then analysed a coralline, and found in it 6·7 per cent of azote, exactly as much as these lower plants usually have. After he had removed the calcareous crust by dilute hydrochloric acid, he observed in the subjacent tissue grains of starch, as the test with iodine proved. Corallines thus belong to the vegetable kingdom. The author is ignorant of what has been done upon this subject in Germany long ago. Given also in the 'Annal. des Scienc. naturel.' 2d series, vol. xx, p. 65, and in the separately printed work in which all the Essays of the author are collected, under the title 'Mémoires sur les développemens des Végétaux,' par M. Payen; Paris, 1842, 4to.

4. *Fungi.*

The three orders of cryptogamic plants, Lichens, Algæ, and Fungi, are so strikingly distinguished from the other

Cryptogamæ, namely the Mosses and the Ferns, that we must regard them as a special class, which I have long designated by the name Cryptophytes; but there is such a gradual transition from one to the other, that it is extremely difficult to assign their distinctive characters. We are accustomed to distinguish Algæ from Fungi by the fact that the former grow in fluids, which the latter do not. But the white flocculent thallus of *Penicillium glaucum*, unquestionably a fungus, occurs very frequently in solutions of sugar, dilute solutions of tartaric acid, &c. Conversely, *Trentepohlia Jolithus*, one of the Algæ, grows on mountain rocks, and never in water. I know only of two distinctions which may serve to indicate the limits of each order: first the absence of colour of *fungi* growing in water; and secondly, that the *fungi* or *mould* of lower development bear their fructification more externally, the Algæ more internally, or that the former shed the fructication in masses, which is not usual in the Algæ. A great many fungi, in a state of imperfect development, are included in the Algal genera, *Hygrocrocis*, *Leptomitus*, &c.

First, with respect to the vegetations which occur in, and upon living bodies; and although the investigation of these is not new, it has nevertheless been taken up during the past year with greater accuracy than previously.

We must turn back to the paper 'On a contagious Conferva growing upon the Water-salamander,' by Ad. Hannover (in Müller Archiv für Anat. Physiol. &c. 1839, p. 338.) On this essay Meyen has already very correctly remarked in his Annual Report for 1839, p. 63, that the plant is *Achlya prolifera* Nees, which occurs on many dead parts of animal and also of vegetable bodies. He also justly regards the contagious character as an ordinary propagation of this lower plant by granules or spores. Nees von Esenbeck, in the appendix to the treatise of Carus, (in the Nov. Act. Acad. Natur. Cur., vol. xi, P. 2, p. 403), has spoken of the plants which are intermediate between Algæ and Fungi, termed Hydronemata, to which the above-mentioned fungus belongs. He distinguishes plants with transverse septa which he calls *Saprolegnia*, and those without septa, which he terms *Achlya*. To the former class he refers a plant which Gruithuisen found on a dead water-snail (*Valvata branchiata*), and called *Conferva ferax;* to the second, the algal, or mouldy growth, described by Carus. Subsequently both genera have been united, and Kützing refers to the *Achlya prolifera*, in the above-mentioned 'Phycologie' (p. 157), as *Saprolegnia ferax*. I would rather ascribe this plant to the fungi; the filaments themselves are colourless, the spores or sporidia of a blueish gray, exactly as in the common mould *Penicillium glaucum;* the granules at the apex of the filament are also rapidly emptied out, one after another.

On a Contagious Confervoid Growth on Living Frogs, and on the Influence of the Nerves on the Circulation in the Capillary Vessels, by Dr. Stilling at Cassel (in Müller's Archiv für Anat. 1841, p. 279.) After a large but reunited wound, whereby the lower half of the spinal marrow was removed from the canal, frogs often survived for a month. The ends of the toes became white, and there grew upon them the so-called *Conferva*, which extended itself to other parts. The description and especially the drawing of the plant indisputably indicate *Achlya prolifera*. The movements of the spores are remarked, but erroneously interpreted. The author succeeded in propagating the plant upon living and dead animals. Although the author maintains the contrary, there is no doubt that the parts in which this mould grew were not in a living state. See also the following memoir.

Further Illustrations of the Contagious Confervoid Growth on Frogs and Water-salamanders, by Ad. Hannover (in Müller's Archiv, 1842, p. 73.) In opposition to the essay of Stilling who was inclined to reckon this plant among animals. The author shows that the motion of the granules or spores had been not unfrequently observed in *Confervæ* and also in *Fungi*, and he correctly regards the animalcules which Stilling had noticed on the filament of the mould, as accidental parasites. According to the description and drawing, the fungus is distinctly articulated, and would therefore be *Saprolegnia ferax*.

On the Conferva which vegetates on the Skin of a Goldfish, by J. Goodsir, (Annals of Nat. Hist. vol. ix, p. 333.) A good description of *Saprolegnia ferax* or *Achlya prolifera;* especially the transformations of the last articulation, before the evacuation of the spores, and the germination of the spores are well described. "The vesicle," says he, "elongates, and appears doubled, that is consisting of two cells; each of these cells then elongates, and acquires additional cells at its upper extremity." He describes distinct articulations, thus again the *Saprolegnia ferax*. Towards the lower end of each segment he observed a vesicle contained in the interior. Lastly, he says that the plant resembles in many respects those described by Hannover and Stilling. He observed satisfactorily the motions of the spores previously, but not subsequently to their escape.

In the essay on the Occurrence and the Nature of the Entophytes and Epiphytes of the Living Organism, in 'Klencke's Neuen Physiologischen Abhandlungen,' Leipsic, 1843, 8vo, at p. 36, there is a description of a *Conferva*, as the author says, which he found in the discharge of a glandered (rotzkranken) horse. There can be no doubt from the description and the drawings that this Conferva was the *Achlya prolifera*. The escape of the spores from the last segment, and their motions subsequently, are accurately detailed.

A Contribution to the History of the *Achlya prolifera*, by F. Unger, (Linnæa, Th. 17, p. 129.) The author met with this plant on sickly goldfish. He gives a very accurate description of it; and since he, a very excellent observer, saw only inarticulate filaments or tubes, we might be induced to believe that the plant with articulated filaments, which Gruithuisen and others subsequently have described, was in reality different. The granular contents of the tube are in constant motion; and beside the progressive motion, imparted to them by currents, they have also a peculiar molecular movement. When the end of the tube, by the increase of its contents, has become club-shaped, it is partitioned off by a transverse septum, whose origin is here described. The terminal tube now acquires a reticular surface; but the apparent cells arise from the gelatinous substance, which has been secreted from the granular masses, and which now, from pressure in opposite directions, become angular. This disappears, the previously compressed granular masses or sporidia elongate, and whilst the granules accumulate more posteriorly, the apex becomes transparent. The sporidia now come into motion, rush out one after the other from the parent-tube, move about like the sporidia of *Vaucheria clavata*, though the author could not discover any ciliæ, then become adherent and germinate. This copious account forms the keystone of the observations on this remarkable plant.

There is also a remarkable description in the recently quoted work of Klencke (p. 62) of a fungus which he found on the skin of a dropsical leg; and also, on two subsequent occasions, viz., on the margin of a gangræna ex decubitu (bed-sore), and on the toes of a paralytic patient. The fungus formed a crust, which appeared to the naked eye like a whitish powder, but consisted, under the microscope, of smaller white filaments, and of larger ones of a yellowish-brown colour, bifurcated, and inclined towards each other. On the inner side of these filaments grew pear-shaped sporangia directed towards each other, which as soon as they came in contact, discharged their spores into each other. This fungus is evidently a species of the genus *Syzygites*, which Ehrenberg, when he was studying in Berlin, found in the Zoological Gardens, and described and represented in his 'Inaugural Dissertation,' as well as in the 'Verhandlungen d. Naturforsch Frde,' Th. i, p. 91, t. 2, 3. See also my continuation of

Willdenow's 'Spec. Plant,' vol. vi, pt. 1, p. 94, Berlin, 1824. In this book also, at p. 93, the characters of a genus of fungi are given under the name *Sporodinia*, in which the spores pass over from the filaments of the thallus into the sporangium with a more evident motion. Along with this we may include:

On the Free Motion of the Spores of Nemaspora Incarnata Pers, by Professor Goeppert, in Müller's 'Archiv,' 1842, p. 145. When the author placed in water the red gelatinous filaments of this fungus, the enveloping jelly was dissolved, and the spores, which were extremely small, elongated, pointed at each extremity, and apparently transparent, became free, moving about and rotating, not merely in a horizontal, but also in a vertical direction.

We have treated above of *Achlya* and *Saprolegnia*, Fungi which occur externally on diseased living animal bodies; we have now to report what has been advanced concerning *fungi* in the interior of animal and vegetable substances.

Fungi in the Interior, observed by K. Naegeli, (Linnæa, T. xvi, p. 288.) In the roots of several species of Iris, of which it is not mentioned whether they were quite healthy, the author discovered fungi, which he describes and figures. He elevates two species into a special genus *Schinzia;* one of them he terms *Sch. cellulicola*, the other *Sch. penicillata*. The former seems to me an immature *Aspergillus*, the latter an immature *Penicillium;* the third species, the racemose fungus, is certainly a distinct form. The determination as to whether anything lies within the cells, or external to them, is, from the transparency of their walls, by no means easily made.

The Potato Epidemic of the last Year, by Dr. C. F. Ph. v. Martius, (Munich, 1842, 4to, with 3 plates of figures.) I quote this paper because the disease mentioned, has been especially ascribed to the action of a fungus. Undoubtedly this paper is the best upon the disease, which has for a time very much engrossed the attention of economists, and I might term it a model for such inquiries. After a literary introduction on potato diseases in general, follows a sketch of the disease, which is called dry gangrene of the potato, (trockene Stockfäule der Kartoffeln,) and also a description of the fungus which occurs in it. He refers it rightly to the genus *Fusisporium*, as an hitherto undescribed species, which he names *F. Solani*, and characterizes as follows: "Erumpens, pulvinatum; floccis erectis ramosis parce septatis, sporis ellipticis aut cylindricis obtusis septatis facile decidentibus." A second form, remarkable for its great longitudinal extension, and for the deficiency of the large cylindrical spore-granules, is described as a variety β. *sporitrichoides*. It arises from the same base (hyphasma), and is certainly only a variety. Rarely in this variety is remarked a second form with small roundish germinal granules, not provided with septa, as the result of a peculiar division (Abschnürung). Then follows a description of the potato scab (Kartoffelraüde); and the fungus which is always present in it, is also described. Wallroth termed it *Erysibe*, because he claimed for the name *Cæoma*, the older *Erysibe*, already described by Theophrastus; and what others called *Erysibe*, he has named *Alphitomorpha*. Had Theophrastus already distinguished *Puccinia* from *Cæoma?* He improperly calls it *Protomyces*, since this name rests on an hypothesis which is very doubtful. The author now with great care goes through the external and internal causes, which might produce a deterioration in the race, or a predisposition to disease, upon which the contagion is superadded as the proximate cause. On this point he expresses an ingenious idea. He compares the contagious character of the fungus with the inoculation of diseases in animal bodies. "The organic matter," he says, "which lies next to the source of contagion, reacts upon it, and undergoes an after organization, which is subjected, but with characters more or less individual and independent, to the same physical phenomena, by which the organism originally attacked showed itself to have been a recipient of the contagion. This is altogether equivocal generation, and like it hypothetical; but is it not still more hypothetical to regard the atmosphere, or the water, as a rich collection of the minute seeds of fungi, to which are added also the collected ova of infusoria, and the like?"

As a means against the disease, the purification of the seed potatoes from adhering germinal granules of the fungus is especially enjoined.

The following notices refer to the species of fungi found in living animals:

Cryptogamæ developed during life on the internal surface of the Air-cells of an Eider Duck (*Anas mollissima*), by M. Eudes Deslongchamps, (Comp. rend., 1841, pt. i, p. 1110.) The animal died in a state of dyspnœa. In the aerial cavities the walls were found occupied by patches of mould. These patches were round, and remarkably elevated in the centre. The fungus consisted of transparent unarticulated filaments, but little, if at all, branched, and which formed a felt. At the base, where they were attached, they were scarcely 1-50th of a millimeter in diameter; but further on they were of twice this size, and even more. In all parts of these filaments were seen globular or oval vesicles, of a whitish or greenish-gray colour. In some places, upright filaments projected from the felt, on the summits of which masses of greenish spores were supported; and after the shedding of the spores, presented the appearance of a disc. A fungus, which is nearly allied to the genus *Aspergillus*, if not a species of that genus.

This account is given in the 'Annals of Natural History,' vol. viii, p. 229, and at the same time, a similar case is quoted from the 'Philosophical Magazine,' 1833, vol. ii, p. 74, in which a mould-like fungus was found in the lungs of a Flamingo. An older case, from Montagu's 'Supplement to his Ornithological Dictionary' of 1813, in the article "Scaup Duck," is given by Yarrell in the 'Annals of Nat. Hist.,' vol. ix, p. 131, where it is stated, "The cause of death, in this female, appeared to be in the lungs, and in the membrane which separates the lungs from the other viscera; this latter was thickened, and the whole cavity lined internally with a *mucor*, or blue mould."

On the Formation of Fungi in the Lungs of Birds, there is a more accurate observation, by J. Müller, in his 'Archiv,' 1842, p. 198. He saw in the Anatomical Museum of Stockholm, a preparation of a *Strix Nyctea*, which died with severe dyspnœa. Yellow bodies, viscid and dense, round and flattened, marked by concentric rings on the surface, of increased thickness in the centre, occupied the mucous membrane of the lungs and of all the aerial cavities; and also the bones of the pelvis, wherever they were in contact with the aerial cavities. Another case was observed at Berlin in a falcon (*Falco rufus*), in which similar bodies occurred on the kidneys, and also in the aerial cavities in the chest. These bodies are round, from one fifth of a line to two lines and upwards in diameter; the surface smooth, depressed in the centre, presenting in the younger a cup-shaped excavation; and in the older, concentrically elevated zones; the under surface is flat and attached, but it may be peeled off without any injury to the subjacent mucous membrane. The author regards the mould which covered the surface of these bodies in the preparation at Stockholm as a casual occurrence, and it was wanting in the bodies observed at Berlin. In a transverse section, with a power of 600 diameters, were seen fine, unarticulated, branched, and anastomosing filaments; and besides these filaments, much thicker roundish or irregular bodies dispersed through the substance, and which were not unfrequently elongated into longer or shorter cords variously projected, and sometimes having a forked division. Figures of these filaments, and of the corpuscules found in company with them are given. I have seen these very remarkable discoid bodies, as the author has mentioned. I should not at all regard the mould as of secondary importance. Is it not probable that the filaments which occur in the interior of these bodies are the commencement of the mould, which has been subsequently sometimes observed on the surface? This idea struck me while I was observing the fungi on rotten fruit, in which the filaments of the thereon existing species of mould penetrate deeply through the cellular tissue, and are often already present, when they are scarcely remarked externally. And in the same way probably, the mould in the bodies found at Berlin was not yet developed. The discoid bodies themselves seem to be of an animal substance.

On Entophytes on the Mucous Membranes of the Dead and Living Human Body, by Adolph. Hannover, (Müller's Archiv, 1842, p. 281.) This microscopical plant consists of delicate, straight filaments, which are transparent, or internally present little globules, or occasionally they contain a nebulous matter, seemingly divided into cells, although no actual septa exist. The filaments are much branched, without any determinate arrangement; the branches also do not become thinner than the stem. The author has not remarked spores in the interior or exterior, though he has seen globules in the former. He found these filaments first in the œsophagus of a sick man; upon which he quotes Langenbeck's observation of such filaments in the œsophagus of a person who had died from typhus, (see Froriep's Notiz. 1839, No. 252); but here the filaments consisted of rows of cells, having on the surface transparent cells (spores?) which often had a greenish colour like the spores of mould.

Bennett found a filamentous fungus with articulated filaments in the lungs of a man who had died of phthisis, and it was also noticed in the expectoration during life. Bennett very aptly compares the fungus to *Penicillium* *glaucum*. It is singular that the extremely frequent appearance of this mould in vegetable fluids, has been so little noticed. See 'Transactions of the Royal Society of Edinburgh,' vol. xv, p. 2, also an extract in the 'Annals of Nat. Hist.' vol. xi, p. 126.

History of a Case in which a Fluid periodically ejected from the Stomach contained Vegetable Organisms of an undescribed form, by J. Goodsir, (Ann. of Nat. Hist. vol. xi, p. 125.) A young man, aged 19, who had already suffered four months from disorder of the stomach, ejected in the morning a sour fluid from the stomach, without any effort of vomiting. Under the microscope could be recognized in it little four-sided or elongated corpuscles, which the author regards as vegetable, terms *Sarcina*, and assigns to them the following generic characters: coriaceous, transparent plants, which consist of from 16 to 64 four-celled, four-sided segments, which lie parallel to one another in a four-sided transparent matrix. Undoubtedly one of the Infusoria, and, in fact, a *Gonium*, perhaps the familiar *Gonium pectorale* itself. The observation is in other respects otherwise remarkable, and I have for that reason quoted it here, although it does not belong to an annual report of physiological botany.

The discovery of the Fermentation-fungus was made in the year 1826, when Desmazieres described and figured it in a separate pamphlet which appeared at Lisle, and was afterwards printed in the 'Ann. d. Scien. naturel.' vol. x, p. 59. He called it *Mycoderma*, after a genus of Persoon; concerning which not only Desmazieres, but also Persoon himself, says, that it is of doubtful nature. Under this term Persoon describes superficially a membranous mould of frequent occurrence, found in cellars about bottles, &c. Desmazieres defined the genus anew, refers it to the Infusoria, and comprehends in it animalcules, which join together and form a film on the surface of water, or of moist substances. The fungus of fermentation he denominates *Mycoderma cerevisiæ*. Biasoletto now paid attention to the little fungi, which originate in many solutions and infusions, see 'Di alcune Alghe microscopiche,' Venetia, 1834. Kützing also found, at the same time, in diluted tincture of rhubarb, an alga, which he called *Cryptococcus infusionum*, (Journal für prakt. Chemie, 1834, p. 475.) Turpin occupied himself with yeast in his well-known manner, but no one yet had thought of fermentation, until papers appeared quickly one after another, which regarded that microscopical organism as the essential part of yeast. The first was that of Cagniard Latour, the notice of which appears in the 'Journal de l'Institut,' Nov. 23, 1836; the second by Schwann, in 'Poggendorf's Annalen der Physik und Chemie,' B. 41, p. 184; the third by Kützing, in the 'Journal für praktische Chemie,' 1837, B. 2, p. 385. Schwann opposes the opinion that this organic being is one of the Infusoria; he refers it, by the advice of Meyen, to the fungi, and calls it *Saccharomyces*. When in this manner the affair was brought under the notice of chemists, it was speedily condemned by Berzelius and Liebig, and it was also represented in the 'Annalen der Chemie und Pharmacie' in a jesting manner. However, Mitscherlich joined the physiologists and botanists, and I extract the following from the 'Report of the Academy of Sciences at Berlin,' for February, 1843. "In brewing beer we can distinguish from each other with precision two kinds of yeast, the lower yeast and the upper yeast (Unterhefe and Oberhefe); the former is generated at a temperature which must not exceed + 7°, and which must not fall as low 0°: it is the fermenting principle of the Bavarian beer. The most beautifully formed upper yeast is that of the white beer, which multiplies at a temperature of about + 25°. The lower yeast consists of separate globules of the most various dimensions: the author has scarcely ever remarked the formation of a smaller globule on any part of a larger one: the smaller ones are always distributed through the fluid. In the upper yeast isolated small globules are scarcely ever remarked, but only large ones, on the end of which smaller ones are developed, and thus give rise to branchings. These propagate by germination, the lower yeast on the other hand does not, for the little globules grow isolated in the fluid. In the older yeast we can very clearly distinguish an envelope with granular contents, which become still more evident when a dilute solution of iodine is poured upon them. The author thinks it very probable that in the lower yeast, the globules burst, and that the granular contents are set at liberty; this kind of yeast would therefore propagate by spores." Kützing, in p. 148 of his 'Phycologie,' which was noticed above, mentions the fermentation fungus as *Cryptococcus fermentum*, and says concerning it: "Yeast is an alga in its lowest, and a fungus in its higher grade of development. If, for instance, we put yeast in a flat vessel with the fluid to be fermented, in the air, solitary yeast-globules are produced on the surface. These elongate, arrange themselves in rows, and ultimately grow together. In the elongated cells 2—3 punctiform nuclei then arise, (like the spores of many fungi), and, lastly, there results from elongation and intimate adhesions of the cells, an articulated filament, whose segments have a cylindrical form. By still further development the filaments extend themselves either into very delicate fibrillæ, or they expand themselves into larger elongated cells, which finally swell up to the form of vesicular spheres, in which great numbers of little globules (sporidia) are formed: in this stage, therefore, they completely resemble a "mucor." I am convinced that the greater number of fungi which occur in the interior of animal and vegetable bodies are only the thallus (the plant, as it were), of more perfect forms, which only develop themselves in the air; as the dry rot, *Merulius vastator* forms a quantity of Rhizomorphæ, and only when it has opportunity to grow in the air does it produce its fruit, the sporangium. For the fermentation fungus the name *Cryptococcus* must be retained: it has no resemblance to *Torula herbarum* Pers., a persistent, firm, dark fungus; to *Oidium aureum* it has far more, but this grows on the stems of trees, and its joints separate at first in water but then resemble remarkably in size and figure the separate joints of the fermentation fungus.

Schönlein first drew attention to fungi in skin diseases, (see Müller's Archiv, 1839, p. 82.)* He found such a growth in Porrigo lupinosa of Willan, but he gives no description of it, and a figure from which much cannot be learnt. In the same 'Archiv,' 1842, p. 22, Gruby gives a description of fungi in Tinea favosa. Within the epidermic covering there is an amorphous layer, representing a capsule, which is divided into two halves, in which is found the parasitic plant. It resembles most nearly a *Mycoderma.* The roots and little stems of the mycoderm are smooth, cylindrical, transparent little tubes, which sometimes undergo a repeated dichotomous division; their investing membrane is smooth, their contents either molecular or granular, and the characteristic septa of plant cells are often seen at their junctions. The terminal branches, which are found in the centre of the cavity of the capsule have furrowed margins. In the terminal segment of the branch are found the germinal granules arranged together in rows, and often after the form of a rose garland: they are frequently heaped together irregularly, of a yellowish white colour, each granule being perfectly smooth, round or oval, transparent, and formed of a homogeneous substance. The description is evidently drawn by one unacquainted with the subject, and is altogether unintelligible.

The same author has found a fungus in Porrigo decalvans, (see Compt. rend. 1843, xi, p. 301), in which it forms a sheath around the lower part of the hair, so thickly does it incrust it. It consists of branches, stem, and spores. The branches arise in the substance of the hair, and from the inner layer of the sheath, whilst the sporules form its external layer. The stems have an undulated form, and follow the direction of the fibres of the hairs. They are transparent, their thickness amounts

* M. Remak claims priority in this observation. Vid. 'Medicin. Zeit.' No. xvi, p. 73-4, and Valentin's Repertor. 1841.

only to ·002 or ·003 in diameter: they contain in their interior no molecules. They divide occasionally into two branches at an angle of from 30° to 50°. The stems and the branches are for the rest of the same diameter. The anthor calls this fungus *Microsporium Audouini*, in honour (!) of M. Audouin. What the author understands by stems I do not know. His description does not show that he is competent to establish new genera among the fungi. Lastly, Günsburg has also found fungi in the Plica polonica, which he straightway terms *Mycodermes*, (see Compt. rend. 1843, xi, p. 250.) They arise from the bulbs of the hair; the cells of which the stem consists are in the commencement very distinct, but constantly become less so, as the fungus becomes older. The stems of the contiguous fungi unite into a network. The spores are oval, umbilicated, and connected with the stem by an umbilicus or a delicate filament; they generally stand in pairs. Sometimes these mycoderms are confined to the sheath, which incloses the hair, and are covered with a thick layer of spores; but, generally, they perforate this sheath toward the base of the hair. Some are quite external to the sheath, and these are grouped together in a close network. From this intelligible description it results that the fungus stands in near relation to the genus *Botrytis*, perhaps belongs to it. Probably, also, those described by Gruby are similar, so far as they can be deciphered from the confused description. To the same genus also would belong *Botrytis Bassiana*, or the Muscardine.

An important paper on the Development of a Vegetation in Albuminous Fluids, by Andral and Gavarret, appears in the 'Compt. rend.' 1843, xi, 266. When the serum of the blood is treated with very dilute sulphuric acid, so that it acquires a slightly acid reaction, and is then diluted with an equal bulk of water, the fluid becomes turbid, and lets fall a sediment which consists of albumen, and subsequently becomes clear again. At the end of about twelve hours, if the fluid be examined under the microscope, we find vesicles which are spherico-oval, elliptic, quite detached from each other, transparent, or occupied internally by an amorphous substance, or by little globules. These vesicles only appear on the surface, when the fluid is in contact with the air. Shortly after we see germs upon the vesicles, which grow into stems which branch, and all present in their interior an amorphous material or little globules. But there arises still another different structure. The vesicles fall into rows, elongate, and form hollow stems, which though in the beginning they exhibit interruptions on the exterior, afterwards appear as a tube with transverse septa. If the serum treated as above described be placed in an atmosphere of carbonic acid or of hydrogen, no such vegetations arise. Not only sulphuric acid, but also acetic acid has a similar effect. Albumen treated in like manner furnishes vegetation of the same kind, and so also do the following pathological fluids:

1, Serous fluid in the peritoneum, from diseased liver;

2, Serous fluid from a hydrocele;

3, Serous fluid from the vesications produced by a blister;

4, Serous fluid obtained by the filtration of pus.

The question of equivocal generation has been again brought up by all these researches, and cannot be dismissed by a simple denial. But it is especially necessary to investigate accurately these lower organizations, and not to despise and slight them as imperfect beings. Whilst Ehrenberg could be zealous only on the score of the infusorial animalcules, he could have decided the inquiry on equivocal generation, but was not disposed to do it.

After Mitscherlich's ingenious, I might say Linnean declaration, that "the lower animals produce rot, the lower plants fermentation," there is nothing more to desire, beyond patient investigation of this subject. Chemists, like botanists, in the physiology and anatomy of plants, have lost their way, and are fallen into perplexity.

Motion.

On the Spontaneous Rotatory (révolutifs) Movements observable in Plants, by M. Dutrochet, (Compt. rend. 1843, xi, p. 989.) A remarkable paper in which M. Dutrochet does not speak of Endosmosis and Exosmosis, but of the internal and external causes of the movements witnessed in the vegetable kingdom, the former of which are as usual attributed to vitality. At the same time he communicates observations on the motion of the tendril in several plants, or rather he sets out with this part of the subject. Since Dutrochet is rather diffuse in his exposition, I will here quote a passage which will give the readiest view of the matter. The observations were made on *Pisum sativum*. " I have said before that both internode and the leaf which terminates the internode (it is known that " merithalle" is the abominable, ungrammatical word employed by the French botanists for internode (stammglied), describe, together, an ellipsoid curve in the air. To wit, these parts produce during their movement a sort of cone, the apex of which coincides with the inferior part of the internode, and the base with the curve described by the point of the petiole, in the air, at the spot where the pair of folioles is attached. My observation of the rotation commenced at the moment when the point of the petiole was directed towards the window or towards the south. The internode and the petiole which follows it exhibit at that time a uniform curve with the concavity towards the window. The simple tendril had directed itself exactly vertically towards the zenith; the curved internode with the leaf now slowly rotates towards the south-west, and in fact with the curve directed towards that point of the heavens. When this movement commences, the tendril quits its vertical direction, and it rotates towards the north-west, so that its point continues to avoid the light of the window. The concavity of the curve of the internode, and of the petiole turns away by degrees from the south and from the window, till it stands opposite the west, but the curve is not then so great as when it is towards the window or towards the south. The point of the tendril, which moves away from the light, then precedes the petiole, without however assuming its curve. The internode and petiole now continue to turn towards the north, at which point, however, the curve is at its minimum. The tendril now turns back, inclines first towards the sky, then to the north, so that it directs the point to the petiole, whereby it avoids the light of the window. The internode and petiole continue to turn from the north, through the east, to the south, during which the curve is continually increasing. The tendril, which constantly remained behind the petiole, reverses its direction with regard to the petiole, continues to avoid the light, and precedes the petiole, which has commenced its second revolution. The time in which these revolutions are performed, depends on the temperature and age; they are accomplished more rapidly under the influence of warmth and during youth; the light, however, does not contribute to these motions, but is even unfavorable to them, and increases the degree of curvature, as the author shows in detail. The author has made similar observations upon *Bryonia alba*, and *Cucumis sativus*. He also somewhat ingeniously brings in the motion of *Hedysarum gyrans*. In conclusion, he says, "In animal motions there is volition, but not in that of plants; but behind these beings destitute of intelligence, the creative intelligence is at work which gave existence to these wonderful vegetable machines." Is the motion of the heart voluntary? Have animals anything to do with their own creation?

Researches on the Movement and on the Anatomy of the Labellum of *Megaclinium falcatum*, by C. Morren, (Annal. d. Scienc. naturel. vol. xix, p. 19; also in abstract in the Bullet. de la Soc. Roy. d. Bruxelles, 1841, P. 1, p. 385.) An accurate anatomical account of the flower of this orchideous plant, and description of the motions of the lip. It is twofold, mechanical and vital; the first arises from the elasticity of the support of the lip, and this again from the property of the cells in the dermis of the support; the latter is observed in the elevation and sinking of the labellum upon its support; care, however, must be taken that we do not ourselves occasion this motion by the current of the breath. The cells which give rise to the elasticity are spherical, and of a white or transparent substance like parchment, but scarcely any trace of successive layers can be perceived.

Notice on the Mobility of the Florets in the Cynareæ, by Ch. Morren, (Bulletin de la Soc. R. d. Scienc. d. Brux. 1842, P. 2, p. 47.) The author distinguishes five motions in these flowers:

1. If we touch lightly the florets, before the development of the stigmata, they incline towards the centre of the compound flower, and back again.
2. The shedding of the pollen.
3. The protrusion of the stigmata.
4. If we now touch lightly the flowers or the stigmata, they present a rotatory motion.
5. Finally, if we irritate the stigma, the tube of the anther is drawn downwards, and then again moves outwards. The first motion arises from the shortening of the internal fibres of the stamens which are united to the floret, and which drag the floret with the pistil. The second and third are produced by the subsequent growth of the style; the fourth is also a consequence of the shortening of the adhering stamens, the one succeeds the other, and this is also the case with the fifth. In all these cases it is thus the stamens which, by their irritability, produce the motions.

Some Observations on the Rotatory Movements in the Cells of Plants, by Professor Czermak, (Verhandlungen der K. K. Gesellschaft der Aertze zu Wien, Vienna, 1842, p. 125.) The author says, "If we glance at the appended corollaries, which result from my researches and experiments a thousand times repeated, we may draw the following conclusions: the evaporation of the fluids of the cells is the principal reason of the motion of the granules of chlorophyll. It is increased by warmth, and the motion of the granules at the same time is accelerated; with the fall of temperature both equally diminish. If we call to mind the well-known phenomena of the motion of particles of dust in warm water, we have the key to the explanation of these rotatory movements." The inquiries of the author are valuable; it is very astonishing, that oil at once stops the motion. But the motions in warm water arise solely, because the warm water beneath being expanded and specifically lighter, rises, while the upper and colder portion sinks. Can we assume this to be a parallel case, when the movement takes place in a circle, and on the same plane?

NUTRITION AND ABSORPTION OF PLANTS.

WE might expect that Liebig's book, 'Organic Chemistry in its application to Agriculture and Physiology,' of which a notice was given in the Annual Report for 1840, should attract the attention of the investigators of nature, not only on account of the novelty of many of the ideas and representations, but also for the acuteness, we might say, the audacity with which they are put forward, and for the attacks upon all which stood in his way. Gruber and Sprengel first wrote against it, and to them Liebig replied in the 'Annalen der Pharmacie und Chemie,' (B. 38, p. 216.) He also replied to Hlubeck in the same periodical, (B. 41, p. 358.) Schleiden then attacked Liebig, who was defended by Winkelblech. Schleiden replied in a public letter, addressed to Winkelblech, which was followed by a second from him. The letter of H. Mohl in reply to Liebig (1843) was almost restricted to the field of chemistry, and sought to give currency especially to Saussure's theory of the nutrition of plants. In the 'Annalen der Pharmacie,' (B. 42, p. 275,) this theory is supported by new researches, but to which Liebig himself (p. 291) opposed calculations. I pass over what has been said for and against Liebig in the journals of the economists, and the like. There is also an important Essay, by Liebig, on the Rotation of Crops (Wechselwirthschaft,) in the same 'Annals,' (B. 46, p. 58,) wherein especial attention is paid to the inorganic matters taken up by plants, and many inquiries on this topic are subjoined. But if we take the whole of what has been written on the nutrition of plants according to the doctrines of Liebig, we can by no means say that anything has been determined, or that science has made great progress during the discussion.

On the Inorganic Constituents of Plants, a prize essay, by A. F. Wiegmann and Polstorff, (Brunswick, 1842,) to which Liebig has already referred in his treatise on the 'Rotation of Crops.' With this we couple the essay of Wiegmann in the 'Botan. Zeit.' (No. 47) whose inquiries result in the fact that plants grow better when manured with organic matters, and in water mixed with such matters, than in carbonate of lime and salts of carbonic acid, and sprinkled with water impregnated with carbonic acid. We are hereby reminded of the well-known proposition of Thaer, that only those crops, the seeds of which must become ripe to be available, exhaust the soil; whilst this does not happen, or certainly not in a marked degree, when they are made use of before maturity of the seed.

As this appeared to contradict Liebig's theory, (the later experiments of Wiegmann were occasioned by Mohl's letter,) so on the other hand, the experiments with ammonia and ammoniacal salts, by which fertility is increased, are favorable to that theory. Here belongs the treatment of the manure with sulphate of iron, which gives rise to sulphate of ammonia, according to the experiments of Schattemann, (Compt. rend., 1842, x, p. 274; also the same, 1843, xi, p. 1128;) and Kuhlmann's inquiries, (the same, p. 1121.) A specimen of *Gardenia radicans*, which, in November, at each time of watering, was supplied with three drops of carbonate of ammonia (*liquor ammon. carb. pharm.?*) retained its leaves much longer than others, which had not this addition.

Unger's Experiments on the Nutrition of Plants, (see Flora, 1842,) "in truth," as the author says, "a repetition of the experiment already made by Hartig," show that humate of potass is rather injurious than useful to plants.

The Researches on Manures, by Boussingault and Payen, (see Compt. rend., 1841, x, p. 323, and 1842, xi, p. 657,) would prove that the strength of manure stands in direct proportion to the quantity of azotized matter in the same.

The Treatise on the Nutrition of Plants, by Scheideweiler, translated in 'Flora,' 1843, p. 621, contains a very good summary of the different opinions on this subject; but all the results which he draws are not so much beyond dispute as he represents them.

An Inquiry into the Absorption of Salts by Healthy Plants, provided with uninjured Roots, by A. Vogel, of Munich, (Journal für Praktische Chemie, 1842, p. 1.) It is very questionable, whether the roots in these experiments were uninjured, as is hinted in the 'Botanische Zeitung,' 1843, p. 30. The inquiry is, nevertheless, very important, since it affords the result that the metallic oxide is deoxidized in many saline combinations, and in many plants. In this respect it matters little whether the roots were uninjured or not. It is much to be wished that more experiments should be instituted with this view only.

On the Action exercised upon Vegetables by the Organic or Inorganic Productions which are poisonous to Animals, by Bouchardat, (Compt. rend., 1843, xi, p. 112.) Many experiments of this kind have been already instituted by Jäger and others; but there is much here which has not been elsewhere noticed. The great virulence of all the salts of mercury, even in the smallest quantity, is especially pointed out. The biniodide of potassium is much more active than the bichloride of potassium. Sulphate of potass acts much more power-fully than sulphate of soda or magnesia. Extract of opium has a much stronger action than an equal quantity of hydrochlorate of morphia. These are only specimens of the frequently remarkable results of these experiments. The author has at the same time made parallel experiments on the lower animals, chiefly fishes.

EXPLANATION OF THE PLATES.

I.—ZUCCARINI ON THE MORPHOLOGY OF THE CONIFERÆ.

PLATE I.

Fig. 1. The summit of a young plant of *Phyllocladus*. *a*, Separate bud scales; *b*, branching phyllodia; *c*, bracts on their axis, either at the base of the secondary phyllodia, *d*, or ascending to their border; *e*, buds at the extremity of the phyllodia.

Figs. 2—4. The summits of branches of young plants of *Callitris quadrivalvis*.

Figs. 5—10. Cicatriculæ of leaves and pulvini of *Abies*. Fig. 5, *A. canadensis*. 6, *A. excelsa*. 7, *A. Larix*. 8, *A. Cedrus*. 9, *A. pectinata*. 10, *A. homolepis*.

Figs. 11—29. Transverse sections of leaves, showing the contour of those sections and the distribution of the stomata. 11, *Callitris*, (a leaf of fig. 4). 12, *Sciadopitys*. 13, *Cunninghamia*. 14, *Abies pectinata*. 15, *Cephalotaxus*. 16, *Pinus Cembra*. 17, *Pinus massoniana*. 18, *Taxus*. 19, *Juniperus communis*. 20, *Abies polita*, 21, *Dammara australis*. 22, *Araucaria excelsa*. 23, A young plant of the same. 24, *Cryptomeria*. 25, *Thujopsis*, upper side of the branch. 26, The same, under side of the branch. 27, *Thuja*-spec. under side. 28, The same, upper side. 29, Phyllodium of *Phyllocladus*, under side.

PLATE II.

Fig. 1. Young shoot of *Salisburia*, exhibiting the circinate vernation of the leaves.

Fig. 2. Portion of a young branch of leaves of *Encephalartus horridus*, with a similar vernation of the phyllodia.

Fig. 3. Young fan of *Zamia integrifolia*, with adpressed, flat phyllodia.

Fig. 4. Leaf of *Salisburia*, with radiating dichotomous vessels.

Fig. 5. A portion of the leaf magnified, with the elongated cells situated between the veins.

Fig. 6. Cones of *Abies Douglasii*, Figs. 7, 8, 9. Various forms of the bracts in the same plant, presenting indications of the formation of stipules on the lateral lobes.

Fig. 10. Branch of *Taxus baccata* with ripe fruit, but without the succulent cup, and not swollen like a berry.

Fig. 11. The dry cup without the fruit, magnified.

Fig. 12. Seed of *Pinus nigricans*, viewed from the side presented to the fruit scale, where the wing encircles only the edge of the testa.

Fig. 13. The same, viewed from the external side, where the wing extends over the testa.

Fig. 14. A portion of the wing magnified, (*a*) the toothed margin shows where the wing was torn away from its attachment to the testa, (*b*) the smooth edge shows the former point of connexion of the wing to the fruit scale.

Fig. 15. The seed magnified; (*a*) represents the point where the seed was originally attached to the compartment of the fruit-scale formed by the wing.

Figs. 16, 17. Seed of *Dammara australis* with one, and two lobed wing, which, however, only appears as a continuation of the testa; *a*, point of attachment of the seed to the fruit-scale.

PLATE III.

Fig. 1. Stunted lateral branch of *Salisburia*, and fig. 2, of *A. Cedrus*, for comparison with the stems of the Cycadeæ.

Figs. 3—7. Skeletons of fruit scales: 3 and 4 of *Pinus Pinea*, 5 and 6 of *Cryptomeria*, 7 of *Sciadopitys*, showing the dichotomous arrangement of the vessels.

Fig. 8. Puncture made by an insect in *Abies excelsa*.

Fig. 9. The same magnified.

Fig. 10. One of the morbidly altered leaves, from both sides, with its enlargement, which is similar to that of the fruit-scales.

Fig. 11. Female flower of *Salisburia* for comparison with

Fig. 12. The female flower of *Zamia integrifolia*.

PLATE IV.

Male flowers of the Coniferæ:

Fig. 1. *Pinus*.

Fig. 2. *Abies* (*Picea*) *firma*.

Fig. 3. *Salisburia*.

Fig. 4. *Cephalotaxus*.

Fig. 5. *Thujopsis.*

Fig. 6. *Cunninghamia.*

Fig. 7. *Thuja.*

Fig. 8. *Taxus.*

Fig. 9. *Araucaria brasiliensis.*

Fig. 10. Floral scales of *Encephalartus*, viewed from beneath, closely covered with stamens.

Fig. 11. The same, viewed from above, bearing small anthers.

Fig. 12. A portion of the underside magnified to show the regular disposition of the stamens.

Fig. 13. A stamen viewed from the side.

Figs. 14, 15. The same, magnified, upper and under surface.

PLATE V.

Male branch of *Taxus wallichiana*, Zuccar.

Fig. 1. The scaly husk of the male catkin.

Fig. 2. The catkin without the husk.

Fig. 3. A stamen viewed from above, and

Fig. 4. from below : magnified.

Fig. 5. The lower portion of the leaf viewed from above.

Fig. 6. The superior portion viewed from beneath : magnified.

II.—NÄGELI ON VEGETABLE CELLS.

PLATE VI.

1-3. *Gaillionella*, n. sp.

1. Seen from below; Diam. = ·020;* nucleus with nucleoli, and sap-currents; large and small chlorophylle-globules.

2. From the side; Length (D. of the base) = ·022; Breadth (L. of the axis) = ·010. The focus is adjusted to the upper wall; the two lateral bands of chlorophylle are seen. A row of very minute shining granules lie within the chlorophylle-granules on each side. A parietal nucleus with sap-currents occuring in the centre of the base, becomes visible at a deeper focal distance (contrary to the usual condition, the filament passing through is here deficient).

3. An individual, after division, seen from the side, L. (D. of the base) = ·024; Br. (L. of the axis of the *two* new cells) = ·015. The focus is adjusted to the plane of the axis; the chlorophylle bands appear only in section. Each secondary-cell possesses a parietal nucleus (*n*) on the surface opposite to the dividing wall; with an axial mucilage filament (*m*). Each of the secondary cells has, at first, but one band of chlorophylle in the distal angle;

* The figures denote decimal parts of a *line* when not otherwise distinguished.

these are the same which originally belonged to the parent-cell.

4-7. *Bacillaria*, n. sp.

4. Viewed from the broad side. *a a* (Long D. of the base) = ·008; *b b* (L. of the axis) = ·006. The green contents are accumulated in the centre, into a mass resembling a nucleus. The two angles (*b b*) exhibit the four striæ.

5. Also the broad side. An individual before division. The green contents resembling nuclei have separated into two parts.

6. The broad side, after division. A septum has formed between the two portions of the green contents, parallel with the two bases (*b b*).

7. From the base. *a a* (Long D. of the base) = ·008; *c c* (broad D.) = ·004. The base is marked with four slight furrows, which are continued over the margin, and some little distance up each broad lateral surface (4, 5, 6; *b b*).

8, 9. *Conferva glomerata*, L. (from the sea).

8. Terminal cell of a filament. D. = ·024; *a*, cell-membrane of the original cell; *b*, contents decaying, detached from the membrane, and in course of solution. *c*, Newly-formed membrane, which has originated on the surface of the living contents (*d*). The latter are bounded by a mucilage-layer (*e*), which, at first, is in contact with the membrane (*c*); here, however, through the endosmose of water (*f*), during the examination, it has detached and retracted itself from the wall.

9. Formation of a branch. *a* and *b*, Two stem-cells with transparent contents; a thin mucilage-layer rests upon the cell-wall; on this are the chlorophylle-globules, which are arranged reticularly; *c*, the out-growing portion of a stem-cell. The parietal meshes of the chloro-

phylle become smaller upwards, and pass into an irregular mass, occupying the whole cavity; next comes a granular; and, lastly, in the apex, a homogeneous and colourless mucilage. The wall makes its appearance between *b* and *c*, without further apparent alteration of the contents of these two cells.—D. of *a* and *b* = ·018.

10. *Conferva glomerata*, L. (from fresh water).

a, *b*, and *c*, Three new cells produced in one articulation; they are densely filled with dark-green granular contents, and possess a clear nucleal utricle in the centre. *d*, Extra cellular substance. *e*, Membrane of the original articulation. *f*, Membrane of the newly-formed cells; this is visible as a distinct membrane within the membrane of the parent-cell (*e*). In the original articulation, two cells were first formed (*a*), and the parent-cell of *b* and *c*; *a* divided no further, while *b* and *c* were subsequently formed in the other cell, and in consequence of this, the septum between *b* and *c* is much thinner than that between *a* and *b*, in which latter the two lamellæ have already become perceptible; *g* and *h* are portions of the cells of the bordering articulations. L. of *a*, *b*, and *c* together = ·070—Br. of *a* = ·032.

11, 12. *Bryopsis Balbisiana*, Ag.

11. An old utricle; D. = ·035. *a*, Original membrane of the utricle. *b*, Newly-formed delicate membrane which originates on both the surfaces of the dividing cell-contents (*e* and *f*). *c*, Transparent fluid. In *d*, the contents have retracted from the walls, in consequence of endosmose of water, and a new membrane has also been produced on their surface. *g*, Mucilage-layer which rests upon the membrane, and on which the chlorophylle-granules are scattered. The whole of the solid contents are parietal; the manner in which they clothe the approximate surfaces of the utricle is exhibited.

12. Also from an old utricle; D. at *d* = ·050. *f*,

Living portion of the utricle furnished with contents retaining their power of forming new structures. The solid contents lie upon the walls, and consist, toward the exterior, of a broad layer of finely granular mucilage (*e*); toward the interior of individual chlorophylle-globules, they are seen in cross section. *g*, Decayed portion of the utricle filled with colourless transparent fluid. *a*, Extra cellular substance; *b*, cell-membrane on the decayed portion; *d*, cell-membrane on the living portion of the utricle. *c*, Newly-formed membrane, which clothes the free surface of the mucilage-layer (*e*).

13, 14. *Conferva bombycina*, Ag.

13. From a filament in course of division. The contents consist of almost homogeneous and scarcely coloured mucilage. In the centre is a transparent utricle. The two articulations (*a* and *b*) have been produced in the parent-cell (*c*), which has become almost dissolved. Other joints present the appearance of fig. 14, from the formation of two new nucleal utricles, and an intermediate wall.

14. From a filament which had been kept some days. The contents had become bright green; the nucleal vesicles very distinctly apparent. The membrane had become somewhat thickened; the two secondary-cells (*a* and *b*) were to be perceived as individual cells inside the parent-cell.

15, 16. *Cystoseira abrotanifolia*, Ag.

15. Transverse section through the *punctum vegetationis*. Each cell possesses a central, free, homogeneously mucilaginous nucleus, and radiating circulation-threads. One cell, become larger, contains two nuclei, between which a septum is subsequently formed. D. of the smaller cells = ·008; nuclei = ·0016.

16. Isolated nuclei from an older frond. They are utricles; *a*, without contents; *b*, *c*, with one or more

amylum granules; *d*, with colourless, finely granular contents; *e*, *f*, *g*, with chlorophylle. D. of the utricles = ·004-·006.

17-20. *Rytiphloca tinctoria*, Ag.

17. A young dichotomous hair, from the apex of the frond, in the first stage of formation. It consists at first of two cells. The upper, larger cell (= ·013) contains a homogeneous colourless mucilage. The nucleal utricle (= ·007) contains a parietal nucleolus, and homogeneous contents, which are somewhat less dense than those of the cell.

18. As in fig. 17. The contents of the cell, and of the nucleal utricle are quite clear. Radiating sap-threads are given off from the utricle.

19. Young bud- or germ-cell from the *cystocarpium* (Kützing). It contains an almost homogeneous and uncoloured mucilage; no nucleus can be seen. L. ·007.

20. Somewhat older bud-cell; L. = ·012. The contents are slightly reddish and granulated. The free nucleal utricle (= ·004) possesses thin homogeneous contents and a dense nucleolus.

21, 22. *Laurencia dasyphylla*, Grev.

21. Transverse section through the *punctum vegetationis*. The cells are uncoloured; D. = ·003. The nuclei are dense and opaque.

22. Three cells from the base of a younger dichotomous hair, from the apex of the frond. They are colourless. Each has a parietal nucleus, and a reticular circulation. L. of *a* = ·016, of *b* = ·018. Nuclei = ·0018.

23-25. *Hutchinsia*.

23. Two cells newly produced in a parent-cell, of these the upper (*a*) is the parent-cell of the spore, the lower (*b*) its basal-cell. The cells contain a transparent fluid, and

a parietal nucleus. Height of *a* = ·007; Br. of *a* = ·005.

24. Two similar cells, somewhat later. The contents are finely granulated, and slightly reddish. The parietal nuclei have become dissolved. In the parent-cell of the spore (*a*) a new, free nucleal vesicle, with a nuceolus has been formed. The contents of the nucleal utricle are homogeneous and thinner than those of the cell. H. of the cell *a* = ·012; Br. = ·007; nucleal utricle = ·0035.

25. Similar cells to figs. 23 and 24, later still. The basal-cell (*b*) is filled with clear fluid. The spore parent-cell (*a*) has granular, reddish, and somewhat dark contents. The nucleal utricle is hidden by the superposed mass of granules; from this proceed radiating currents. The membrane of the parent-cell has begun to be thickened by gelatinous depositions. D. of *a* = ·020.

26. *Callithamnion versicolor*, Ag.

A parent-cell with four special parent-cells, (the fourth is turned from us, and therefore not visible on this side). Each of these possesses a central red nucleus. The decaying cell-contents have become green; the nuclei have retained their colour.

27. *Wrangelia penicillata*, Ag.

Cells of the axis, filled with uncoloured transparent fluid. Each has a parietal nucleal utricle, with nucleolus and clear contents.

28. *Morchella esculenta*, Pers.

The upper part of an utricle, in which the spores subsequently form. The contents of the utricle are colourless, and, as yet, almost homogeneous mucilage. The nucleal utricle is clear; the nucleolus thick and whitish. L. of the whole utricle = ·140; Br. ·008; nucleal utricle = ·005.

29, 30. *Bangia atropurpurea*, Ag.

29. From the lower part of a filament, which consists merely of a simple row of cells. The inter-cellular substance extends, not only over the lateral surfaces of the filament, but also lies between the lamellæ of the septa. The cell-contents are transparent. A colourless nucleus is situated upon the membrane. It has become coloured reddish from the superposed mucilaginous contents. The circulation-threads running through the cavity are almost colourless. The apparent nucleoli in *a*, *b*, and *d*, are only sap-threads seen perpendicularly.

30. Lowest portion of an older filament. The mucilaginous contents (become thinner) have retracted themselves from the walls—which consist of the original membrane, and the intercellular substance, and have become invested with a new very delicate membrane (*n*). Between the primary cell-membrane and the newly-formed cell is a hollow space filled with water (*o*). The cell-contents and the nuclei are as in the preceding figure. With the exception of the uppermost (*a*), all these cells (*b-f*) have put forth laterally and inferiorly a delicate process, which breaks through the septa, grows out downward, and constitutes a radical hair.

31-41. *Anthoceros lævis*, L. (*Parent-cell of a Spore*).

31. The scanty, colourless mucilage is distributed in radiating circulation-threads round the central nucleal utricle, which contains transparent contents, and a dense nucleolus.

32. The nucleal utricle possesses two nucleoli. The mucilage resting upon the nucleal utricle has acquired a green colour.

33. The chlorophylle invests only one side of the nucleal utricle.

34. The chlorophylle forms merely a band lying on one side of the nucleus.

35. The band of chlorophylle (fig. 34) has separated into two portions, which rest upon the nucleal utricle as two longish, tolerably well-defined bodies.

36. The two masses of chlorophylle (fig. 35) appear distinctly now as two green oval nuclei, which still lie on one side of the nucleal utricle. A broader mucilaginous thread here proceeds from the central nucleus to the wall, and there divides in a circular manner on the inner surface of the cell.

37. The two oval green nuclei (fig. 36) have moved to two diametrically opposite points of the central nucleal utricle.

38. Both the oval green nuclei have become divided by a delicate septum into two parts. Each of the latter has a little point resembling a nucleolus in its centre. The division of one of the oval nuclei is invisible, because it is viewed perpendicularly, so that it appears round. The diameter of the oval nuclei, and also their dividing walls, which are perpendicular to the former, intersect at a right angle. The nucleolus of the central nucleal utricle is parietal.

39. The four new round green nuclei produced by division begin to be separated from one another. Two proceed to a greater distance from each other horizontally, the other two perpendicularly. The lines of separation intersect at a right angle.

40. The four round green nuclei (fig. 39) have taken on a tetrahedral arrangement. The fourth is turned to the opposite side, and is not visible. The central nucleal utricle now lies outside the circulating currents. These form—1, filaments of communication between the green nuclei themselves; 2, between the green nuclei and the periphery. The wall has become thickened by gelatinous depositions. The layers of thickening are indented, as if perforated by many very slight or imperfect pores, of which a more magnified figure is given in *a*.

41. Two round green nuclei, figured separately; they contain, besides a clear fluid, only a little chlorophylle lying upon the wall. In *a* this forms separate lines in connexion with each other; in *b* an uniform layer investing the whole inner surface of the utricle.

PLATE VII.

1, 2. *Sphacelaria scoparia*, Ag.

1. Apex of the axis; D. = .045, *a*, Obliquely situated, lenticular, compressed apical cell, full of dark granules. *b*, Second cell, which, as it overgrows the actual apical cell (*a*), becomes the factitious terminal joint; it possesses dark granular contents, in its lowest portion a transparent network of mucilage; *c* and *d*, two cells densely filled with granules, and which have been produced by the division of an apical cell turned aside (like *a*); *e*, second articulation of the axis (it is the lower part of a terminal cell like *b*, dividing by a horizontal wall); it contains a transparent network of mucilage on the surface and throughout the whole cavity, and in the centre a longish heap of granules, which next passes into a short and thicker ray-like filament, and finally loses itself in the reticulated circulation.

2. Apex of the axis without the terminal joint; *a*, second joint of filament; D. = ·045; H. = ·065. It is the same cell as fig. 1, (*e*); the contents behave in same manner, only the central granular mass, resembling a nucleus, has divided into two of half the size. Between these two heaps of granules a horizontal wall originates; *b* and *c* together represent the third joint, and have been produced by the division of a parent-cell, like *a*. The central nucleus has already separated into two, lying contiguous, horizontally, between which a perpendicular septum is subsequently formed.

3-5. *Padina Pavonia*, Gaill.

3. Perpendicular section through the upper circinate border of the frond; *a*, terminal cell with granular contents and a nucleus; this incessantly divides by a horizontal wall; *b*, second joint; the central nucleus divides into two nuclei lying horizontally contiguous. The cell-contents consist, as in the cells of the following articulations, of radiating sap-threads and a transparent fluid; *c*, the third joint has divided into an anterior broad and a posterior narrow cell; *d*, two new nuclei have been produced by the division of the central nucleus of the posterior cell (*c*), a perpendicular wall (*e*), has been formed between the two nuclei (*d*).

4. Germinating spore-cells (L. = ·050), with granular contents and two nuclei, which have been produced by the division of the original central nucleus.

5. Germinating spore; a septum has appeared between the two nuclei. (Fig 4.) The nuclei themselves, are invisible, on account of the overlying granules.

6, 7. *Equisetum arvense*, L.

6. Cortical cellular tissue below the apex of the stem. In each cell lies a parietal nncleus with homogeneous mucilaginous contents, and several nucleoli. Threads of circulation run through the cavity. D, of the cells = ·012-·014; nuclei = ·004.

7. Separate nuclei from the young subterraneous stem; *a*, with two, *b*, with four nucleoli; *c*, with three nucleoli; each of these lies in an excavation of the mucilage, which fills the nucleal utricle; *d*, i and ii, the same nucleal utricle in a different position, produced by turning it 90° round on its axis; the two nucleoli are free, and certainly in the long axis of the utricle; *e* treated with tincture of iodine; the membrane of the utricle become distinct, it remains uncoloured; the homogeneous mucilaginous contents have become somewhat granular and yellowish-

brown, the nucleolus is dark brown. D. of the nucleal utricle = ·006-·007; nucleoli = ·005-·002.

8, 9. *Lycopodium clavatum*, L.

8. Cellular tissue from the young leaf, with parietal nuclei. D. of the cells = ·005; nuclei = ·002,

9. Nuclei from the cortical cells of the undeveloped stem, with more distinct membrane and transparent contents; *a* contains merely a lateral nucleolus (*n*); *b*, larger parietal granules in addition; in *c* are smaller granules, as well as nucleolus.

10, 11. *Nitella flexilis*, Ag.

10. Young leaf, consisting of three cells; *a* (L. = ·090); *b* (L. = ·004); and *c* (L. = ·015); and bearing a sporangium in course of development, which is at first formed of four cells; these cells contain a homogeneous, colourless mucilage and bright nucleal utricles with a point-like nucleolus.

11. Spermatic fibre-cells from the *antheridium*. Br. of the cells = ·004; H. = ·003; *a*, in each cell a large nucleal utricle filled with thin, homogeneous mucilage, with a nucleolus; *b*, the same filament as *a*, after it had lain a short time in water. The nucleal utricles have contracted into denser, smaller globules of mucilage, in which the nucleolus is no longer visible.

12. *Aspidium violescens*, Link.

Young hair from the apex of the frond. In each cell a nucleal utricle with nucleoli and a circulation. D. of the cells = ·011. Nucleal = ·004.

13. *Diplazium arborescens*, Sw.

Nuclei from the germ-leaf; *a* (D. = ·006.) A very young nucleal utricle with homogeneous mucilage and a nucleolus; *b*, the same nucleal utricle treated with tincture of iodine; the membrane has become visible, and remains uncoloured; the contents are rendered brown and granular; *c* (D. = ·008). An older nucleal utricle with a more distinct membrane, granular contents, and parietal nucleolus; *d*, a nucleal utricle from the side, with transparent contents.

14. *Philonotis fontana*, Brid.

Nuclei from the parenchyma of the wall of the capsule. D. = ·005; *a*, from the side; *b*, with homogeneous mucilage, the nucleolus lies in a cavity of the mucilage; *c*, also with homogeneous mucilage.

15. *Jungermannia bicuspidata*, L.

Apex of a young leaf. The lower cells contain chlorophylle; only the two uppermost still possess a nucleal utricle with a nucleolus. D. of the cells = ·005—·006. Nuclei = ·0025.

16. *Lunularia vulgaris*, Nichel.

Cells of a hair from the female inflorescence, with parietal nucleal utricles and currents of sap. Nuclei = ·004-·005.

17. *Orchis maculata*, L.

a-m. Nuclei from the flower stem. D. = ·006-·002; *a* i, i, iii, the same nucleus turned twice at a right angle; it possesses two dissimilar large, free nucleoli; *b*, *c*, *d*, the nucleoli lie in a cavity of the mucilage; *e*, from the side; in tearing the nucleus from the cell-wall, the part of its membrane by which it was attached has been left behind; the larger nucleolus is surrounded by a hollow space the two smaller ones not; *f*, on one side of the nucleolus is a void space; it is hollow; *g*, *h*, *i*, the nucleoli are in cavities; *k*, the larger nucleolus has a small cavity in its centre; both the smaller are solid; *l*, the nucleolus lies in a cavity of the mucilage, it is hollow itself, and contains a little granule; *m*, the membrane of the nucleal utricle (*r*) is distinct; the homogeneous mucilage is hollow, and thickened in a membranous manner (*q*) around this cavity; the membrane of the nucleal utricle (*s*) also appears distinct; this too is hollow; *n, o, p,* nucleoli figured separately; they contain several or many cavities; in *n* the enveloping membrane over may be distinctly perceived.

18. *Solanum tuberosum*, L.

Nucleal utricle from the parenchyma of the stem, with a membrane, transparent contents, and a parietal nucleolus.

19, 20. *Tradescantia originica*, L.

19. Nuclei from the hairs of the stamen, with homogeneous mucilaginous contents; the nucleoli lie immediately in the mucilage or in separate cavities.

20. Terminal joint of a growing staminal hair; *a,* with a longish nucleus; *b,* this is divided by a septum; *c,* the two new nuclei separate; *d,* they have retreated from each other; cell-formation has not yet taken place.

21. *Orchis maculata*, L.

a, Coulum with homogeneous mucilaginous contents in the cells and nucleal utricles, which are merely to be perceived as rings with a small nucleolus; *b,* altered by the endosmose of water; the nuclei have become smaller, dense, and opaque.

22. *Cobæa scandens*, Cav.

a. Parent-cell of pollen (D. = ·016), with granular mucilage; the central nucleal utricle (D. = ·007) is transparent; the nucleolus (= ·003) dense and whitish; *b* and *c* nuclei figured separately; D. = ·008; contents homogeneously mucilaginous; the nucleus lies in a cavity (*e, e*). In *b* the nucleolus contains one, in *c* several cavities. In *c* the nucleolus possesses a distinct membrane (*d*).

23. *Cucurbita Pepo*, L.

Parent-cell of pollen (D. = ·020), with transparent central nucleal utricle (D. = ·008). The nucleolus (D. = ·004) contains granular contents within a membrane.

24. *Amaryllis formosissima*, L.

Pollen-grain with free nucleus. The nucleus has dark granular appendages. *b, c, d, e*, similar nuclei figured separately.

25. *Lilium bulbiferum*, L.

a. A young pollen-grain (L. = ·024) with transparent central nucleal utricle and three dense nucleoli; *b*, the same pollen-grain altered by endosmose of water; the nucleal utricle has become smaller, clouded, and slightly yellowish, at its circumference a water vesicle has formed; *c*, the same pollen-grain still more altered; the nucleus has become still smaller, quite dense, and yellow, the water vesicle larger.

26. *Pancratium illyricum*, L.

Young pollen-grain; L. = ·028. Br. = ·020; *a*, primary parietal nucleus; D. of transparent nucleal utricle = ·006; nucleoli = ·0013; *b*, secondary, more central nucleus. D. of the transparent nucleal utricle = ·008; nucleoli = ·003; *c*, accumulation of dark granules around the central nucleal utricle.

27, 28. *Gaillionella*, n. sp. (fig. vi, Pl. 1-3.)

27. From the base D. = ·025. The chlorophylle globules stand in radiating rows round the nucleus. It is an individual after division, where the formation of chlorophylle again takes place.

28. i. From the lateral surface; L. = ·027; Br. =

·012; *a*, the ring-like plate of solid, siliceous extra-cellular substance; where it lies upon the outside of the membrane the chlorophylle is wanting within; *b*, the two bands of chlorophylle; they appear at *c* in section.

28. ii. From the base; one of the two bands of chlorophylle here appears as a circle.

INDEX.

THE END.

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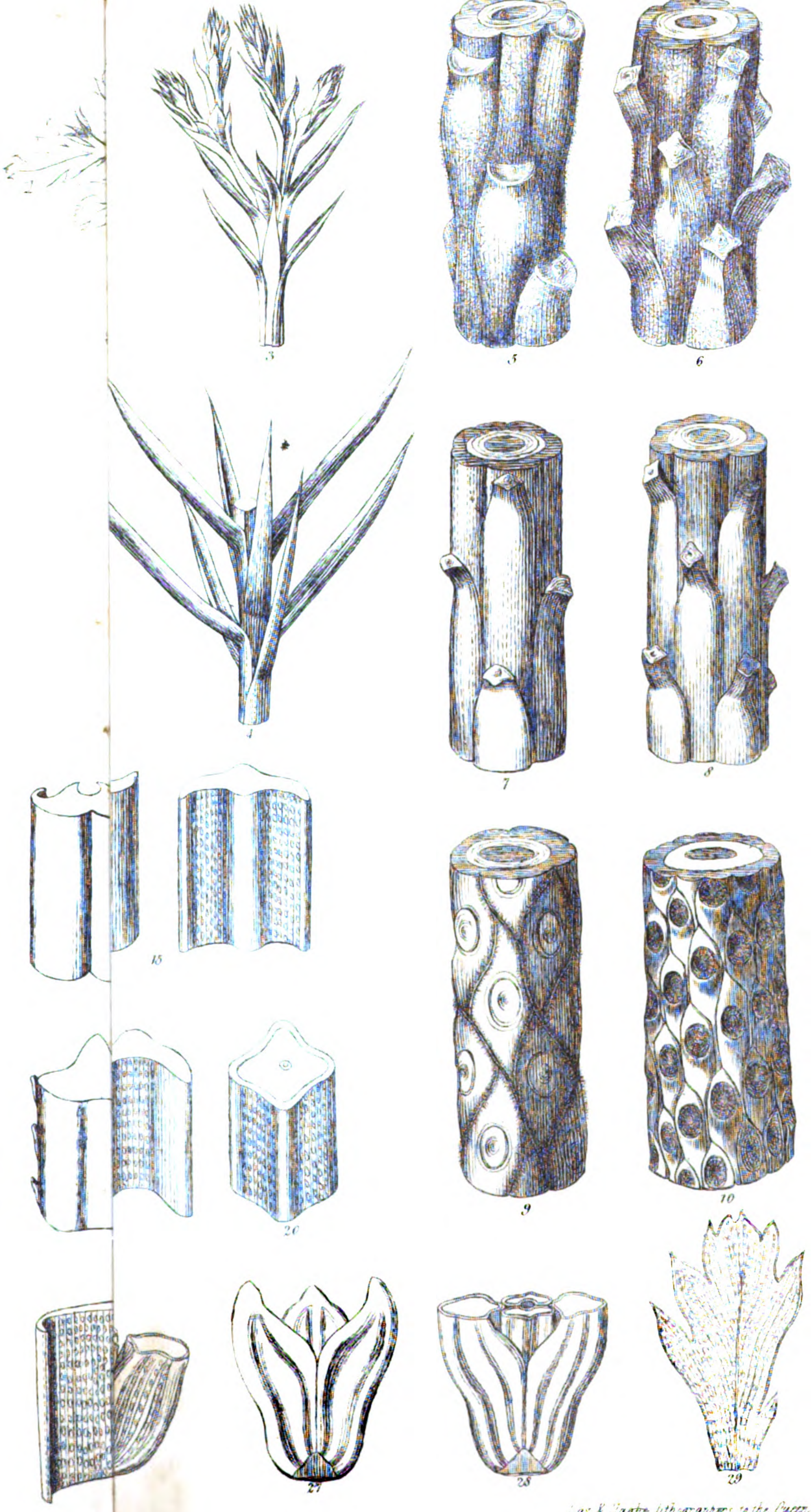

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Day & Haghe Lithographers to the Queen.

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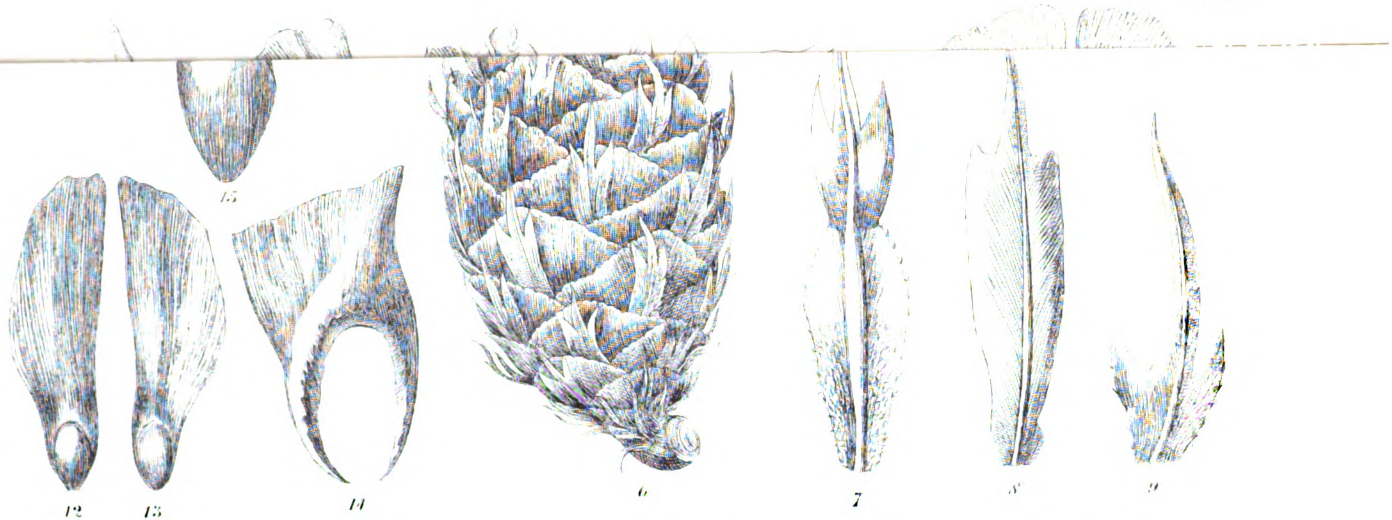

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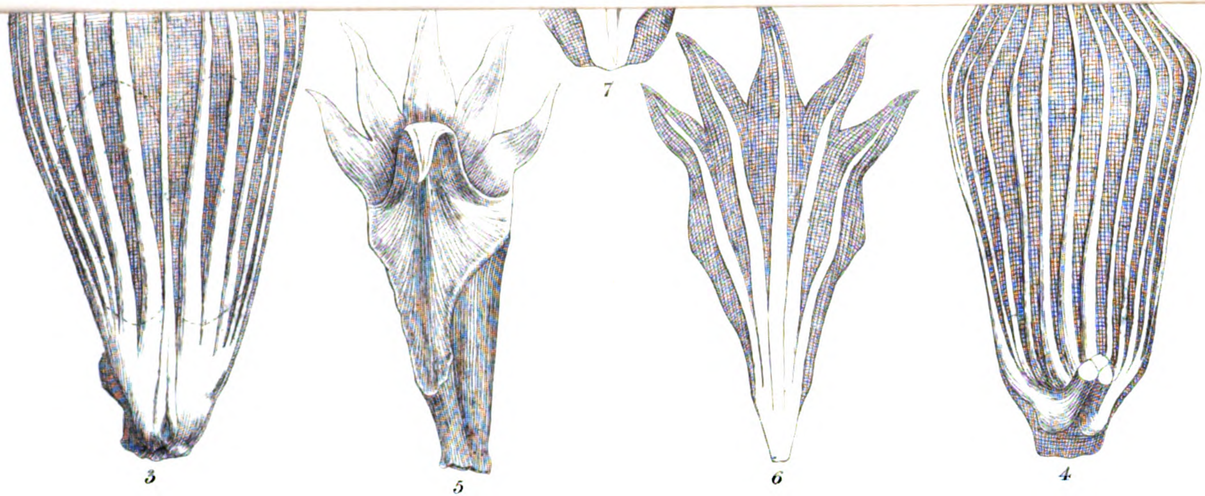

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Day & Haghe lithrs to the Queen.

Tab. IV.

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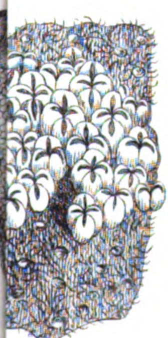

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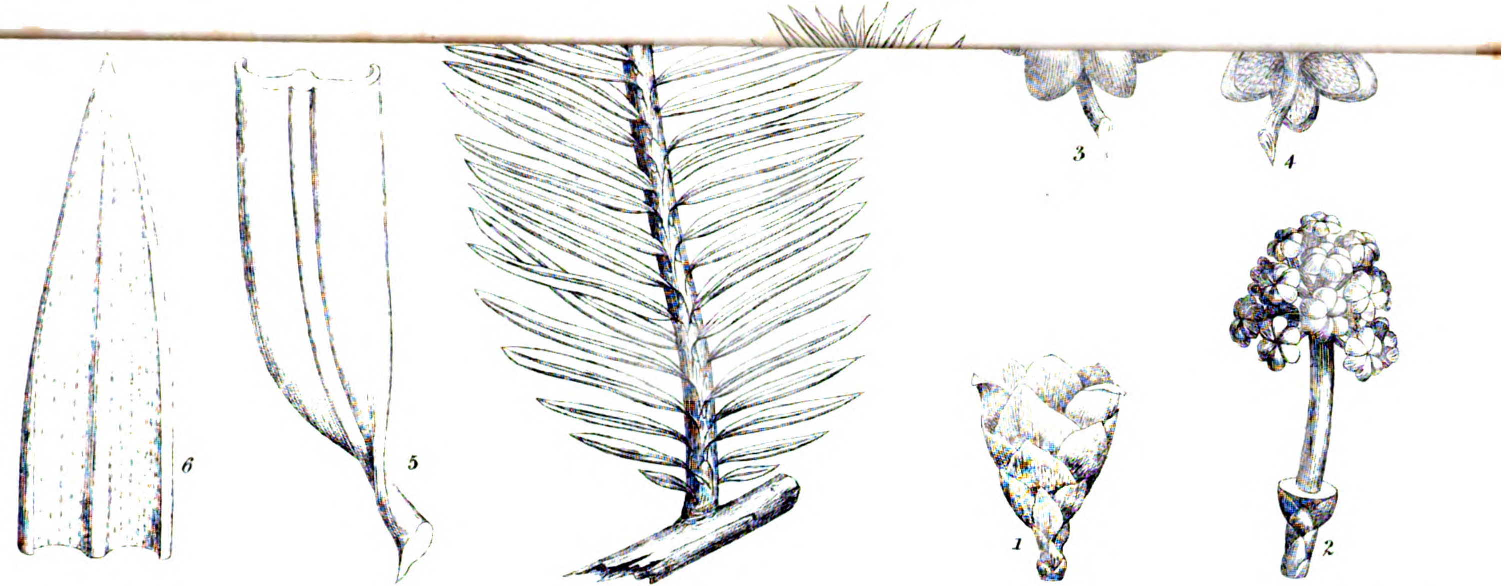
Lens Aldous

Day & Haghe, lithrs to the Queen



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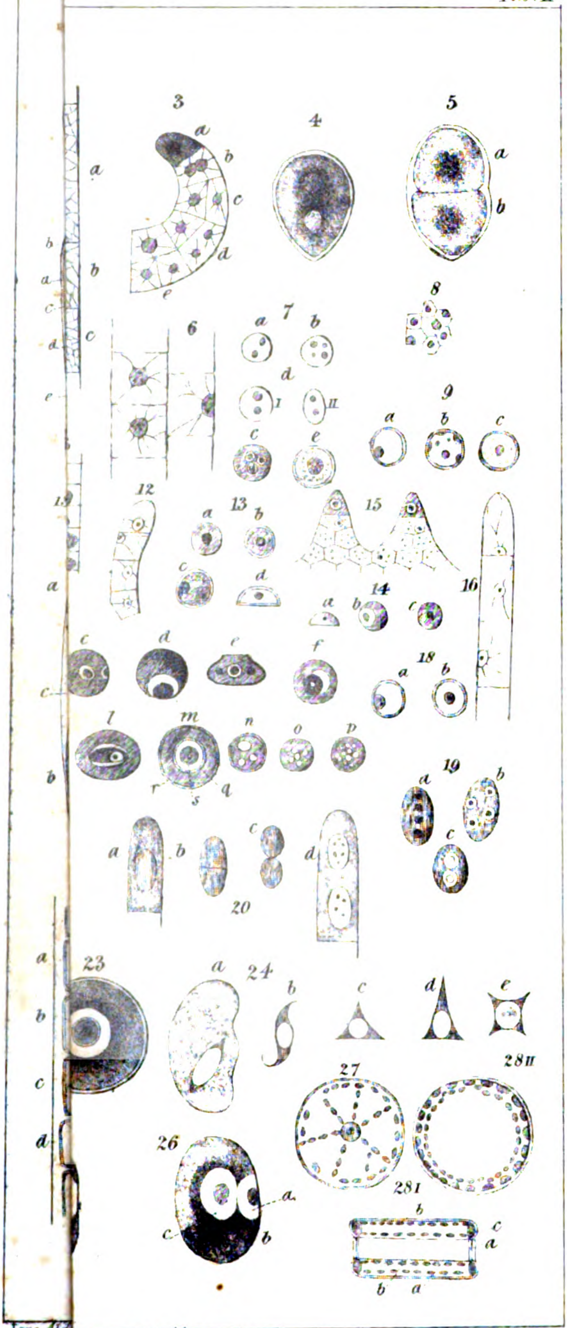
Day & Haghe Lith^rs to the Queen

Taxus Wallichiana.

For D^r. Zuccarini's Coniferæ.

Tab VII



Jens Ald.

Day & Haghe Lith to the Queen.