

A lecture delivered in King's College, London, on Tuesday, the 11th of October, 1831, being introductory to the first botanical course of the session opening the institution / by Gilbert T. Burnett.

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For Dr. W. W. W. H.
with the Author's complete

A LECTURE

DELIVERED IN

KING'S COLLEGE, LONDON,

On Tuesday, the 11th of October, 1831,

BEING INTRODUCTORY TO THE FIRST BOTANICAL COURSE
OF THE SESSION OPENING THE INSTITUTION.

BY GILBERT T. BURNETT,

PROFESSOR OF BOTANY TO THE COLLEGE, AND FELLOW
OF SEVERAL SOCIETIES.

LONDON:

ADLARD, PRINTERS, BARTHOLOMEW CLOSE.

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With the Author's name

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KING'S COLLEGE, LONDON

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BEING INTRODUCED TO THE FIRST BOTANICAL COURSE
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BY GILBERT T. BENNETT

LECTURER IN BOTANY TO THE COLLEGE, AND ASSISTANT
OF THE

LONDON

AND

1850

INTRODUCTORY LECTURE

ON

BOTANY.

GENTLEMEN: Meeting for the first time within these walls, for the first time treading on this, now classic ground, it is natural to expect that the first thoughts conceived, the first words spoken, should be those of congratulation. Yes, now, if ever, may all concerned in the establishment of King's College be well permitted a moment's pause to indulge their feelings of honest pride, in contemplating the progress of a work like this; a work so noble in its design, so grand in its execution, and so incalculably beneficent in its anticipated results. Based on the fear of God, and built for the love of man, we cannot doubt that with such a beginning, thus continued, our system of instruction will conduce to temporal good, and tend to happiness eternal.

Gentlemen: on an occasion like the present, when our doors have been so lately for the first time opened, and our threshold for the first time passed by those students who now throng our halls; when the patrons and friends of this noble institution have assembled, even at this early hour, to encourage by their presence the exertions of those, to whom its future care has been committed; I feel that I should be wanting in duty to them, I should be wanting in respect to my office and myself, were I, as if on an ordinary occasion, to proceed without preface to the business of my course; and to neglect an opportunity, which can never occur again, of giving vent to those sensations that all must feel, and mingling my heart-felt congratulations with those which I hear echoing on every side around me. At an epoch like the present, I repeat, some more general observations than at any other period would be allowed, seem to be not only relevant, but required.

For common occasions, common congratulations would suffice; but how unfit does ordinary language seem to celebrate the extraordinary events of an age like this: when wisdom, which so long has been despised and rejected by the many, is urged on their attention by the ardor of the few; when all those treasures of science, which through such dangers have been guarded, and such labours have been earned, by the liberal, the enlightened, and the thoughtful, are now freely opened, and as freely offered, nay, not only given, but forced on the acceptance of the prejudiced, the ignorant, and the thoughtless; given by those who know their value, to such as too often esteem them not.

The restoration of knowledge as their birthright to the many, which so long they had forsaken that it became the heritage of the few, is indeed a noble act; and one worthy no mean congratulation. It is a boon, however, which, at an earlier epoch, might possibly have been bestowed in vain; nay more, it would probably have proved not a blessing, but an occasion of falling. May the power of knowledge, now so generally entailed, be ever hereafter rightly used; may its importance be always duly felt; and, to feel its worth, let them who have it, think of their state who have it not; and further, let them who *will have it*, but who *now have it not*, bethink them, *when they have it*, that once *they had it not*.

Gentlemen. Wisdom, our most excellent gift, is too often, and has been too long, considered, as something abstruse and difficult of attainment, as arduous in the pursuit, and repulsive when obtained; and thus philosophy, the desire or love of wisdom, has too lightly been esteemed, and too commonly denounced as a passion little suited to the welfare of the world in general, and only fit to be indulged by those who, forswearing its pleasures, its allurements, and its cares, withdraw from intimate communion with their species, and, scarcely remaining within the pale of society, become no longer of much service either to their kind or to themselves. Philosophers, in accordance with this error, have too frequently been esteemed peculiar and eccentric individuals, who, dreaming by day as well as by night, are bewildered in the mazes of thriftless speculation, and engaged in the hopeless task of straining after knowledge as far beyond human reach as it would be found unfit, if gained, to further the happiness of man.

Here, however, it would be a needless task to tell, that such are not philosophers, that such is not philosophy. I stand not here the apologist of what neither needs to be defended nor excused: I seek but to remove a prejudice, to reconcile the

froward to so great a good; to shew that true wisdom is not only valuable when obtained, but pleasing in the acquirement; that it is not only desirable as an end, but delightful in its means.

The greatest philosophers are still but men by nature, and ever must remain but men in knowledge. They differ no more from their fellow-men than do such as see with just perceptions from such as behold without perceiving; no more than do such as seek the sun of science from such as, shrouding themselves in Cimmerian shades, believe all things invisible they see not.

Man is an inventor, not a creator; he finds, he does not form; and philosophy is the handmaid, not the ancestor of truth. She does not make the facts that she reveals, nor do the deeds that she discloses: her utmost is to raise the shroud, or rend the veil of ignorance, and point to that which already is, to that which always has been, to that which always will be; to those realities which always have been, are, and will be, whether we know them or know them not. And should she seem ever to prefer a bitter boon, her followers may rest assured it is like the bitterness of Tobit's gall, by which the scales of mental blindness may be shed; or by which may be absorbed the "drop serene," more dangerous by far, because, more subtile and invisible itself, it makes more surely all invisible within.

Hence, as leading to a more just estimation of science, all true philanthropists will esteem it a matter of fervent congratulation, that "philosophy no longer is confined to the study and the cloister, but walks abroad amongst the busy haunts of men;" frequents our most public ways, and rears her splendid fanes on the banks of this our noblest river, and by the side of one of our most public streets. It is truly a subject for no slight congratulation that now it is no longer considered "unphilosophic, and the height of ill-breeding in scholarship, to vulgarise science, by rendering it intelligible and useful;" that philosophers no longer are compelled to veil knowledge in mystery, as men no longer are content to admire the most what least they understand, but science is esteemed according to its practical utility.

These, and many other features peculiar to our age, and which this institution is so well calculated to encourage and correct, are meet subjects for no common congratulation; but, grateful as the pursuit of such a theme would be, I check myself abruptly; for, after the dedicatory service, the address, and the lectures of my colleagues, to which you have already listened with so much interest and attention, and which must be still fresh in your memory, if not almost sounding in your

ears, I am conscious that my feeble voice would scarcely now be heard, my humble meed be praiseless; and yet I will venture to affirm, that tribute by none would more willingly be given, were the mite but worthy of acceptance. Hence, feeling that the best offering I can make, will be a conscientious performance of my duty, I shall turn at once to the business of the course, and close these prefatory remarks by breathing a fervent hope, that the principles you have so lately heard laid down, the advice so ably and so kindly given, will be always, and by all observed; for should any of us, rejoicing in the pride of life, and trusting to our own strength alone, swerve from the strict path of duty, we shall surely fall; fall, perhaps, never to rise again: or, if to rise, arise shorn of our strength, like Sampson from the arms of Delilah.

I quit then, as it becomes me, all such general topics, and leave them in far abler hands: by our most reverend diocesan and learned principal, their tenor has already been in part explained: and, computing from the data thence derived, we boldly may foretell that this Institution, founded on the most philanthropic basis, (always referring to that only true philanthropy, the united love of God and man,) supported by the most patriotic zeal, (always distinguishing zeal from zealotry, true patriotism from false parade;) and conducted on the most liberal principles, (always meaning by these terms freedom, not licentiousness, liberality not libertinism,) will confer a blessing on the present generation, and descend to future ages a glorious testimony of the pious care, munificence, and wisdom of its illustrious founders. Who, while engaged in the pleasing task of planting science in this soil, which is fruitful to a proverb, (for what does not London nurture, even to excess, whether of good, to pre-excellence in worth, or of evil, to the contrary sad extremity in crime,) have so fenced round their tree of knowledge, that its branches may not be warped by sophistry, nor its buds blighted to disease by scepticism, hoping thus, by careful culture, to ensure an abundant crop of the fruits of good, not evil; and desiring rather by vigilance to exclude, than by severity to extirpate those deformities which negligence would undoubtedly encourage and suffer to increase: and who thus have shewn that, whatever others do, they do not dare to pave the road to the tree of knowledge, and neglect the path which leads to the tree of life.

Would truth alone dispense, then, indeed, we might rest content with Plato, that "knowledge were but remembrance." On the contrary, however, knowledge is often to be made by oblivion; and, to possess a clear and warrantable body of

truth, we must forget and part with much we know. Yet this is no easy task: how doubly hard do we find it to forget those things which we wish not to remember! Were it not better, then, as it were easier far, that they had been never learned? for, as Sir THOMAS BROWNE most truly adds, "such errors as are but acorns in our younger brows, become sturdy oaks in our elder heads, and resist inflexibly the powerfulest arm of reason."

Can such a system merit man's reproach? if so, reproach be thou my lot; for such reproach should ever be esteemed more truly praise.

But to our theme.

Gentlemen: Botany, the professed object of these lectures, is a science which relates to all those inferior ranks of the organic creation called PLANTS, or *Vegetables*.

But what is a plant? what do we mean by this word vegetable? It is a term the most ignorant presume they understand, although the most learned are unable exactly to define: for a plant is, indeed, as Theophrastus long ago observed, "a various thing, of which it is difficult to give a definition."

Tell a clown that it is difficult to distinguish between an animal and a plant, he will smile incredulously, and perhaps will say, can I mistake man-orchis roots for men? but shew him a conferva and a polype, a lichen and a coralline, a flustra and a flag, or even a mushroom and a mollusc, and he will at once confess, at least by silence, if not by words, that he "kens not which they be."

Such presuming self-confidence in what they know, is the "badge of ignorance and the curse of fools;" it is the humble privilege of the wise alone to doubt; and they who know the most are always the most sensible how little the most enlightened know.

But this matter is apocryphal not to the unlearned and the ignorant alone: physiologists the most astute have laboured, and do labour, still in vain, succinctly, yet comprehensively, to define a plant. The difficulty, however, consists not so much in the perception of the differences which undoubtedly do exist, as in reducing these perceptions of the progressive scale of creation to our still very imperfect language. The dilemma somewhat resembles that in which an ancient philosopher is said to have been involved, who, when desired to state what motion is, after much consideration, rose from his seat, walked towards the inquirer, and replied, "You see it, I can shew it to you, but I cannot tell you what motion is. Thus, also, to our opening question I would answer, here are plants; you see them; I can shew them to you,

even if I cannot, at this early period of our course, precisely tell you what a vegetable is.

Let not the bearing of this statement, however, by any one be misunderstood. Remember it is not science which *makes* the difficulty she here points out; she only shews what already is: just as "a microscope does not make the hairs on a mite's back, but only brings them within our sphere of vision. Examine for a moment these specimens illustrative of the different departments of the vegetable world; these mushrooms, flags, and mosses; these jointed and these jointless ferns; these grasses, sedges, rushes, lilies, palms; these pines, and forest trees; and these more showy flowering herbs and shrubs; of each of which extensive sections, but meagre examples, can, of necessity, be brought before you, and yet which are scattered in such infinite profusion "o'er all the deep green earth," that their varied forms and beautiful appearances are familiar to the least observant: examine these, and say, do they not attest the dogma of him of old that a vegetable is, indeed, a various, a very various thing, of which it is difficult to give a definition: and do they not equally proclaim that science does not make the difficulty she here points out? do they not declare that she only shews what already is, although it may have hitherto escaped our observation? And hence we may conclude that the unlearned do not know more truly, because they are insensible of the imperfections of their knowledge, any more than a road becomes smooth to the purblind, merely because they do not see its roughness. Whatever is, still is, whether we know it or know it not; doubtless from the beginning eight planets always were, although the ancients knew but seven; for Herschel's telescope did not create the Georgium Sidus, but only shewed to man what mortal eyes had never seen before.

But the difficulty of diagnosis between animals and plants, and even between living and lifeless beings, so often and by so many dwelt on, is rather a speculative than a practical obscurity. Every one is sensible of differences existing between the numerous productions of nature; for were not such differences obvious, the whole would be esteemed not various, but the same. All persons, then, distinguish the peculiarities that mark the successive grades of physical existence, though few are competent to state precisely in what that difference consists: the one is the unsought observation of the savage, the other the hard-earned achievement of the sage; the former a perception that no one can avoid, the latter a science in which, not seldom, the wisest are at fault.

Now this great and extraordinary variety, this almost infi-

nite diversity in the structure and functions, the characters and appearances, the properties and purposes of plants, which renders it so difficult to frame a concise definition rigidly including the whole, and as rigidly excluding all that *we think* not plants; which circumstance so many have bewailed, and which some superficial philosophers have regarded as the reproach of Botany, because it suits not their weak and artificial systems of arrangement, so far from being an "opprobrium botanicum," is in truth one of the chief advantages of which the science has to boast; and if I wished for a change at all, I would wish (although it is needless,) that the variety were ten times greater: for though the vegetable kingdom, by stretching to such wide extremes, may render the absolute definition of a plant somewhat abstruse and difficult; and, though in some few cases, at the confines of the animal and vegetable reigns, doubts may arise as to whether certain microscopic beings are animals or plants, belong to this kingdom or to that, or in fact to either, still their ambiguity, which has been lamented as a disadvantage, when rightly viewed, becomes at once an index to elucidate the things themselves; and their very obscurity indicates at once their station, by referring them to the debatable land of natural existence; just as green is neither blue nor yellow, but in the bow of heaven holds an intermediate place. And furthermore, it, of course, will follow that the greater the diversity among decided plants, the stronger will the contrasts be; and, of course, the more easily will they be distinguished from each other; a secondary advantage, which far outweighs any slight inconvenience attending the diffuseness of the primary definition.

Still, before we presume to talk of plants, it may perhaps be required that we should attempt to solve the question that so continually recurs; viz. what is a vegetable? For plants are the principles on which all botanic lore depends; they are the very subject-matter upon which we must discourse: and although we cannot absolutely, we can relatively define them, which relative definition is, in truth, all that can legitimately be sought in any branch of natural history or philosophy. With this relative definition we shall, therefore, rest content; for the search after the absolute and positive too often becomes, as Butler has observed, on a somewhat similar occasion,

"An ignis fatuus that bewitches,
And leads men into pools and ditches."

Hence, to shew what constitutes this various thing we call a vegetable; i. e. to indicate the various phenomena exhibited by certain physical existences, to note what characters dis-

tinguish the organic from the inorganic world; and amongst organic beings the vegetable, or merely vital, from the animal or sensual creation; in a word, which constitutes the several grades of men, brutes, and plants, as it involves much curious and important knowledge, shall find a place in this course of lectures.

But, for the present, let the speculative problem pass: to it we shall return hereafter; and its consideration is only now delayed, that a previous practical demonstration of plants, as they are found in nature, may better enable us to venture on its solution. Hence to a future lecture we postpone our definition of a plant, and propose in this, as a most useful preliminary step, to practically shew what a varied thing a vegetable is.

Here you must grant me, what will, however, scarcely be denied, (for it is a postulate without which no step can be advanced,) viz. that the examples adduced are truly vegetables: I have endeavoured to select as specimens those which will the best illustrate the varied characters of plants: that they are truly such I shall prove to you hereafter; that they are what I describe them you must grant me now.

Something must be assumed in every science, and the pupil must take much, at first, on the authority of the teacher; but, although it is convenient, in order that every point, even the simplest, should receive its due share of consideration, to assume that students are totally ignorant of the subject to be discussed, still such *tabulæ rasæ* are never met with; many things are unavoidably known to almost all, our very existence convinces us of many: and from the certainty of things already known, we proceed to inform ourselves respecting those which are as yet unknown; and not only this, but from knowledge thus acquired, we are enabled to correct those errors by which, either from ignorance or prejudice, we had been previously enthralled.

To this practical solution of the problem what is a vegetable, let me, therefore, entreat your earliest attention; for familiar as science and art, working by the head of the botanist and the hands of the gardener, have rendered the inhabitants of this island with vegetables in almost all their multiplied diversities, (for, besides the productions of its natural fertility, our country has long blushed with flowers not its own,) I am still inclined to think that even the most common and the most strongly marked types and classes to which I have referred will be recognised more surely by the exhibition of specimens, be they never so homely, than by reference to them by words alone, be the language never so precise. Hence, to aid verbal descriptions, which of necessity must ever be imperfect,

I have collected, and here present you with some few samples of the regions and classes, and of several of the subordinate departments of the vegetable reign; most of which have been long established, and although their names at first may have been waywardly imposed, custom has now rendered them more or less current terms, and science, if she has scrupled to adopt the popular language, has not scrupled to avail herself of popular observations, and has frequently adopted and confirmed the popular distribution, as a reference to these tables and diagrams will shew; and as, with very slight modifications, many of these common and familiar words may be rendered synonymes of less familiar technicalities, I shall use them now in preference; not, however, as superseding the terms of science, but as paving the way for their introduction.

Plants or Vegetables.	{	Musts or Worts.	{	Flags or	Algæ	}	Acolyledones vel Cellulosæ.	} Plantæ vel Vegetabilia.
				Mushrooms or	Fungi			
	Mosses or	Musci						
	Leas or Herbs.	{	Palms, Lilies, &c. or Grasses and Sedges or Ferns or	}	Palmites ^a	}	Monocotyledones vel Endogenæ.	
Segetes Filices								
Cresses or Plants.	{	Pines and Zamias or Cresses, Fruges, or Sel-worts	}	Za-Pini ^b	}	Dicotyledones vel Exogenæ.		
				Eucarpæ ^c Selanthi ^d				

It is curious to observe the coincidence which exists between the popular and scientific distribution and nomenclature, and that the Fungi, Algæ, Musci, Filices, Segetes, &c. are but technical synonymes for nearly equivalent groups, known to all as mushrooms, flags, mosses, ferns, grasses, sedges, and so forth: and this is still further remarkably the case in the

Primary Groups admitted by Linnæus.

Vegetabilia	{	Monocotyledones vel Fruges.	{	Palmeæ or	Palms,	(Principes.)	
				Gramina or	Grasses,	(Plebeii.)	
				Lilia or	Lilies,	(Patritii.)	
		Dicotyledones vel Plantæ.	{	Herbæ or Arbores or	}	Herbs,	(Nobiles.)
						Trees,	(Proceres.)
		Acotyledones vel Cryptogama.	{	Filices or Musci or Algæ or Fungi or	}	Ferns,	(Novaccolæ.)
						Mosses,	(Servi.)
						Flags,	(Vernaculi.)
						Mushrooms,	(Nomades.)

I stop not here to justify the classes and the regions into which the vegetable reign, or kingdom, has been almost universally distributed: this will engage our subsequent attention.

^a Including the *Petaloid Endorhizæ* of Richard, or Monocotyledons of Jussieu

^b Including the *Synorhizæ* of Richard.

^c Including the *Exorhizæ* of Richard.

^d Including the *Cytineæ* and *Rhizanthææ* of authors.

Neither am I called on to defend the names which custom has, in general too loosely, applied thereto, and which science often, too fastidiously, condemns. Much of the arrangement I think very natural, and most of the terms, if used with somewhat more precision, highly expressive; (and why should not English technicalities be as carefully defined as Greek and Latin words?) and, although not all so classically elegant as some of our botanical nomenclature is, they are equally intelligible, and far more euphonious than many semi-barbarous technicalities: but of this, more hereafter. I merely use the vulgate now, because, although I am aware that many of my hearers are well versed in botanical language, to some it may not be familiar; and hence, that every point may be explained, it is, as I have already observed, convenient to assume, even if it be a kind of legal fiction, that all are ignorant of the subject. Hence, those who are veterans in botany will be pleased to excuse, (indeed, I know they will ever be the last to condemn,) the adoption of any method which may tend to familiarise science and facilitate the progress of the student. Who is there that has not at some time felt the galling yoke of technicalities? Who has not found, that to learn a science, and at the same time to learn a language, is indeed to have the tale of bricks demanded, while the straw to make them is denied.

Let me, therefore, in conjunction with the scientific names, employ the common English synonymes, whenever such exist, and, when there are none known, translate the foreign epithets into our mother tongue; at least for the purposes of this momentary glance at the several most commonly accepted sections of the vegetable world, which, by means of specimens and drawings, can be brought as it were in review before us.

The first class to which I shall direct your attention contains several very curious types of plants which, collectively, are termed *Flags*, or *Algæ*. Their English name has reference to the flagging habits of a large proportion; as, for example, the sea weeds, which are usually fixed to rocks and stones, and flag, i. e. droop or float, according as the water quits them or bears them up. *Alga*, the technical synonyme, is said to be derived from *ab algore*, coldness, as if it had been supposed that some of these productions, which are chiefly aquatic, were formed by the congelation of films or drops of water; to which, indeed, many bear no slight resemblance. To this ancient hypothesis there seems to be allusion in the names of several: e. g. *ulva* (ab uligine,) signifies oozy or moisture: as our English word *laver*, from *laver*

(a lavo) to wash, literally means *froth*, *scum*, or *lather*; whence, perhaps, *läver* or *läver*. Again, *Halymenia*, if literally translated, gives a pellicle of sea-water or sea-membrane. Thus, also, *Achnanthes* is sea-froth; *Anthachne*, froth-flower; and *Alcyonidium*, the foam of the sea. Many other similar examples might be given, for they continually occur, and in every language; although, when veiled in foreign tongues, or even when custom has given them an adventitious meaning, their original significations are often not attended to. Thus our own *mildew* is but a contraction of *soft* or *mild dew*, referring to the delicate texture of the minute plants of which mildew consists, and of which each spot is, as it were, a forest.

In the infancy of philosophy, such fanciful speculations and ideas, which we now think absurd, were common to all branches of science, and to other departments of natural history, as well as to the study of plants. Indeed, it is comparatively not long since, that an elaborate and learned dissertation was written in order seriously to prove that the "flowing gossamer," the aerial spider's web, so common in autumnal mornings, is *not* frozen dew.

The names alone are all that now happily remain to us of many of these crude doctrines which we are too apt to denominate absurdities, not remembering that many of our received hypotheses, it is more than probable, are equally destitute of truth. These are but the clouds which attend the morning twilight of philosophy; and, as the sun of science rises, like the early dew they pass away.

The class, denominated the Flags or Algæ, includes in its several orders, sections, types, and genera, some of the most curious living structures which as yet are known: proto-phytes just emerging from lifelessness to life, and beings which are almost animals but still linger on the confines of the vegetable world.

Many of these microscopic creatures are so simple in their nature, that their very simplicity renders them a doubt. Here, indeed, is the problem of which mention has been already made; for so similar are many of the lower tribes of algæ and of fungi, that it is not only sometimes indeterminable to which of these two great classes certain individuals should be referred, but whether, in truth, they are plants at all; for, strange as the statement does appear, many of them may only be parts of other organic beings, and to more there has been attributed an animal existence.

Upon this point, however, modern research has thrown very considerable and very important light; and several of those ambiguous things called infusorial animalculæ, and named

and arranged as such in their systems by zoologists, and to which, by some, an equivocal or fortuitous generation had been most gratuitously attributed, it is more than probable are not of an animal, but of a vegetable nature: and, besides this, very many of the moving corpuscles, which have often been mistaken for monads, and which hence were once most unphilosophically supposed to have sprung into existence without parental aid, are proved to be merely portions of dissolved or dissolving organic matter, loosened in its structure, and put into motion by physical powers, which had previously escaped detection by the observant eye of man. I allude, of course, to the curious phenomena described by PORRETT under the name of *Electro-filtration*, and which DUTROCHET has termed *Endosmose* and *Exosmose*, i. e. a *flux inwards* and a *flux outwards*, from the circumstance of two currents of different strengths being noticed to pass through organic membranes, when the fluids on either sides are of different densities or in different electrical states; and which will either fill or empty a fixed saccule, or put a moveable one in motion. This phenomenon was first observed by Dutrochet to take place in the cellules of a small conferva, or moss-like production, which he detached from a fish's tail. Each portion of this moss consisted of a filament and saccule, from which globules were expelled, and into and out of which the currents of fluids passed. He procured other similar globules by putting pieces of flesh into the water, so that their formation was not connected with the living state of the fish. He saw these globules spread throughout the fluid, agitate themselves in divers directions for an instant, and then precipitate themselves to the bottom of the vessel.

But methinks I see some ultra-utilitarian smiling at the thought of a grave philosopher being thus engaged for hours in watching the motions of a corpuscule so minute as to be scarcely visible to the naked eye, and methinks I hear him ask "cui bono?" a question that any child may ask, but one that the wisest philosophers must often find it difficult to answer; although they may be far from admitting the pertinency of the question. When such queries are proposed, as they often are, I love to meet them with FRANKLIN'S counter question, "What's the use of a baby?" for no one will venture to inquire, what is the use of a man?

The experiments which have led to this digression as yet are in their infancy; but, even imperfect and crude as they confessedly at present are, they have already thrown much light on some very obscure parts of animal and vegetable physiology, and they promise to afford much more: they certainly disclose

one of the most curious physical forces which have been discovered in modern times, and the just value of which we have not at present the means of estimating.

The same observations apply, and perhaps with still more truth, to that most curious discovery lately made by the celebrated Mr. ROBERT BROWN, who has shewn, by an unexceptionable series of experiments, that locomotion, even when apparently independent of external forces, may and does exist among particles that are absolutely lifeless; nay, which have never been alive: so that, should not this phenomenon admit some more probable solution, it would seem that the long-established definition, which declares matter to be inert, may perhaps require a serious modification.

This apparently independent motion of the molecules of matter may appear to some to be a close approximation to the vital motions of plants, or the spontaneous movements of animals; and, indeed, the idea would seem more plausible than the belief of some German philosophers, that crystallization is an effect of vitality. The facts are simply these: that grains of pollen, particles of dead plants, some of which have been in herbaria for upwards of a century, nay, even fragments of pounded glass and stone, when diffused through water, and viewed with a good microscope, are seen to be in a constant state of motion; and this independent of any evaporation of, or currents in, the fluid. Furthermore, that they still maintain their restless activity when hermetically sealed between two plates of glass, so as to exclude, as far as possible, all external agitation; and are found, even under such circumstances, to continue their motions unremittingly during an indefinite period; nay, even after the lapse of months, (I believe we may now say years,) to be as full of motion as when first observed.

This discovery, as just now hinted, has been thought by some to militate against the ancient dogma, which enunciates the inertia of matter. It would ill become me to advance any speculations other than as mere hypotheses, and this the more especially as the discoverer himself, with that modesty which always attends true genius, does not even venture an explanation: I, therefore, scarcely dare to suggest that it would be desirable to ascertain whether these movements may not be indicators of external motions, so slight as to be imperceptible to other means, rather than as inherent in the particles themselves. Just as many atmospheric changes are notorious with the water, that are utterly inappreciable with the mercurial barometer; and as the expansions of bodies by

heat, and the vibrations of sound, are measurable by some instruments, which are imperceptible by others, so it would be desirable to ascertain whether the motions of these molecules do or do not depend upon vibrations, otherwise imperceptible, communicated by distant moving bodies on the surface of the earth, to the supports on which they stand; or whether it is possible, as the movements seem very constant and similar, that they can evidence the motions of the earth itself, and thus afford the means of constructing a delicate *kineometer*.

But, although many pseudo-*animalculæ* and (if we may be allowed the parallel word) *vegetalculæ* (?) are thus shewn not to be those wonders they were once supposed to be, and although locomotion is thus proved not to be absolutely diagnostic of life, still they are not the less wonderful now that they are regarded as what they truly are, lifeless corpuscles, put in motion by newly discovered and extraordinary laws, which their observation has been the first to reveal, than when they were considered paradoxes, and almost a reproach to natural science. And besides, even after their exclusion from the organic realm, there still remain many living beings, as simple in their structure and as curious in their functions as imagination can well conceive a vital organization to be, or ever to have been. For example, the slimy matter often seen on rocks and stones, on hard gravel walks, and on damp walls and cellars, or on the glass of windows, garden pots, and so forth, and which is often so minute as to be lost to ordinary vision, consists of curious and most admirable vegetable structures. All the green pulverulent coating seen on old trees and paling is likewise found, by microscopic observations, to be composed of an infinite number of small plants, of an exceedingly primitive formation.

The slimy masses known as Will o' the wisps, or Nostocs, are instances of other similar species, some of which are called by the common people "flowers of heaven;" a name which they deserve more than many that are often given to plants, if it be true, as the old herbalists declare, that, "infused in brandy, they cause a disgust to that liquor in those who drink of it;" for, as JOHNSTON adds, they would then become "an excellent remedy for the '*potatores summi*.'"

Not one of the least curious of the lowly flags is the "red snow," which excited so much attention on Captain Ross's return from the North Pole in 1819. This phenomenon seems in some cases to depend upon the sudden appearance of a very minute plant, which the microscope declares to

consist of small cells filled with a red fluid, and which is referred to a genus named, from its very simple structure, "*proto-coccus*."

This plant, as well as the *Palmella cruenta*, or gory dew, *Lepraria kermesina*, or bloody rain, with many others called *reeks* or *earth-sweats*, as well as certain minute animalculæ, suddenly appear, and in such great abundance as even to tinge pools of water with the hue of blood, to make red stains on the sea shore, and to discolour considerable tracts of ground, so as to simulate red snow, or dew, or rain; and such, in fact, the appearance is vulgarly supposed to be. These occurrences are often regarded by the ignorant as of sinister omen: indeed, whole towns have been occasionally alarmed with the report that, in the course of a single night, the water of their pools had become changed to blood; and the dismay was not relieved until a philosopher exhibited to the eyes of many, the minute living corpuscles which had wrought the change of hue, and which were easily separable by filtering the fluid.

Palmella cruenta, or gory dew, is common in many places: I found it abundantly a few weeks since at Oxford, and it is frequently observed in damp situations, forming "broad indeterminate patches of a deep rich purple, with a shining surface, as if blood or red wine had been poured over the stone or ground." During dry weather, it contracts, grows dull, and disappears; but, after rain, spreads anew, resumes its sanguine colour, and becomes conspicuous even to vulgar gaze. Its history affords (says JOHNSTON, in his *Berwick Flora*,) an easy explanation of a phenomenon considered supernatural by monkish chroniclers, and to which DRAYTON, in his notes to Polybion, refers: "In the plain near Hastings, where the Norman William, after his victory, found King Harold slain, he built Battle Abbey, which at last (as divers other monasteries) grew to a town enough populous. Thereabout is a place which, after rain, always looks red, which some have attributed to a very bloody sweat of the earth, as crying to heaven for revenge of so great a slaughter."

The simple plants which constitute the so-called red snow, and rain, and hail, and dew, and which consist of one or several cellules, distinct or coadunate, give way to more advanced and regular structures in the *Confervinæ*, or boneworts; and these, again, to the higher grades immediately contingent, known familiarly as seaweeds, lavers, or kelp-ware. These weeds (*Thalassiphytes*, or *Phycæ*,) are followed by the land-flags, or lichens, which latter have been called *Algæ aëriæ*, to distinguish them from their aquatic allies; and, as

they affect a very different station, they exhibit, as they leave the water, several important modifications of structure, to fit them for the peculiar functions they are destined to perform.

The seaweeds or wrackworts (Phycæ), including the lavers (Ulvinæ,) and the kelp-ware (Fucinæ), &c., are generally water-plants, scarcely ever growing in situations that are not frequently submerged: the lichens, on the contrary, are as universally aërial plants, affecting often peculiarly arid sites; fixing their shield-like bases on bare and barren rocks, or dead but not rapidly decaying timber, and, when growing upon living trees, not deriving nourishment therefrom. Hence, being what are physiologically termed Epiphytes, to contradistinguish them from the true parasites, such as fungi, which not only grow upon, but draw their nourishment from the other vegetables to which they are attached.

The marine Algæ were formerly, for the most part, included in the single genus *Fucus*, as the land-flags were in the single genus *Lichen*; but the groups of species are in both as generically distinct as in any equivalent orders of terrestrial plants; and hence they are now considered and named as such.

The aquatic flora, so long neglected that what was formerly considered knowledge can be regarded as little more than a veil for ignorance, has, by modern research, been already made a very important and interesting branch of study, and it promises to become much more so, as they well know, who ever have explored the vegetation of the sea, and all will soon confess, who, like us,

“ Shall tread from rock to rock in pleasing trance
And note the novel forms that deck the sides
Or float upon the surface; too fair
Either to be divided from the place
On which they grow, or to be left alone
To perish in their beauty.”

The history of the Fuci, as yielding iodine and kelp, two such valuable articles in medicine and commerce, affords an instructive lesson to those persons who hastily and presumptuously condemn all things as useless, the use of which they know not: for that very weed confers great benefits on man, who for ages stigmatized it as the synonyme of things most vile and worthless, useless and despised. “*Alga inutilis*,” exclaimed the ancient poet; “*Vilior alga est*,” in a tone of contumely, he repeats; “*Refunditur alga*,” exclaims another bard: the sea itself spurns forth the worthless flag; that flag, the gathering of which for years enriched both peer and

peasant on our northern coasts; the very flag that now affords the iodine which really does relieve that evil which the *manus regalis*, the boasted royal touch, (if it ever benefited the superstitious,) so long has failed to cure.

The lichens are plants familiarly known even to the least observant, as giving much of the venerable air of antiquity to aged trees, by covering their broken limbs, and reconciling the beholder to the deformity of decay. They likewise impart that subdued appearance and softness in colour and in outline which renders ancient buildings, by their calm grandeur, peculiarly impressive: hence in our language, often so admirably emphatic, they have been called "time-stains;" a name which may vie in force and elegance with any that, in any other tongue, they have hitherto obtained, and which, though long all but obsolete, may well demand its restoration to general favor.

The lichens afford several valuable dyes, a few drugs, and occasionally some food to man, though much more to certain beasts; e. g. the *Cenomyce rangeriferina*, or rein-deer moss, is the chief support of the Lapland herds. But the immediate uses made of these plants by us are insignificant when compared to the functions they perform in the general economy of nature. Here their utility is great, and their value may almost be stated to be in an inverse ratio to their size.

LINNÆUS called the *Algæ Vernaculi*, or bond slaves, as fettered to the rocks on which they grow. The title is particularly appropriate when applied to the lichens, which are, as it were, chained to the soil they labour to improve for the benefit of others, though from it they derive no nourishment themselves.

The first conquests of life over death, the first inroads of fertility on barrenness, are made by the smaller lichens, which, as HUMBOLDT has well observed, labour to decompose the scorified matter of volcanoes, and the smooth and naked surfaces of sea-deserted rocks, and thus to "extend the dominion of vitality." These little plants will often obtain a footing where nothing else could be attached. So small are many that they are invisible to the naked eye, and the decay of these, when they have flourished and passed through their transient epochs of existence, is destined to form the first exuvial layer of vegetable mould; the successive generations give successive increments to that soil from which men are to reap their harvests, and cattle to derive their food; from which forests are designed to spring, and from which future navies are to be supplied.

But how is this frail dust to maintain its station on the

smooth and polished rock, when vitality has ceased to exert its influence, and the structure which fixed it has decayed? This is the point which has been too generally overlooked, and which is the most wonderful provision of all: the plant, when dying, digs for itself a grave, sculptures in the solid rock a sepulchre in which its dust may rest. For chemistry informs us that not only do these lichens consist in part of gummy matter, which causes their particles to stick together, but that they likewise form, when living, a considerable quantity of oxalic acid, which acid, when by their decay set free, acts upon the rock, and thus is a hollow formed in which the dead matter of the lichen is deposited. Furthermore, the acid, by combining with the limestone or other material of the rock, will often produce an important ingredient in the vegetable mould; and not only this, the moisture thus conveyed into the cracks and crevices of rocks and stones, when frozen, rends them, and, by continual degradation, adds more and more to the forming soil. Successive generations of these plants successively perform their duties, and at length the barren breakers, or the pumice plains of a volcano, become converted into fruitful fields.

The Fungi form a large and very curious and important class of vegetables, differing little in the lower grades from several types of Algæ; and, indeed, often considered as of inferior rank in the general scale of creation: they are simple in their structure and rapid in their growth, and, although parasitic, for the most part grow upon lifeless organic matter, which they rapidly decompose and speedily remove; thus making what has become useless to itself useful to its survivors. For these duties they are peculiarly fitted by their wandering habits; whence, by Linnæus, they were figuratively called *vagrants* or *Nomades*. On weak and sickly plants these parasites abound; whence they are often supposed, as blights and blasts, to produce the diseases they attend. They likewise flourish most luxuriantly amongst refuse matters, muck and offal, and often in great part form what is called mustiness, mouldiness, or mildew: hence, indeed, they have been named respectively Brands, Musts, Moulds, Mildews, Mushes, Mushrooms, &c.

The botanical term *fungi*, (a word which has now very properly become almost naturalized to our tongue,) is peculiarly expressive of the functions they perform, whether it be immediately derived from *funus* and *ago*, as indicative of their office, the removal of the dead, or intermediately from *fungor*, to discharge or execute a duty.

The natural history of these plants is one replete with in-

terest, and, notwithstanding the little attention they commonly excite, they are constantly labouring for the general advantage. The quickness of their growth is astonishing, and the rapidity of their increase all but past belief. The Bovista, or bull-puff-ball, has been computed to grow at the rate of many million cells per minute, upwards of a million per second, and to be, when at maturity, so many times larger than when beginning to germinate, that figures shrink from the expression of the sum; and FRIES asserts that he has counted in a single individual plant of the smaller kinds, called smuts, ten million sporules so subtile that they rise into the atmosphere like smoke: and hence, although lost in astonishment at their prolific powers, our wonder ceases that they should be every where dispersed, and colonise every spot that affords fit nutriment for their growth.

The Fungi are associable into three chief groups, or orders; the first including those known as blights, blasts, and mildews, (Mucedines;) the second, the puff-balls, truffles, &c. (Tuberes, or Gastromyci;) and the third, the mushrooms and toadstools, (Hymenomyci, or rather Mycetes;) for it is probable that to this section the original Greek *μύκης*, like the modern French *champignon*, was particularly applied; for to it, in reference to the common form of the plants, both terms are peculiarly applicable; resembling, as many do, the handle of a sword, and others the pinions of a watch.

The mosses (Musci, using the term in an extended sense, though far less vaguely than formerly was done, when almost every thing moist and soft was called a moss,) will include in one class, along with the true mosses or mossworts (Muscosæ or Bryodes), the liverworts (Hepaticæ) and the stoneworts Charæ or Muscharæ), orders which, although sufficiently distinct, have several important characters in common, by which they are associated together more naturally than either with any other class. The liverworts (Hepaticæ) which now are classed with the mosses, were formerly considered more nearly connected to the flags; and, indeed, by Linnæus they were denominated Algæ hepaticæ; and the curious stoneworts (Characeæ) have likewise in general been separated too widely from their natural allies, both when arranged, as is still done by some, with the confervæ and the ferns. From the latter they are distinguished by their simply cellular structure, and from the former by the evolution of a distinct axis of growth around which central line, various processes, as leaves or branches, are arranged. These characters associate them with the Musci, which thus exhibit, by their more elaborate forms a further stage of vegetable development.

With the mosses the first region of the vegetable reign concludes, in which the three classes, flags, or Algæ, funguses, or Fungi, and mosses, or Musci, are included; three classes which, although essentially distinct in the more highly developed and normal genera of each, are still on their confines scarcely distinguishable from each other. The simply cellular structure of the whole is their chief bond of union: in this they all agree, and future investigations will shew it to be a most important diagnostic sign: hence they have been called Cellulosæ, or Cellulares. Furthermore, the fact may be enunciated, that these vegetables are not reproduced by seeds; and hence they have been named Acotyledons, as stated in the tabular conspectus, the musts, mustallies, or mosses of our rustic dialects and older systems. In most languages it will be found that these lower tribes of plants have originally had the same or nearly similar appellations; and, that although their names are different now, that the difference often consists in a mere modification of the original term, and that all may be traced to a common root.

This etymological evidence it would not be right at present to dilate on; but one example may not be irrelevant to shew the general impression which their most obvious characters are calculated to produce.

Our word Moss (which the Normans gave us for the elder *reet*;) is derived immediately from the Gallic *Mousse*, a term of exactly similar meaning when applied to plants, but which also signifies froth or lather, and is itself a derivation of *Mou soft*, or loose, like the foam of the sea or the vesicles of lather; analogous to our must or wort, given to fermenting liquors and to many similar plants. Hence also seaweeds, many of which are called sea-froth, sea-foam, sea-membranes, &c., as already shewn, are called by the French *Mousses de mer*, or sea-mosses, the Musci Marini of the older writers, the βρύον θαλάσσιον of DIOSCORIDES and PLINY. Furthermore, Fungi, or mushrooms, are named Mousserons, moss-allies, which is perhaps a contraction of *Mousse ronde*, or round moss; i. e. soft or puff balls.

This softness of texture and cellular formation seems to have given names to almost every section. Thus mouldiness or mustiness is called Moisissure, and Mucor; Mildew, like our mild-dew, Serein and Sideratio; adverting to its supposed deposition from the atmosphere, or belief that the plants were star-struck: Mucedo, Muceo, and Mucus, are of nearly similar import to each other, and to our muck or slime; just as must in mustiness, and mush in mushroom, are but corruptions of moss, or *mousse*; and hence the whole

series may well associate under the common names of musts, or mushes, or mush, i. e. moss-allies, technically Myc-affines. The connexions are evident in Muscus, a moss, Muces or Mousseron, and Mouceron, a mushroom, *Mousse de mer*, and βρύον θαλασσιον, sea-weeds, Mycinema, an articulate flag, &c., shew a similar affinity to be recognised by other people and in other languages besides by ourselves and in our own.

The uses of mosses are great in the general economy of nature: well have they been called by Linnæus the Servi, or ministers of nature, filling as they do and consolidating bogs, clothing mountains even to the verge of perpetual snow, and condensing the moisture of the atmosphere; thus giving origin to rills, and being the living fountains of many streams: but of their functions more hereafter.

Linnæus, who viewed nature with the kind affections of a philosopher, and the warm imagination of a poet, gave to the ferns (Filices) the figurative name of Novaccolæ, or *new settlers*: and no synonyme could more happily express their habits and general importance; for barren tracts are colonized by ferns long before many other tribes could vegetate thereon: and on sterile soils, where other plants would perish for want of food, the hardy ferns find sustenance enough; consequently in such situation they flourish and abound, unmolested by loftier and more luxuriant shrubs and trees. Ferns are truly colonists, and to fit them for the migrations they are destined to perform, it would seem as if nature, even while developing their organs of vegetation, and giving them both shrubby and arboreous stems, had considerably restrained an equivalent evolution of the reproductive system, lest they should be encumbered by weighty seeds in their successive and continued transits over large tracts of land and in crossing extensive seas.

Hence, instead of elaborate fruits and seeds, ferns, with the stems and nearly the foliage of palms, have spores little differing from those of mushrooms and of mosses. Like them, they are most prolific; for a single frond, and one fern bears many fronds, has been computed to produce upwards of a million spores.

Like the musts and their allies, so minute are these reproductive spores of ferns that their existence was for a long time doubted, and before microscopes exposed them to our sight, this belief was common, and many references are made to it in our older writers. SHAKSPEARE, in allusion to this, the popular opinion, observes, "we have the receipt of fern-seed, we walk invisible." The final cause of this reduced development appears to be, that such dust-like spores should be easily

transportable from place to place; and hence it is that barren heaths, and coral rocks, and new-made islands, raised probably by submarine volcanoes, after that lichens and mosses have first subdued the sterility of stone, are colonized by ferns, the heralds of a more luxuriant vegetation, and harbingers of plants more immediately subservient to the purposes of man. And not only is such the course which nature now pursues in the conversion of barren into fertile soils, but geology informs us that such was the scheme of her primæval operations in preparing the earth for the reception of man; for, from the strata in which ferns are found, it is more than probable that they preceded and prepared the way for the introduction of many other vegetables, for the higher animals, and for the human race. The peculiar characteristics of the several groups of moss-like, jointless, and jointed ferns, must, from the limits to which an introductory sketch is of necessity confined, be reserved for subsequent explanation; but this need not be regretted, for, as the illustrations successively become more and more familiar, they will of course require, in this bird's-eye view, a less and less elaborate description, and for some a mere nominal reference will probably suffice.

Hence, the grasses and the sedges, the lilies and the palms, the pines, &c., although much more important plants, as ministering to the comforts and conveniences of man, will, from their being so much more familiar to all, require *far* less descriptive detail than the lower classes of mosses, flags, and fungi; many of which are comparatively so much less known.

The grasses and sedges, though in some features similar to the shave-grass-ferns, are as characteristically distinguished by the higher development of their organs of reproduction, as the ferns are by that of their organs of nutrition. In this class it is that true flowers are first observed, and the fruit no longer developed as spores, but in the form of grains. Hence they have been called by some botanists, in reference to their fruit, *Graniferæ*; by others, referring to the husks within which their flowers are found, *Glumaceæ*; and by others again, from their stalks, which are called straws or culms, *Culmiferæ*.

The grain-bearing, husk-flowered, or straw-stalked plants of the botanist are the grasses and sedges of the farmer: but as these, including in the first-named the cereal species, or corn, can no longer be referred to the single genus *Gramen*, it has been proposed to call them collectively *Segetes*, or *Grassedges*, (or *Gracarices*,) to avoid the periphrases *Gramina* and *Carices*, grasses and sedges; *Plantæ glumaceæ*, *P. graniferæ*, *P. culmiferæ*, and so forth.

The *grasses* pass by the *reeds* and *canes* to the *palms*, the *rushes* and the *lilies*; the *Palmæ et Lilia* of the Linnæan scheme, both of which are included in the *Palmites* of our scale.

This class, *Palmites*, contains some of the most curious, splendid, and majestic plants existing, which Linnæus called the Princes (*principes*) and Patricians (*patritii*), while he denominated the grasses the Plebeians (*plebeii*) of the vegetable kingdom. The tulip, iris, orchis, and banian types are the pride of our gardens and conservatories; and the palms, although insignificant when grown in our largest houses, still shew, even in confinement, what majestic plants they must be when growing unrestrained in the wild luxuriance of desert nature: for some, with erect stems, attain the height of nearly two hundred feet, and others, that are climbing palms, are found of five hundred feet in length.

The three classes forming this, the second region of the vegetable reign, include plants possessing a very peculiar and characteristic structure; which, although pervading all, is more decidedly developed in the palms and arboreous ferns, than in the grasses, sedges, or any of the other sections. This structure will be hereafter fully explained, but even now the fact may be enunciated that anatomical investigations, in the first place, shew that these plants consist not of cells alone, as in the mosses, funguses, and flags, but of tubes and cells, more or less irregularly collected into fasciculi, which are dispersed without reticulations in the leaves, and deposited centrally within the stems; that the stems are covered externally by the squamous remnants of the successive crops of leaves, just as the bulb of a lily is by its scales; that the oldest growths are likewise, as in the bulbs of the lily, tulip, onion, hyacinth, &c., external, and the newer growths internal; so that the parts first formed are gradually forced outwards and distended, until they become so far indurated as not to yield further to pressure from within. Hence, when this hardened girth has once been formed, the stems never after increase in thickness, how much soever they may increase in height. From this law of evolution a very important character results; for, as the stems can never increase in girth, and the successive crops of fruit and leaves can only be supported by maintaining a communication with the roots, by successive internal deposits of adducent and reductent vessels; so when the first-formed cylinder is filled with fibres, year after year condensed, a period at length arrives when, the internal space being filled, no further deposits can take place, and the plants inevitably die.

This period is of greater or less extent in different species; but, however great it may be, a limit is fixed in early life to their duration, beyond which they cannot pass; life being to them but a preparation for death, and the very means by which they subsist render their extinction progressively more certain.

In different palms the diameter thus first formed varies, and the height to which they grow is various likewise; but to whatever extent either may proceed, the one is decidedly the limit of the other; for every additional bud or crop of leaves depositing its fibres in the centre of the stem renders the mass more dense, and more and more confirms the outer ring, which, when filled, will permit no further fibres to descend, and the plant, without redemption, dies: should, however, this cylinder be cut through, or by any means be burst, then the term of existence may become indefinitely extended: and such is the case in the *Dracæna*, and the celebrated one in Franqui's garden, in the island of Teneriffe, is probably six or seven hundred years of age.

The general mode of growth being thus internal, has caused the whole region of plants in which it is found to prevail to be called *Endogenæ*, or inside growing plants; as the previous region, from their cellular structure, were called *Cellulosæ*, or *Telogenæ*. From the term of their existence being fixed during their earliest years, which the very act of growth renders more and more inevitable, and which is strengthened by their strength, may not improbably have led the ancients to apply the name *Termes* to a palm-tree, as well as to the fruit branches of other plants, when plucked, and a period put to their existence: and hence the region in which this peculiar characteristic is found to prevail may be called *Term-affines*, as indicative of this, one of the most notorious diagnostic signs.

Experiments have shewn that some bulbous plants, when freely supplied with water and with abundant food, produce more leaves than flowers, and not unfrequently the blossoms entirely fail, and, until the supplies become diminished, neither flowers nor seeds are formed. This is a matter of experience, and gardeners avail themselves of this knowledge to force unwilling plants to blossom, and barren trees to bear. A somewhat similar phenomenon is observable among certain palms, and may not improbably be accounted for on similar principles. For example, the Talipot, with its majestic columnar stem, equalling in height the mainmast of a man of war, and bearing annually, through ages, its royal crown of gigantic leaves, never flowers but once; the foliage

is luxuriant in the extreme, one leaf being sometimes five and thirty feet in circumference, and large enough to cover thirty or forty men; and this very luxuriance in foliage is probably the cause of its continued barrenness in flowers: but towards the close of its existence, and when the stem has become so far indurated that fresh ducts from the terminal buds cannot readily descend, when the supplies of food are curtailed, and its last efforts to live bring inevitable death, then the *Corypha* blossoms, and its beautiful yellow flowers, which smell so strongly that they can be perceived at a great distance, are succeeded by an abundant crop of fruit, one tree yielding enough to supply an entire country; and thus the *Corypha*, after having lived so long for itself, dies for its posterity.

It rarely happens among the palms, and not frequently among any of the Term-affines, that more than the central bud is developed; and hence these plants are seldom branched, and their trunks, when elevated and no longer rhizomata, are for the most part cylindrical, or nearly so. There is no absolute necessity, however, for this abortion of the lateral buds, and hence occasionally an extra one is developed, and forms a branch. In some, as the Theban doom-palm (*Cucifera thebaica*, or *Hyphæne coriacea*), two buds are naturally and equally developed, so that the stem becomes repeatedly forked.

In certain grasses likewise, as the bamboos, the stems are branched; and various exceptions to the general law are known, which hereafter will be detailed, and which circumstances render Term-affines a preferable name to Termites; the use of which, moreover, is now forbidden, from its being appropriated by zoologists to a destructive tribe of ants.

Zamiæ, or *Zemiæ*, names given by the ancients to the cones of firs, which, being left to open ungathered, they believed to injure the trees, and lessen the following crop, have in modern science been devoted to the designation of several curious plants, which, with their allies, the Cycases, connect, by their habits, the ferns and palms of the Term-affines with the pines and forest trees, to which, by their internal structure, they are found to be legitimately allied.

Hence this first class of the third region, including the *Zamiæ* and *Pini*, might, to avoid a periphrase, be called *Za-pini*, and the two orders it contains, the *Zamiales* and *Pinealess*.

The naked seeds and peculiarly porous wood vessels, which so closely associate these plants, otherwise, at first sight, so apparently dissimilar, are characters but comparatively a

short time known; and therefore, previous to their discovery, the *Cycases* and *Zamias* were arranged by some authors with the ferns, on account of their gyrate veneration, and by others with the palms, on account of their simple stems. But the internal structure of these plants differs greatly both from the ferns and from the palms; for, although not to the fullest possible extent confirmed, still their growth and annual depositions are decidedly external; they increase in thickness, and the layers of vessels which constitute their wood are stratified each succeeding year, externally to those of the preceding; a character which is common to this region, and which forms a strong contrast with the internal growth of the *Termaffines*. Hence the plants in this region increase in girth as well as height, and have no determinate period assigned for their duration. These circumstances are indicated by their collective name, *Crescaffines*, or *cress-allies*, and among them will be found examples of the tallest, the largest, and the oldest vegetables existing. From the external growth and exterior deposition of wood, these plants have been likewise called *Exogenæ*, or *outside growers*, and they have also had other names indicative of other characters, to which reference shall be made hereafter.

Zamia and *Cycas*, neither being indigenous to this country nor naturalized to our climate, firs, larches, yews, cypresses, and cedars, are among the most familiar examples of the first class of the *Crescaffines*, which is distinguished from the succeeding not only by the peculiar structure of the wood, but also by the seeds being naked, i. e. not furnished with an especial covering or seed-vessel, as in the following class: hence their descriptive synonyme, *Plantæ gymnospermæ*; but as this term has been otherwise, though generally incorrectly used, and, as it is not applicable to these plants alone, perhaps a name compounded of the appellations of the most important genera and orders it contains, may be esteemed the most fit to designate the class, such as *Zapini*; i. e. *Zamiæ et Pini*, as before observed.

Pines, which rank among our loftiest trees, are seldom known in this country to exceed a hundred feet in height, and are not to be compared with the magnificence of the New Zealand and Canadian species, which tower from one to two, and even to three hundred feet in height, maintaining at the same time a proportionable girth. One tree, indeed, I have had an account of, (but, not being a pine, it rather belongs to the succeeding class,) which grew in New South Wales, that is said to have exceeded four hundred feet in height, being higher than the cathedral of St. Paul; and we

are told that an American cypress is now existing that measures above a hundred feet in girth.

The herbs and trees (*Herbæ et Arbores*) of Linnæus, figuratively called by him the Nobles and Elders, (*nobiles et proceres*,) of the vegetable kingdom, and amongst which he distinguished those bearing arms (such as thorns and prickles) as warriors (*milites*) that not only thus defend themselves, but also protect otherwise defenceless vegetables from the aggressions of animals, were collectively denominated by HILL Plants, or *Plantæ*, under which common name he included all those species which were not reducible to any of his six previous classes, *Fungi*, *Algæ*, *Musci*, *Filices*, *Gramina*, et *Palmæ*. But the plants of Hill thus formed such an extensive group of negatively characterized and heterogeneous sections that the term *plant*, instead of being restrained even to the extent that he designed, has long been used as a synonyme for vegetable; and the herbs and trees both of Linnæus and the older writers are so inseparable, and (as systematic groups) so ill-defined, that the words are now indifferently employed, in almost every class, merely to distinguish the larger and perennial from the smaller and more transitory species.

Hence reformation was greatly needed here, and the group has been entirely remodelled and recast; many sections have been excluded, and other classes formed. But, notwithstanding these exclusions, the class still remains very large; yet, though extensive, it is now well characterized and easily defined: for the seeds, instead of being naked, as in the *Zamias* and the *Pines*, are invested with a peculiar covering called a pericarp, or seed-vessel, and known commonly as the fruit; such as the fleshy part that is eaten in the melon and the peach, the shell or pod that is thrown away in the nut and the bean. Hence by some botanists these vegetables have been called *Exogenæ Angiospermæ*, or *seed-vesselled*, to contradistinguish them from the *Exogenæ Gymnospermæ*, or *naked-seeded plants*. RICHARD and BARTLING, who regard other characters as more distinctive and important, call them *Exorhizæ* and *Gymnoblastæ*; but we had rather name them, with special reference to the high development of the fruit and seed, *Fruges*, or *Eucarpæ*. Indeed, this latter change seems necessary, from the exclusion of the plants which form our seventh and ninth classes, which we think improperly blended, whether with the *Angiospermæ*, *Gymnoblastæ*, or *Exorhizæ*, by the botanists who use these names. The gymnospermous *Pineales* being excluded on the one hand, and the evascular *Rafflesias* on the other, the *Eucarpæ* or *Cressels*, much as they may differ, and much as they do vary

in size and in duration, are mostly coincident in their radiate stratified arrangement, and all in the exogenous disposition of their tubes and cells, by which, with their seeds, they are distinguished from the *Selanthi*; and in the constant development of a seed-vessel at some period of their growth, by which they are known from the *Zapini*.

Amongst the Fruges, or Eucarpæ, are found many of our culinary vegetables, known commonly as cresses, and some of the most elegant of our garden plants: hence, as a distinction they might familiarly be called *cressels*: *sel*, as in *selago*, *groundsel*, &c., indicating worth or beauty.

To illustrate plants so well known seems almost a work of supererogation; and yet not to cite examples from such an important and extensive series might appear to be unpardonable neglect.

Although agreeing in their common and essential characters, in no class is there exhibited a greater diversity in the subordinate developments and the secondary modifications: and hence these plants are distributable, and have been distributed, into very numerous types and sections. These it will be the object of future lectures to describe; it is the general characters of the classes and the regions that, in this introductory conspectus, we chiefly desire to illustrate.

Let, therefore, the oak, the chesnut, and the baobab, as being the most familiar and noble, serve now as sufficient illustrations: for these, besides by their covered fruits exemplifying the class, will, with the fir, the yew, and the cypress of the Pineales, mark most strongly the all but unbounded size to which the *Cresc-affines* may increase, and the almost indefinite term of their duration.

In my "*Amœnitates Querneæ*" I have collected many records of extreme size and age in trees, especially in oaks; several of these are British, and some are still existing. Perhaps the Tortsworth, the Salcey, the Allouville, and the Cowthorpe are the most interesting and curious examples: the first-named measures fifty-two feet, the second forty-six, and the last, at its lowest level, seventy-eight feet round. Baobabs, however, have been described still larger: ADANSON measured several varying from seventy-four to seventy-seven feet in circumference; and PERROTTET and GOLWORTHY mention having found them of ninety, and occasionally even exceeding one hundred feet in girth.

The age of several European trees, especially chesnuts and oaks, can be satisfactorily traced by records through many centuries, and of that of more a fair estimate can, in some cases, by other means be formed. Thus, the old chesnut

of Tortsworth is known to have numbered above seven hundred, and is calculated to have lived upwards of a thousand years; the age of the Salcey oak has been computed at above a millenium and a half; the oak of Allouville is believed to be between eight and nine hundred years of age; and the Cowthorpe oak is probably more than twice as old. But what then can be the probable age of the still larger baobabs? Of the natural history of these enormous plants too little is at present known to allow any positive deductions to be drawn from their size alone: but still calculations have been made, although not on wholly unexceptionable data. It is with the *degree*, however, that I am less satisfied than even with the *kind* of evidence adduced. And furthermore, I do not think that the observations have been made with sufficient care: for trees increase very irregularly in the several radii of their diametric bulk; and if three hundred rings, measuring, say, three feet across, be granted to be the produce of three centuries on one side of a certain tree, and that an injured or wounded side, this fact cannot alone warrant the conclusion that three feet of the diameter measured on the other unwounded side, or in another tree, have likewise been three hundred years in forming. I do not mean to say that the evidence is bad in principle, but that not enough has been afforded for reducing it to practice: and yet on such evidence it is by some botanists of celebrity asserted, that the smaller baobabs are a thousand, and the middling-sized ones above two thousand, years of age; and hence, forsooth, that the largest which have as yet been found (exceeding one hundred feet in girth,) must have lived for upwards of fifty centuries at least.

But however this may be, it is for the purpose of our present illustrations, a matter of comparatively little moment: for, whether they have numbered quite so many years as their admirers contend or not, their antiquity, doubtless, is extreme, and their sturdy dwarfish stature, as they seldom exceed sixty or seventy feet in height, must favor their almost indefinite duration. Their age, even at the lowest computation, will form a striking example of that one great characteristic of these plants and their allies, the structure of which sets naturally no limit to their duration; and hence it is that they have been called the *Cress-allies*, or *Cresc-affines*.

It must not, however, for a moment be supposed that all the plants included in this region are essentially so long-lived, for many are quite ephemeral; but, however long or short a period they endure, their structure is similar to that of the most long-lived species; and, unlike those included amongst

the Term-affines, there is nothing in their structure anatomically incompatible with indefinite duration. But it is time that some further account be given of the examples already cited.

Seven hundred years ago the "great chesnut of Tamworth" was referred to, in writings still extant, as a signal tree; and if, in the reign of King Stephen, A.D. 1135, it was called the Great Chesnut, it is more than probable that it has bounded the manor of Tamworth, now Tortsworth, for upwards of a thousand years. Some time since it measured fifty-two feet in circumference: from calculations that have been made it is believed that in its youth it must have been contemporary with the Saxon Egbert. I have lately made inquiries concerning the state of this venerable tree, and also of the chapel-oak of Allouville, and learn with satisfaction that they are not only still alive, but flourishing in their green old age; and, from the vigour their shoots evince, they will probably outlast the present generation.

The oak of Allouville, in Normandy, known there as the *Chêne Chapelle*, and to which reference has been made, was, above a century and a quarter since, converted into a place of worship: its trunk was at that time hollow, and its head in part decayed. This living cavern was then paved and roofed, and divided by a floor into two apartments. The lower was fitted up by the Abbé du Détroit as a chapel, and the upper as a dwelling for the officiating priest. The caverns in hollow oaks are, however, seldom devoted to such honourable purposes: that in Damery's, for years, was used as a tavern; in the prison oak at Kidlington, vagrants and other slight offenders are said to have been occasionally confined; and the shell of the venerable Salcey patriarch, which is nearly half as large again as the chapel oak, was formerly enclosed by gates on either side, and cattle penned within it: and inside the hollow of the Cowthorpe oak, it is said that upwards of seventy persons have been at one time assembled. Were it not, as I elsewhere have observed, for instances such as have been mentioned, some of which occur in our own country, and in our own or in our father's time, we might almost be allowed to treat as fables the tales of modern travellers, who tell of hollow trees converted into tombs and prisons, as well as those older histories which declare that the ancient Germans had castles of oak; that in one vast Cerrus a hermit built his cell and chapel; and that another "served both as a castle and a fort." Of these stupendous oaks the history would almost seem to be as monstrous as their reported bulk; but that a hollow oak might be sufficiently large for a hermit's cell and

chapel, we have existing proof in the oak of Allouville; and it may be also well conceived, when we reflect that the cavity in Damery's oak was three feet wider than the parish church of St. Lawrence in the Isle of Wight, and that the trunk of the Cowthorpe oak, just noticed, where it meets the ground, stands on a plot exceeding by more than six feet *the length*, and by two feet twice *the width*, of the parochial church just mentioned.

Few persons, indeed, save those to whom habit has rendered it familiar, form any thing like just estimates of the actual size of trees. The situations in which they commonly are seen harmonizing with the illimitable expanse of heaven, and the wild extent of forest scenery or of mountain heights, lessen ideally their apparent bulk. Nor is it, till singled from the surrounding landscape, nor even then until the theodolite or rule proclaim their sums, that we become persuaded of their vast extent: nay, figures themselves, to the generality of the world, convey but very imperfect conceptions of length and breadth, and height and girth; some more familiar representations are wanted to prove that a majestic tree, which is only in moderate proportion as an ornament to nature, in the country, is really an enormous mass, and would be esteemed a large and glorious structure amongst the dwellings and palaces of men in town. It is by comparing these forest kings with more homely objects, that we alone become acquainted with their correct capacity. When seeing an oak seven feet in diameter, its size arrests not our attention; we even pass with little thought such as hold ten or twelve feet across, or more, although the smallest of these has a width as great as the carriage-way of Fetter lane near Temple bar, or of Bedford street in the Strand. Oaks can be named which would suffer two broad-wheeled waggons to pass each other on the kerf; the stub of one has been described, on which two men could thresh without incommoding each other; and this was not one of the largest size. The chapel oak of Allouville, not half so large as our Cowthorpe tree, is of equal size with the famous Greendale oak, the trunk of which is pierced by a road, over which it forms a triumphal arch, higher by several inches than the entrance to Westminster Abbey (the Poet's Postern), and under which men on horseback pass, and through which carriages have been driven.

The area occupied by the Cowthorpe oak where the trunk enters the soil, exceeds the groundplot of that majestic column of which an oak is confessed to have been the prototype, viz. SMEATON'S Eddystone lighthouse. Sections of the stem of the one would, at several heights, nearly correspond

with the sections of the curved and cylindrical portions of the other. A chamber of equal extent, or larger, than either of those in the lighthouse might be hollowed out of its trunk; the natural caverns in Damery's and other oaks were larger than the chambers alluded to; and transverse slices of the stem would be considerably too large to floor any of them. Arthur's round table, which is a plank from such an oak, would form for it an entire roof or projecting capital; indeed, upon this table there might be built a round church as large as that of St. Lawrence before referred to, and space to spare; so that if the extent of the sapwood were added, or the groundplot of the Cowthorpe oak were substituted for the table, there would be plenty of room, not only to build the parish church, but also to allow enough for a small cemetery beside. Indeed, with reference to this last-named oak, and also the tree-castles and tree-chapel, I would merely observe that St. Bartholomew's, in the hamlet of Kingsland, between London and Hackney, which, besides the ordinary furniture of a place of religious worship, viz. desks for the minister and clerk, altar, staircase, stove, &c., has pews and seats for one hundred and twenty persons: upwards of one hundred have been in it at the same time; and some months since myself made one of a congregation there assembled of nearly eighty persons (seventy-six or seventy-seven were counted), when the pews were by no means crowded, and plenty of room left vacant: still this chapel is nearly nine feet less in width, and only seventeen inches more in length, than the groundplot of the Cowthorpe oak: in fact, the tree occupies upwards of thirty square feet more surface than does the chapel. Or, to take another illustration; in Little White Lion street, Long Acre, within five minutes' walk of the place where we are now assembled, the inspectors of a district-visiting society found, about nine months ago, a house, the internal area of which is only twelve feet by twenty-four, (not half that of the Cowthorpe oak (which is twenty-six feet in diameter,) containing nine small rooms, in which there dwelt, i.e. ate, drank, and slept, and did all that poor mortality requires, no less than eleven men, thirteen women, and sixty-nine children, making a total of ninety-three human beings, to whom there has been denied, in this great town, so much surface of the earth as is granted for the growth of a single tree.

The next and concluding class is formed by the Selanthi, or Selworts: these plants, like the Pineales, were until lately blended with the Fruges or Eucarpæ, but, although still less as yet are known, those which have been discovered and examined constitute a group as structurally distinct, or even more

so, than the *Zamia* and *Pini*: for in them the vegetable kingdom, after proceeding through many successive stages of development, from seedless to flowering plants, exhibits a return to the point whence the series of evolutions began. They seem, in fact, to form the descending links which connect the highest with the lowest grades of vegetable development.

By their flowers, sometimes evolved in a most exuberant degree, they establish their connexion with the highest flowering plants; while, by their destitution of tubular vessels, and their frequently fungoid characters, they shew their close affinity to the lower mushroom sections. Some of these plants, such as the *Cytinus*, &c. have long been known, and, from their paradoxical structure, regarded as anomalies and exceptions in the class to which they were formerly referred. But the most splendid of the group, and that which alone would justify their collective name of Selworts, or Selanthi, was only discovered in the year 1818 by Dr. Arnold, the naturalist, who accompanied Sir Stamford Raffles in one of his journeys into the interior of Sumatra. It is said that the natives call it *Ambun Ambun*, or *Krúbût*, i. e. the *great flower*; and it is in truth a vegetable Titan. The specimen first found by the lamented Arnold, in remembrance of whom, and likewise of Sir Stamford Raffles, it has been called the *Rafflesia Arnoldi*, measured *a full yard across*; the petals being twelve inches long and a foot apart from each other; the nectary, adds the Doctor (in an unfinished letter to a friend, which was published posthumously), would, in the opinion of us all, hold *twelve pints*; and the weight of this prodigy we calculated to be fifteen pounds.

Several other allies have since been found, some of which are figured by BLUME in his *Flora Javæ*, but none have been as yet discovered that equal Arnold's flower in bulk.

All these curious plants agree in several particulars. In the first place, they have no proper roots of their own, and they derive their nourishment from the vegetables on which they grow; in the second, they have no stems, the flowers being sessile on the vines that bear them; thirdly, they are destitute of leaves, the buds being covered only by scales, which are purplish or brownish, and resemble the chaffy scales of other parasitic plants; for, as they derive their nourishment already prepared by the leaves of another vegetable, they do not require any foliage of their own: so that here we have plants consisting of flower only, neither root, stem, nor leaves being truly present. And what seems still more curious is, that, although the largest and most magnificent flowers in the

world, they have very little in common with other flowering plants. They have no proper seeds, but are multiplied by *spores*, similar to the spawn of mushrooms, to which indeed their general form and internal structure bear no slight resemblance. The petals are of a mushroom-like substance, and smell like tainted beef; and in them flies deposit their eggs, as they often do in fungi. Again, they contain no tubular or spiral vessels, like most other flowering plants, but consist of cells alone, like the mushroom tribes; they also spring from beneath the bark of the *Cissus*, which becomes gradually enlarged by their growth, somewhat resembling that false covering which several of the fungi have that grow on living plants; raising the outer surface into tumors, and bursting it as they become more fully developed; such as the blights and blasts of corn, and so forth: and hence these stupendous flowers, which are from six to nine feet in circumference, shew a likeness to the most lowly of the mushroom tribes, many of which are so minute as scarcely to be visible to the naked eye.

The *Helosis* and *Balanophora*, with the *Cynomorium*, or *Fungus Melitensis*, formerly guarded with such jealous care by the knights of Malta, and sent by the grand master to all the friendly sovereigns and potentates of christendom, as one of the most precious offerings he could make, may be cited as further examples of this extraordinary group. So fungus-like are some of these vegetable paradoxes, that they have been commonly considered such; and the latter, especially, has long been known as *the Maltese champignon*, or *the mushroom of Malta*; and, were it not for the development of stamens and pistils, the propriety of changing the name, and disturbing the old arrangement, might well be questioned. As it is, the characters will fully justify their segregation, as a class, from other flowering plants; the higher grades of which are by them allied to the lower flowerless and leafless sections.

Thus, having traced the gradual evolution of the vegetable organismus, from the simplest of the flags and fungi, through the numerous stages of development which characterize the several orders and regions of the vegetable reign, to the plants included in this final class, the present sketch is closed; for they descend to those with which the series was begun: and, connecting the extremes of an extended scale, declare that however, for convenience, art may reduce the productions of nature to isolated groups, and divide them into separate sections, still that they are divisible by art alone, and, although relatively distinguishable, they are not absolutely separable: for, however diverse the distant members may appear, they are all intimately connected, and essential to each other: and

form, in their respective subordinations, but integral parts of one majestic and harmonious whole.

Gentlemen: This bird's eye view of the vegetable kingdom, which has now been condensed into a single lecture, has of necessity been very brief and general: it was, indeed, intended as nothing more than an index or an outline, a sketch or diagram of the several chief departments, that are recognized or easily recognizable by all. But, slight as the notice of the several classes purposely has been, still here our conspective view must cease; for time forbids any further demonstration: nor is it needed, as hereafter each class must be examined separately and in detail; and it is hoped that the object proposed has already been attained, viz. to prove by actual illustrations what "a varied thing a vegetable is."

Although differing from the usual schemes of introduction, I have thought it advisable thus to begin with a demonstration of plants as they exist; to shew their positive characters, before comparisons are instituted between them and other kingdoms of the organic and inorganic worlds: in fact, first to have materials to compare, before comparative views are taken. Hence, in this first section of our extended course I propose to follow out this plan of demonstrating the special structures, functions, properties, and uses of each succeeding group, from the lowest to the highest grades; before any general views or comparisons are instituted, even between the varied developments of equivalent organs, as pervading the whole vegetable kingdom; and much before any are made between the different, and often essentially diverse, constitutions of the adjacent animal and inorganic reigns. I know that this is not the usual scheme of study, but I am convinced, (and I speak from no slight experience,) I am convinced that its advantages are great, and that it should be occasionally pursued.

This course will, therefore, be devoted to the special study of plants as the subjects of botany; the next to the general investigation of their attributes, as its objects; and the third, or summer section of the series, to a practical application (especially during the herborizing excursions and demonstrations) of those special and general principles, the theories or philosophic views of which have, in the two former portions, been explained. Thus I hope to be enabled to offer to the King's College students, during each session, a complete course of botanical instruction. The subordinate particulars of this scheme I shall not now attempt more fully to develop: enough has perhaps been already said to shew the route that in this autumn term will be pursued: and further observations on

the objective view will be more opportunely made at the commencement of the objective series of these lectures, to be delivered in the spring; and to that period I therefore shall reserve them.

But, gentlemen, it is not to plants alone that even in a botanical course I would have you confine your whole attention. Philosophy has lost much of its interest and power by the too, the far too-exclusive dedication of the mind to some one branch alone; and it is only now that knowledge is again raising itself to the state of science from the condition of art, by entering on a more liberal and expanded sphere of exertion.

Gentlemen, recollect that natural history and natural philosophy are, in truth, the history and the philosophy of nature, and not the partial study of some especial parts. Just as philosophy itself does not consist merely of the philosophy of nature or the learning of the schools, but comprises both: it is abstract as well as experimental, intellectual as well as physical. These studies have been too long and too widely severed; let us hope that this College may be the happy means of their re-union: the spirit of the age is favorable to the attempt, and the object is worthy our most strenuous exertions. How eloquently did RAY lament the separation; I cannot forbear quoting his expostulation, his reproof. "We content ourselves (says he), we content ourselves with the knowledge of tongues, and a little skill in philology, or history perhaps, and antiquity, and neglect that which to me seems more material: I mean natural history and the works of the creation. I do not discommend or derogate from those other studies; I should betray mine own ignorance and weakness, should I do so; I only wish they might not altogether jostle out and exclude this. I wish that this might be brought into fashion amongst us; I wish men would be so civil as not to disparage or deride and vilify those studies which themselves skill not of, or are not conversant in: no knowledge can be more pleasant than this, none doth so satisfy and feed the soul; in comparison whereto, that of words and phrases seems to me insipid and jejune." This is just the spirit with which I wish our students to become imbued; just the spirit with which I wish them to prosecute their studies; just the spirit with which I shall endeavour to make botany a part of general philosophy, and shew them that the science does not consist in the mere knowledge of names and systems, in the bare ability of deciding on the identity of a species, but also in the equally, if not more important, study of the general laws which regulate the evolutions of their organs, and determine their properties and powers; as well as of the still more general connexions

of all the sciences with each other: and with this same spirit, gentlemen, it is that, in the words of my Lord BACON, the *minister et interpres naturæ*, I shall invite you to approach and peruse this volume of the creation, which is written in the only language that hath gone out unto all the ends of the earth, unaffected by the confusion of Babel."

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