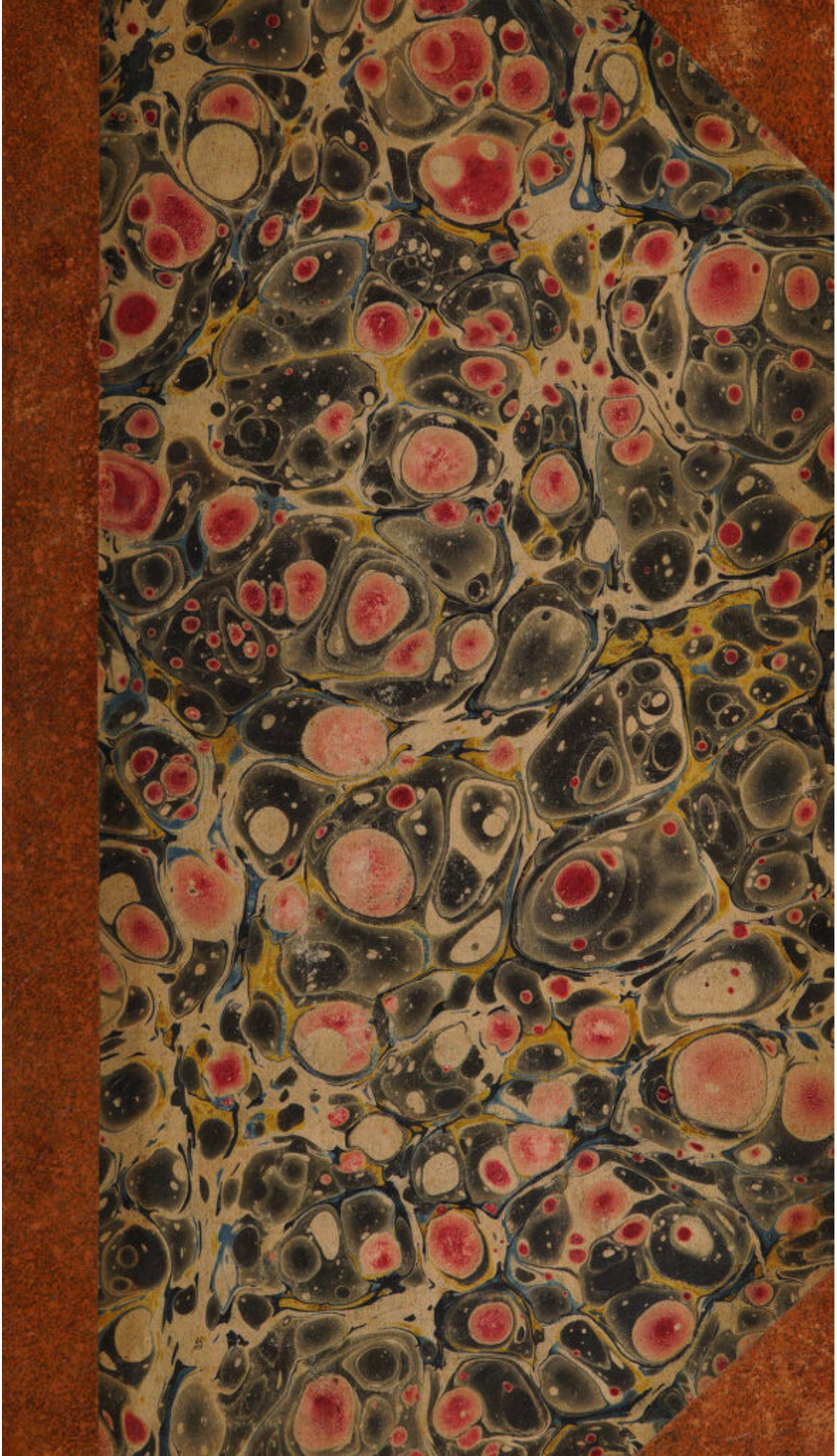
The botanist. Being the botanical part of a course of lectures on natural history, delivered in the University at Cambridge. Together with a discourse on the principle of vitality / By Benjamin Waterhouse.



THE

BOTANIST.

BEING

THE BOTANICAL PART

OF A

COURSE OF LECTURES

ON

NATURAL HISTORY,

DELIVERED IN THE UNIVERSITY AT CAMBRIDGE.

TOGETHER WITH A

DISCOURSE

ON

THE PRINCIPLE OF VITALITY.

BY BENJAMIN WATERHOUSE, M. D.

Fellow of the American Academy of Arts and Sciences;—of the Philosophical Society of Philadelphia; and of Bath and of Manchester in England; Fellow of the Medical Society, London;—of the Academy of Arts and Sciences, Belles Lettres, Inscriptions, and Commerce, Marseilles; and of the National Medical School of France: and Professor of the Theory and Practice of Physic in the University of Cambridge, Massachusetts.

BOSTON:

PUBLISHED BY JOSEPH T. BUCKINGHAM,
WINTER-STREET.

1811.

DISTRICT OF MASSACHUSETTS, to wit:

District Clerk's Office.

BE it remembered, that on the third day of July, A. D. 1811, and in the thirty fifth year of the Independence of the United States of America, Benjamin Waterhouse of the said district has deposited in this office the title of a book, the right whereof he claims as author, in the words following, to wit:

"The Botanist. Being the Botanical Part of a Course of Lectures on Natural History, delivered in the University at Cambridge. Together with a Discourse on the Principle of Vitality. By Benjamin Waterhouse, M. D. Fellow of the American Academy of Arts and Sciences; of the Philosophical Society of Philadelphia; and of Bath and of Manchester in England; Fellow of the Medical Society, London; of the Academy of Arts and Sciences, Belle Lettres, Inscriptions, and Commerce, Marseilles; and of the National Medical School of France: and Professor of the Theory and Practice of Physic in the University of Cambridge, Massachusetts."

In conformity to the act of the Congress of the United States, intitled, "an act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the times therein mentioned;" and also to an act, intitled, "an act supplementary to an act, entitled, an act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies during the times therein mentioned; and extending the benefits thereof to the arts of designing, engraving and etching historical and other prints."

WILLIAM. S. SHAW,

Clerk of the District of Massachusetts.

THESE ESSAYS ARE DEDICATED TO

JOHN ADAMS, LL. D.

PRESIDENT OF THE MASSACHUSETTS AGRICULTURAL SOCIETY: AND

PRESIDENT OF THE BOARD OF VISITORS OF THE MASSACHUSETTS PROFESSORSHIP OF NATURAL HISTORY IN THE UNIVERSITY OF CAMBRIDGE:

AND

PRESIDENT OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES: AND LATE

PRESIDENT OF THE UNITED STATES OF AMERICA.

AS A TOKEN OF GRATITUDE FOR HIS EARLY RECOMMENDATION OF NATURAL HISTORY TO HIS COUNTRYMEN, AS EXPRESSED BY HIS ABLE PEN IN THE CONSTITUTION OF THE

COMMONWEALTH OF MASSACHUSETTS:*

AND AS A MARK OF THAT ESTEEM AND RESPECT FOR HIS CHARACTER, SOCIAL, DOMESTIC, LITERARY, AND POLITICAL, LONG ENTERTAINED FOR HIM BY

THE AUTHOR.

CAMBRIDGE, JULY, 1811.

* See chap. V. sec. 2.

ADVERTISEMENT.

THE Essays, entitled the "BOTANIST," which are here collected in one volume, appeared first in the *Monthly Anthology*, printed in Boston in the summer of 1804; and were continued, from time to time, in a series of numbers, down to 1808. Their appearance was occasioned by the following circumstances: the gentleman who commenced the Monthly Anthology in 1803, had been a medical pupil, under the particular instruction of the author, and made frequent applications to be allowed to publish, in his new work, certain portions of the *Lectures on Natural History*, which had been given in the *University of Cambridge* ever since the year 1788; and which this editor of the Anthology, and some other pupils, had preserved in their notes. The author, not being willing to trust entirely to their discretion in the selection, nor to their partiality in the phraseology, made, in the year follow-

ing, a selection for himself, from the botanical part of his lectures. His individual wish was to commence the selection from the *Mineralogical* part of the course; and so pass on to the *Vegetable*, and close with the *Animal* kingdom; but he relinquished it, on the suggestion that mineralogy would be less popular than botany; and therefore less adapted to such a monthly magazine of knowledge and pleasure, as the Anthology was meant to be; and less likely to attract the attention and patronage of readers of both sexes,

The author was biassed by another, and a stronger reason, in favour of botany. There had never been any lectures on Natural History in the United States prior to the course referred to. Neither had *Botany* nor *Mineralogy* been publickly taught in any part of the Union anterior to the year 1788; excepting, indeed, a short course of twelve lectures, on Natural History in general, given by the author in the college at Providence, in the years, 1786 and 1787; he being, at the same time, Professor of the Theory and Practice of Physic in the University at Cambridge.

After the Lectures on Natural History had been given at Cambridge, four or five years, they began to excite some curiosity beyond the walls of the

college; and, in a year or two more, several gentlemen of opulence and literary influence in the government of the University, came to the resolution of laying a foundation for a *Professorship of Botany and Entomology;* to which they determined to annex an extensive *Botanical Garden.* Rejoiced at a prospect of seeing accomplished, by a rich association, what he had long anxiously, and alone, endeavoured in vain to effect, the author of these essays did every thing in his power to forward the design. The business began, and progressed with a zeal bordering on enthusiasm. Besides a subscription of between thirty and forty thousand dollars, the Legislature of the Commonwealth gave two townships of land towards maintaining a *Professorship of Natural History*, and for a *Botanical Garden at Cambridge.* But the author saw, that amidst all this ardour, scarcely one in ten of the subscribers knew exactly what they were subscribing for. Very few of them knew what a Botanical Garden was, or rather what its objects and ends were; yet with a general and indistinct idea, that the knowledge of plants and insects would be of vast benefit to the community, they subscribed to the scheme with a generosity characteristic of New-England merchants.

Under a serious impression, that the Massachusetts public needed more information on the subject of Natural History in general; and on Botany, and Botanical Gardens in particular, the author was induced to accommodate these extracts from his lectures to that desirable end; at the same time, that he gratified the editors of the work in which they appeared. It was a delicate task, as those most forward in that business, must, at this time, be sensible.

The author has no reason to be much dissatisfied with the reception of these essays by the public; and still less of their reception by a succession of editors of the *Monthly Anthology and Boston Review.*

From what has been said, the trans-atlantic disciples of LINNÆUS will see the reason, and therefore excuse the popular dress, in which BOTANY, that beautiful handmaid of Medicine, has been introduced to the inhabitants of a region, characteristically called by the English a century ago, THE WILDERNESS.

Cambridge, July 4, 1811.

PREFACE.

THERE are few people of education who have not a pretty accurate idea of what is meant by the terms *Astronomy*, or *Chemistry ;* but there are not many among us, who have a satisfactory idea of the term NATURAL HISTORY. If when puzzled they recur to the meaning of words, they learn, that Natural History is a treasure of the mind kept by memory ; whereas most people conceive it to be merely a knowledge of those criteria by which we are enabled to distinguish, at first sight, one natural body from another ; and therefore instead of an history, is frequently a mere description of a fixed and permanent substance : and if they consult those splendid and costly books, in which the graphic art almost equals nature, they still wonder why those pictures are called histories, since they do not express those alterations and successive

changes, which the earth, and all that it produces undergoes; and which alone would entitle them to the name of histories. In recurring again to books, they find that histories are either civil, or natural; that civil history records the works and acts of men; and they thence infer that Natural history records the works and acts of nature; but that which is ordinarily understood by the term Natural History, leaves the *acts* of nature out of the question; and circumscribes the knowledge to the sight alone. The enquirer is still at a loss what ideas to annex to the term NATURE. When he is told that by the word *Nature*, we mean *the energy of* GOD, *seen in the various productions that replenish and adorn the world*, he is silenced, but not satisfied.

In the course of the last year, when the *Lectures on Natural History*, as well as the *Medical Lectures*, which were heretofore given at this University, were all transferred to Boston, Natural History became a subject of general conversation among characters of the first rank, and of both sexes. The general expression of those who attended the lectures was sufficient to excite a suspicion in the author, that the public had but inadequate ideas of that science which is denominated Natural History; seeing that men of the first rate talents and educa-

tion had no fixed and determinate ideas on the subject. To be able to pronounce, at first sight, the name of each mineral, to distinguish one genus of plants from another, and to discriminate stuffed animals in a museum, were, it seems, enough to entitle a man to be considered a Natural Historian; when, at the same time, he perhaps knew nothing of the anatomy of a seed, and of its gradual development into a perfect plant and flower, producing again a seed, or epitome of its parent, capable of generating its kind forever.

That profound Natural Historian *C. Bonnet* of Geneva exclaims, "what ought we to think of those boasted *Nomenclators*, or of that which they presume to give us for the *System of Nature?* It is like a scholar undertaking to compile an index to a large folio volume, of which he has only read the title, and first pages. I do not mean to censure the writers of Dictionaries: they endeavour to reduce our knowledge to order; but I affirm, that considered simply, they will never make any great discoveries. I should have a greater esteem for a good treatise on a single insect, than for a whole insectological dictionary: because definitions and divisions are not history; and people too easily persuade themselves that they understand history, when

they only know in the gross the persons it consists of." Our classes and genera will be often put out of course by new beings, which we know not where to fix, because we suffer ourselves to be too hasty in making distributions."

The objects in nature are "like the colours of the rainbow, of which the dullest eye can perceive the varieties, while the keenest cannot catch the precise point, at which every separate tint is parted from its neighbouring hue."*

Nature, coeval with matter, never ceases to operate ; but then she occupies whole ages in some of her works, while man remains too short a time on earth to observe and to record them. Every thing that he sees has been more than once handled by Nature. This globe has been penetrated by fire, and covered and acted upon by water ; and great changes have been the result. Thus, in smaller things, a piece of wood having been changed by fire into charcoal, passes from thence through various changes of refinement and excellency, till, at length it becomes a concrete of elementary fire and light, in the form and qualities of a diamond. He who traces and records these things is indeed a Natural Historian : so is he, who knowing the an-

* Adams, p. 288, vol. II.

atomy of an egg, is able to trace its evolutions into a perfect animal, and thence through all its successive stages to its acme, or perfection; and so in like manner, of a vegetable from a seed.

Is there not then a distinction, in the very nature of things, between a mere describer of what Addison calls "the shell of the world," and "the world of life?" There appears to be as much difference between the nomenclator of a museum of natural bodies, and a natural historian, that is an historiographer of the economy of nature, as there is between the mere anatomist, or dissector of the human body, and its physiologist.

Passing from Natural History in general to one of its branches, may we not ask if the like confined notion of *Botany* does not prevail? To know the name of a plant, and to be able to ascertain its place in the Linnæan system, is, in the opinion of many, to be a botanist; although such a person may be entirely unacquainted with its anatomy, or organic structure, and ignorant of its peculiar, or medicinal qualities; as well as of the nature of its food, and the means of its nourishment; yet these are the things which principally govern its nature.

It is of importance however that one universal language should be adopted by botanists; but it is

wrong to make that, and classification the primary object. Agreeably to this doctrine is the sentiment of the famous Rosseau, who, in his *Letters on the Elements of Botany*, says, "I have always thought it possible to be a very great botanist, without knowing so much as one plant by name."

The author has been desirous of giving the young gentlemen in this University a more enlarged view of Natural History in general, and of Botany in particular, than what has commonly been taken of them. Whether the BOTANIST has contributed to enlarge the sphere of their vision, is not for him to determine. He by no means considers himself a master in the science. Physic is his profession; and Natural History his amusement. During a residence of several years in the family of the celebrated Dr. Fothergill in London, he acquired there a taste for the works of nature; but has endeavoured to follow the advice of his venerable kinsman, "never to suffer Natural History to supersede Medicine; but to regard it only as an agreeable adjunct to the healing art."

THE BOTANIST.

N°. I.

Cambridge, June, 1804.

As Natural History is a subject that has excited some attention for more than a dozen years past at the University in this place; and as that branch of it denominated *Botany* has lately become a topic of conversation, and likely to become more so, we have thought that it would conduce to good, if we laid before the public a few essays on this pleasant department of nature.

Natural History, taken in its greatest extent, is, perhaps the most delightful of all the Sciences. It fills the mind with the greatest variety of ideas; and has this encouraging circumstance annexed to it, that no closeness of inspection, or keenness of investigation ever brings weariness, or disgust: for in studying it, gratification and appetite are perpetually interchanging. The study of Nature, like the contemplations of religion, is "forever rising with the rising mind." Nature opens to genius that im-

mense horizon, in which to the end of time, it may exercise its strength, and at every step behold the boundary receding to a greater distance! No mind is so capacious but is filled full, and often more than full; for the contemplations of Nature sometimes overwhelm the mind with undiscerning amazement!

If Natural History forms, as Lord Bacon says, *the basis of all the sciences*, it is certainly a study of the first importance to our youth. It is of more importance than even Natural Philosophy, which only aims to teach those quiescent forms of Nature, which all bodies indiscriminately possess, as extension, figure, durability, and *vis inertia;* whereas the Natural Historian describes and aims to explain the growing, or living state of organized bodies, as well as their structure after life has departed.

When the Lectures on Natural History commenced at this University, it was found that our youth had scarcely any idea of what was meant by Natural History; and even now, men of education have an inadequate idea of what is comprehended under that term. It is not, as they conceive merely, a dry description of that which strikes the eye only of the spectator. The Natural Historian is led to explore the origin, or primordium of organized bodies; and to trace their gradual development to a perfect plant, or animal; and to expatiate on their accretion, or growth up to their destined magnitude; and from thence to their dissolution. The Naturalist treats not only of *matter*, as an elementary constituent in composite substances, which appertains in common

to all bodies, but he is compelled to investigate also that *efficient cause*, or *moving principle* which associates these elements; and which employs them when associated, according to their various and peculiar characters. Within this wide view of Nature, its historian discovers, or imagines that he discovers a division of things, which he calls the THREE KINGDOMS of *Nature*, namely---the *Mineral*, the *Vegetable*, and the *Animal*. One of them only attracts our attention, at this time, viz. the Vegetable.

We wish to give to the term *Botany* a wider scope than is generally allowed to it. We would define *Botany* to be that branch of Natural History which teaches the anatomy, physiology, and economy of vegetables.

Some of the leading principles of this charming science we mean to extend through a series of monthly essays; but in an order a little different from that found in books. We shall give our doctrine a dress partaking more of the popular, than of the scientific garb; as much of the former, as not to disguise this beautiful handmaid of Medicine; and yet not so divested of the latter, as to displease the eye of the most rigid disciple of the Linnæan school. We avow LINNÆUS to be our lawful chief; and his *Philosophia Botanica* our rallying point and standard. In acknowledging him our teacher and leader in the field of Botany, we wish to refer the learned reader to his admirable writings for the reasons of this our attachment.

Whoever casts his eyes on the surface of the earth, at this season* will see that it is covered and adorned with a beautiful green carpet of vegetables, which carpet is spread anew every year. If after viewing, and admiring its agreeable effect, and after reflecting on its annual renovation, the student of nature should take the pains of examining any individual plant, of which this carpet is composed, he will find that the stem, or trunk of each vegetable is not like a lump of clay, or piece of dough; but that it has an internal adjustment, arrangement, or disposition of its matter into tubes and vessels, which is called for that reason, *organization*. If he view the plant through a microscope, he will discover in it different orders of vessels, like those of an animal; and should he submit it to a careful and nice anatomical investigation, he will be convinced that a plant possesses a vascular system. If he compares it with those things which belong to the other two kingdoms, he will see that a plant occupies a middle space between animals and minerals. On still closer examination he will find that it partakes of the nature of both. If he pluck it up by the roots, he perceives that its appearance is directly changed, for it loses its turgescency, colour and specific odour: or in other words, it fades, wilts and dies, and is finally decomposed. Hence the inquirer learns that a growing plant is not only a regularly organized body, possessing a vascular system, but is, while attached to the ground by its roots, a living one. That this view of a plant

* June.

is agreeable to truth may be inferred from consulting the best authors on Botany: thus the illustrious *Boerhaave* defines a plant to be a hydraulic body, containing vessels, replete with different juices, by means of which it derives the matter of its nutriment and growth; to which he might have added, possessing the power of producing its kind forever by *seed.*

Although agriculture and gardening are of prime importance to civilized man, they have continued to be only arts, consisting of detached facts, and vague opinions, without a true history to connect them. And the first step towards giving Botany the stability of a science is to submit a plant to anatomical investigation, as we do animals; that being, says Dr. A. Hunter, the only rational method of arriving at any certainty concerning the laws of the vegetable economy; and without it, agriculture, that useful, important, and honourable profession, must ever remain a vague and uncertain study.

In teaching Botany, different authors have adopted different plans. Some begin with a description of the leaf; then of the stem; next the flower; afterwards the fruit, strictly so called, and lastly the seed. Others commence with the flower, then they describe the fruit and seed conjunctly, and lastly the root. We shall pursue a different order. We shall begin with describing a seed; after demonstrating its structure, we shall show that *every* seed contains, under several membranes, the future plant in miniature. There we may see by the help of a micro-

scope, that the embryo plant has, not only a little radicle, which is hereafter to become the root, but also two diminutive leaves, which hereafter become the herb. We shall then endeavour to show how the embryo plant, when placed in a due degree of moisture, and a just degree of heat, and at such a proper depth in the ground, as not to exclude it from the vivifying influence of the air, gradually unfolds itself; the radicle extending itself into a root, which attaches itself to the earth, and the little leaf aspiring into a stem. We shall show how the fœtal plant is supported by that part of the seed, which answers to the *albumen*, or white of an egg, until it is able to appear above ground, when this temporary nutritive part drops off and decays, leaving the plant, in future, to grow, and to flourish, by imbibing solid nourishment from its mother earth; and by inspiring *vital air;* and by inhaling the celestial light.

Delightful as Natural History really is, the study of it is not here recommended to amuse the idle, or gratify the fanciful. We Americans dwell in an agricultural country; and agriculture is the sure and certain support of a nation. It gives to a country the only riches that it can call its own. *Tacitus* says, that the Romans were several times reduced nearly to famine, by depending on Egypt and Africa for *grain;* instead of relying on the prolific vigour of their own Italian soil: and thus, says this celebrated historian, were the lives of the Roman people committed to the caprice of the winds and waves. If commerce bind the world together in a golden chain,

that chain is frequently broken by the wars of men, and by the wars of the elements; while agriculture gives us the staff of life, and the chief support of our independence.

COMMERCE is congenial to all of us who sojourn near the sea; and is indeed the grand source of wealth, comfort and power; but with riches, commerce, too often, imports effeminating luxuries; whereas agriculture is an athletic task, kindly imposed upon man, by a beneficent CREATOR, as the best means of preserving his health and his innocence.

Now the ground-work of this salutiferous and honorable profession is the science of Botany, in the enlarged sense, which we have given to this branch of Natural History.

It may perhaps be said that this branch of knowledge has not been neglected among us; and that the seeds of it, at least, were sown, sixteen years since, at Cambridge.*—Be it so—Their growth has nevertheless been slow. Whether this has been owing to the soil, or the cultivator, we leave to the investigation of others; observing only, that a private in-

* At a Meeting of the President and Fellows of Harvard College, April 29, 1788,

Voted, that Dr. Waterhouse deliver annually a course of Lectures on Natural History to such students as shall obtain permission, under the hands of their Parents or Guardians to attend; for each of which students he shall receive one Guinea, to be charged in their quarter bills.

JOSEPH WILLARD, President.

This Vote concurred by the Overseers, May 8, 1788.

S. HOWARD, Secretary.

The history of the progress and termination of these Lectures at Cambridge will soon be given to the public.

dividual, however cordially disposed to rear the "*Nemorale Templum*," can do but little without the assistance, support and co-operation of the constituted *fautores* of science and of government.

A clergyman of Scotland, the Rev. *Charles Cordiner*, in a splendid work on "ancient monuments "and singular subjects of Natural History, in North "Britain," speaking of the Marischal College of Aberdeen, remarks, that "it is a good proposal, now in agitation to add Lectures on Agriculture and Botany to *the general course of education*. That the former, if understood on scientific principles, would be of high importance to the improvement of the country. Botany is intimately connected with agriculture and medicine: knowledge of that must prove of great consequence to all who are to spend their lives in the country. The general body of the clergy, as well as the proprietors of landed estates, are therefore particularly interested in the success of these studies. Besides, the sons of farmers, by the easy terms on which attendance at the college is obtained, can easily acquire that useful instruction, which might prepare their minds for a more judicious application of their industry and talents. The more general diffusion of knowledge, and of the experience from whence it is derived, must confer superior advantages on youth, in all the different walks of life. The prosperity of a commercial city is even promoted by such a seminary."

Lord Kaimes, long since, advocated a similar opinion; and recommended that the subjects of

Natural History should be treated in Lectures in a general way, mixed with reasonings. The mere narrative of detached facts, and concise description of a plant, animal or mineral, is indeed as tedious to the aspiring youth as it is useless. It is the qualities and economy of the plant; the instincts, powers and faculties of the animal; and the virtues and uses of the mineral that constitute that code of knowledge which is so useful and ornamental to every gentleman in his passage through life. Instead of trammelling the minds of young people, and cramping inquiry by engaging in disputes about classifications and systems, so called, let us rather study the accordance, relationship, and conformity, which the different objects bear to one another, and to *ourselves*. The construction of the Temple is impeded by disputes about the ladders and the scaffolds.

Some complain that the science of Botany is incumbered, and overloaded with technical terms. Our great master LINNÆUS wrote in Latin. Sometimes he gives generic names compounded of two entire Latin words; but he uses commonly, such compound words in the Greek language, as are more expressive as well as more beautiful. Beginners are sometimes daunted by this terrific style. They are apt to conclude that good sense has not fair play when thus oppressed by hard words. They do not perhaps know that LINNÆUS has simplified the botanical language of his predecessors. Before his day, we had *Hydrophyllocarpodendron*, and *Stachyarpo-*

*gophora.** To convey botanical descriptions in a plain, simple, yet intelligible language to the merely English reader is a difficulty still to be encountered. There is another difficulty of a more delicate nature. The *sexual* system of Botany is founded on a discovery that there is in vegetables, as in animals, a distinction of sexes. But there are those who think that LINNÆUS has drawn the analogy too close, and continued it too long. The analogy between the structure and functions of the higher class of animals and vegetables is remote; but the analogy between the higher order of vegetables and those outskirts of animated nature, the *Vermes*, and Insects, is closer than is commonly known.

The botanical phraseology sometimes embarrasses the teacher. We hope however to parry this difficulty, if not entirely surmount it. In our next number we shall give the anatomy of a *seed;* and also treat of the *food* of *plants*.

* See Boerhaave.

THE BOTANIST.

N°. II.

Omne vivum ex ovo ; per consequens etiam vegetabilia ; quorum Semina esse Ova *decet eorum Finis, sobolem parentibus conformem producens.*

LINNÆUS, Philos. Botanica.

Every living thing derives its origin from an EGG, and consequently vegetables, whose seeds are EGGS: this appears, by their producing offspring, similar to the parent plant.

IN describing a Plant, we shall adopt a different order, from that commonly pursued by botanists. We deem it more agreeable to the laws of botanical philosophy, to begin with the description of a *seed;* and to trace its gradual development into a perfect plant, producing seed again, than to reverse this procedure, as is commonly done, by treating of the seed last.

A seed of a plant and an egg of a bird are so analogous in their structure and economy, that we may, without impropriety, use the same term for either. By a seed then we mean an organized particle, produced by a plant, or animal, from which new plants, and new animals are generated. All seeds of plants and all eggs of animals have essentially the same structure, and the same mode of development.

A perfect, or fecundated hen's egg is an organized body, pervaded by vessels, and endowed with that humble portion of life, or capability of living, which, in the scale of vitality, we denote by the term excitability; and is replete with a moveable fluid, and in-

closing, under divers membranes, the animal in miniature. The egg-shell is almost entirely filled with a glutinous substance, laid up for the nourishment of the fœtal animal: the one is called the *albumen*, or white; the other *vitellus*, or yolk. In the latter is the *cicatricula*, or *punctum vitæ*, which is about the size of the seed of the vetch, or small pea, and has a considerable resemblance to the pupil of the eye. It is in this spot that the first palpitation, or signs of life appear, in consequence of the application of heat.

If the egg be kept in a certain degree of warmth, whether by the natural heat of the parent animal, or by art, as in stoves, it occasions an increased action of that *vis vitæ*, or living power, which every organized body, susceptible of stimulus, naturally possesses; and which, being a momentary distention of the smallest vessels, is similar to a blush; or rather that state of them, which immediately precedes the slightest inflammation. Motion thus begun, the vessels, surrounding and pervading the *punctum vitæ*, expand; and the embryo appears spontaneously to unfold itself, until by slow degrees, it develops, like a flower, and becomes a perfect animal, capable of producing a similar egg.

Now every seed of a plant is, in like manner, an organized body, endowed with vessels, and contains, under several membranes, the plant in miniature; which seed requires a due portion of moisture, and a just degree of heat for exciting the dormant *vegetative* life, which distending gradually the vessels, expands the several membranes, and develops

the plant. The embryo plant lies in a sleeping state, though alive; but exerts not its life, until it is put in proper circumstances, which proper circumstances are *moisture*, *heat*, and some exposure to the influence of the *air*.

Every seed of a vegetable, and every egg of an animal hitherto examined, are in structure essentially the same. To grow, that is, to nourish itself, by changing a foreign matter into its own substance, and to continue its kind, is the end and aim of every living organized body. Let us examine the seed of a vegetable, that we may see how far such a body is adapted to effect these important purposes. The Windsor bean, or, as we call it in this country, the *English-bean*, from its size and shape, affords us the fairest example. If, when such a bean is fully ripe, you cut through its membranes lengthwise, in the direction of the eye, *hilum*, or little scar, it will naturally separate into halves. Simple maceration will have the same effect without cutting. These smooth and equal parts of the bean are called *seed-lobes* by gardeners, and *cotyledons* by botanists. Of those seeds, that we use for food, they form the more farinaceous or nutritive part: thus in wheat, rye, and Indian-corn, they form the meal, while the investing membranes form the bran.

The most important part of the seed is the embryo; and the most important part of the embryo is the *corculum*, or little heart, punctum vitæ, or speck of life; because at this point in the hen's egg the first pulsation of life is discovered; but in the

seed of a plant, there is no palpable motion. The whole *seminal apparatus*, contained within the external membrane of the bean, and which corresponds with the *albumen*, and *vitellus*, in the bird's egg, conspires, when acted upon by heat, to elicit the latent spark of vegetative life; and to nourish afterwards the unborn plant.

When the miniature plant is separated from the seed lobes, we can easily discern the leaf which is called the *plumula*, or that part which is hereafter to become the herb of the bean; and likewise the *rostellum*, or *radicle*, which creeping downwards becomes the root. The *cotyledons*, or lobes of the bean taken collectively, without any discrimination of albumen, or vitellus, appear through a microscope, to be of a glandular structure; and to have a regular system of vessels, resembling the placental veins in quadrupeds; and to run together, like them, in a few trunks, precisely at that point of the lobe, where the embryo grows to the cotyledons.*

Botanists define *cotyledons* to be the lateral, bibulous, perishable lobes or placenta of the seed, destined to nourish the corculum, and then to fall off. Now these lobes, afford a nutritive juice, resembling milk, for the sustenance of the unborn plant: but when the tender vegetable is so far advanced as to merit the name of an infantile plant, these evanescent lobes are converted into a pair of thick *seed-leaves*, which compose a shield of defence, until the plant has fairly and firmly taken root in the

* See Grew's Anatomy of Plants, plate 79. 80. 81. & 82.

earth; then these two protecting leaves drop off and decay. And now the little, erect plant, depends, like the just born infant, on a *new* principle for its future existence.

From what has been said, it is apparent, that when a hen's-egg is alive, it is fit to be eaten; but if killed, whether by too much heat, or by too great cold, or by violent concussion, or by being sat upon by the bird, and then abandoned, it soon becomes rotten. So in like manner a seed, though kept several years, is not a dead substance, like a pebble or a pearl; but is a body regularly organized, and arranged harmoniously into a system of vessels, glands, and membranes; and it is moreover, like a prolific egg, alive, or at least, in a state, or fitness to be acted upon by certain external agents, which agents are FIRE, AIR, and WATER.

Some seeds will retain the vegetative life a great number of years. Indian corn has vegetated after keeping it upwards of seventy years. We neglected to mention, that there was a small quantity of vital air in a sack, bladder, or partition, at the big end of every bird's egg; and we presume, that there is a portion of the same kind of fluid in every seed; or it may be oxygen in a concentrated state, which is afterwards combined with *caloric* in the process of incubation. It appears also, that the most important, nay the essential part of that organized body denominated a seed, is the embryo; for it is that part alone which grows into a new plant, beginning again a new progeny. It likewise appears, that all the other parts of the seed

are subservient to this; and that they are employed chiefly in converting the farina, or mealy substance of the seed into a lactescent fluid, which is conveyed by the lactiferous vessels to the embryo for its nourrishment, which, like the infantile animal, is supplied with milk, until it can stand alone in the ground.

Although nature has established a marked uniformity in the internal structure of seeds, she nevertheless displays an astonishing variety in their external appearance. Neither mathematician nor painter can ever convey adequate ideas of their different shapes, and variegated colours. Some shine like silver, and some like gold; whilst others appear like little balls of fire. It is remarkable that seeds are seldom of the same colour with the flower, which produced them. Seeds of a deep green are rare; blue still more uncommon.

Beside the *essential* parts of a seed already described, there are certain *accessory* parts, which, whilst they add to the beauty of the seeds, serve important purposes in their migration: such, for example, are the feathery crowns, or *aigrettes*, which serve as wings to waft them to a distance, as we see in the *Dandelion*,* *Lettuce*, and *Thistle*. Who, walking the fields, has not observed,

> Wide o'er the *thistly* lawn, as swells the breeze,
> A whit'ning shower of vegetable down
> Amusive float? *Thomson.*

If seeds are diversified in shape and colour, they vary as remarkably in their size. *One thousand and*

* Called by the country people "*clocks.*"

twelve seeds of the tobacco plant weigh but a single grain, while a single cocoa-nut weighs several pounds. The *Ferns* differ from other plants in having their seeds in the leaves. They are very small, and when inclosed in the seed vessel, they all together form a round ball with a notched band or rim of a beautiful structure. They have some resemblance to the fingers shut up, or clenched so as to form the fist; and when the seeds are quite ripe and dry, they become very elastic; in which state the seed vessel bursts open, not unlike the suddenly throwing open of the fingers, in changing their position from the clenched fist to that of the open palm. This sudden action throws the seed to a considerable distance; and then we see the two hemispheres, which composed the ball, in the situation of two empty cups. This is well expressed by an engraving in *Swammerdam's book of Nature.*

THE BOTANIST.

N°. III.

NATURAL things which are common, are disregarded because they are common; while rare and monstrous productions are gazed at with idle curiosity and stupid admiration. What is more common than a *seed* or grain? Yet how few give themselves the exertion of inquiring what a seed really is! If a

seed, or grain answer the whole purpose for which the farmer supposes it was created, that of fattening his cattle, and feeding his family, he neither searches into its curious structure, nor inquires into its physiology. Nor is this to be wondered at. But that the Lawyer, the Physician, and the Minister of religion should go on through life as most of them do, without once stopping to inquire into the laws by which the acorn becomes an oak, is to the Botanist surprizing! There are few little things in nature more worthy of attention than a seed. It is a *system*, or complete whole, wrought up into a narrow compass, retaining a living principle. By system we mean a combination of many things reduced to regular dependence and co-operation. If we contemplate closely the vegetative life and growth in a seed, our admiration will increase at every view, so that our baffled reason will be compelled to seek a solution of its difficulties in a Power anterior to *Water*—*Air*—*Fire*—or *Light*. Some of the wise antients were so impressed with the philosophy of the egg, or seed, that they taught that the *mundane system* itself sprung from an egg, hatched by *Nox*.

It is only organized bodies that are capable of growth. Every *organized* body grows; and beside them none. There are accretions among minerals; and concretions and crystallizations without end; but these do not rise up to our idea of *growth*, which implies matter organized into vessels, containing a moveable succus, or juice, operated upon

by a very gentle heat; whereas the changes wrought in the mineral kingdom, are commonly by a very violent one. If we knew how a single fibre grew, we could tell how the whole plant or animal grows; for the bodies of both of them are only assemblages of fibres differently formed and combined. Growth always operates by nutrition; and nutrition incorporates into the fibre, external matter, or matter taken in, *ab extra*, and this process always requires heat. Now all bodies in nature are imbued, surrounded, and penetrated, in every way by fire, or rather *caloric*, which is a better and and more expressive term for that all powerful agent which transforms solids into fluids, and fluids into vapour.

Although heat, or caloric, which is the fluid matter of heat, expands the egg and causes it to grow up into a living animal: and although it agitates and gently unfolds the plant, causing it to grow from an acorn up to the magnificent oak, yet this query arises naturally in the mind of the young student of nature, *what is the pabulum*, or *matter*, which adds to the bulk, and increases, to a certain size, the vegetable and the animal? For it is evident that heat only causes an absorption of a foreign matter. Nutrition, or growth implies life; but in some vegetables, this life is so low in the scale of vitality as to be almost down to where Nature has marked her degree of o.

That an animal receives its pabulum or matter of nourishment and increase from without, is known to to every one from the irresistible calls of hunger, and

the destruction that follows famine. But that Plants were nourished, and sustained by *food*, in nearly the same way, has not been so generally understood. The animal has a warm receptacle, or stomach, of about 98 degrees of heat, with a due quantity of moisture and a peculiar compound motion; whereas the plant has no such receptacle, nor any other stomach than the cold earth, which is about 53 degrees of Fahrenheit. The possession of a *stomach* lays the discriminating line between the animal and vegetable kingdom. All other distinctions fail us.

Besides air and water, to which we may add fire, animals stand in need of aliment, or food taken by the mouth, digested by the stomach, forming there a milky liquor, called chyle. The constituent parts of the chyle of quadrupeds and birds, as well as most other animals are, *water—sugar—mucilage—oil—carbon—phosphorus*, and *calcareous earth*. The constituent parts of the *sap-juice*, which is the chyle of vegetables, is, in like manner, water—sugar—mucilage—oil—carbon—phosphorus, and calcareous earth.* Now sap-juice, or the chyle of vegetables, is absorbed from the earth, by the roots, which have a peculiar structure, adapting them to that operation; and from this juice, farther elaborated, refined and exalted, is formed the various fluids in the stem, leaf, flower, fruit and seed Some plants can extract, or compose these nutritive substances from

* *Calcareous earths* are marle of all sorts. limestone, chalk, plaster of Paris, and all earths, formed from the bodies of animals, especially the shells of fish. *Fordyce.*

water, and apparently from the air alone. We however find by repeated experiments, that there are certain substances, which contribute more to the production of this vegetable chyle than others. Let us then inquire *what these materials are, that afford the* FOOD *of plants?* The subject is not merely curious, but of high importance to our country; for if we can ascertain the appropriate aliment or food of any particular family of our most useful vegetables, we shall be able to increase their size with as much certainty as a farmer fattens his cattle by giving them corn.

It is known from experiment,* that a plant will grow in *sand alone* moistened with water, purified by distillation from all earthy particles, and in the purest air.

But a plant will grow better in a mixture of *sand and clay*, in which the tenacity is adapted to the pushing power of its roots, than in sand alone; and it will grow better still, if a proper quantity of water be applied. But with both these advantages it will not flourish so well as in a *rich soil.*

If a plant be put in a proper mixture of sand and clay, and duly supplied with water, it will grow better than in the same mixture, exposed to the hazards of the weather, and the chances of being too moist or too dry; but it will grow still better in a rich soil. There is, therefore, in *a rich soil*, SOMETHING independent of texture, or the retention of water, which contributes to the flourishing of plants.

* See Fordyce's Elements of Agriculture and Vegetation.

From observing the fertility after the ground was divided by the plough, some have imagined that the *earth* was the food of plants. To this opinion succeeded another equally erroneous, that *water* was their aliment, when in fact it is only the vehicle of their nourishment.

The upper stratum of earth, or garden mould, contains some articles that are soluble in water, and some that are not. Those which are insoluble in water are, acording to FORDYCE, *sand*, *clay*, *calcareous earth*, *magnesia*, *oxydes of alum*, *earth of metals*, particularly of *iron*. These cannot enter the vessels of the roots of plants; but they may contribute to the production of substances which are soluble in water, and that may enter them.

Substances found in this black garden mould, that are soluble in water, are, says the same author, *mucilage*, *nitrous ammoniac*, *nitrous selenites*, *common ammoniac*, and *fixed ammoniac*. We find all these salts in the juice of vegetables; a proof that they pass into the plant along with the water.

From numerous well conducted experiments, it appears that a MUCILAGE, produced by the decomposition of vegetable and animal recrements, constitutes the food, or aliment of plants. This mucilage is formed from stable manure; from rain water putrefied, from dew, as well as from dead animals, and vegetables. But mucilaginous juices are of two kinds; one, when dissolved in water, forms a sort of jelly, and is an *immediate* aliment; the other

forms a gummy, or rather saccharine liquid, and must putrefy before it can become a proper food or manure.*

To reconcile the doctrine, taught by some, that *salt* is the active principle in manures, it should be remembered that putrefaction has *two* stages; that the first converts animal and vegetable substances into a mucilage; and the second converts that mucilage into one or more species of salt.*

As mucilaginous substances were known to invigorate roots, by affording them good nourishment, it was natural for agriculturalists, not enlightened by chemistry, to infer that *steeping* seeds in mucilaginous, or oleaginous liquors would increase their powers of vegetation; especially if a portion of nitre, common salt, and lime were added. This opinion prevailed among the antients, as we learn from Pliny; and is also recommended by Lord Bacon.† A belief in the efficacy of the fructifying liquors still prevails in many parts of Europe, notwithstanding Duhamel in France, and Dr. A. Hunter in England, have exposed their futility.

Dr. Hunter assures us, that he sprouted all kinds of grain in a variety of "*steeps*," so called in England; and always found, that the radicle and germ of the embryo plant never appeared so healthy, as when sprouted by pure water. He tells us that he constantly observed that steeps containing nitre, sea-

* See Count Gyllenborg's, and also Fordyce's Elements of Agriculture.

† Sylva Sylvarum, art. *acceleration of germination.*

salt, and lime rendered the radicle and germ yellow and sickly. He then steeped a variety of seed in broth, as coming nearer the nature of the mucilage beforementioned, and, at the same time, put an equal number of the seeds in pure water. The result was, that the radicle and germ, produced by the broth, were weaker, and less healthy than those sprouted by simple water. Here the scientific agriculturalists have been led from the path of truth and nature, by following some erroneous notions of the Physicians, who conceive, that if they give their weak, emaciated, hectic patients milk, broth, or jellies, they will pass as such into the blood vessels, without giving any labour or trouble to the debilitated organs of digestion; not considering that milk, for example, is first hardened in the stomach, by the coagulating property of its internal coat, into a curd, and then gradually digested, and, in a degree animalized, before it enters the blood vessels; and these messes occasion more trouble to the stomach than a piece of beef. The milk which nourishes the embryo plant, is as far distant from the steeps used by Dr. Hunter, as eggs and milk are from the *animalized* lymph in the blood vessels. The same philosophical Physician proves that the opinion is erroneous which is entertained by some gardeners and farmers, that small thin grain may be so impregnated by steeps, as to make them equal, in vegetative force, to the largest. He found, by repeated experiments, that the largest and plumpest seeds, from the same

heap, were superior in goodness to the small, thin ones, though steeped ever so carefully.

If what we have said of the office of the *seed-lobes*, in our last number, be just, that the farina, or meal of which they are composed, is converted into milk; that it serves to nourish the infantile plant until its roots are large enough to imbibe mucilaginous food from the earth, it follows, that the vegetative powers of seed will be in proportion to the *quantity* of their mealy substance. If so, then it will remain an established truth, that PLUMP *seeds, placed at a just depth, in a good soil, and at a proper season, will never disappoint the gardener.*

From the preceding doctrine it also follows, that the *food of plants*, or *manures*, are of *two kinds:* the one adds nourishment to the soil; such as all animal, and other putrescible substances, from which a *mucilage* is formed: the other gives no nourishment to the soil; but *forces* it, by agitating and preparing the nourishment already there. Hence we see how substances, of opposite natures, contribute to the growth of vegetables;—putrescent animal substances on one hand; and lime, marle, and plaster of Paris on the other.

THE BOTANIST.

N°. IV.

EVERY thing generated by nature, or made by art, is generated or made out of something else; and this something else is called its substance, or *matter.* But there can be no change of one thing into another, where the two changing beings do not participate the same matter. Hence were there not a congeniality between the food and the plant, and the food and the animal, these two organized bodies could not be nourished; but the material imbibed, would operate as a medicine, instead of being assimilated as an aliment.

Whoever attends closely to the operations of nature will be convinced, that every recent production, whether vegetable or animal, that daily occurs, is not absolutely a fresh creation, an evocation, or calling of something out of *nothing;* for that is impossible. "*Ex nihilo nihil fit.*" What then is it? 'Tis a change, or mutation of something which *before existed.* Every thing around us is in motion. No terrestrial thing is stationary. On every earthly thing mutability is written; and substances of every kind, either *immediately*, or *intermediately* pass into one another; and reciprocal deaths, dissolutions and digestions support, by turns, all substances out of each other.*

* See Aristotle's Phys. and Harris's Philos. Arrangments.

We have said that every living thing, or organized being derives its origin from an egg, or seed: and this doctrine may be extended beyond the objects of sight. When the SUPREME CREATOR, says the eloquent *Count Buffon*, formed the *first* individuals of each species of vegetables and animals, he gave a certain degree of animation to what has been called "*the dust of the earth;*" by infusing into it a greater, or smaller quantity of *living organic particles*, or *seeds*, which infinitessimally small seeds, or particles are indestructible, and common to every organized being. These particles, or *original* seeds, pass from body to body, and are equally the cause of life, nutrition and growth. When an organized body dies, the organic particles survive; for death has no power over them; but they circulate through the universe; pass into other beings, producing life and nourishment. A growing vegetable receives these invisible seeds, or organic particles from the earth, from water, and from the air; and their reception perfects the plant. A quadruped receives the plant into its stomach for food; when its digestive powers destroy its vegetative life, should any be remaining; and then the digesting apparatus animalizes the vegetable, and gradually converts it into the nature, and substance of the creature. And when this animal dies, his constituent particles fly off in vapour: these are absorbed by the growing plant with avidity, they being its appropriate food; and this absorption of putrid vapour causes them to grow, and to flourish; and thus

do animals and vegetables mutually nourish and support each other; so that what was yesterday grass, is to day part of a sheep, and tomorrow becomes part of a man.*

From the foregoing doctrine may be deduced the true theory of the action of *manures;* or the sustentation of a plant by its appropriate food. This is the corner-stone in the foundation of that Temple of *Ceres*, which we hope to see reared in AMERICA. It will moreover illustrate that doctrine which teaches, that in this world which we inhabit, there is an universal change, or mutation of all things into all; that nothing is lost, but the sum total of matter in the Universe remains perfectly the same; and that which some consider as fresh creations, or calling of something out of nothing, is only a change or mutation of something which before existed.

From the experiments recorded in our third number, we learn, that there is *something* in a rich soil beside water, which contributes to the growth of a plant; and it appears that there is a mucilage produced by the decomposition of vegetable and animal recrements which affords the matter, *pabulum*, or provender for the support of plants. If it be inquired farther,—of what is this mucilage composed? We answer, that its base is a gluten resembling the *coagulable lymph* in our own blood vessels. The oxygenous principle concerned in germination will be spoken of hereafter.

* See Locke on Identity and Diversity.

The growth of organized bodies is a mysterious process. Philosophers who believe with *Lucretius* and *Buffon*, in the pre-existence of germs, or seeds, organic particles, or *moleculæ*, denominate them which you will, have endeavoured to sooth the imagination by an hypothesis. They have supposed that these very subtle germs, or seeds of things, were merely susceptible of life by the application of a due degree of heat; and that they were, at the creation of the world, dispersed universally into all parts of this terraqueous globe, that are accessible to air, and to light; so that they are in the waters, as well as in the earth. Pope refers to this theory when he says,

"See through this *air*, this *ocean*, and this *earth*,
All matter quick, and bursting into birth!
Vast chain of beings! which from God began—
Beast, bird, fish, insect, which no eye can see,
No glass can reach; from infinite to thee,
From thee to nothing."--

So that the production of vegetables, or any other organized body is only a *dissemination* of what before existed. They grew, or unfolded themselves only when they fell into a proper matrix, or nidus, adapted by nature to their support and growth. Thus for example, if the eggs of certain insects fall on my writing desk, they perish; because the cloth which covers it, is not the proper nidus, or matrix for them; but if they are deposited on a piece of cheese, that being their proper matrix they soon become animated.* This doctrine opens to our

*The earth duly moistened and warmed, is the proper matrix for the Bean, which we selected in No. 2, as an example of all other seeds.

view an host of comforting facts, that banish entirely the dismal one of equivocal generation. Now we presume that while a vegetable is growing and flourishing, it attracts and absorbs these original seeds, or moleculæ, from the *earth*, and from the *water*, and from the *air*, and that this imbibition is continued until the plant attains its full perfection; and when it has risen to its acme, it rejects their further admission into all its parts; and therefore instead of being distributed as heretofore all over the plant, they now tend to the seed vessels only, and there form and perfect the seed, which increase very rapidly; and become *an organic particle of a larger size*. Nearly the same process takes place in animals.

The Roman poet *Lucretius* sums up the doctrine of unceasing mutation thus,

> "And so each part *returns* when bodies die,
> What came from earth to *earth*; what from the sky
> Dropt down, ascends again, and mounts on high.
> For DEATH doth not destroy; but disunite
> The seeds, and change their order, and their site:
> Then makes *new combinations*, whence arise
> In bodies all those great varieties
> Of shape and colour."——*Creech's Translation.*

To scrutinize how an organized body *first* began, is, perhaps, a presumptuous attempt; but to inquire after what manner, when once begun, they have been continued, is a work more suited to human abilities, and is gratifying to the towering faculties of reason, and honourable to religion: provided we substitute for the disconsolate doctrine of blind and vague chance, conspicuous in *Lucretius*,

that of an intelligent, and sovereign *Creator* and *Legislator* of the Universe, the Almighty Director, and merciful Controller of that never ceasing change, or circulation, through which *every thing* on this evanescent globe is doomed to pass.

From what has been said, it appears that a seed, the garden bean, for example, is a body regularly organized, and arranged into a *system* of vessels, glands and membranes; and that it is, in a degree, alive; so far at least, as to be in a state, or fitness to be acted upon by certain external agents, which agents are, *fire*, *air*, and *water*, or to speak more correctly, a certain vivifying principle, in the air, and in the water, called *oxygen*, which is the very spirit of fire and flame. This oxygenous principle lies in a dormant state in the hen's egg, until it is awakened by fire, or caloric, which combining with it, expands, and agitates the subtle fluids, and the very minute vessels of the egg, so that the wheel of life begins to oscillate; and then slowly to rotate; and at length, the membranes thicken and all the parts gradually unfold themselves: the same thing takes place in the seed, or bean, when placed in the earth.

But we cannot advance with confidence a step farther without some knowledge of the properties of the wonderful agent FIRE; which alike animates and sustains the great system of the world, and the diminitive system in a seed. What shall we say on this subtile subject? Fire, or caloric, by a gentle agitation, enlivens all entire organized bodies, and

conducts them by slow degrees to their destined perfection. It foments the embryo plant in the seed, and the miniature branch in the bud. But fire illudes inquiry by its being totally invisible; for it becomes visible only when it borrows a body to appear in. It seems secretly to unite itself to an inflammable something, and when united with this inexplicable principle, it enters into the composition of other bodies. But a mind that has scarcely ceased vibrating between the Priestlian doctrine of *phlogiston*, and the Lavoisierian doctrine of *oxygen*, feels the utmost diffidence in speaking of a subject in which a BACON,* a NEWTON, and a BOERHAAVE, a PRIESTLY, and a LAVOISIER, have all guessed differently. The *Botanist* ceases to wonder that sensible nations, not blessed with a revelation from heaven, have worshipped the *sun*, or a *flame of fire*, as the Deity. He believes that this vivifying something called *fire*, or *caloric*† fills the immense space of the whole universe, pervades all bodies, and actuates every particle of matter; and that by it the phenomena of magnetism, fire, and light are produced; and that on it the various, and astonishing phenomena of *vegetation* and *animation* depend. He

* *Lord Bacon* pronounced *heat* to be the effect of an intestine motion, or mutual collision of the particles of the body heated; an expansive undulatory motion in the minute particles of the body, by which they tend with some rapidity towards the circumference, and, at the same time, inclined a little upwards.

† The chemists of the present day use the word *heat* to express the *sensation*, and have adopted the word *caloric* to express the *cause* of the *sensation of heat*.

moreover believes that the SUN is the efficient cause of the motions of this fluid; and that the various phenomena of our system, are the effects of these motions; but the modus operandi of this *anima mundi* is, like its great Author, past finding out!

Let us turn from this difficult subject to one that is more within the management of human abilities. It appears from experiments that *oxygen* gives seeds their first determination to germinate; just as the same vivifying principle first excites the movements of life in a bird's egg. Old seeds, that would not germinate, even in the most favorable soil and situation, have been made to vegetate, by sprinkling the earth, in which they were planted, with water, to which was added some *oxygenated muriatic acid.* Garden cresses, thus treated, germinated in *six hours;* while those, treated with common water, required *thirty-six* to produce the same effect. Metallic oxydes, or calces of ores, and burnt clay, are good manures, because they abound with oxygen.*

Whoever takes an extensive view of those slow operations that are going forward on the globe which we inhabit, will perceive that the decay of animals increases the quantity of such matter as is fitted to become the food of vegetables, and vice versa. Calcareous earth is produced by the exuviæ, recrements, or remains of animals, especially their *shells*, which shells, left at the bottom of the ocean,

* On this subject, consult Mr. Jacquin of Vienna, Homboldt, and Darwin. See also the experiments of Sir Francis Ford, in Philos. Mag. 1798, and Dr. Barton's Elements of Botany, p. 272.

until they have become wonderfully accumulated, and since elevated by submarine fires, constitute, at this day, those immeasurable strata of chalk, marble, and lime-stone, which are found here and there, throughout the earth. The strata incumbent on these, consisting of coal, iron, clay, and marle, are principally products of the vegetable kingdom. Thus are all these strata of materials fabricated, *circulated*, and, in the course of countless ages, refabricated, and *re-circulated* by the procedure of vegetable and animal life, and decay. Hence may we not conclude with the modern *Lucretius*,* that vegetables and animals, during their growth, increase the quantity of matter which is fit, or capable of being fitted for the food of each other; while they elaborate a part of the materials of which they consist, from the simple elements of hydrogen, nitrogen, carbon, phosphorus, and oxygen, into which modern chemistry has resolved them by analysis?

This transmutation of animal to vegetative nature; and of the vegetable again to animal, may be rendered perhaps more intelligible by the following example from Darwin. In *animal* nutrition, the organic matter of dead animals and vegetables, taken into the stomach is there decomposed; and the most nutritive parts are absorbed by the lacteals, and so

* In calling *Darwin* the modern Lucretius, we wish not to convey an idea derogatory to the christian character of the British poet and philosopher. He resembles the heathen poet in genius, and not in his atheistical notions. Whether they resembled each other in a licentious, or *amatorial* cast of mind, is left for others to determine.

become part of the creature. In *vegetable* nutrition, the organic matter of dead animals and vegetables suffers likewise decomposition, and undergoes new combinations, on, or beneath the surface of the earth, while the more nutritious parts are absorbed by the roots of the plant in contact with it.

"Hence when a MONARCH, or—a *Mushroom* dies,
A while extinct th' organic matter lies;
But,—as a few short hours, or years revolve,
Alchemic powers the changing mass dissolve;
Born to new life unnumber'd insects pant—
New buds surround the microscopic plant. *Temple of Nature.*

These general principles being premised, we shall next attempt to show how the nutriment of vegetables is received from the earth by the roots of a plant.

THE BOTANIST.

N°. V.

WE have said that there were few little things in nature more truly surprizing than a seed; that each seed was a system, or complete whole, wrought up into a narrow compass, and retaining a living principle.

The antients, from the scarcity of books, and some other causes, had their attention less divided than the moderns. They therefore viewed Nature with keener eyes, and more concentrated attention, than

those who have lived since the multiplication of books by the discovery of the art of printing. They were of opinion that every thing, even the great globe itself, sprang from an Egg; which egg, their poets say, was hatched by Nox, *night*, or *obscurity;* or something behind a dark veil, which they could not see through. Darwin alludes to this doctrine, in speaking of that *Spirit*, which presided over chaos,

> ——— "Who, ere the morn of time.
> On wings outstretch'd, o'er *Chaos* hung sublime;
> Warm'd into life the bursting Egg of Night,
> And gave young Nature to admiring Light!"

Some, less diffident than the sagacious antients, imagine that they have penetrated this veil, and illumined the obscurity by saying that *fire* is the primary cause of the development of a seed. Be it so. But what do we mean by *fire*, or *caloric?* Is it here any thing more than a mere word denoting the last term of our analytical results? We moderns have decomposed substances, which under the antient doctrines of philosophy, had passed for elements, not susceptible of decomposition. We have been able to dissect Light, analyze Air, and decompose Water, and have discovered substances which all previous investigation had found too subtle for the detection of the senses; but we have not yet detected the *essence* of fire. When therefore we attempt to investigate the primary motion in seeds, we should not stop at the visible effects; but push forward to the invisible cause. Thus when we speak

of the motive powers of magnetism, or electricity, we should strive to raise our minds beyond these visible effects to the *cause* of them. In such an intense view of things, we must exclude the word *spontaneity* from the book of Nature. We must not grant it even to fire, which constitutes fluidity.*

If proud science be humbled by speculations of this sort, the agriculturalist may indulge his pride by considerations of another kind; by reflecting that he is, in some degree, a partaker in the power and privilege of the CREATOR; who has enabled him to rear from a few organized particles, a field of vegetables, a variegated garden, or a forest of trees. Man alone, says the chemist *Chaptal*, possesses the rare advantage of knowing a part of the laws of nature; of preparing events; of predicting results; of producing effects at pleasure; of removing whatever is noxious; of appropriating whatever is beneficial; and of composing substances, which nature herself never forms: in this point of view, himself a creator, he appears to partake with the SUPREME in the most eminent of his prerogatives!

From this digression we turn again into the path, whence we musingly wandered; which path is to lead us to a full view of that *Nemorale Templum*, which christian philosophy consecrates to the honour of the PARENT OF UNIVERSAL NATURE!

OF THE ANATOMY OF A VEGETABLE.

The principal vessels of plants are of two kinds, *tubes* and *cells*. The tubes run from the roots

* See Harris's Philos. Arrangements.

to the different parts of the plant in separate bundles, communicating with each other, but not branching and joining, or anastomosing, as in animals. These tubes contain the sap-juice, or chyle of the plant. When immersed in a watery fluid, they fill themselves on the principle, some suppose, of capillary attraction; but as this principle is not yet clearly settled among philosophers, we are inclined to believe with *Fordyce*, that it is from a power similar to the muscular power in animals, by which this absorption, and all other motions of vegetables are performed. These tubes terminate in *cells*, which cells contain the peculiar juices of the plant.

In the root of a plant certain cells surround the tubes; which are opened only at the extreme point of them; and fluids cannot be absolved any where else. The tubes are not simply open at the end of these radicle fibres; but there is a *particular structure*, or *configuration*, which adapts them to the imbibition of fluids; so that if the ends of all the fibres of the roots of any vegetable be cut off, the growth of that vegetable is stopped until a fresh configuration is formed. As roots can only absorb nutriment from the very points of their fibres, the configuration, just mentioned, defends the absorbing tubes from a superabundance of water. The roots of some plants will bear without injury a greater quantity of moisture than others. Those of aquatic plants have a peculiarly firm structure, for defending them from the effects of long maceration.

LINNÆUS has not rejected the idea of certain philosophers, who defined a plant to be an *inverted animal.* He considers its roots as its lacteals; the earth as its stomach; the trunk and branches the bones, and the leaves its lungs. There is, however, this difference between them;—an animal is an organized body, or a kind of hydraulic machine, nourished by roots, or syphons, or in other words the lacteals placed *within* him. A plant, is in like manner, an organized body, or kind of hydraulic machine, nourished by means of roots, made up of lacteal vessels, or syphons, placed on the *outside* of it. Moreover, is not the long cylindrical absorbent vessel, which runs from the roots of trees up to the caudex of each bud, and which enters at the foot stalk of each leaf analogous to the *thoracic duct* in animals?*

Every part of a plant that is under ground is not its root. Some vegetables, as the onion, the tulip, and all the tribe of lilies, terminate in a large bulb. But this bulb is not the root; but the *hybernacula*, or winter quarters of the vegetable *ens.* It is a subterraneous bud, inclosing the embryo plant, and protecting it from the destructive effects of frost. The radicles, or stringy appendages, proceeding from the bulb, as in the onion and tulip, are in fact the roots; because they alone contain those absorbing tubes, through which nutriment is imbibed from the earth. The Marquis de St. Simon, however, controverts this doctrine; and imputes the absorb-

* See Bonnet's Contempl. de la Nature.

ing power to the middle part of the bulb. The absorbents in a plant differ from those in animals in the facility with which they carry fluids *either* way. Invert a plant, and its roots, now in the air, will produce leaves; and its branches, now in the ground, will shoot forth into roots; or rather radicles, or ligneous absorbents.

The roots of plants show a remarkable instinct in searching for food, by creeping towards collections of water; and into a rich soil. The roots of plants, says *Bishop Watson*, seem to turn away, with a kind of abhorrence, from whatever they meet with, which is hurtful to them; and to desert their ordinary direction and to tend with a kind of irresistible impulse towards collections of water, placed within their reach. Thus the *willow* creeps into our wells, after water; and has been known to form a mat, or netting across them. The *Lombardy poplars*, which now ornament most of the cities, and many of the villages in America, have very extensive roots, running horizontally at a small distance from the surface of the ground. They injure our gardens, and damage our pavements in the streets, in search of water, or of air. This growing evil, will perhaps compel us to eradicate these handsome trees from the streets, which they at present adorn.

In summing up all that has been said, it appears, that a seed is the sexual offspring of a plant, containing not only the rudiments of the future vegetable, but also a quantity of aliment laid up within its membranes for its early nourishment. A whitish

subject of a delicate nature forms the substance of the seed. Small vessels, which proceed from the germ are in every part of this substance, dividing, and subdividing it every where. After the seed has lain in the ground, moistened and warmed to a certain degree, it gently expands, and then begins to shoot forth; the radicle downwards, and the plumula upwards. The warmth, which had penetrated its outward folds, operates on their moisture, and dissolves the mealy substance of the seed lobe, and mixes with it. Of this mixture is formed a kind of milk, which being conveyed to the infantile plant by a concourse of vessels, terminating in a little protuberance or papilla furnishes it with nourishment, adapted to its tender age, and extreme delicacy.

By these means the radicle, or incipient root unfolds itself, and increases in bulk and extent every day. In a short time, it seems to become, like the chicken in the egg, sensible of too close confinement, and it makes an effort to come forth. The small orifice, which may be observed on the outside of the bean, and every other seed, facilitates its egress. Then the radicle creeps downwards into the earth, and soon after the plumula stretches upwards to taste the air, while the seed lobes, emulating leaves, serve as shields to defend the infant plant from harm. As the plant acquires size and strength, these are no longer useful, but dropping off, perish; and from this time forward the plant depends for its coarser nourishment on certain fluids in the earth; and on more subtle and refined ones from the at-

mosphere. For it is with plants as with ourselves, while our stomachs are digesting coarser food, our lungs are digesting air; so that while plants are receiving mucilage from the earth, their leaves, or lungs inspire the oxygenous, or vital principle from the atmosphere.

From this view given of the seed, and its economy, the assertion will no longer appear strange that the spacious oak once existed in an acorn. Thus says the poetical Darwin,

> The pulpy acorn, e'er it swells, contains
> The oak's vast branches in its milky veins.

And again,

> Grain within grain, successive harvests dwell,
> And boundless forests slumber in a shell.

THE BOTANIST.

N°. VI.

We left the infantile plant struggling for life, and extending its roots, which contain those vessels that answer to the lacteals in animals, in order to imbibe nutriment from its mother earth; while the *plumula*, or little stem and leaf were aspiring to drink the vital air, which soon changes it from a yellowish white to a beautiful green colour. That leaves do not acquire this splendid green before they enjoy the light of heaven, is known to every one who has noticed plants growing in dark cellars, or covered

ver with boards, or otherwise secluded from the sun's rays.* We shall resume this subject when we speak of the office of the leaves in cleansing a foul atmosphere from putrid exhalations. We must now pursue

THE ANATOMY OF A VEGETABLE; BEING THE EXAMINATION OF A TRUNK OF A TREE FROM WITHOUT INWARDS.

In cutting the trunk of a tree from the circumference to the centre, the instrument passes through *seven* distinct parts in the following order :

I. The EPIDERMIS.
II. The CORTEX.
III. The LIBER.
IV. The ALBURNUM.
V. The VASCULAR SERIES.
VI. The LIGNUM.
VII. The MEDULLA, or *Pith.*

Under which of these heads must we place the Silver grain, or those bright radii which pass from the centre to the circumference? Are these any thing more than mechanical braces of the ligneous part of the tree ; a sort of dovetailing to preserve the limb from breaking into concentric circles, on suf-

* This operation called *bleaching*, or *etiolation*, renders plants less acrid and is usually performed on endive and cellery.

fering violent flexures in high winds and storms? Or do they contain the air vessels, passing from the epidermis to the centre?

The *Epidermis* is a delicate, but firm, transparent membrane, covering the plant every where. It is impenetrable to water, and, like the cuticle of the human body, is sooner elevated in the form of a blister, than destroyed by any corrosive fluid. The epidermis of vegetables is, as in the human scarf-skin, a single membrane, although Duhamel says he counted six in the birch tree, and our countryman, Dr. Barton, distinguished twice that number. Notwithstanding this respectable authority, we apprehend, that both these naturalists were deceived. We admit, as a well established opinion, that the epidermis, or cuticle of a tree, is renewed every year; and that where we discover several layers, they are only the old ones, beneath the recent one. Some trees, says Darwin, have as many cuticles, as they are years old; others cast them more easily, as a snake casts its skin. Hence the service of currying or scratching trees.*

The use of the epidermis is to protect the ultimate ramifications of the aerial and aqueous vessels; those minute vessels, by which they are enabled to

* It is said, if you continue to scratch the curvature of a crooked tree, it will in time become straight. It resembles in this respect a contracted leg or arm, which is sometimes restored by friction. We should be careful not to scratch trees that exude a gum, such as peach trees. An insect will sometimes injure the bark of the peach tree near the surface of the ground, which occasions an exudation of gum, and soon after the tree becomes sickly and at length dies.

absorb aeriform fluidities, which are needful to the life, health, and beauty of the plant.

On removing the Epidermis,

The *Cortex*, or *hide* of the plant, as the word imports, appears. This is the part known to every one by the name of *Bark*. It consists of vessels, glands, and *Utricles*, which are little bags, or cells, inosculated, contorted, interwoven, and compacted, in such a manner, as to render it very difficult of demonstration. It is among this compounded structure of the cortex, or bark, that the work of digestion is performed; and the product of this digestion is conveyed through the whole vegetable, till at length the leaf and the flower, the first the lungs, the last the face, mouth, and entrails, perfect the plant. It is in the bark of the plant, that the medicinal virtues principally reside. In this reticular substance are found the oils, resins, gums, balsams, and more occult virtues, so precious to the healing art. The Peruvian bark, and the cinnamon have stamped celebrity on this part of a vegetable.

After the bark is stripped off, we discover the third integument, namely the *liber;* which consists of laminæ or plates, bound together by a cellular matter, which, when dissolved by maceration in water, detaches these plates or coatings from each other; when they resemble the leaves of the *books* of the antients; whence arose the name of *liber*. The liber is softer and more juicy, than the cortex. It grows however harder and harder, until it assumes the quality and name of *lignum* or wood.

Between the liber and lignum is interposed a peculiar substance called *alburnum* by *Linnæus*,* *blea* by the British, *arebier* by the French, and *sap-wood* by the American yeomanry. It is whiter and softer, than either the cortex or liber. It is not at all times easy to distinguish between the alburnum and the wood, the structure being similar. Indeed the alburnum appears to be but the infantile stage of the wood, progressing from a mucilaginous to the adult state.

We have said that the liber grows harder and harder till it assumes the quality and name of lignum; but Du Hamel says that in certain circumstances the wood is capable of producing new bark. A cherry tree stripped of its bark exuded from the whole surface of its wood, in little points, a gelatinous matter, which gradually extended over the whole, and became a new bark; under which a layer of new wood was speedily formed. This gelatinous substance, or matter of organization is called *Cambium*, (from, I presume, the Italian word *cambio*, or *cambiere*, to *exchange*, or *commutate*,) which Mirbel supposes to produce the liber, or young bark; and at the same time, by a peculiar arrangement of the vascular parts, the alburnum, or new wood. Is this a process similar to the exudation of that part of our blood called coagulable lymph in consequence of inflammation in the human body? When, by inflammation, a vascular part of the body

* "Intermedia substantia libri et ligni." *Linnæ.*

is roused to an extraordinary action, then millions of vessels are called into existence, and glands also, which secrete the coagulable lymph, or matter of organization, which is one link in the chain of renovation. Or is it like the exudation that repairs the broken shell of the snail? Or the exudation which forms the calhis that reunites a fractured bone?*

Between the alburnum and the wood lies a fifth ring, or circle of vessels called *the vascular series.* Its structure is simple, being a single course of greenish vessels, lodged between two cellular membranes. It terminates, says Dr. Hunter,† in the *nectaria* of the flower. Some botanists consider the vascular series, as part of the alburnum.

The sixth part in order is the *lignum* or wood, which is the most solid part of the trunk; and is defined by our great master to be the alburnum and liber of the preceding year, deprived of their juice, hardened and firmly agglutinated. The wood is composed of concentric rings. The centre of these circles is generally observed to be nearer the north, than the south side of the tree.

On examining a transverse section of a trunk, or large limb of a tree, an oak for example, we can generally observe, that the interior rings are harder than the exterior. It is a prevalent opinion, that one of these rings is added every year, and that, regarding the number of circles, we can ascertain the age of the tree. Some have ventured to deny

* See Smith's Botany. † Philosoph. Botanic.

this criterion, although they knew, that Linnæus himself examined very aged oaks in some of the islands of the Baltic with that principle for his guide. This illustrious secretary of nature was persuaded, that he could point out by the ligneous circles, the severe winters of 1587, 1687, and 1709, as they were thinner than the rest. This curious circumstance merits the attention of our rural philosophers. Who knows, but we may hence form a probable conjecture of the age of those surprizing antiquities, discovered in this new world on the banks of the *Ohio* and *Muskingum?*

Substantial as is the wood or ligneous part of a tree, it is nevertheless so far from being an essential part, that many plants are without it. The arundacious plants, as the reeds, and the grasses, and indeed all the gramina, are naturally hollow. How often do we see trees, so internally decayed, as to be kept alive merely by a vigorous state of the bark?

The seventh and last part is the *medulla*, or *pith*. This is a spongy or vesicular substance, placed in the centre of the wood, and is according to Linnæus, essential to the life of the vegetable. In the new productions of trees it consists of a number of oval, greenish moist bladders, which at length become empty, dry, and spherical, and by degrees assume a whitish colour. We know but little of the minute structure of the pith. It resists the tincture of the most subtle colouring fluids, and is as impenetrable to water, as the pith of a goose-quill. Ought we to infer, that the pith is destitute of vessels? May it

not be like the most subtle parts of the brain of animals, the vessels of which elude the sharpest sight, by reason of their exility? In plants, which have hollow stems, the tube is lined with pith.

Linnæus attributes great importance to the pith, and asserts, after Bradley, that it gives birth to the buds. Some botanists of the first rank believe, that the pith is, in a plant, what the brain and spinal-marrow are in the inferior order of animals. The pith, says Darwin, appears to be the first or most essential rudiments of the new plant, like the brain, spinal-marrow, and medulla oblongata, which is the first visible part of the figure of every animal fœtus from the tadpole to mankind. It seems however that the pith is not essential, or absolutely necessary to vegetation, as we often observe trees to live and thrive without it.* The guaicum or lignum vitæ, it is said, has no pith. If the pith be the brain of a tree, may it not be with some trees as with some animals, in which the brain is not confined to the head, but spread all over them, as in the earth worm and polypus, the parts of which, though cut in pieces, live and become entire animals? Some animals, like some vegetables, are more vivacious than others. A tortoise will live and crawl several days after decapitation; because his body is replete with *ganglions*, which are subordinate brains, having an innate energy independent in some measure of the

* If *Forsyth's* book had not come forth under such uncommonly high sanction, we in America should have been disposed to doubt some of his accounts of the restoration of decayed trees.

capital portion in the skull. After all, the office of the medulla or pith in vegetables is among the desiderata in the science of botany.*

There is no part of the anatomy of a vegetable involved in more intricacy and uncertainty, than the VASCULAR SYSTEM. *Linnæus* speaks of three kinds of vessels,

I. The *Sap vessels*,
II. The *Vasa propria*, or *proper* vessels, and
III. The *Air vessels*;

but later botanists have increased their number to seven.

The *Sap vessels* convey the sap-juice or chyle of the vegetable. They rise perpendicularly and pass principally through and between the wood and the bark; and though imperceptible, they must pervade other parts of the plant.

The *Vasa propria*, proper, or peculiar vessels, are so called because they contain the peculiar or specific secreted fluids, as the gum in the peach tree, and the resin in the fir. In these vessels are found the medicinal qualities, peculiar to a plant. The utricles are small repositories, which contain the colouring matter of the plant. In them the nutritive juice of the plant is lodged, just as the marrow is preserved in bones, whence it is taken both in animals and vege-

* Some have conjectured that the *pith* was a reservoir of moisture, against a dry season, like the deposites of marrow in the bones, or rather the fat in our bodies, and on which it is supposed we subsist during the emaciating state of fevers.

tables, when they are not sufficiently supplied with chyliferous nutriment.*

The *air vessels* are called *tracheæ* from their resemblance to the respiratory organs of insects. They are found in the wood and in the alburnum, but not in the bark. In order to detect them, you must take a young branch of a vine, and clear away the bark, and then break it by drawing the two extremities in opposite directions, when the air vessels may be seen in the form of small corkscrews. See engraved representations of them in *Grew's Anatomy of Plants*, and *Darwin's Phytologia*.

These tracheæ or air vessels carry other fluids beside air. Darwin says they are *absorbent* vessels of the adult vegetable, and the *umbilical* ones of the embryon bud.

As to the *absorbent*, the *excretory*, and the *secretory* vessels, we shall speak of them when we describe the leaves.

To the foregoing description of the parts of a plant should be added that which contemplates it as a whole. *Linnæus*, in some measure helps us to that view of it when he says, that the *cortex* of the flower terminates in the CALYX; the *liber* in the PETALS or painted leaves; the *lignum* in the STAMINA; the *vascular series* in the NECTARIA; and the *pith* in the SEEDS.

It is very difficult to convey a clear idea of these different parts of a plant; we would therefore refer

* See Chaptal's Chemistry, Vol. 2.

the reader to *Grew*'s admirable engravings, copied after magnified specimens of various parts of a vegetable, which, though executed more than a century ago, have not since been surpassed.

Dr. GREW and MALPIGHI began their anatomy of plants about the same time, unknown to each other; one in England, the other in Italy. Much praise is due to the Italian, but more to the Englishman. So finished are his descriptions, that he has left but little to his successors but admiration.

The best solar and lucernal microscopes of the present day serve to increase our admiration of the accuracy and industry of Dr. *Nehemiah Grew* in the anatomy of plants. His excellencies are numerous, and his mistakes few. Darwin contends, that what Grew and Malpighi called *bronchia*, or air vessels, are really absorbents; that they have been erroneously thought air vessels, in the same manner as the arteries of the human body, were supposed by the antients to convey air, till the great Harvey, by more exact experiments, and juster reasoning evinced that they were blood vessels.

The *Botanist* is not entirely satisfied with the account he has here given of the anatomy of a vegetable from the epidermis to the centre. Grew, Hales, Du Hamel, Linnæus and Darwin, with many living naturalists have examined the minute structure of a plant, but every one of them has left a wide field for discoveries to his successor. We in America have not all the means for examining these things, as have our elder brethren in Europe. It is but lately that

we have begun to construct microscopes; by whose magical powers men have sometimes called things that are not into existence, as well as established the existence of others that were doubtful.

THE BOTANIST.

N°. VII.

Several Philosophers distinguished for sagacity and industry, have devoted a considerable portion of their lives to the examination of the structure of plants, and to the study of the process of vegetation; yet the subtile organization of vegetables has baffled their sight, though armed with the microscope; and the laws of vegetation have been but imperfectly explored. Who has been able to discriminate that peculiar organization in each kind of plant which gives the specific medicinal quality to each? If matter, considered as mere matter, give not the peculiar qualities to bodies, they must result from the different arrangement of the same matter in different vegetables. It is from the different modification of vegetable matter, which produces those various and opposite qualities, observable in two plants growing in the same bed of a garden, and breathing the same air, and which produces both bread and poison out

of the same soil. It is, says Dr. Hunter,* from the different elaboration of a mass of innocent earth, that gives life and vigour to the bitter aloes, and to the sweet sugar cane, to the cool house-leek, and to the fiery mustard, to the nourishing grain of wheat and corn, to the deadly night shade, and the still more deadly *upas*.

It is incompatible with our plan to exercise much attention in describing the different forms and structure of the trunks or stems of plants. Seven are enumerated by *Linnæus*.

1st. The *Caulis*, or stem properly so called, bearing the leaves and the flower.

2d. The *Culmus* or straw, which species of stem is generally hollow, as in grasses.

3d. The *Scapus*, or stalk, which bears the fructification only, the leaves not being raised above the ground, as in the Dandelion.

4th. The *Pedunculus*, or flower-stalk, which bears the flower, or fructification from the caulis. It is the stalk or immediate support of a single flower or fruit.

5. The *Petiolus*, or stalk of a leaf. It fastens the leaves, but not the fructification.

6. The *Frons*, a vague term, generally used to signify that the root, stem, leaf and fructification are all in one, as in Ferns.

7. The *Stipes*, which is the stalk, or trunk of a frons, and is applied only to the Palms, Filices and Fungi.

* Georgical Essays.

Turning from these things* let us examine some other objects of more importance, viz.

THE BUDS.

A Bud is a protuberance, hard body, or pointed button, being a compendium, or epitome of its parent plant, jutting out from its stem or branches. A bud is composed externally of scales, which are elongations of the inner bark. It is commonly covered with a resinous varnish, to protect it from cold, insects, and moisture; and it contains the rudiments of the leaves, or flower, or both, which are to be expanded, or exfoliated the following year. Buds are called by Virgil *gemmæ*. As many plants have no buds; and some that have are divested of them when removed from cold to warm climates, it is evident that the buds are not parts essential to a vegetable. They are however so very common in these northern states, that our *Flora* would appear awkward without her gems. Of the arborescent plants growing among us, which have no buds, all of them have been brought from warm climates, as the *orange*, *lemon*, *acacias*, *geraniums*, the *oleander* and *guiacum*.

* The branch of an oak is called *ramus*; and a twig of that branch *ramulus*; but what is the discriminating term for the huge trunk of any tree which rising from the root supports them all? Can it be arranged properly under either of these seven heads?

If you examine a twig of almost any of our trees at this season,* especially the horse chesnut, you will find that the bud is rooted in, or proturberates from the pith. You will also find, that wherever a new bud is generated in the stem or twig, or in the bosom of a leaf, there a membraneous diaphragm divides the cavity. This division, which is covered with a medullary, or pithy substance, distinguishes the insertion of one bud from another. Beside the scales of the bark, and the rudiments of the leaves, we discover by searching deeper, that the bud, like the seed, contains the parent plant in miniature.

Seeds are vegetable eggs; and buds are fœtal plants, both equally adapted to continue their species forever. A bud on the stem or twig of a tree in the winter, as well as the bulb of a tulip, is the *hybernacula*, or winter quarters of the vegetable *ens*, where the embryo plant sleeps in safety during the severity of winter, secure from the destructive effects of frost, moisture, or insects.

There are three kinds of buds; one containing a flower, another containing only leaves, and a third containing both. A just discrimination of these three kinds of buds is important to gardeners. Leaf-buds should be always selected for inoculation, although flower-buds are commonly chosen for that purpose, because they are fuller, thicker, less pointed, and resemble plump seed; whereas if they should be transplanted into the bark of a tree, they are more apt to disappoint the expectations of the ingrafter than

* December.

if he used the leaf-buds. An accurate knowledge of these things will tend to explode the vague terms of "barren buds," and "fertile buds." Another illustration of our former assertion, that anatomical investigation is the only certain, and rational method of arriving at certainty in the laws of vegetation.

By the term FOLIATION, botanists mean the *complication*, or folded state of the leaves, while concealed within the buds. This intricate and *complicated* structure, was first evolved and displayed by our great master LINNÆUS; who has taught us, that the leaves in buds are either,

INVOLUTE; that is, *rolled in*, when their lateral margins are rolled spirally inwards on both sides.

REVOLUTE, *rolled back*, when their lateral margins are rolled spirally backwards on both sides.

OBVOLUTE, *rolled against* each other; when their respective margins alternately embrace the straight margin of the opposite leaf.

CONVOLUTE, *rolled together;* when the margin of one side surrounds the other margin of the same leaf in the manner of a cawl or hood.

IMBRICATE; when they are *parallel*, with a straight surface, and lie one over the other.

EQUITANT, *riding;* when the sides of the leaves lie parallel, and approach in such a manner, as the outer embrace the inner, which is not the case with the

CONDUPLICATE; or *doubled together*, that is, when the sides of the leaf are parallel, and approach each other.

PLICATE, *plaited;* when their complication is in plaits lengthwise.

RECLINATE, *reclined;* when the leaves are reflexed downwards towards the *petiole.*

CIRCINAL, *compassed;* or in *rings*, when the leaves are rolled in spirally downwards.*

Although *Loefling*'s natural history of buds has not been surpassed, as any naturalist will be convinced, if he peruses his paper, entitled "*Gemmæ Arborum*," in the *Amænitates Academicæ;* yet *Darwin* is more to our present purpose, which is to mix the *utile* with the *dulce.*

Dr. *Darwin*, in his "*philosophy of agriculture and gardening*," says, "if a bud be torn from a branch of a tree, or cut out, and planted in the earth, with a glass cup inverted over it, to prevent the exhalation from being at first greater than its power of absorption;† or if it be inserted into the bark of another tree, it will grow, and become a plant in every respect like its parent. This evinces, that every bud of a tree is an *individual* vegetable being; and that a tree therefore is a family or swarm of individual plants, like the polypus, with its young growing out

* See chap. xvi. of a book well known in America, entitled "*An Introduction to Botany*, &c. which was compiled from the writings of *Linnæus*, by an English Baronet, and published by *James Lee*, nursery man, at the Vineyard, Hammersmith," near London, an honest, sensible, hardworking, *unlettered* North Briton.

† In this situation a greater heat may be given them, than in hot houses, without increasing their quantity of perspiration, which ceases as soon as the air in the glass is saturated with moisture. *Phytol. Sect.* ix.

of its sides, or like the branching cells of the coral insect."

"When old oaks or willows lose by decay almost all their solid internal wood, it frequently happens, that a part of the shell of the trunk or stem continues to flourish with a few healthy branches. Whence it appears, that no part of the tree is alive, but the buds and the bark, and the root-fibres; that the bark is only an intertexture of the caudexes of the numerous buds, as they pass down to shoot their radicles into the earth; and that the solid timber of a tree ceases to be alive, and is then only of service to support the numerous family of buds in the air, above the herbaceous vegetables in their vicinity."

"A bud of a tree therefore, like a vegetable arising from a seed, consists of three parts; the plumula or leaf, the radicle or root-fibres, and the part which joins these two together, which is called caudex by LINNÆUS, when applied to entire plants; and may therefore be termed *caudex gemmæ*, when applied to buds.

"An embryon-bud, whether it be a leaf-bud, or a flower bud, is the VIVIPAROUS offspring of an adult leaf-bud; and is as *individual*, as a seed, which is its OVIPAROUS offspring.

"As the season advances, the leaf-bud puts forth a plumula, like a seed, which stimulated by the *oxygen* of the atmosphere, rises upwards into leaves, to acquire its adapted pabulum; which leaves constitute its *lungs*. The flower-bud under similar circumstances puts forth its bractes or floral-leaves;

which serve the office of lungs to the pericarp and and calyx; and expands it petals, which again serve the office of the lungs to the anthers and stigmas; and thus like the leaf-bud, it becomes an adult vegetable being, with the power of producing seed."*

Close observers of nature have remarked, that about midsummer, there is a kind of pause in vegetation, for perhaps a fortnight; and it is believed, that *leaf-buds may be changed into flower-buds*, and *flower-buds into leaf-buds*. The probability of this idea of transmuting flower-buds and leaf-buds into each other is confirmed, says the ingenious author of "the Botanic Garden," by the curious conversion of the parts of the flowers of some vegetable *monsters*† into green leaves; if they be *too well* nourished, after they are so far advanced, as to be unchangeable into leaf-buds. Instances of this luxuriance are sometimes seen in the chaffy scales of the calyx of the *Everlasting*, in the *Pink*, and in the *Rose-Willow*. The artificial method of converting leaf-buds into flower-buds is by disturbing the natural course of vegetation by binding some of the most vigorous stalks or roots with strong wire.‡ The success of this operation depends on weakening, or strengthening the growth of the last year's buds.

* Darwin's Phytol.

† Double, or very luxuriant flowers, however beautiful in the eyes of the *florist*, are called *monsters* by botanists.

‡ See Bradley on Gardening, vol 2, p. 155. Also, Mr. Fitzgerard's mode in Philos. Transact. for 1761, and Count Buffon's in Act. Paris. An. 1738.

Instead of planting buds in the earth, we plant them within the bark of another tree; taking care to place them so, that the pith of the bud comes in close contact with the pith of the branch, in which the slit is made. This mode of propagation is called *inoculation.**

An argument among others, that the Chinese had no communication with either Greeks or Romans, is their total ignorance of the art of ingrafting or inoculation. That the antients were well acquainted with this operation appears by this passage from VIRGIL'S *Georgics*, as translated by *Darwin*.

When cruder juices swell the leafy vein,
Stint the young germ, the tender blossom stain;
On each lopp'd shoot, a foster scion bind,
Pith prest to pith, and rind applied to rind.
So shall the trunk with loftier crest ascend,
And wide in air robuster arms extend,
Nurse the new buds, admire the leaves unknown,
And blushing bend with fruitage not its own.

We might conclude this number by a beautiful poetical description of *the arts of producing flower-buds;* extracted from "*the Botanic Garden*" of the fanciful *Darwin;* but his allusions forbid it. While our *Flora* presents a bouquet to the Massachusetts youth of both sexes, she must not sprinkle poison on her flowers.

* In France and in Switzerland they improve the fruit of a tree by ingrafting it with a scion from its own branches. This is found to ameliorate the quality of the fruit, and increase the size of it.

THE BOTANIST.

N°. VIII.

How dead the vegetable kingdom lies!.....*Thomson's Winter.*

In the past numbers we treated of the SEED, the ROOT, the STEM, and lastly of the BUD, *hybernacula*, or *winter quarters* of the vegetative life. Order indicates that we describe the LEAVES and opening FLOWERS in this; but alas! a frost, "*a killing frost,*" has "*nipt our shoot,*" and check'd us in the bud. Our congeniality, or uncongeniality to the seasons, is founded in the nature of things, let Johnson say what he will to the contrary. When the mercury in the glass, and the mercury in the man, is a degree or two below o, he is fitted rather to write on modern patriotism, and public generosity, than on the vernal bounties of exuberant NATURE. *Anthology** requires the etherial warmth of spring.

We attribute to the hard, inflexible, horn-beam fibre of a Johnson, which no climate could alter, nor season soften, this erroneous sentiment:—"Those who look upon the mind to depend on the seasons, and suppose the intellect subject to periodical ebbs and flows, may justly be derided as intoxicated by

* i. e. A treatise on *Flowers.*

the fumes of a vain imagination. The author that thinks himself weather bound, will find, with a little help from *hellebore*, that he is only idle or exhausted. But while this notion has possession of the head, it produces the inability which it supposes." This stern philosopher however was compelled, in the evening of his life, to groan out, that we are "*the slaves of sunshine and of gloom.*"*

When

> ——— " The vernal sun awakes
> The torpid sap detruded to the root
> By wintry winds ;"———

or in better words, when " *the winter is past, and the rain is over and gone ;*" when " *flowers appear on the earth, and the singing of birds is come ; when the fig tree putteth forth her green figs, and the tender grapes give a good smell,*" then will the BOTANIST quit his conglaciated state, and, congenial to the cheerful season, once more attempt to delineate the beauties of earth's renovated carpet ;—unless the cold hand of death, or the still colder hand of a gothic spirit should paralyze *his* forever !†

Lest those who have regarded the past numbers of the Botanist with a favourable eye should be disappointed, we seize this opportunity of introducing them to the acquaintance

* Verses on Winter.

† *Circumventive attempts, about this time, to deprive our author of the honour and profits of twenty years indefatigable labour in the field of Natural History, may have given rise to these gloomy reflections.* ED.

OF LINNÆUS.

The figure which this learned physician, and illustrious naturalist made while living, and the great reputation of his works now he is dead, will justify us in devoting the rest of this number to his honour.*

CHARLES VON LINNE, or as the learned throughout the world have latinized it, CAROLUS LINNÆUS, was born at Smaland in Sweden, in the year 1707. It has almost always happened that those who have occupied some of the highest seats in the temple of fame, have been obliged to climb up to it through the rough, dirty and difficult road of poverty, calumny and opposition. It was remarkably so with Linnæus, who was the son of an obscure clergyman, of an inconsiderable village in a gloomy region of the globe. His father's income was so small, and his family so large and straightened in their circumstances, that this prince of naturalists was on the point of being bound to a mechanic. The design of binding Linnæus to a shoe-maker was over-ruled by his uncle, and he was sent to school, when he was ten years of age. At this early period, his chief amusement was gathering plants and hunting after insects.

Almost all young men, when just stepping on the stage of busy life, press forward to the acquisition of

* If the reader would glance over Dr. Pulteney's general review of the life and writings of *Linnæus*, he will see whence we have taken most of our facts; and will perceive that we have sometimes used his expressions.

riches, as the surest road to power and reputation; whilst a few, a very few consider wealth as a secondary object, and pursue with ardour fame or reputation as the first. Hence there have not been many very famous literary characters who have not commenced their career in poverty; and most of them have found that "*Slow rises worth by poverty depress'd.*"

In the year 1728, he removed to Upsal, where he obtained the patronage of several eminent men, particularly of OLAUS CELSIUS, at that time Professor of Divinity, and the restorer of natural history in Sweden. Under such encouragement he made rapid progress in his studies, and in the esteem of the Professors. We have this striking proof of his merits and attainments, that after only two years residence, he was thought sufficiently qualified to give lectures, occasionally, from the botanic chair, in the room of Professor Rudbeck.

In 1731 the Royal Academy of Sciences, having a desire to improve the natural history of Sweden, deputed Linnæus to make the tour of Lapland, with the sole view of exploring the natural history of the arctic region, to which his reputation, as a scholar and a naturalist, and his tough constitution, equally recommended him. He traversed the Lapland desert, which was destitute of villages, roads, cultivation, or any conveniences. He spent about five months in this tour, suffering innumerable hardships and privations; and that too for a very small stipend, scarcely enough to buy him shoes, which must

have been an important article of clothing; for poor Linnæus travelled ten degrees of latitude on foot. Several years after he travelled through Holland, Brabant, and France, in the same manner, gathering plants on the way, and searching for minerals.

In 1733 this indefatigable naturalist was sent by the government to visit the mines in Sweden. On his return to Upsal, he gave lectures on mineralogy in the university. In 1735, when he took his degree of Doctor of Physic, he published the first sketch of his SYSTEMA NATURÆ, in a very compendious way, and in the form of tables, in twelve pages only. By this it appears, that he had at a very early period, before he was twenty-four years of age, laid the basis of that magnificent work, which he afterwards raised, and which will ever remain a lasting monument of his genius and industry. In the same year he retired to *Fahlum*, a town in Dalecarlia, where he gave lectures on mineralogy and the docimastic art; and where he practised physic. In 1736 he passed over into England, carrying letters of recommendation from the famous BOERHAAVE, who was at that time Professor of the Theory and Practice of Physic at Leyden, the glory of the medical world, and one of the best botanists of the age. That the sagacious Boerhaave penetrated the true character of Linnæus, and predicted his future fame and greatness appears by his letter of introduction to Sir Hans Sloane, in which he says, "Linnæus, qui has tibi dabit literas, est unice dig-

"nus te videre, unice dignus a te videri; qui vos "videbit simul, videbit hominum par, cui simile "vix dabit orbis." Although Boerhaave particularly recommended him to Sir Hans Sloane, President of the Royal Society, Sir Hans paid him but little attention; for Linnæus was not one of those gay young men that attract much personal attention. He was negligent of dress and diminutive in stature. The patronage of so illustrious a man rendered Linnæus still more conspicuous; Boerhaave himself being a cultivator of natural history and botany, the merits of Linnæus could hardly escape his perspicacity.

Boerhaave's friendship for Linnæus continued to the latest period of his existence. When Linnæus visited him in his last sickness, and but a short time before this light of the medical world was extinguished, Boerhaave taking an affectionate leave of his young friend, said, "I have lived my time out, "and my days are at an end. I have done every "thing that was in my power. May God protect "thee, with whom this duty remains! What the "world required of me, it has got; but from thee, "my dear Linnæus, it expects much more!"

In 1737 Linnæus published the *Genera Plantarum*, which completely unfolded the sexual system, as far as related to classical and generical characters; and in the same year exemplified it in the species by the *Flora Lapponica*, and the *Hortus Cliffortianus*. At the same time, he dedicated to DILLENIUS, the *Critica Botanica*, in which he explains his reasons

for the change of names, and for the establishment of new distinctions, both of which, he well knew, would be considered as dangerous innovations.

In 1738 Linnæus really imagined, that he had fixed down for the last time in the practice at Stockholm; for being now married, he concluded it was time to settle down for life, and give over gathering plants in the arctic circle, and searching the bowels of the earth for minerals. He however met with great opposition in his business. He was too learned and too eminent not to excite all that envy and jealousy could engender and inflict. At Stockholm his enemies oppressed him with many difficulties; but the abilities and persevering spirit of Linnæus surmounted them all, so that he came at length into extensive practice as a physician. But his vast and ardent mind would not allow him to confine it to such drudgery; especially when the fruit of his labour was to be only money. *Count Tessen* was his patron, through whose influence medals were struck in his honour. He enjoyed also a stipend from the citizens of Stockholm for giving lectures in botany.

In 1741 Linnæus was appointed joint Professor of Physic with *Rosen*. These two colleagues agreed to divide the medical department between them. Professor Rosen took *anatomy*, *physiology*, *pathology*, and *therapeutics;* whilst Professor Linnæus took *natural history*, *botany*, *materia medica*, *dietetics*, and the *diagnosis morborum*. The systematic genius of this prince of naturalists displayed itself in his mode

of teaching medicine; for he arranged in the form of a table all the diseases that afflict mankind. Sauvage in France followed his plan, and made many improvements; and the late Dr. Cullen carried it to a high degree of perfection. According to this plan, diseases are arranged, in imitation of botanists, into *classes*, *orders*, *genera*, and *species*. This mode of arranging disorders is called *Nosology*. The reputation of the Swedish University at Upsal rose to a height before unknown, during the time when its medical department was under the direction of Linnæus. But that, which has established forever the name of Linnæus; and which has reflected honour on his country, is the SYSTEMA NATURÆ. Nothing since the labours of Aristotle can be compared to it for depth of knowledge and extent of research.

From this period the reputation of Linnæus bore some proportion to his merit; and extended itself to distant countries; insomuch that there was scarcely a learned society in Europe, but was eager to elect him a member; scarcely a crowned head, but sought some means to honour him. His emolument kept pace with his fame and honours. It was no longer *laudatur et alget.** His practice as a physician became lucrative; and we find him possessed of his country house and gardens in the vicinity of the capital. Linnæus received one of the most flattering testimonies of the extent and magnitude of

* Starving on universal praise; or living in splendid wretchedness.

his fame, that perhaps was ever shown to any literary character, the state of the nation which conferred it, with all its circumstances, duly considered. This was an invitation to Madrid from the King of Spain, there to preside as a naturalist, with the offer of an annual pension of 2000 pistoles, letters of nobility, and the perfect free exercise of his religion. But, after the most perfect acknowledgments of the singular honour done him, he returned for answer, "*that if he had any merits, they were due to his own country.*"

This extraordinary man died January 11th, 1778, in the 71st year of his life, leaving behind him a glorious reputation. Uncommon respect was shown to his memory. At the commemoration of his death, by the Royal Academy of Sciences, the King of Sweden honoured the assembly with his presence; nay farther, in his speech from the throne to the Swedish parliament, that philosophic monarch lamented the death of Linnæus, as a public calamity. He said, "I have lost a man whose fame was as "great all over the world, as the honour was bright, "which his country derived from him as a citizen. "Long will Upsal remember the celebrity which it "acquired by the name of Linnæus!"

Linnæus had a good constitution, though often grievously afflicted wth the head ache, and in the latter part of his life with the gout. This great man was of a diminutive stature, his head large, and its hinder part very high. His look was ardent, piercing, and apt to daunt the beholder; and his temper

quick; nevertheless his conduct towards his numerous opponents shews a dignified spirit of forbearance. He disavowed controversy, and seldom replied to the numerous attacks on his doctrine. He however, when attacked by *Siegesbeck*, and some other virulent calumniators, wrote a reply, entitled *Orbis eruditi judicium de Caroli Linnæi scriptis:* and with it gave a memoranda of his life. This Siegesbeck was a brother professor. He laid it down as a firm maxim, that every system must finally rest on its intrinsic merit; and he willingly committed his own to the judgment of posterity.*

Diminutive as was the stature of Linnæus, his mind was of gigantic size. He was possessed of a lively imagination, corrected by a strong judgment, and guided by the laws of system; added to these a most retentive memory, an unremitting industry, and the greatest perseverance in all his pursuits; as is evident from that continued vigour with which he prosecuted the design, that he appears to have formed so early in life, of *totally reforming and fabricating anew the whole science of natural history;* and this he actually performed, and gave to it a degree of perfection before unknown. He had moreover the uncommon felicity of living to see his own structure

* The Massachusetts BOTANIST is far from being disposed to censure any cotemporary writer: but he cannot refrain from remarking, that while some American writers speak in respectful and proper terms of Martyn, Milne, Loefling, and other retailers of botanical knowledge, our *great master Linnæus* is spoken of in a tone of disrespect. Has not Linnæus been to naturalists what Columbus was to Geographers?

raised above all others, notwithstanding every discouragement its author at first laboured under, and the opposition it afterwards met with. Neither has any writer more cautiously avoided that common error of building his own fame on the ruin of another man's. He every where acknowledges the several merits of each author's system; and no man appears to be more sensible of the partial defect of his own.

Linnæus was of a noble mind; and his mind was made better by struggling with adversity. To be poor, and to be at the same time struggling on with some new discovery, or precious improvement, is, in the strict sense of the word, to be in adversity; for one thus circumstanced never fails to have a numerous host against him, chiefly composed of the jealous, the envious, and the knavish. But has adversity no consolations? Is it not the best course of discipline a wise man can endure? He who has never been acquainted with adversity, says Seneca, is ignorant of half the scenes of nature; for prosperity very much obstructs the knowledge of ourselves. And he who was greater than Seneca, I mean Johnson, observes, that, that fortitude, which has to encounter no danger; that prudence, which has surmounted no difficulties; that integrity, which has been attacked by no temptations, can, at best, be considered as gold not yet brought to the test; of which therefore the true value cannot be assigned.

When Linnæus first published his sexual system of botany, he experienced the same treatment which

generally falls to the lot of those who have enlightened the world by the rays of their genius and learning: a few admired and extolled him; others ridiculed him, while some laboured to prove that he was destitute of common sense; and that he wrote about that which he did not himself understand. That those rivals who dwelt in the same city should view him with an "*evil eye*," that is, an eye made *sore*, by reason of his extraordinary light, which gave it pain, and which they therefore sought to veil, or put out, is not to be wondered at; but that it should give pain to the eye of Count Buffon, and other celebrated men in France is indeed pitiful. In England, and in some other parts of Europe they received the new doctrine with all that caution which became an enlightened age and people; and Nature was traced experimentally through all her operations in the vegetable economy before the sexual doctrine of Linnæus was acknowledged. It is now as firmly established as any law in nature.

Linnæus not only silenced all gainsayers; but had the uncommon good fortune of living to see the fruits of his own great exertions. He lived to see Natural History raise herself in his native country under his culture, and the fostering hand of the government to a state of perfection unknown elsewhere. He lived to see it diffused thence all over the civilized world. He lived to see the sovereigns of Europe establishing societies for cultivating that science to which he had so long devoted his head and heart. And when he ceased to live, the philoso-

pher saw with grateful admiration the sovereign of Sweden pronouncing the eulogy of Linnæus from his throne, and lamenting his death as a public calamity!

Linnæus was well acquainted with the art of recommending science by elegance of language, and embellishing philosophy with polite literature. No man of the age had a more happy command of the Latin tongue than Linnæus; and no man ever applied it more successfully to his purpose, or gave to description such copiousness, precision, and elegance. The glaring paint of Buffon suffers in comparison with the pleasing but solid manner of Linnæus; for this prince of naturalists possessed the sound, distinct, and comprehensive knowledge of Bacon, with all the beautiful light graces and embellishments of Addison. He knew, that those authors who would find many readers, and those lecturers who would secure attentive hearers, must please, whilst they instruct.

Physiology owes much to Linnæus. But *Pathology*, the foundation of the whole medical art, and of all medical theory, has been more improved by Linnæus in his *Calvis Medicinæ*, of eight pages only, which is a master piece in its way, and one of the greatest treasures in medicine, than by a hundred authors and books in folio.

The *Materia Medica* was in a confused state, and many articles were imperfectly known, until Linnæus reformed it. He was the first who said that all our principal medicines are *poisons;* and that phy-

sicians ought not to condemn poisons, but to use them, as surgeons do their knives, cautiously.

Besides medals there are several monuments erected to the honour of this great naturalist in the gardens of his admirers in different places in Europe. In 1778, Dr. Hope laid the foundation stone of a monument, since finished, in the botanic garden at Edinburgh.

The Botanist possessing an original letter, written by the son of this great man to the celebrated Dr. *Fothergill*, giving an account of his father's death, conceives that its insertion here will be generally pleasing to the learned part of his readers, and particularly to every American naturalist.

CAROLUS a LINNE, *Filius nobilissimo & experientissimo Medicinæ & Botanices Professor Upsaliæ, Dno. Doctori* FOTHERGILL, *S. P. D.*

LENTO per biennium morbo intabescens, omnibus tandem prostratris corporis viribus, vitæ statione septuagenarius: decessit pater opt. *Archiater & Eques de stella polari* CAROLUS a LINNE d. IV. Iduum Jan. MDCCLXXVIII.

Hunc mihi totique domui Ejus luctuosum casum, exigente id non sincera minus in TE observantia mea, ac, quæ beate defunctum TIBI junxit, amicitiæ necessitudine obsequiossisime significandum putavi.

Ut vero, qui TE coluit, viri post funera beati memoriæ faveas, quaque ille, dum in vivis erat, apud TE valuit, gratiæ hæredem constituas Filium, quo decet verborum honore contendo, Deum immortalem precaturus, velit, in singulare scientiarum decus & emolumentum, TIBI, Vir Nobilissime extentum omnique felicitatis genere refertum vitæ spatium concedere. Dabam Upsaliæ d. X. Cal. Febr. MDCCLXXVIII.

But now this father, and this son lie buried together, under a marble monument, in the cathedral of Stockholm, bearing this inscription,

OSSA
CAROLI A LINNE
EQUITIS AURATI.
MARITO OPTIMO
FILIO UNICO
CAROLO A LINNE
PATRIS SUCCESSORI
ET
SIBI
SARA ELIZABETA MORÆA.

Dr. Smith, President of the Linnæan Society in London, is now in possession of the Herbarium, the Library and the manuscripts of Linnæus.

THE BOTANIST.

N°. IX.

In our last number we gave a biographical sketch of that learned physician, and prince of naturalists, Linnæus. This great man was not more distinguished for a profound knowledge of natural history, than remarkable for a happy mode of displaying it. He availed himself, says one of his biographers, of the advantages of an uncommon share of eloquence, and an animated style to display in a lively and convincing manner, the relation which this study has to the public good; and to encourage and allure youth into its pursuits, by opening its manifold sources of pleasure to their view, and to show them how greatly this agreeable employment would add both to their comfort and their profit. Nevertheless this good man had to contend all his life with secret and open enemies. We are told by one of the greatest men of our age and country, "that the heroic characters of every age and nation have generally lived in a continual struggle with a great portion of mankind; that their principal merit often consists in the firmness, perseverance, and fortitude with which they bear up against the torrent of opposition from their fellow mortals; that the tempest of obloquy rages against them not only through their lives, but

often redoubles its fury for centuries after their earthly career is closed.

> Sure fate of all; beneath whose rising ray
> Each star of meaner merit fades away!
> Oppress'd we feel the beam directly beat;
> Those suns of glory please not till they set. *Pope.*

Nor are the malignant passions of mankind, which are always arrayed in such formidable strength against talents and virtue, more destitute of cunning than of violence. They have plausible pretexts, as well as deadly weapons. The best of men are not only often exposed to the worst of imputations; but, from the artifices with which they are propagated, to be robbed of that greatest of all earthly blessings, the good opinion of the virtuous and the wise."* Linnæus had a better fate than most great men; for he silenced his opponents, and lived down all the calumnies of his enemies.

We shall now present our readers with a concise *History of Botany* from the earliest ages, until this Science came finished from the hands of our great master Linnæus.

Βοτάνη in the Greek language means an *herb*, whence is derived botany, which at this day signifies the science relating to vegetables, for which the antients had no name; as it was not in their days erected into a regular science.

Although botany, as a science, may appear to some a study too dull for an exalted and refined genius; yet if we cast our eyes back on the earlier ages, and trace this branch of knowledge down to our own

* Lectures on Rhetoric and Oratory, by the Hon. John Quincy Adams.

times, we shall find that it has been cultivated by those of the brightest parts, and fostered by men of great distinction. We need only mention him who is called by way of pre-eminence "*the wise man.*" Though born to a throne and destined to rule over a powerful people, yet was SOLOMON so captivated with the charms of botany, that he is said in the scriptures to have known plants "*from the cedar of Lebanon to the hyssop that springeth out of the wall;*" and we find in his "book of wisdom," that he not only "*knew the diversities of plants*, but *the virtues of their roots.*"

SOLOMON flourished about 170 years after the siege of Troy, or in the year of the world 2129, and is said to be the first botanist on *our* records of mankind. But on examining the oldest book we have, the Bible, we find an account of a plan for establishing a *Botanical Garden* as early as 899 years before Christ. The account of it is contained in less than three verses in the first book of Kings;—*And it came to pass, after these things, that* NABOTH, *the Jezreelite, had a vineyard, which was in Jezreel, hard by the palace of* AHAB, *king of Samaria. And* AHAB *spake unto* NABOTH, *saying, Give me thy vineyard that I may have it for* A GARDEN OF HERBS, *because it is near to my house. And* NABOTH *said to* AHAB, *God forbid!* But in order to force it from him *they set two sons of Belial to bear witness against him, saying, Thou didst blaspheme God and the king: and they stoned him so that he died.* But divine justice, which forever pursues dis-

honourable and base deeds, avenged the cause of persecuted Naboth; for the dogs in the streets licked up the blood of the two principal contrivers of this plot.

We find no mention of a botanist, from the glorious SOLOMON down to the venerable father of medicine, *Hippocrates*. He gives us the names and virtues of two hundred and thirty four plants, but no description by which we can ascertain what they were. Cotemporary with the father of physic, lived *Cratevas*, who he calls the prince of botanists. A considerable space after him appeared *Theophrastus;* who wrote ten books on plants, of which nine have reached our hands. These merit the highest encomiums.

Theophrastus was a disciple of Aristotle, and flourished in the third century: he may justly be considered as the *father of botany*. He treats of the vegetable life; and the anatomy and construction of plants, and of their origin and propagation. He divides vegetables into seven classes, which division is founded on the generation of plants, their place of growth, their size, as trees and shrubs, their use, and their lactescence, which last circumstance respects every kind of liquor, of whatever colour, that flows in great abundance from them when cut. This golden monument of botany cannot be too strongly recommended to the curious.

The Romans were devoted to Victoria; a deity so adored by that rough people, that they paid little attention to natural history. Pliny says that they were

strangers to botany till Pompey conquered *Mithridates*, the most philosophic king of the age. His observations on the medicinal virtues of plants falling into the hands of Pompey, were, by his orders, translated into Latin. *Dioscorides*, though by birth a Grecian, lived under the Roman empire. He was the next botanist of note after Theophrastus. It is highly probable, that several botanists lived between the time of Theophrastus and Dioscorides, a space of nearly 400 years; yet if we except Antonius Musa, Euphorbius, and Æmilius Macer, who was a soldier, poet, and botanist, and the first who clothed botany in poetry, we find no mention of any one who paid attention to this science. Dioscorides mentions about six hundred plants; four hundred and ten of which he described, together with their medicinal virtues; about five hundred of them are mentioned by the father of botany. Dioscorides arranged plants, from their uses in medicine and domestic economy, into four classes, viz. *aromatics*, *alimentary vegetables*, *medicinal*, and *vinous*; a vague and fallacious distinction.

Pliny, in his immense compilation, called the history of the world, mentions four hundred plants more than are to be found in Dioscorides; and yet he lived but about forty years after him. He, who wishes to see all the natural history of the antients at a glance, may consult Pliny to advantage.

The famous *Galen* flourished about 130 years after Christ. He was, for that day, a great traveller, and might have increased the catalogue of plants;

but he contented himself in descanting on the medicinal virtues of those mentioned by his predecessor.

After the sixth century, learning was almost entirely abolished by the Goths. Whilst a swarm of northern barbarians were destroying taste and learning in the western empire, the Arabians who were followers of the renowned Mahomet, over-ran the eastern. By conquering Greece, they monopolized all the writings of that famous nation. During 400 years there was no attempt to draw from its obscurity the botany of the antients. At length one of the Saracen califs ordered the Greek books on medicine to be translated into Arabic, or their mixed Saracen language; and botany, which is a branch of medicine, attracted their notice. Serapio collected the Greek and Arabian authors, who had written on plants; and after him followed Razis, Avicenna, Averhoes, Actuarius, and several others of less note. They were more attentive to the materia medica in general than to plants in particular. To them we owe the knowledge of sugar, of distilled spirits, of rhubarb, senna, and most of the milder cathartics.

After a dark and dismal period, emphatically styled the barbarous or dark ages, a dawn of light began to to appear, first, in Italy, and from thence, a second time, over the world, when Medicine, and her hand-maid Botany, emerged from the gloom of barbarism; for in 1470 *Theodore Gaza*, a Greek refugee at Rome, resuscitated philosophy by making elegant translations of Aristotle and Theophrastus, who were commented on in the sequel by Scaliger

and Stapel. Dioscorides was likewise translated into pure and beautiful Latin by a Venetian nobleman.

John Parkinson wrote his *Paradisus Terrestris* in 1629. He was apothecary to the king. The history of flowers he gave at great length. In his *Theatrum Botanicum* he has comprehended more species of plants, than were to be found in any history of plants published before his time.

Among public gardens, in which plants were demonstrated by professors, that of Padua is the oldest. It commenced about the year 1530. From that period, professors of botany have been established in almost every school of medicine.

The famous *Cosmo de Medicis* founded a botanic garden at Pisa; and committed it to the care of *Andreas Cæsalpinus*, a celebrated physician, botanist, and anatomist, the father of the botanic system and professor of botany at Padua.

Prosper Alpinus was nearly as eminent in botany as in physic. He made a large and rare collection of plants in Egypt, and afterwards read lectures on botany at Venice.

The famous *Henry the fourth* of France founded the botanic garden at Montpelier in 1598; the care of which has successively been committed to distinguished botanists, who were also physicians.

Francis the first was a great admirer of botany, and a liberal encourager of every plan that could improve and advance it.

Lewis the fourteenth founded a noble garden in the suburbs of St Victoris at Paris, and put it under

the care of *Heroard*, his chief physician, and *Guido Borossæas*, his physician in ordinary.

It is about 150 years since botanic gardens were established in England. Those at Chelsea and Oxford are the most antient. About the same time, botanic gardens were formed in Holland. The garden at Leyden is the most celebrated. The great *Boerhaave* was professor of botany there, at the same time that he filled Europe with his fame as professor of physic.

Prior to this period two illustrious brothers appeared, who alone have done more for the advancement of botany, than all the rest together, who preceded and followed them, until Tournefort. Rare geniusses! says the celebrated Rousseau, whose vast knowledge and solid labours, consecrated to botany, rendered them worthy of that immortality which they have acquired. For, till this part of natural history falls into oblivion, the names of *John* and *Caspar Bauhin* will live along with it in the memory of mankind. Each of these indefatigable men, *par nobile fratrum*, undertook an universal history of plants, and to add to it a *synonymy*, or exact list of the names that every plant bore in all the writers which preceded them.

John nearly completed his undertaking in three volumes folio, but did not live to publish the whole. *Caspar* laboured forty years, but the life of man is too short for the execution of a plan so extensive. Their works are still the guide to all those, who wish to consult antient authors on botany. John

Bauhin was born at Lyons in 1541, and died in 1624. Caspar was born 1560, and died 1624.

After this period, scarcely an author wrote on medicine, but wrote more or less on botany; of these we must not omit *Fuchsius*, who in 1530 published five hundred and ten figures of plants; nor *Rondeletius*, a physician of Montpelier. Nor may we forget *Turner*, a learned English physician, who published the first history of plants in English, with most of the figures of Fuchsius. He gave the names of the plants in Latin, Greek, German, and French, in alphabetical order.

Hyéeronymus Boue, a German, was the first of the moderns who has given a methodical distribution of vegetables. In his history of plants published 1532 he divides the eight hundred species there described, into three classes, founded on their qualities, habit, figure and size; *Clusius* endeavoured soon after to establish the natural distinction of Theophrastus, which was into trees, shrubs, and undershrubs. Others attempted to characterize plants by the roots, stems, and leaves, but all were found insufficient.

THE BOTANIST.

N°. X.

SUCH was the unsettled state of botanical method, when CONRAD GESNER of Switzerland turned his eye to the *flower* and *fruit;* and suggested the *fisrt idea* of a systematic arrangement. It was in 1506 that Gesner proposed to the world his idea of an arrangement from the parts of the flower and fruit. No plan however was established by Gesner upon this principle; he merely suggested the idea; but the application of it was made, twenty years after, by *Cæsalpinus*, a physician and professor of botany at Padua, who thus favoured the world with the *first system* of botany; which occurrence marks the second grand æra in the history of this science.

It might have been expected, that a method, founded like that of Cæsalpinus upon genuine scientific principles, would have been immediately adopted by the learned, and in establishing itself, have totally extirpated those insufficient characters, which during so many ages have disgraced the science. The fact however is, that this system of Cæsalpinus perished almost as soon as it had existence; for with this learned physician died his plan of arrangement; and it was not till nearly a century after, that Dr. *Robert Morison* of Aberdeen, attaching

himself to the principles of Gesner and Cæalpinus, re-established their scientific arrangement upon a solid foundation; and from being only the restorer of a system has been generally celebrated as its founder.

Imperfect as is the mode of distribution by Morison, it has furnished many useful hints to *Ray*, *Tournefort*, and *Linnæus*, those great luminaries of the science, who were not ashamed to acknowledge the obligation.*

Ray proposed his method to the world in 1682. It originally consisted of twenty-five classes; two of which respect trees and shrubs, and the remaining twenty-three herbaceous plants. The distinction into herbs and trees, which Ray's method sets out, acknowledges a different, though not more certain principle, than that of Cæsalpinus and Morison. The

* We mentioned in our last number Dr. *William Turner*, an English physician of singular learning, who had the honour of publishing the first botanical work in the English language. There is a copy of this curious book in the library of the university at Cambridge, bearing this title, *A newe Herbal, wherein the names of herbs in Greke, Latin, Englysh, Dutch, Frenche, and in the Potecaries and Herbaries Latin, with the properties, degrees and natural places of the same, gathered and made by William Turner, Physician unto the Duke of Somersettes Grace* Imprinted at London, anno. 1551.

There are but few books in the English language, printed 250 years ago, executed with more elegance, as it regards the numerous figures of plants as well as the type. There were but one or two botanical books, containing figures of plants, prior to this, in Europe; yet most of Turner's wooden stamps are so well done, that the herbariser would know the plant at first glance.

It is pleasant to compare these first efforts of the graphic art with the splendid performances of *Miller*, *Curtis*, and *Thornton* in London, and those of the FLORA BATAVA, executed under the direction of Messrs. *Sepps* and *Kops*, at Amsterdam.

former, in making this distinction, had an eye with the antients, to the duration of the stem; the latter to its consistence. Ray has called in the buds as an auxiliary, and denominates trees, all such plants as bear buds; herbs, such as bear no buds. The objection, which lies against Linnæus's distinction into shrubs and trees, from the same principle, may be still more powerfully urged in the present case: for though all herbaceous plants rise without buds, all trees are not furnished with them; many of the largest trees in warm climates, and some shrubby plants in every country, being totally devoid of that scaly appearance, which constitutes the essence of a bud.

Ray allots one division to submarine plants, or such as grow at the bottom of the sea, or upon rocks that are surrounded by that element. They are either of a hard stony nature, as the plants termed *lithophyta*, of a substance resembling horn, as the *corallines*, or of a softer herbaceous texture, as the *fuci*, *spunges*, and *sea mosses*. It is curious, that the *corallines* have successively passed through each of the three kingdoms of nature. Some have classed them with the *mineral* kingdom; the greater part have arranged them with *vegetables;* but naturalists have now demonstrated, that they belong to the *animal* kingdom. The animality of this singular tribe of natural bodies was hinted at by *Imperati*, an Italian, in the year 1599, and afterwards by *Peyssonel*, in 1727; but it is to M. *Bernard Jussieu*, a French academician, and Mr. *Ellis* of London, that

we owe decisive facts, and a regular detail, demonstrating, that corallines are ramified animals. Mr. Ellis has, in his natural history of corallines, parcelled them out into their several genera, by means of fixed and invariable characters obvious in their appearance.

Ray's general history of plants contains *eighteen thousand six hundred and fifty-five* species and varieties. His method was followed by *Sir Hans Sloane*, in his natural history of Jamaica; by *Petiver*, in his British herbal; by *Dillenius*, in his synopsis of British plants; and by *Martyn*, in his catalogue of plants that grow in the neighbourhood of Cambridge, in England.

Dr. *Herman*, professor of botany at Leyden, was the first who introduced into Holland a genuine systematic arrangement of plants from the parts of fructification. Morison's method had been left incomplete; and Ray's, though perfect from its first appearance, did not, all at once, attract the attention of the learned; and was indeed for many years studied chiefly in England, the native country of its author. Ray laboured under some disadvantages; he was not a physician, but a divine. The defects of Ray's original method, and its *impracticability*, did not elude the observations of Dr. Herman. He had applied himself with unremitting ardour from his earliest years to the study of plants; had examined with attention every plan of arrangement, and actually undertaken a long and perilous expedition into India, with the sole view of promoting his favourite

science. Herman exhibited such marks of unwearied diligence, that he alone, it is said, reared twice as many plants in the garden at Leyden, as had been introduced by all his predecessors, Bontius, Clutius, Pavius, Clusius, Vortius, Schuylius, and Syenus, put together, in the long space of an hundred and fifty years. Such a man merited the applause of the public, and attained it.

Dr. Herman's method consists of twenty-five classes, which are founded upon the size and duration of plants; the presence or absence of the petals and calyx; the number of capsules, cells, and naked seeds; the substance of the leaves and fruit; the form and consistence of the roots; the situation and disposition of the flowers, leaves, and calyx, and figure of the fruit. The method proposed by Herman excels all, which preceded it, in the uniformity of its classical characters.

The famous *Boerhaave*, the glory of the medical art, was appointed professor of botany at Leyden in 1709. His method was a mixture of Ray's, Herman's and Tournefort's. The submarine and imperfect plants, which find no place in the system of Herman, are borrowed by Boerhaave from Ray. Boerhaave's classes are thirty-four in number, and subdivide themselves into an hundred and four sections, which have for their characters the figure of the leaves, stem, calyx, petals, and seeds; the number of petals, seeds, and capsules; the substance of the leaves; the situation of the flowers, and their difference in point of sex. By this method Boer-

haave arranged six thousand plants, the produce of the botanical garden at Leyden, which he carefully superintended for the space of twenty years, and left to his successor, Mr. Adrien Royen in a much more flourishing state, than he had himself received it.

Botanical writers were disposed to walk in the track of their predecessors. Few had sufficient courage to venture upon an unbeaten path. Morison followed Cæsalpinus; Ray improved upon Morison; Knaut abridged Ray; and Boerhaave makes Herman his guide. *Rivinus*, a professor of physic and botany at Leipsic, was the first, who in 1690, relinquishing the pursuit of affinities, and convinced of the insufficiency of the fruit, set about a method, which would atone by its facility for the want of numerous relations and natural families. A method purely *artificial* appeared to Rivinus the best adapted for the purpose of vegetable arrangement. It rests upon the equality and number of the petals; a system no less admired for its simplicity, than for the regularity and uniformity of its plan.

The method of *Knaut*, *Ludwig*, *Pontedra*, and *Magnolius*, will be presented in a future number in the form of a table, together with several others from Cæsalpinus to Linnæus.

The celebrity of *Tournefort* requires that we should dwell a little on his history and character.

Joseph Pitton de Tournefort was born at Aix in Provence in 1656. He was educated in the Jesuits' college in Aix; and like the great Boerhaave intended for a divine; but like that great man, quitted

divinity for physic. In early life he was nearly as fond of anatomy and chemistry, as of botany. In 1679 he went to Montpelier, where he perfected himself in anatomy and physic. The botanic garden, established in that city by Henry IV. rich as it was, could not satisfy his unbounded curiosity. He ransacked all the tracts of ground within more than ten leagues of Montpelier. Then he explored the Pyrenean mountains and the Alps, and afterwards examined the vegetables in Provence, Languedoc, Dauphiné, and Catalonia. He travelled through Spain and Portugal. He took his degree of doctor in physic in 1698, when he published his *History of the plants which grow about Paris, together with an account of their use in medicine.*

In the year 1700 Dr. Tournefort received an order from the king to travel into Greece, Asia, and Africa, not only to discover plants, but to make observations on natural history in general; upon antient and modern geography; and even upon the customs, religion, and commerce of the people. From this grand tour he brought home *one thousand three hundred and sixty-six* NEW species of plants, most of which ranged themselves under one or other of the six hundred seventy-three genera he had already established; and for all the rest he had only twenty-five genera to create, without being obliged to augment the number of classes: a circumstance, which sufficiently proves the advantage of a system, to which so many foreign and unexpected plants were easily reducible. When Tournefort returned

to Paris he thought of resuming the practice of physic, which he had sacrificed to his botanical expedition; but experience shows us, says his biographer,* that, in every thing depending on the taste of the public, especially affairs of this nature, delays are dangerous. Dr. Tournefort found it difficult to resume his practice. He was at the same time professor of physic; the functions of the academy employed some of his time; the arrangement of his memoirs still more of it. This multiplicity of business affected his health; and, when in this uncomfortable state, he accidentally received a blow on his breast, which in a few months put an end to his active, useful, and honourable life, which happened in Dec. 1708.

The system of Tournefort is too extensive and intricate to allow us to give even an analysis of it. We hope to be able to give an outline of his method in some future number; and shall only observe here, that Tournefort surpassed all his predecessors in supplying a clue to the immense labyrinth, which the vegetable kingdom exhibited to the astonished botanist. He gave the first complete regular arrangement, and cleared the way for one still greater than himself. For in 1735† rose the sun of

* See Hist. de l'Acad. des Sciences, An. 1708.

† The first sketch of Linnæus's system was published in 1735, the last edition of the *Systema Vegetabilium* in 1784; the *Critica Botanica* was published in 1737; the first edition of the *Genera Plantarum* the same year; and the last in 1764; the first edition of the *Species Plantarum* in 1753; the second in 1762 and 1765.

the botanic world, LINNÆUS, of whom we have already spoken; and to whom we shall frequently advert, as the source of light and intelligence.*

THE BOTANIST.

N°. XI.

BOTANICAL GARDENS.

WE asserted in a late number, that the first mention of "*a garden of herbs*" was in the xxi. chap. of the first book of Kings; but prior to this was the garden erected by Solomon. *I made me*, says he, *gardens and orchards, and I planted trees in them of all kinds of fruits. I made me pools of water to water therewith the trees.*

The island of Crete was the physic garden of Rome. The emperors maintained in that island gardeners and herbarists to provide the physicians of Rome with simples. The establishment of professorships gave rise, in modern times, to *Botanical gardens;* a new species of luxury to the botanist.

The first public botanical garden of this sort was that of Padua, established in 1533.

* We have compiled this history of botany from the writings of Linnæus; from the history of the French Acad. of Sciences, from Milne, and J. J. Rousseau.

The utility of these institutions is self-evident. By public gardens medicinal plants are at the command of the teacher in every lesson; the eye and the mind are perpetually gratified with the succession of curious, scarce, and exotic luxuries; here the botanist can compare the doubtful species, and examine them, through all the stages of growth, with those to which they are allied; and all these advantages are accumulated in a thousand objects at the same time.

The first botanic garden in Switzerland was constructed at Zurich, by *Gesner*, in 1560.

The botanic garden at the University of Oxford was founded in 1632 by *Henry, earl of Danby;* who gave for this purpose five acres of ground, erected green-houses and stoves, endowed handsomely the establishment, and planted in it as supervisor *Robart*, a German, who published in 1648 *Catalogus Plantarum Horti medici Oxoniensis*, &c. which contained, if we read rightly, sixteen hundred species.

The botanical garden at Edinburgh was founded by Sir *Andrew Balfour* in 1680; and may be considered as the first introduction of natural history in Scotland. This garden was so successfully cultivated, that it is said to have contained three thousand species of plants, disposed according to Morison's method.

Among those public institutions, which in a singular manner invigorated the spirit of natural history in England, the *Royal Society* claims the most distinguished notice. In its design, as in its pro-

gress, it was the fostering parent, and guardian of natural knowledge. Such was the respectability of this society, both as a body, and in its individuals, that through its means the whole nation may be said to have amply contributed to its aggrandizements. Under the auspices of this illustrious society the anatomy and philosophy of plants were illustrated by *Grew* and *Hales*.

We mention, in connection with the Royal Society, the *Physic Garden at Chelsea*, founded by the company of apothecaries in 1673, but which was not effectually constructed till thirteen years after; so slow and gradual is the progress of such institutions at their commencement.

From the time of *Johnson*,* who was the editor of that celebrated English botanist, *Gerard*, a custom had prevailed among the London apothecaries† to form a society each summer, and make excursions to investigate plants. The *Itinera*, published by Johnson, may be considered as the fruit of such expeditions in his day. After the foundation of Chelsea garden this laudable practice was fixed to stated periods, and put under regulations, the herbarizing being now distinguished into private and general.

* *Johnson* received a degree of M. D. at Oxford in 1643; the year following he was killed in a desperate action with the parliamentary troops. He was lieutenant-colonel in Sir Marmaduke Rawdon's regiment. Botany owes much to this accomplished scholar and soldier.

† In England an apothecary is not, as with us, a vender of drugs; but a practitioner of physic and surgery; and differs principally from a physician in not having taken a degree in medicine.

They first begin on the second Tuesday in April; and are held monthly on the same day till September inclusively, in some of the villages in the immediate neighbourhood of London. These are for the benefit of pupils. At the end of the season the premium of *Hudson's Flora Anglica* is presented to the young man, who has been the most successful in discovering and investigating the greatest number of plants. The general herbarization is annually in July; when the demonstrator and others of the court of assistants belonging to the company make an excursion to a considerable distance from the city; collect the scarce plants, and dine together near London.

This institution at Chelsea was rendered more stable, and received permanency from the liberality of Sir *Hans Sloane;* who in 1721 gave four acres of ground to the company, on condition, that the demonstrator should, in the name of the company, deliver to the Royal Society fifty new plants, till the number should amount to *two thousand;* all specifically different from each other; the list of which was published yearly in the *Philosophical Transactions.* The first was printed in 1722, and the catalogues have been continued till 1773; at which time the number of two thousand five hundred and fifty was completed. These specimens are duly preserved in the archives of the society, for the inspection of the curious.

Under excellent superintendants *Chelsea Garden* has flourished; having been excelled perhaps by no public institution of the kind in Europe, for the number of curious exotics it contains. Of this *Miller's Dictionary* affords sufficient proofs. In justice to the memory of those, who filled the place of lecturers and demonstrators in Chelsea garden, we recite the names of the following gentlemen. They were all practitioners in physic.

Isaac Rand	from 1722	to 1729
Joseph Miller	1740	1746
John Wilmer	1747	1767
William Hudson	1765	1769
Stanesby Alchhorne	1770	1772
William Curtis*	1773 to his death.	

Soon after the restoration of Charles II. a growing taste for the cultivation of exotics sprung up among the great and opulent in England. *Archibald, Duke of Argyle*, was one of the first, who was conspicuous for the introduction of foreign trees and shrubs. *Evelyn*, both by his writings and example, encouraged the same taste; and the royal gardens at Hampton court were made rich in fine plants. Dr. *Compton, Bishop of London*, had a garden richly stored with plants at Fulham; and many private gentlemen vied with each other in these elegant and

* The Botanist cannot omit here a tribute of respect to his departed friend, *Curtis*, under whose tuition he herbarized in the environs of London two years in succession. His *Flora Londinensis*, replete with learning and taste, is a picture of the man.

useful amusements. The growing commerce of the British nation, and the more frequent intercourse with Holland, where immense collections from the Dutch colonies had been made, rendered the gratifications more easily attainable, than before, and from these happy coincidences, science in general reaped great benefit.

We ought not to pass over some eminent British *gardeners*, who, while others were increasing the catalogue of plants and giving accurate descriptions of exotics, were equally serviceable to real science in the art of culture. *Fairchilds*, *Knowlton*, *Gordon*, *Miller*, and *Forsythe*, have distinguished themselves in the useful and healthy* exercise of horticulture. In the xxxii. vol. of Philosophical Transactions there is a paper by Fairchilds on the motion of the sap. Knowlton was gardener to the Earl of Burlington, and was much noticed by Sir Hans Sloane. Several of his communications are to be found in the Philosophical Transactions. He died in 1782, aged *ninety*. Gordon was eminent for his successful cultivation of exotics. He maintained a correspondence with Linnæus, and has a plant named after him.

The extraordinary merit of *Philip Miller* demands a more particular notice, as he raised himself to an eminence never before equalled by a gardener. He was born in 1691. His father was gardener to

* Cadogan says, he never knew a gardener afflicted with the gout, unless he was notoriously intemperate.

the company of apothecaries at Chelsea; and he himself succeeded in that station in 1722. It is not uncommon to give the name of botanist to any man, who can recite by name the plants of his garden; but Mr. Miller rose much above this ordinary attainment. He added to the knowledge of the theory and practice of gardening that of the structure and character of plants, and was early and practically versed in the methods of Ray and Tournefort. To his superior skill in his art we owe the culture and preservation of a variety of fine plants, which, in less skilful hands, would have failed to adorn the conservatories of the curious.

Mr. Miller maintained an extensive correspondence with persons in distant parts of the globe, from the Cape of Good Hope to Siberia. He was emphatically styled by foreigners *Hortulanorum Princeps*. His *Gardener's Dictionary* was first published in folio in 1731, and has been translated into various languages; the reception it has every where met with is a sufficient proof of its superiority. Linnæus said of his dictionary, *Non erit Lexicon Hortulanorum, sed Botanicorum*. He was not only a member of the Royal Society, but of its council. This "prince of gardeners" died in 1771, aged eighty years. A plant has been dedicated to his honour.*

We shall close this number with an account of the botanical garden reared by that celebrated physi-

* The *Milleria* was a new genus, discovered at Panama, by Houston.

cian and naturalist, Dr. FOTHERGILL, at the village of Upton, six miles from the royal exchange, London. The wall of this garden enclosed above five acres of land; a piece of water, or winding canal forming it into two divisions. A glass door from the winter parlour gave entrance to a long range of hot and green-house apartments, of nearly two hundred feet extent, containing upward of three thousand four hundred distinct species of exotics, whose foliage wore a perpetual verdure, and formed a beautiful and striking contrast in the winter to the shrivelled natives in the cold, open air. In the open ground, with the returning spring, about three thousand distinct species of plants and shrubs vied in verdure with the natives of Asia and Africa. It was in this spot, where a perpetual spring was realized, that the elegant proprietor sometimes retired to contemplate the vegetable productions of the four quarters of the globe united within his domain, where the spheres seemed transported, and the arctic circle joined to the equator.*

But let us have recourse to the description of this celebrated garden, as given by the President of the Royal Society, who, besides circumnavigating the globe, was acquainted with most of the botanical gardens of Europe.

"At an expense, says Sir Joseph Banks, seldom undertaken by an individual, and with an ardour that was visible in the whole of his conduct, *Dr. Fothergill*

* See Lettsom's life and writings of Dr. Fothergill, Vol. III.

procured, from all parts of the world, a great number of the rarest plants, and protected them in the amplest buildings, *which this or any other country has seen.* He liberally proposed rewards to those, whose circumstances and situations in life gave them opportunities of bringing hither plants, which might be ornamental, and probably useful to this country or her colonies; and liberally paid these rewards to all that served him. If the troubles of war had permitted, we should have had the cortex winteranus introduced by his means into this country; and also the bread-fruit, and mangasteen, into the West-Indies. For each of these, and many others, he had fixed a proper premium. In conjunction with the *Earl of Tankerville*, Dr. *Pitcairn*, and myself, Dr. Fothergill sent over a person to Africa, who is still employed upon the coast of that country, for the purpose of collecting plants.

"Those whose gratitude for restored health prompted them to do what was acceptable to their benefactor, were always informed by him, that presents of rare plants chiefly attracted his attention and would be more acceptable to him, than the most generous fees. How many unhappy men, enervated by the effects of hot climates, where their connexions had placed them, found health on their return, at that cheap purchase!

"What an infinite number of plants he obtained by these means, the large collection of drawings he left behind him will amply testify; and that they were equalled by nothing but royal munificence, at

this time largely bestowed upon the botanic garden at *Kew*. In my opinion, *no other garden in Europe, royal or of a subject, had near so many scarce and valuable plants.*

"That science might not suffer a loss, when a plant he had cultivated should die, he liberally paid the best artist the country afforded to draw the new ones as they came to perfection; and so numerous were they at last, that he found it necessary to employ more artists than one, in order to keep pace with their increase. His garden was known all over Europe, and foreigners of all ranks asked, when they came hither, permission to see it; of which Dr. Solander and myself are sufficient witnesses, from the many applications, that have been made through us for that permissson."*

An *Hortus Siccus*, *Herbarium*,† or collection of dried plants, is often a pleasant auxiliary to the botanist. Sir Hans Sloane's collection of dried plants, now deposited in the British Museum, contains about eight thousand species; but Dr. Sherard's is a vast deal larger. Tournefort's collection, in France, contains four thousand species; that of Valiant twelve thousand; and those of Jussieu and Adanson contain each about ten thousand species and varieties. These, says

* See Sir Joseph Banks's note to Dr. Thompson's memoirs of Dr. Fothergill.

† Linnæus has described a chest capable of containing six thousand dried plants, in which the divisions or cells correspond to the number of classes in the sexual method, and differ in dimensions according to the greater, or less number of species in each class.

Dr. Milne, are gardens which flourish when vegetation is no more; which please by the surprising variety which they display, and are rendered eminently useful by the facility with which the natural history of countries the most remote from each other, is, by such means, acquired.*

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N°. XII.

We are disposed to devote a number to the memory of

MARK CATESBY,

principally on account of his unwearied diligence in collecting; and of his taste and elegance in describing plants, quadrupeds, birds, amphibia, fishes, and insects of the southern parts of these United States; and because his splendid volumes have been long known and admired in America; especially by those who have visited the library of our University.

* We asserted in our last number, that *Turner's Herbal* was the first botanical work printed in the English language. It was the first original work; but in 1516 Peter Traveris printed the first English book on botany, bearing this title—"The GRETE HERBAL whiche geveth parfyct "knowledge and understandyng of all manner of Herbes & there gra- "cyous vertues whiche God hathe ordeyned for our prosperous welfare "and helth, for they hele and cure all manner of dyseases & seknesses that

Mark Catesby was, says Dr. Pulteney (to whom we are indebted for this article) one of those men, whom a passion for natural history very early allured from the interesting pursuits of life; and it led him at length to cross the Atlantic, that he might read the volume of nature in a country but imperfectly explored, and where her beauties were displayed in a more extended and magnificent scale, than the narrow bounds of his native country exhibited. It is but too true, that the world at large will forever treat with ridicule and disdain that man, who, thus deserting the paths that lead to riches, to perferment, or to honour, gives himself up to what are commonly deemed unimportant and trifling occupations. Few will give him credit for that secret satisfaction, for that inexhaustible pleasure, which the investigation of nature, in all her objects, incessantly holds forth to his mind; or believe, that such employment can possibly compensate for the solid treasures of gain.

Mark Catesby was born about the latter end of 1679, or the beginning of the next year. He acquaints us himself, that he had very early a propensity to the study of nature; and that his wish for higher gratifications in this way, first led him to

"fall or misfortune to all manner of creatoures of God created, practysed "by many expert & wyse masters, as Avicenna &c. &c. prented by me "Peter Traveris 1516," &c. &c. This book was evidently fabricated from a German work, entitled *The Book of Nature;* the first book ever printed on natural history, viz between 1475 and 1478; and from the *Hortis sanitatis*, printed at Paris in 1499.

We have compiled this number chiefly from Dr. Pulteney's Biographical Sketches, and the works mentioned in a note to our last.

London, which he emphatically styles "the centre of science;" and afterwards impelled him to seek further sources, in distant parts of the globe. The residence of some relations in Virginia favoured his design; and he went to that country in 1712, where he staid seven years, admiring, and collecting the various productions of the country, without having laid any direct plan for the work he afterwards accomplished. During this residence, he communicated seeds and specimens of plants, both dried, and in a growing state, to Mr. Dale, of Braintree, in Essex; and, some of his observations on the country, being communicated by this means to Dr. William Sherard, procured him the friendship and patronage of that gentleman. On his return to England, 1719, he was encouraged by the assistance of several of the nobility, of Sir Hans Sloane, Dr. Sherard, and other naturalists, whose names he has recorded, to return to America, with the professed design of describing, delineating, and painting the more curious objects of nature. Carolina was fixed on, as the place of his residence, where he arrived in May, 1722. He first examined the lower parts of the country, making excursions from *Charleston;* and afterwards sojourned, for sometime, among the Indians in the mountainous regions at and about Fort Moore. He then extended his researches through Georgia and Florida; and having spent nearly three years on the continent, he visited the Bahama Islands, taking his residence in the Isle of Providence; carrying on his plan, and particularly

making collections of fishes, and submarine productions.

On his return to England, in the year 1726, his labours met with the approbation of his patrons. Catesby made himself master of the art of etching; and, retiring to Hoxton, employed himself in carrying on his great work, which he published in numbers of twenty plants each. The first appeared in the latter end of the year 1730; and the first volume, consisting of one hundred plates, was finished in 1732: the second, in 1743; and the appendix, of twenty plates, in the year 1748.

A regular account of each number, written by Dr. Cromwell Mortimer, secretary of the Royal Society, was laid before the society as it appeared, and printed in the Philososophical Transactions; in which the Doctor has sometimes interspersed illustrative observations.*

The whole work† bears the following title: "The "Natural History of *Carolina*, *Florida*, and the *Ba*- "*hama* Islands; containing the figures of birds, "beasts, fishes, serpents, insects, and plants; par- "ticularly the forest trees, shrubs and plants, not "hitherto described, or very incorrectly figured by "Authors; together with their descriptions, in "French and English. To which are added, ob-

* See No. 415. 420. 426. for Vol. I.; No. 432. 438. 441. 449. 484. for Vol II.; and No. 486 for the Appendix.

† Tom. I. 1731. pp. 100. tab. 100. Tom II 1743. pp. 100. tab. 100 Account of Carolina, &c. pp. 44. Appendix, pp. 20. tab. 20. Fol. imperial, fig. 407.

"servations on the air, soil, and waters: with re-
"marks upon agriculture, grain, pulse, roots. To
"the whole is prefixed a new and correct map of
"the countries treated of." By MARK CATESBY, F. R. S.

The number of subjects described and figured in this work stands as below:

Plants - - -	171
Quadrupeds - -	9
Birds - - -	111
Amphibia - - -	33
Fishes - - -	46
Insects - - -	31

In this splendid performance, the curious are gratified with the figures of many of the most beautiful trees, shrubs, and herbaceous plants, that adorn the gardens of the present time. Many also of the most useful in the arts, and conveniences of life, and several of those used in medicine, are here for the first time exhibited in the true proportion, and natural colours. It is only to be regretted, that, in this work, a separate exhibition of the flower in all its parts should be wanting; in defect of which, several curious articles have not been ascertained. It is a requisite of modern date, and without it, every figure, especially of a new species, must be deemed imperfect.

Most of the plates of plants exibit also some subject of the animal kingdom. To these my plan does

not extend; but I will in the note,* enumerate some of the most remarkable of the vegetable class. As Catesby etched all the figures himself, from his own paintings, and the coloured copies were at first done under his own inspection, and wherever it was possible, every subject in its natural size, this work was the most splendid of its kind that England had ever produced. I do not know that it had been equalled on the continent, unless by that of Madam *Merian*, which, however, falls greatly short in extent. Seventy-two plates of Catesby's work were copied by the Nuremberg artists, and published in 1750. His "Observations on *Carolina*, &c." were separately printed in folio, at the same place, in 1767.

* I. Of those used in food or medicine, I select the following: The Chinkapin, *Fagus pumila*; the nuts of which are preferred to chesnuts, and stored by the Indians for winter food. The live Oak, *Quercus Phellos* β. of which the acorns yield an oil not inferior to that of almonds. The Snake-root, *Aristolochia Virginiana*, well known in medicine. The May-apple, *Podophyllum pelatum*; used as ipecaquanha in Carolina. The Hiccory tree, *Juglans alba*; the nuts afford excellent winter provision among the Indians, and yield fine oil; the young wood preferred for hoops, and the old for fire-wood. The China root of Carolina, *Smilax Tamonides*. Sassafras-tree, *Laurus Sassafras*; used in Virginia for intermittents. The Cocco, and Tyre, *Arum Colocasia*; of which the roots are eaten by the negroes, after destroying the acrimony by boiling. Ilathera Bark, *Croton Cascarilla*. Laurel-leaved Canella, *Canella alba*; well known in the shops, and used as Winter's bark. The Cassena, or Yapon of the Indians, *Prinos glaber*; in great repute as a restorative. The Virginian Potatoe or Battatas, *Convolvulus Battatas*; of general use as food among whites as well as negroes. Marsh Custard Apple, *Annona palustris*. Indian Pink, *Spigelia marilandica*, of the shops. Rice Plant, *Oryza sativa*. Netted Custard Apple, *Annona reticulata*. Wild Pine, *Tillandsia polystachia*; a parasitical plant, remarkable for holding a large quantity of water in the hollow of the

Catesby was the author of a paper, printed in the forty-fourth volume of the Philosophical Transactions, p. 435, "On Birds of Passage;" in which, in opposition to the opinion that birds lie torpid in caverns, and at the bottom of waters, he produces a variety of reasons, and several facts, which his residence in America offered, in support of their migration in search of proper food. His voyages across the Atlantic, had taught him the ability of these wanderers to take long flights. He mentions, in another place, his having seen Hawks, Swallows, and a species of Owl, in twenty-six degrees of north latitude, at the distance of six hundred leagues from land. He shows, that birds before unknown to the

leaves. Mangrove Grape-tree, *Coccoloba uvifera*. Cacao, or Chocolate-tree, *Theobroma Cacao*. Vanelloe, *Epidendrum vanilla*. Cashew Nut, *Anacardium occidentale*. Ginseng, *Panax quinquefolium*; the famous Ninsin of the Chinese.

II. Of such as more immediately respect the common conveniencies of life, are, The Cypress of America, *Cupressus disticha*; the tallest and largest of the American trees, nine or ten feet in diameter at the ground, and sixty or seventy high, affording a light but excellent timber. The purple Bind-weed of Carolina, said to be one of the plants the Indians use to guard against the venom of the rattlesnake. The water Tupelo, *Nyssa aquatica*; the root supplies the place of corks. The Red Bay, *Laurus Borbonia*; the wood excellent for cabinets, and beautiful as sattin-wood. Candle-berry Myrtle, *Myrica cerifera*; the green wax boiled from the berries with one-fourth of tallow, forms candles which burn long, and yield a grateful smell. Soap-wood, *Sapindus saponaria*; the bark and leaves beaten in a mortar, produce a lather used as soap. Glaucous *Mimosa*; used as sattin-wood. Brasiletto wood, *Cæsalpinia Brasiliensis*; a well known die. The Mangrove-tree *Rizophora Mangle*; forming almost impenetrable woods, the recesses of turtle, fishes, and of young alligators. The sweet Gum-tree, *Liquidambar styraciflua*; yielding a fragrant gum, like the Tolu

country, find their way annually into various parts of North America, since the introduction of several kinds of grain; of this the Rice-bird, *Emberiza orizivora*, and the white faced Duck, *Anas discors*, are, among others, instances too sufficiently known and felt by the inhabitants.

Catesby was elected a Fellow of the Royal Society soon after his second return from America, and lived in acquaintance and friendship with many of the most respectable members of that body; being "greatly esteemed for his modesty, ingenuity, and upright behaviour."

Before his death, he removed from Hoxton to Fulham, and afterwards to London; and died at his

Balsam; the wood adapted to cabinet-making. Logwood, *Hæmatoxylon campechianum*. Mahogany-tree, *Swietenia Mahagoni*.

III. Of the ornamental kind, are, The Dogwood-tree, *Cornus florida*; singular for the gradual growth of the petals, which, after the opening of the flower, expand from the breadth of a sixpence to that of a man's hand. The sweet flowering Bay, *Magnolia glauca*. The blue Trumpet-flower, *Bignonia cærulea*. Loblolly Bay, *Gordonia Lasianthus*. Carolina All-spice, *Calycanthus floridus*. Tulip-tree, *Liriodendron Tulipifera*. Catalpa-tree. *Bignonia Catalpa*; unknown in Carolina, till Catesby brought it from the remoter inland parts. Sessile flowered *Trillium*. Viscous *Azalea*. Small ash-leaved Trumpet-flower, *Bignonia radicans*. The Fringe-tree, *Chionanthus Virginica*. Broad-leaved Sea-side Laurel, *Xylophylla latifolia*. Willow-leaved Bay, *Laurus æstivalis*. American *Callicarpa*. Herbaceous Coral-tree, *Erythrina herbacea*. Yellow Martagon Lily, *Lilium superbum*. Philadelphian, or red Martagon Lily, *Lilium Philadelphicum*. Purple *Rudbeckia*. Laurel-leaved Magnolia, *Magnolia grandiflora*; the most superb fragrant flowering tree that ornaments our gardens. Yellow, and purple Side-saddle Flower; *Sarracenia flava, purpurea*. Umbrella Magnolia, *Magnolia tripetala*. Climbing, or four-leaved Trumpet-flower; *Bignonia capreolata*. Lime-leaved *Hibiscus*. Red *Plumeria*. White *Plumeria*. Broad-leaved

house behind St. Luke's church, in Old-Street, Dec. 23, 1749, aged 70, leaving a widow and two children.

His work has been re-published in 1754 and 1771. To the last edition a Linnæan index has been annexed; but it is by no means so copious or perfect as a work of such merit and magnificence demands."*

THE BOTANIST.

N°. XIII.

I HAVE *always thought it possible to be a very great botanist*, says the celebrated Rosseau, *without knowing so much as one plant by name.*† He nevertheless exhorts his pupil to pass from his closet to the gardens and fields, to study the sacred scriptures

Kalmia. Balsam-tree, *Clusia rosea.* Virginian Cowslip, *Dodecatheon Meadia.* Carolina *Pancratium Lilium Canadense.* Atamasco Lily, *Amaryllis atamasco.* Common *Stuartia Mulacodendron.* Blue Magnolia, *Magnolia acuminata. Rhododendron maximum.* And finally, the Lily-thorn, or CATESBÆA *spinosa.* Dr. GRONOVIUS called by the name of *Catesbea*, a thorny shrub of the *Tetrandrous* class, bearing a long trumpet-shaped flower, succeeded by a yellow berry, which Catesby first discovered in the Isle of Providence, and sent to Europe in the year 1726.

* From Historical and Biographical Sketches of the Progress of Botany, by R. Pulteney, M. D.

† See J. J. Rosseau's "Letters on the Elements of Botany," translated by Martyn.

of nature, instead of books written by men. This famous Genevan had doubtless seen persons, who bestowed all their attention on the nomenclature and classification of vegetables, and thought themselves botanists. The celebrated *J. Hunter** knew not the names of every individual in the armies of Britain; nor the discriminating mark of each company in each and every regiment; yet he knew most accurately the anatomy and physiology of every individual.

One universal language should be adopted by botanists; and it is important that it should be well understood; but it is absurd to make this the primary object. If the study of plants do not lead to a knowledge of their uses in rural enconomy; and to their medicinal virtues, the attention to the aspect and names of plants is of very litte importance to the public.† Before the Spanish overran Mexico, *Montezuma* transplanted innumerable vegetables from the woods and fields into his royal garden; and it was the business of his physicians to investigate and announce the medicinal virtues of his vast collection. Would it not be well, if the philosophers of the north should imitate the wise example of these more than half civilized people of the south?

The first step we should take towards perfecting the science of botany in New-England is to trans-

* Surgeon-General of the British army.

† It appears from the preceding history, that every professor of botany was a *medical* man.

plant vegetables from our woods, bogs, fields, and, if possible, marshes, into one garden; and then attempt the naturalization of tropical and other exotics. We must not expect to have a garden in which every plant of every country will prosper, or even grow. To effect this we must imagine a garden planted on a mountain directly under the equator, and gradually sloping to the height of more than two miles above the level of the ocean. There every plant of every climate would grow. *Alexander de Homboldt*, a Prussian gentleman, has given us some very interesting facts to this purpose, collected within a few years past, in the equatorial region. The vast range of elevation, from the shores of the Atlantic to the heights of the Andes, affords every possible degree of temperature, and exhibits all the diversity of the vegetable tribes. This distinguished traveller represents the different kinds of plants as following each other in a regular succession up the mountains.

We are told that the inhabitants of New-Spain distinguish the cultivated part of the country into three zones, 1. The *tierras calientes*, or warm grounds, which never rising above one thousand feet above the sea, have a heat of eighty degrees, and yield abundantly, sugar, indigo, cotton, and plantains or bananas. 2. The tierras *templades*, or temperate grounds, which lying on the declivity of the great ridge, at an altitude, from four to five thousand feet, enjoy a mild, vernal temperature, of sixty-eight, or seventy degrees, that seldom varies

ten degrees through the whole year. 3. The *tierras frias* or cold grounds, having an elevation of eight thousand feet, and comprehending the high plains, or table land, such as that of Mexico, of which the temperature is generally under sixty-three degrees, and never exceeds seventy degrees.*

The following account of the succession of plants from the low grounds up to the boundary of perpetual congelation, as marked on the Andes, we esteem both curious and instructive. They are the remarks of Humboldt as given to the English reader by the Edinburgh Review for 1810.

"Under the equator, from the coast to the height of three thousand feet, grow the *scitamineæ* of Jussieu,—the palms, the sensitive plants, and the most odoriferous of the liliaceous tribe. In that sultry zone, where vegetation wantons in the rankest luxuriance, appear likewise the *theophrasta*, the *hymenæa*, the *cecropia peltata*, the *allionia*, the *conocarpus*, the *convolvulus littoralis*, the *cactus pereskia*, the *sesuvium*, *portulacastrum*, the *toluifera balsamum*, and *cusparia febrifuga*, or the *quinquina* of Carony. Between three thousand and six thousand feet of elevation, occur the *melastomæ*, the *clusiu alba*, the *prunus occidentalis*, the *ficus*, the *moræa*, the *calicarpa*, the *acrosticum*, the *solanum*, the *dolichos croton*, and the *passiflora tomentosa*. Above those limits, the sensitive plant ceases to appear. The tree-ferns range from the height of fifteen hundred to

* From the Edingbugh Review, April, 1810.

that of five thousand feet. The tracts which have an elevation from six to nine thousand feet, and enjoy a mild temperature, varying between thirty-four and seventy-two degrees, produce the *fuchsiæ*, the *lobeliæ*, the *styrax*, the *tropœolum*, the *begonia*, and the *columella*. Towards the upper part of that zone, the *acæna*, the *dichondra*, the *nierembergia*, the *hydrocotile*, the *nerteria*, and the *alchemilla*, cover the surface with a fine herbage. This is the region of the oak, or the *quercus granatensis*, which annually sheds its leaves, and, from an elevation of nine thousand two hundred feet, never descends near the equator below that of five thousand five hundred feet, though it occurs, under the parallel of Mexico, at the height of only two thousand six hundred and twenty feet. The *ceroxylon andicola*, or wax-palm, whose trunk is one hundred and eighty feet high, grows on the mountains of Quindiu, from six to nine thousand feet above the sea. Beyond this limit of nine thousand feet, the larger trees of every kind cease to appear. Some dwarfish pines, indeed, rise to near thirteen thousand feet. The several species of the *cinchona*, which furnishes the salutary Peruvian bark, are scattered along the chain of the Andes, over an extent of two thousand miles, at an elevation from two thousand three hundred to nine thousand five hundred feet, and therefore exposed to great variety of climate. The *lancifolia* and *cordifolia* prefer the plains; the *oblongifolia* and *longiflora* occur somewhat higher; but the noted *quinquina* of Loxa, and which Humboldt proposes to

name the *cinchona condaminea*, grows at heights from six thousand two hundred and fifty to eight thousand feet, where the mean temperature varies between fifty-nine and sixty-two degrees, on a bottom of micaceous chist in the woods of Caxanuma and Uritucinga. This precious shrub forms one continued forest on the eastern declivity of the Andes, as far as the province of Jaen, and the hills above the river Amazons. Bark of a similar quality is thus obtained from very distinct kinds of the *cinchona*; in the same manner as the *caoutchouc*, or common elastic gum, is procured from the inspissated juice of a variety of different vegetables—from the ficus, the *hevea*, the *lobelia*, the *castilloa*, and several species of the *euphorbium*. The *wintera* and *escallonia* occur at an altitude from nine thousand two hundred to ten thousand eight hundred feet, and form scrubby bushes in the cold and moist climate at the *paramos*. Above the height of ten thousand five hundred feet, the arborescent vegetables disappear. The alpine plants occupy an elevation from six thousand five hundred to thirteen thousand five hundred feet: There grow the gentians, the *stælina*, and the *espeletia frailexon*, whose hairy leaves often afford cover to the shivering Indians, when benighted in those upland regions. The grasses appear at a height from thirteen thousand five hundred to fifteen thousand one hundred feet. In this zone, where snow falls at times, the *jarava*, and a multitude of new species of *panicum agrostis*, *avena*, and *dactylis*, cover the soil with a yellow carpet, which the in-

habitants call *pajonal*. From the height of about fifteen hundred feet, to the boundary of perpetual congelation, the only plants visible are the linchens which cover the face of the rocks, and seem even to penetrate under the snow.

It is a most curious fact, that those plants which seem to constitute the natural riches of the equatorial regions, are never found growing spontaneously. The *carica papaya*, the *jatropha manihot*, or cassava, the plantain and maize, from which the native Americans drew their principal subsistence, were no where seen by Humboldt in the wild state; nor could he discover the potatoe, though this valuable root is, along with the *chenopodium quinoa*, cultivated in the high country of New Grenada. In the lower grounds between the tropics, the natives raise cassava, cacoa, maize, and plantains. It is the region of the *mammea*, of oranges, pine-apples, and the most delicious fruits. The Europeans have introduced indigo, sugar, cotton, and coffee, which they cultivate to near the height of five thousand feet above the sea, chiefly by the labour of negro slaves. Indigo and cacao require great heat; but cotton and coffee will grow at a considerable elevation; and sugar is cultivated even with success, in the temperate parts of Quito. This is the habitation of the *cerealia*, or bread-corn. The introduction of wheat into New Spain, is traced to three or four grains which a negro servant of Cortez picked out from among the stores of rice that had been sent from Europe, for subsisting the troops. The monks

of Quito still preserve, as a precious relic, the earthen jar in which Father Rixi of Ghent gathered the first crop, from a spot of ground cleared away in front of the convent. Wheat, under the equator will seldom form an ear below the elevation of four thousand five hundred feet, or ripen it above that of ten thousand eight hundred. Barley is made to grow somewhat higher; but then with the utmost difficulty. Between the altitudes of six and nine thousand feet, lies the climate best suited for the culture of all kinds of European grain. In the same tract is raised the *chenopodium quinoa*. From the elevation of four thousand three hundred feet to that of six thousand two hundred feet, grows the *erythroxylum peruvianum*, whose leaves, called *cocca*, being mixed with quick lime, serve to stimulate the exhausted force of the Indian, during his long and toilsome journies over the heights of the Andes. In the space between the altitudes of nine thousand eight hundred and thirteen thousand feet, potatoes and the *tropæolum esculentum* are generally cultivated."

While *Padua*, *Paris*, *Madrid*, *Upsal*, *Oxford*, *Leyden*, and *Montpelier* had flourishing botanical gardens, *London*, so celebrated in the annals of science, could boast of no public botanical garden until 1780; and even then it was begun and conducted by a private individual, without any property to carry it on, excepting what arose from his daily practice in physic and surgery; and even this practice was finally sacrificed to his ruling passion, botany. The

person of whom we speak is WILLIAM CURTIS, author of the *Flora Londinensis*, and *Botanic Magazine*. As the writer of these essays was, during several years, a witness of the unwearied exertions of his friend and teacher, he conceives it may be serviceable as well as agreeable at this period, to give some account of the founder of the botanical garden near London, together with a description of it.

Soon after Mr. Curtis* became enamoured with botany, a large share of lucrative practice devolved upon him by the death of an old preceptor and partner. He then began to publish a description of all the plants in and about London, in large folio, elegantly designed, and coloured after nature. Not merely the expense of this great work, but the attention it demanded, alarmed the friends of Curtis. Even the sagacious and benevolent Fothergill, "*the friend of mankind and of merit*," checked the flowings of his bounty, lest he should be accessary to the ruin of his young friend, already too much disposed to quit the practice of physic to follow enchanting *Flora*. Fothergill had a great regard for Curtis, and being of the same religious persuasion, would have left nothing undone for advancing, what he conceived to be his true interest; which he believed to be, that of following with undivided attention, the practice of physic. Often, on receiving the splendid

* Mr. Curtis was a practitioner of physic and surgery, but never had a medical degree; of course he had not the title of doctor, but was called an apothecary;—a distinction rigidly adhered to in London, while we in New England call every practitioner of physic or surgery *doctor*.

numbers of the *Flora Londinensis*, has the BOTANIST heard the venerable Fothergill exclaim, "These plates I view with more pain than pleasure. They will ruin the author, by diverting him from his lucrative practice, and plunging him into expense, beyond what any man of independent fortune can sustain. The load is too heavy for this young man, and it will break his back." But Fothergill, though possessed of the "*perspicax oculus*" in a preeminent degree, did not then see, that the mild and silent Curtis was indued with the persevering spirit of Linnæus. He little thought, that this meek and quiet man would finally effect all that he meditated; and that to the *Flora Londinensis* he would add the *Monthly Botanic Magazine*, and to both a *Botanical Garden!* Deep enthusiasm is seldom accompanied with great ardour of expression. Under a mild and playful disposition, William Curtis was animated with a persevering spirit, that, in a different walk of life, might have wearied out the patience of a Xenophon, and discouraged Hannibal himself. It has been said, that Curtis composed his Botanical Magazine, as Dr. Johnson did his Rambler; the one to support him under the arduous work of his *Dictionary*, and the other of his *Flora*.

The King, the Queen, and most of the Nobility were subscribers to the *Flora Londinensis:* It is however remarkable, that when Curtis began his *Botanic Garden*, although he was presented with many scarce and valuable plants from the royal gardens at Kew, as well as from those of the Earl of Bute

at Sutton, the Dutchess of Portland at Blustrade, from Dr. Fothergill's at Upton, and from Dr. Pitcairn's at Islington, yet he never received any pecuniary assistance towards carrying on his Botanic garden. In 1783 the number of subscribers to this institution did not amount to more than forty. When Curtis died (July, 1799) a general regret, it is said, was felt from the throne to the bookseller's shop, that the author of the *Flora Londinensis* and the founder of the *London Botanic Garden* had never experienced royal patronage, nor national bounty.

His first essay towards a botanic garden was at Lambeth,* near the Magdalen Hospital, St. George's Fields; but he found the situation of the spot he had chosen inconvenient; for although from its position it appeared peculiarly adapted for the growth of aquatic and bog plants, yet this was accompanied by many disadvantages, for which this fortunate peculiarity did not present an adequate compensation. He therefore determined to remove; and here follow the reasons as detailed by himself:

"I had long observed, with the most pointed regret, that I had an enemy to contend with in Lambeth Marsh, which neither time nor ingenuity, nor industry could vanquish; and that was the smoke of London; which, except when the wind blew from the south, constantly enveloped my plants, and shedding its baneful influence over them, destroyed ma-

* The spot was called Lambeth *marsh*, from its dampness; but was not so watery as to deserve the name of marsh in this country.

ny; and, in a greater or less degree, proved injurious to most of them, especially the Alpine ones. In addition to this grand obstacle, I had to contend with many smaller ones, which became formidable when combined, such as the obscurity of the situation, the badness of the roads leading to it, with the effluvia of surrounding ditches, at times highly offensive.

"Nevertheless, when I reflected on the sums I had expended, when I surveyed the trees, the shrubs, and the hedges which I had planted, now become ornamental in themselves, and affording shelter to my plants, such of those inconveniencies, as I could not have remedied I should have borne with patience, and continued my garden under all its inconveniences, had not my landlord exacted terms for the renewal of my lease, too extravagant to be complied with.

"Disappointed, but not disheartened, I resolved to attempt its re-establishment elsewhere: I looked over the list of those who had patronized my former attempts, and finding the majority of my subscribers resided to the westward of the city, I fixed on a spot at Brompton, with the advantage at least of some experience in the cultivation of plants; and here I have witnessed a pleasure I had long wished for—that of seeing plants grow in perfect health and vigour.

"That I have good grounds also to expect that my labours will be crowned with success, the list of those persons, who have honoured my garden with their subscriptions the first year of its forma-

tion, affords me the most pleasing proof. Indeed, while vegetables shall constitute a part of our food, and there is a necessity to distinguish wholesome from poisonous ones—while medicines for the cure of our diseases shall be drawn from the vegetable kingdom—while agriculture, the grand source of the wealth and strength of all nations, shall be capable of being improved by a closer attention to our native plants—while botany shall be studied as an instructive science, or as an object of rational amusement; or, while the beauties of nature have power to charm, so long a garden, on the plan of the one I am endeavouring to establish, will, I humbly presume, meet with the support of the public."

Nor was Mr. Curtis mistaken. His plants acquired fresh health and vigour from a more congenial position; the number of his subscribers increased every year, while his own reputation, which had been augmented by his lectures and his publications, extended not only to the most remote parts of his native land, but throughout many parts of Europe. In this enviable situation, with a fair prospect of wealth and fame opening before him, this excellent botanist was suddenly snatched from his family, his friends, and the public, on the 11th of July, 1799.

On this melancholy occasion, the establishment devolved solely on Mr. William Salisbury, first his assistant, and afterwards his partner. Possessing youth, he has added to the bounds of the botanical garden, increased the library, multiplied the specimens of plants, built a house for his own residence

on the spot, and seems anxious to adapt the establishment for the use and accommodation both of public societies and private individuals.

The botanic garden is situated at Queen's Elm, in the road to Fulham, exactly one mile and a half from Hyde Park Corner, and about three quarters of a mile from Brompton. The site must be allowed to have been well chosen, for the grounds lie open to the south and west, except where the plantations are intended to exclude the sun, while the northeast wind, by being impregnated with the *ignited* air of the capital, loses much of its sharpness, and becomes far less pernicious, than it would otherwise be to such plants as require a bland and genial climate. This extent is about three acres and a half, including the ground occupied by the hot house, green-houses, and library; and seven acres more, immediately adjoining, and now in the occupation of the proprietor, can at any time be included.

The arrangement is strictly Linnæan; and every tree, shrub, and plant, is labelled so as to afford the advantage of an easy reference to the correspondent numbers in the catalogue.

On approaching, from Fulham road, the stranger perceives a door, situated nearly in the middle of the plantation; and, on ringing a bell, will be immedily admitted. A broad walk, extending across the garden, presents a parterre, on each side, in which all the different varieties and beautiful hues of Flora are exhibited, in regular gradation, according to the season:

"Along these blushing borders, bright with hue,
Fair-handed Spring unbosoms every grace."

No. 1. contains all those plants that are considered useful in agriculture. Persons skilled in this art, have an opportunity of seeing, distinctly arranged, with their proper names and species, every tree, grass, and shrub, that is cultivated as food for man, the horse, cow, and all other subordinate animals.—This is a most important branch of natural economy.

No. 2. is the medicinal quarter, in which the student will find the plants of the London and Edinburgh Dispensatories; and whether he himself is destined to prescribe, or to make up the prescriptions of others, will here have an opportunity of becoming acquainted with the characters of those herbs which form a part of the *Materia Medica.**

Among the curious ones will be found the *Assa-fœtida;* while the poisonous tribe,† only thirteen of which will thrive in the open air in Britain, are arranged so as to be hereafter detected by simple inspection alone.‡

No. 3. the Foreign Grass quarter, contains the Lygeum, Spartum, the Melica Ciliata, the Triticum æstivum, the Juncus niveus, &c.

* Who ought, as Dr. Gregory has so emphatically advised, to make himself thoroughly acquainted with these plants.

† The Aconitum Napellus, Actæa spicata, Cicuta Virosa, &c.

‡ A class of plants, with which all ranks of society ought to be acquainted; for, "On the day thou eatest thereof, thou shalt surely die."

No. 4. the British Grass quarter. Here the agriculturalist will, at one view, behold and distinguish those *gramina*, which constitute the real wealth and fertility of a country. These include every species serving for food for the horse, the cow, the ass, the sheep, and the goat.

In this interesting collection is to be found the Meadow Fox-tail (the *Alopecurus Pratensis* of Linnæus), which is the most fattening of this tribe; also the *Anthoxanthum Odoratum*, or the sweet scented vernal meadow grass, that confers a fine aromatic flavour on our hay, together with a complete collection of all the British species of gramina may be seen in great perfection in this quarter.

No. 5. contains the British plants of large growth.

No. 6. the British wood.

No. 7. is dedicated to British rock plants, and aquatics.

No. 8. the Hot-house and Green-house. Here I found the *Dionæa Muscipula*, a fine specimen of which was lately presented to the President of the Linnæan Society, for the purpose of elucidating his lectures at the Royal Institute. I also saw the *Strelitzia Reginæ*, so called out of compliment to the Queen; the *Portlandia*, the *Plumieria*, the *Vanilla*, *Catesbea Spinosa*, the *Ipomæa bona nox*, the *Amaryllis reticulata*, together with the *Crinum crubescens*, all in fine bloom.

In the Green-house is to be met with the *double Camella Japonica*, the *Phormium tenax*, with a very

excellent collection of plants from the Cape of Good Hope and New Holland.

No. 9. the Library. This is an oblong building, with a lattice work towards the south, through which it is intended that the ornithologist should be recreated with the view of British birds, and enabled to study their habits and manners while alive.

The collection consists of useful works, either on, or immediately connected with, the science of botany, such as Curtis's *Flora Londinensis*, and all the other productions of this celebrated naturalist; the *Flora Austriaca*, *Danica*, *Britanica*, *&c.*; Linnæus's *Genera & Species Plantarum*, *Systema Naturæ Opera Clusii*; *Mathioli in Dioscoridem*; the *Hortus Eystettensys*; together with the English Herbals of Gerrard, Parkinson, Johnson, &c. in all about five hundred volumes, including the most celebrated agricultural works of Young, Marshall, Dickson, &c.

No. 10. a Green-house, entirely dedicated to Heaths, chiefly from the coast of Africa, of which there are one hundred and fifty different species.

No. 11. is appropriated to bulbs and flower roots.

No. 12. foreign annual plants.

No. 13. This quarter contains upwards of one thousand different species of foreign hardy herbaceous plants.

No. 14. foreign Alpine plants.

No. 15. American plants, and foreign wood quarter.

No. 16. is a double border of foreign trees and shrubs, extending all round the boundaries of the garden on each side of the walk.

The above is intended as a popular rather than a scientific description of a spot, where either the student or the adept may satisfy his curiosity, by means of an arrangement executed in strict conformity to the system of the great Swedish naturalist. Those also, who delight in the contemplation of nature, are recreated at a very trifling expense; and flowers, plants, and trees, at every season of the year, present an almost endless variety of interesting objects.

Mr. Salisbury is often honoured with the presence, not only of some of the first botanists of England and other countries, but also with many of the British nobility; and he has often beheld, with grateful satisfaction, different branches of the royal family, who have honoured it with their patronage, walking along the paths, appearing delighted with the arrangement.*

Such is, at present, the Botanic Garden at Queen's Elms; in the further improving of which no pains or labour are spared to render it still more useful to the public. It remains for a nation, not only fond of science, but ever considered as its munificent patron and generous protector, to enable the proprietor to complete his plans, extend his views in favour of genius; and finally to form an establishment equally worthy of science, and of the noted liberality of Great Britain.

* European Magazine.

THE BOTANIST.

N°. XIV.

WHOEVER becomes seriously engaged in Natural History, will find it one of the most agreeable studies that can occupy the rational mind. The pleasure which natural history affords differs from all others, because it brings no satiety; for here gratification and appetite are perpetually interchanging: yet the writer never has nor never will recommend it merely to amuse the imagination, or gratify the fancy. Utility, public utility is the principal motive which has impelled him, for a series of years, to hold up *Botany*, *Agriculture*, and *Mineralogy* to the attention of the rising generation. This country, abounding in minerals, is yet dependent on foreign nations for riches that lie under our feet. However humiliating to American pride, we should remember, that no people can truly be said to have obtained absolute civilization who do not work up their own metals, instead of sending them to other nations, there to be manufactured into utensils, tools and weapons. Although it be true that every thing for the immediate support of life is continued with unceasing circulation from the upper stratum of the earth, it is nevertheless as true, that from the bowels of it a nation draws nearly all her means of defence,

labour her tools, commerce most of her riches, agriculture her chief support, and the fine arts all their materials. An inferior nation depends on a superior one for all these instruments of civilization. A country like ours, filling fast with an enterprizing and ingenious people, and possessing *wood*, *iron*, and *hemp*, looking anxiously towards one small nation for protection to its commerce; and towards another one with apprehension, is a singular phenomenon in the history of man! A boy may tie the noble war-horse, by a small string, to a stake, where he will remain until he starve, and this because he is kept ignorant of his own strength, and of the weakness of those who bridle him and manage him!

Agriculture is the art by which we can live in comfort, without dependence on other nations. It is the great art, which we Americans ought above all other arts to pursue, until we shall be able not only to extend commerce, but to defend it. Yet this honourable and independent employment will ever remain a vague and uncertain pursuit unless we acquire a knowledge of the vegetable economy, and obtain a happy insight into the physiology of plants; for then only will agriculture acquire the stability of a science.

Under the head of Agriculture we wish to include the culture of *forest trees*, especially the *oak*; which is among trees what *iron* is among metals, the strength and glory of every nation that is partly maritime, and partly agricultural. That wood, like this

metal is very hard, and yet not very heavy; hence the great value of both. The Romans called the oak *robur;* and used it metaphorically for great strength of body and of mind, or fortitude; hence our word *robust*. *Robur nodosum* was the club of Hercules, the emblem of heroic virtue. And an oak with its acorns was held in high veneration by the renowned Romans. Pliny says, *Glandiferi maximé generis omnes, quibus honos apud Romanos perpetuus*. When speaking of crowns and chaplets, he says, that *that* civic coronet has most dignity, which is made of a branch of the oak, provided it bears, at the same time, acorns. The arms, or ensign armorial of a nation, should be expressed only by the productions of it. The eagle and the olive branch accompany the thunder bolt in the arms of our nation. The olive is the product of those countries, where the human race is debilitated by that warmth which is needful for its growth. Instead of this languid foreigner, let us place in the ensign armorial of the United States a branch of the oak with its acorns. Providence, whose works are distinguished from human art by manifold conveniences flowing from one single contrivance, gives the acorn, and by it communicates power and glory to a nation; provided that nation has wisdom to appreciate, and virtue to co-operate with its bountiful intimation. Let the branch of the oak then, with its acorns, encircle the American eagle; or rather let the emblem

of the western Empire be a *Condor** reposing on a mighty branch of this pride of our forests.

Leaving these general observations† let us turn our attention particularly to the anatomy and physiology of

THE LEAF.

So from the root
Springs lighter the green stalk; from thence the LEAVES
More airy; last the bright consummate flower.——*Milton.*

By *Foliation* English botanists mean the *complication* or folded state of leaves, while concealed within the bud; but this term expresses not that procedure of nature, by which the leaves are renewed and developed *every spring*, so accurately as does the Latin word *vernatio.*

In a former number we have shown, that the bud springs from the medulla, or pith of the plant; and by searching into the bud we have seen the rudiments of the leaves; and when we penetrate still deeper we discover, that the bud, like the seed,

* The *Condor*, *Vultur Gryphus*, (Lin.) is peculiar to America, and is the largest bird that flies. It possesess, says Goldsmith, in a higher degree than the Eagle, all the qualities that render it formidable not only to the feathered kind but to beasts. Acosta, Garcilasso and Condemine have described this preeminent bird.

† The readers of this volume may remember that these essays were first published in the Monthly Anthology, a miscellaneous work, resembling the London Monthly Magazines. This accounts for the introduction of national sentiments, which the Botanist feels no disposition to erase.

contained the epitome of the future plant; but during winter it wants the power of unfolding its parts. Both seeds and buds contain the *primordia plantarum:* buds therefore differ from seeds only, as the living fœtus differs from the egg of an animal; so that buds are seeds in a more advanced stage of vegetation. We have already remarked, that some buds contain flowers, some leaves, and some both; and that an accurate discrimination of them was of importance in the process of *budding*. To watch the *vernation* of the embryo bud, the gradual unfolding of the fœtal leaves and infantile flower, is a pleasing speculation; for the leaves are completely formed, and fairly rolled up for evolution, many months before they begin to expand. The study of the anatomical structure of the full expanded leaf and its functions is equally delightful.

We shall pass silently over the nomenclature of leaves,* which is apt to discourage young botanists unused to geometrical writers in the Latin tongue; and shall pursue the more pleasant task of exhibiting, as far as we are able, the structure and the functions of the leaf.

When we are told, that 'a leaf is a part of a plant, extended into length and breadth, in such a manner

* There is not only the *folium bifidum, trifidum, quadrifidum, quinquefidum,* and *bipartum, tripartum, quadripartum,* and *quinquepartum;* but there is the *folium compositum, decompositum,* and *superadecompositum;* and the *folium amplexicaule,* and *semiamplexicaule,* and a hundred others, having reference to the *shape* of the leaf merely. Good sense is sometimes embarrassed when thus oppressed with hard words.

as to have one side distinguishable from the other,'* the naturalist receives but little information; and we obtain but little more, when we are told, that they are 'the organs of motion;'† but, when we say, that the leaves are the *lungs* of a plant, we convey an idea more consonant to truth and nature: for we find that a leaf will die, if its upper or varnished surface is anointed with any glutinous matter; or when placed in an exhausted receiver. If we should say, that the leaf combines the office of *lacteals* and lungs, we shall come still nearer truth. While our stomachs digest solid food, our lungs digest air; so that what is performed by two organs in animals, is performed by one in plants; let us then examine this organ and its functions.

The *leaf* is attached to the branch of the plant by a short foot-stalk. From these foot-stalks a number of fibres issue, which, ramifying in every direction, communicate with each other in every part of the leaf, and thereby form a curious network. The intermediate substance is greenish;‡ and may be eaten by insects, or destroyed by putrefaction, while the fibrous part remains entire, constituting the skeleton of the leaf. There are, however, two layers of fibres in every leaf, forming two distinct skeletons; the one belonging to the upper part of the leaf, the other appertaining to the lower. It is very difficult to demonstrate the anatomy of a leaf; but we have

* Miller. † Linnæus.

‡ Landskips painted by the best masters are not green.

reason to conclude, that the *seven* essential parts of a plant, enumerated in the fourth number, are extended, rolled out, and extenuated throughout the leaf; so that if you slit a leaf with scissors, you cut through as many different parts of the plant, as if you cut through the trunk of a tree.* The whole leaf is covered with a portion of the epidermis, or that scarf-skin, which covers the stem and stalk of the plant. Between this thin membrane and the cortical net-work, are placed the absorbent vessels, together with what we presume to be the absorbent glands. Dr. Darwin assures us, that there is an artery and a vein in a leaf; and that the artery carries the sap to the extreme surface of the upper side of the leaf, and there exposes it, under a thin moist membrane, to the action of the atmospheric air; then the veins collect and return this circulating fluid to the foot-stalk, just as the artery and vein operate in our lungs. It is hardly fair to compare the leaves of a plant with the respiratory organs of the more perfect animals; but rather to the breathing apparatus of insects, or, what is perhaps more to our purpose, to the *gills* of fish.

When the structure of any organized body is too subtle to come within the scrutiny of the human senses, we must have recourse to analogy; and from the truths we discover, and the observations we make, we must judge of the operations in similar bodies; for we can form our opinion of that which

* Is the wood to be found in an annual leaf?

we know not, only by placing it in comparison with something similar to what we do know. The structure of certain large-leaved plants, that grow in water, are remarkably conspicuous; and the gills of fish resemble, in structure and office, the leaves of these aquatic plants. *Duverney* and *Monro* have scrutinized the gills of fish; the former found, that those of the carp contained *four thousand three hundred and eighty-six* bones, which were moved by *sixty-nine* muscles: and the latter informs us, that, in the gills of the skate fish, there exists *one hundred and forty-four thousand* folds, or subdivisions. This manifold structure gives this respiratory organ a surprising extent of surface. These subdivisions terminating in innumerable points, resemble fringe; but, when examined by the microscope, appear like down; yet is every part crowded with blood-vessels, being ramifications of the pulmonary artery and vein. The whole extent of the gills is covered with an exceedingly fine membrane, in which the microscope discovers a still finer net-work of vessels. By such a structure the fish exposes a greater surface of blood to the water, than is exposed to the air, by the internal membrane of the air-cells of the lungs of quadrupeds; and that for the same purpose, namely, imbibing uncombined oxygen, which is the material or pabulum vitæ, equally necessary to fish as to land animals. Now, if we compare the structure of the gills of fish with that of the leaf of aquatic plants, we can discern a great similarity.

The gills of fish present an immense surface to the water in which they live, in consequence of their innumerable folds of nerves, blood and air vessels. The divisions and subdivisions of this organ are so fine that they resemble a most delicate fringe. In like manner certain aquatic plants, growing in the ponds here in Cambridge, have subaquatic leaves resembling fine moss, or rather that kind of silk called *floss ;* the structure and use of which are the same as the gills in fish. While those leaves, which are growing under water, have this delicate structure, the leaves of the same plant, when it has shot up out of the water, being produced wholly in the air, become intire and firm, having none of those segments or slits, which distinguished them when subaquatic; so that the one leaf under water, has the structure and functions of gills, while the next above it is a firm leaf, or lungs, by reason of its breathing the open air. Here a change takes place in an amphibious plant, like that which is observed in an amphibious animal, on its passing from the tadpole to the frog state ; for in the former state it has gills, and in the latter lungs.

As a tree cannot go in search of food, like an animal, it is forced to draw its nourishment from within the narrow sphere of its existence ; it therefore extends its roots through the surrounding earth, by which it draws in sustentation, as through so many syphons. These imbibing vessels of the roots may be compared to the *lacteals* in animals. This

chyle, or sap, ascends to the leaves, and is there changed into a more perfect fluid, answering to the blood of animals; it is still further exalted in the flower, in order to perfect the seed, and continue its kind. The roots are sufficient to supply nourishment to a large tree during winter, when divested of its leaves, and when the vegetative life reposes in winter quarters:* but stimulated by the warmth of spring, the vegetable *ens* awakes; and when the process of *vernation* has fairly begun, then the tree has more to do than merely to support its own existence; and therefore it spreads through the air its numberless leaves, which are nearly equivalent to the the stomach and lungs of animals.

That the sap ascends to the leaves is proved by the bleeding of vines early in the spring, before the leaves are formed; there being no leaves to receive it; but when these elaborate organs are formed, the vine ceases to bleed, because the sap flows into them for *rectification*;† for, while a vegetable is growing, it is continually going through a regular series of changes, losing the properties of one substance, and assuming those of another; thus mucilage in a young plant, becomes starch in the old; what in green fruit is acid, in a ripe fruit is sugar.

But the function of the leaf is not perpetual and uniform, as in the lungs of the more perfect animals;

* The hybernacula.

† *Rectification*, in the language of chemists, means drawing any thing over again by distillation, to make it yet higher and finer.

its operations differ in the day, and in the night. In the day, the leaves of plants exhale moisture and *oxygen gas*, and absorb *carbonic acid gas;* but during the night, they emit *carbonic acid gas*, and absorb *oxygen gas*. In plainer terms, they exhale, in the light of the sun, salutary, or vital air; but in the dark they emit a noxious air: one of these operations is performed by the varnished side of the leaf, and the other from the rough or under side. This varnish of the leaf is found to be bees-wax.

As air and heat are necessary to the life of a plant, so is *light* to its health.* The want of light prevents a plants forming its proper juices, deprives it of its green colour, and prevents the impregnation of its seed. It is the smooth side of the leaf which is acted upon by light; and is that part, by which a plant, in a great measure lives; hence the leaves of many delicate plants shut up, so as to cover this smooth

* It is remarkable, that the leaves cannot prosper without *light;* yet seeds germinate best in the *dark*.

Light is an elastic fluid, that is reflected from certain bodies which it cannot penetrate: it is also possessed of chemical affinities, by which it enters into combination with other substances; sometimes occasioning their decomposition, and sometimes it is extricated from its combinations. It gives to vegetables their colour, and contributes to their smell, and balsamic principle. It enables the leaves of vegetables to emit streams of *oxygen gas*, or pure *vital air*.

Oxygen, or the *acidifying* principle, is found only in its combinations. The *oxygen gas* is the result of the combination of oxygen with *caloric*. It exists in atmospheric air, in the proportion of 27 to 100, and is heavier than the air of the atmosphere. It is absolutely necessary to respiration, hence termed vital air. During the action of breathing, it enters our blood by the vessels of the lungs, giving to it a vermillion colour, and an augmentation of its vital powers.

side on exposure to noxious vapour, or darkness; or to screen it from an extremely fierce sunshine. In order to make a distinction between the *sensation* of heat and the *cause* of it, the word *caloric* has been adopted. Caloric is a body, and so is light. The sun is the source of both; for he emits two kinds of rays, one *calorific*, the other *colourific;* the first occasions *heat*, the other *colour*.

With what different eyes does the philosopher and the uninformed husbandman view a tree, waving in the full glory of its luxuriant foliage! Ask the woodsman for what a tree was made—he will tell you to bear nuts; to be cut into boards; to burn, to keep him warm, and to cook his victuals. Ask the naturalist, and he will tell you, that they are an important, nay indispensible link in the chain of human existence; insomuch, that were the Parent and Legislator of nature to cause every vegetable on earth, at once to be annihilated, the atmospheric air would directly become a putrid mass of every thing that is noxious, and man, and other terrestrial animals of similar construction, would soon turn into a mortified lump of corruption. The leaves of all sorts of vegetables are in fact so many laboratories for purifying the air we breathe.

During winter, when the surface of the earth is bound up with frost, encrusted with ice, and covered with snow, little or no putrefaction takes place; then the vegetable kingdom appears as if dead; the trees, divested of leaves, seem like so many dead sticks; but when the sun begins to diffuse its warmth

over the earth, promoting that general tendency to corruption, to which all dead bodies are liable, then the trees soon exhibit a pleasing scenery, and the leafless branches by bursting their buds, and by displaying, all at once, their foliage, increase their surfaces many thousand times. The leaves are so arranged on the branches, as to expose their varnished surface to the direct influence of the sun; and, if forced out of that position, they will turn themselves; for leaves are more greedy for the light of the sun, than for the influence of its heat.*

It is from the under, or rough side of the leaf that the *azotic*, or rather *carbonic acid gas*, or unwholesome air is emitted; while the *oxygen gas*, or pure vital air emanates from the upper or smooth varnished surface; but not before the sun has shone some time upon it. This distillation of pure vital air by the leaf diminishes towards the close of day, and ceases altogether after sunset, when unwholesome air is emitted by the rough side of the leaf; and the next day, soon after the rising of the sun, the smooth, or upper side recommences its function. Hence we see the reason why it is unhealthy to tarry in the deep shade of the trees during the night. '*Surgamus*,' says the shepherd in Virgil, '*solet esse gravis cantantibus umbra*.'—*Let us rise; for the evening* shade *is unhealthy to singers;* and, he adds, even the juniper is *now* noxious. Ill-scented and even poisonous plants equally afford salubrious air in sun-

* See Ingenhouz passim.

shine. It is remarkable, however, that while leaves are performing this salutary process, *flowers* render the surrounding air noxious, even in the day time. The effluvia of a large quantity of gathered fruit has, at all times, a deleterious quality. A peach, in a few hours, rendered a body of air, six times its own bulk, so entirely poisonous, that an animal could not breathe, nor a candle burn in it. A rose kept in a glass, so much infected the air, as to render it unfit for respiration.* Persons have been found dead in their beds, whose lodging rooms have been crowded with flowers: others have been suddenly affected with dizziness, nausea, and head ache, on going into a green-house of flowers that had been shut up closely during the night.† While a growing vegetable is capable of this two-fold operation, it absorbs whatever putrescent particles it finds in the surrounding earth and air. A sprig of mint, put into a jar of air, rendered foul by animal putrescency, though faded, will revive, and grow surprizingly; and will moreover correct air, so that an animal shall be able to breathe in it.

Here is the proper place to remark, that the ocean, when agitated by winds, yields oxygenous gas; and that azotic, mephitic, or noxious air is corrected by being strongly shaken with water. Hence we learn that the two grand correctors of the atmospherical

* See Priestly on air.

† Ingenhouz placed twenty-four French beans in a quart jar, which rendered the air, in one night, so poisonous, that a chicken, put into it died in about twenty seconds.

air, are, first, the *agitated ocean*, and secondly, *living vegetables, while operated upon by the rays of the sun.*

If we reflect upon what has been said, it will appear, that plants have their *private virtues*, and their *public* ones.* Besides the peculiar medicinal and nutritive qualities, which some possess, the great family of plants, or what is called the vegetable kingdom, conspire to form one grand apparatus for purifying the atmosphere, and rendering it fit for respiration; these may be called their *public virtues*. In this view no vegetable grows in vain, whether in the interior of this vast continent, or in the wilds of Africa: for the leaves of *all*, whether ill-scented, acrid, or poisonous, elaborate the air they contain, and pour down a shower of depurated oxygenous or vital air, which, diffusing itself through the common mass of the atmosphere, renders it more fit for animal life. In this salutiferous process the fragrant rose and the violet, the deadly night-shade, and the still more deadly laurel,† co-operate. The animal and vegetable kingdom operate on each other. Putrid animal effluvia, noxious to man, is food for plants; while plants transmit a salutary air to man. The winds convey vitiated air from us, for our relief; and they return salubrious gales, for our refreshment; 'and if these salutary gales rise to storms and hurricanes, let us trace and revere the

* Sir John Pringle.

† The *lauro cerasus* yields abundance of the oxygen gas. *Ingenhouz.*

ways of a benificent BEING, who, not fortuitously, but with design; not in wrath, but in mercy, thus shakes the waters and the air together, to bury in the deep those putrid and pestilential effluvia, which the vegetables upon the face of the earth had been insufficient to consume.'*

These traits of wisdom, visible in the economy of those departments of nature which have come under our scrutiny, clearly instruct us how kindly PROVIDENCE restrains, impels, and directs all things to a beneficent end: but in no instance is it more apparent than in the rays of the sun correcting, through the agency of the leaves of vegetables, the noxious influences of the night. Milton seems to have had some idea of this when he makes Adam say in his morning hymn,

'His praise, ye winds, that from four quarters blow,
Breathe soft or loud; and wave your tops, ye pines!
With every plant, in sign of worship wave!
O universal Lord! be bounteous still
To give us only good; and if the night
Have gather'd aught of evil—
Disperse it, as now light dipels the dark.

The BOTANIST is aware, that, in the preceding essay, he has sketched a wider landskip, than he has been able completely to fill up. A cultivated eye will, at once, discover some parts that require retouching: this has been owing to the want of certain requisite materials. How differently situated

* Pringle's discourse before the Royal Society of London, on giving the prize medal to Dr. Priestly.

and circumstanced are our elder brethren in Europe, who easily obtain any book they need? while we, insulated from the source of needed information, spend more time in the vain search after a book, than would suffice to compose the essay in question. If a literary 'matter-o'-fact-man' in Massachusetts, be like unto *Robinson Crusoe* in his desert island, we should make as much allowance, when comparing his productions with those written in the capitals of Europe, as when we compare the vessel, made by this renowned voyager, with those built in the docks of France or England.

THE BOTANIST.

N°. XV.

In the eighth number, written in the severest cold of an inclement season,* the Botanist promised, that when "*the winter was past*," and "*the flowers appear on the earth, and the singing of birds is come*," then would he quit his conglaciated state, and, congenial to the cheerful season, once more attemp to delineate the beauties of earth's renovated carpe. But shall man, who cometh forth as a flower, vain man, promise himself any good at any distant period!

* In January, Mercury 8° below 0.

It is asked, "*Is this season, so full of the bloom of nature, unpropitious to the unfolding of the petals of elocution?** Let the great Montesquieu answer the question. Put a man, says this sage, in a warm, confined place, and he will feel faintness and lassitude. Thus circumstanced, if you propose a bold enterprize to him, you find him very little disposed towards it. His weakness will induce a despondency; he will be afraid of every thing, because he feels himself capable of nothing. Faintness of the body, produced by the heat of the climate, is soon communicated to the mind; and then there is no curiosity, no noble enterprize, no generous sentiment. The inclinations are passive, and indolence constitutes his utmost happiness.

Although the Botanist has been ready to exclaim with Thomson,

> All-conquering heat,† oh intermit thy wrath!

yet he has not been an idle spectator of the transitory blossoms.

> For as the vernal sun awak'd the torpid sap,

he watched the infant bud and embryo flower; and marked, as they gradually unfolded, the beauties of the breathing leaf. And when the bursting calyx gave the struggling petals to the admiring sight, he

* Hints to correspondents in the Anthology for last month, where the Botanist is called upon to renew his labours.

† July. Thermometer between 88° and 95°, and not a sprinkling of rain for five weeks.

hung over their elegant forms and resplendent hues enraptured. But while gazing at the glories of the full blown flower, and contemplating its wondrous economy, it shrunk from the intrusion, and, like the hopes of man, withered on the stalk. So passeth away the splendour of this world!

During this dry and fervid season the vegetable race has a more melancholy aspect, than in the frozen gloom of winter, when the vegetative *ens* naturally retires to its cradle, *hybernacula*, or winter quarters, and is resuscitated by the next vernal sun. But in this arid and adust state of the earth and the air, every annual plant is threatened with speedy destruction: For want of the cherishing influence of supernal rain,

Distressful nature pants.
The very streams look languid from afar. *Thomson.*

To the laborious husbandman, the gardener, and the botanist, the descent of rain on the parched soil and thirsty plants is the most grateful phenomenon in the whole enconomy of nature. Let us put by our flowers then, for the present, that we may consider the nature, and contemplate the source of this precious fluid, which gives health, beauty and vigour to all that lives.

WATER

is indeed a wondrous element! Well might the Grecian sage* contend, that water was the original

* Thales.

matter, or principle of all things; and that even the air was but an offspring, expansion, or expiration of water. We actually find that water bears a part in the formation of every body in the three kingdoms of nature. It enters into all the food of every animal, and every vegetable in creation. It is necessary to the free exercise of every animal function and action: and although it is the common cement of all terrestrial bodies, it nevertheless hastens and facilitates the requisite dissolution of every animal and vegetable, when life has departed; and is therefore an important agent in that never ceasing process of mutation, by which one thing is changed *out of*, and *into* every other in creation.

Can a Naturalist do better, at this dry and threatening season, than solicit the attention of his young readers of both sexes, to the means nature uses to provide the earth with rivers of water; beasts with running brooks; plants with refreshing showers; and man with every thing? It is possible that they may never have once reflected on *the connexion between the sea and vegetation*—between the mountains and the ocean—between the rivers under ground and the atmosphere above it. They may never have considered, that the Atlantic ocean conspires with our loftiest mountains to furnish us with an element indispensably necessary to the life, to the health, and to the beauty of plants, as well as of men.

The clouds dispensing refreshing showers, "turning the wilderness into a standing water, and the dry ground into water springs;" the flow of rivers, with

their long train of beneficial consequences, could hardly escape the notice of any thinking being in any age of the world. We accordingly find the supply of water frequently mentioned, in the oldest book we have, among the most wonderful, as well as valuable of Heaven's blessings; whilst the heathen world imagined every river to be under the guardianship of some particular deity, who they believed created it, because they knew a river of water to be of more than mortal formation.

It has probably impressed others, as well as the writer; with something bordering on wonder, that during seven and twenty centuries, wherein the memory and learning of mankind have been exercised, there has not been found one philosopher so well instructed in the laws of nature, as to be able to give a complete history and satisfactory explanation of *the ascent of fresh water from the salt ocean; the suspension of vapours in the air; the formation of distinctly defined clouds; and the descent of rain*, together with a connected chain of causes. What facts and reasonings we have on these subjects are mere fragments widely scattered. If Pythagoras taught, as Ovid says,

> Unde nives, quæ fulminis esset origo:
> Jupiter, an venti, discussa nube tonarent,

the doctrine has never come down to us.

Seeing the earth covered annually with a rich and beautiful carpet of vegetables; and these surprisingly diversified, variegated, and developing between "seed time and harvest time," must have led those

of antient days to recognize the proximate cause, the warmth of the sun and the moisture from the clouds; and these again to that perpetual circulation subsisting between the ocean and the mountains, through the instrumentality of the air, and by the medium of rivers to the ocean again. But the philosophy, or explanation of this vivifying phenomenon is spoken of as something past finding out. They did then, as we do now, push our investigations as high as ever we can, as in the case of gravitation; and beyond that principle say with them, it is "*the hand of God:*" an expression denoting only the last term of our analytical results. Unable to discover the essence of *light* and of *fire*, the DEITY was called by the name of these inscrutable agents.

In early times, when the knowledge of nature was confined to narrow limits, they, like our Indians,

"Saw God in clouds, and heard him in the wind."

Hence they styled the DEITY, "*the father of the rains,*" and represented him, as "*calling forth the waters of the sea, and pouring them down according to the* VAPOUR *thereof.*" Whence we infer they believed that the water rose, in form of *vapour* from the salt ocean; and that it became freshened in its passage through the air. It moreover appears, that they believed this process was regularly and perpetually performing, in an unceasing circulation; for they remarked that, although "*all the rivers run into the sea, yet was the sea not full; unto the place whence the rivers come, thither they return again.*"

They seem also to have known, that *mountains* made a part of this grand apparatus; and to have believed that it was not a fortuitous or casual operation; but regulated as we now find it, by weight and measure. May not this be inferred from the sublime question of Isaiah—"*Who hath measured the waters in the hollow of his hand, and weighed the* MOUNTAINS *in scales?*"

The people of antient times discerned in part this magnificent apparatus; and saw its effects; but were restrained by a religious awe, from attempting the investigation of it; because *storms*, *lightning*, and *hail* were conceived to be the precursors of the chariot of the DEITY;—"*who maketh the clouds his chariot—who walketh on the wings of the wind,*" accompanied with "*hail stones*" and "*fire.*" The origin and the course of the winds, "*whence they come, and whither they go,*" were all, for these reasons, deemed mysterious. Hence, instead of scrutinizing the cause, their pious minds, overwhelmed with awe, sunk into undiscerning amazement. Under such solemn impressions, I cease to wonder that he, who wrote that antient drama, the book of *Job*, puts, among the most difficult of his questions, that which demands an explanation of "*the balancing of the clouds.*"

The never-ceasing circulation of water between the ocean and *terra firma* has, it seems, been contemplated from the earliest ages with grateful admiration; but not being altogether an object of sight, was ranked among the inexplicable works of Deity.

Des Cartes, *Nieuwentyte*, *Halley*, and a few others among the moderns, have amused the literary public with their hypotheses: But of their learned theories, which of them is not clogged with objections? That all the rivers of fresh water are derived from the salt ocean, no one doubts; but how it rises from the sea is the question. Some contend, that the particles of water are formed into hollow spherules, or diminutive balloons, which being lighter than common air ascend, and are buoyant in it; and that they rise, or fall, or move horizontally, according to the impulse given by attraction, repulsion, by winds, or by electricity. The public have generally acquiesced in the theory of Dr. *Halley;* as they commonly do with every hypothesis presented them in the imposing garb of mathematics. Dr. Halley took a vessel of certain dimensions, filled to a certain depth with water, and warmed to such a degree as the air is in the hottest summer months. After standing two hours, he found, on weighing it, what it had lost by evaporation. From this datum he proceeded in his calculations; and found that a square mile yields six thousand nine hundred and fourteen tons, and consequently that a degree square will evaporate about thirty-three million of tons. He calculated the surface of the Mediterranean; and estimated that it must lose in vapour every summer's day *five thousand two hundred and eighty million of tons.* Dr. Halley considers a certain grade of heat absolutely necessary to the ascent of vapours from the ocean; but we find, that this evaporation goes for-

ward with equal rapidity in the coldest weather, nay in caves at the coldest season, in the frozen regions of the north.

> Strange! what extremes should thus preserve the snow
> High on the Alps, or in deep caves below. *Waller.*

We must then seek some other cause beside *heat;* and the chemico-philosophers have tried to soothe disputants by an hypothesis which is void of it. They consider that the air is a *menstruum*, capable of dissolving, suspending, and intimately mixing the particles of water with itself. That as a given quantity of water will take up just so much salt and no more, without becoming turbid, and at length precipitating it to the bottom; so air, the most powerful solvent in nature, next to fire, will take up, intimately mix, and suspend, just so much water and remain clear. The mixture will continue transparent, just this side saturation; when *saturated*, the abundant waters float in form of clouds; but when *supersaturated*, it lets go the water, which, like a supersaturated solution of salt, falls from the clouds on the earth in the form of rain.

Is the probability of this theory diminished by the new chemical doctrine, which teaches that water is formed by an union of *hydrogen* and *oxygen?* The pneumatic chemists have, by their curious discoveries, removed the boundaries, which separated, as we once thought, air from water; and have led us to respect that very antient idea, which conceived them to be ONE element.

The salt ocean, which covers by far the greatest part of this globe, has a three-fold motion. The first is gentle, like the breathing of an animal; by it the sea swells and rises up against the shores, and enters gradually into bays and mouths of rivers, during the space of six hours. Then it seems to rest for a quarter of an hour, and then as gradually slides down again; when after another pause of a quarter of an hour, it begins again to flow as before. The second motion is more vehement and incessant, and is, like that of the heart, circulatory; whereas that of the tides is merely backward and forward. It comes in the course of the trade winds, which blow everlastingly from east to west; runs past the West-India islands; pours into the bay of Mexico; and rushing rapidly out, forms the gulf of Florida; which sweeping along the American shore, carries the waters of the Atlantic into the North Sea; whence they pass in a never-ceasing circulation around the globe.

The other motion is from the atmosphere, when agitated by winds. It is local and variable; and seems subservient to the transpiration of the ocean. It ruffles the surface merely, and, from this superficial agitation, begins that hitherto inexplicable *distillatio per ascensum.*

By whatever means the water ascends the air from the ocean, this is briefly the course of it: in rising from the ocean it leaves the salt behind, as in the common process of distillation. The ascended vapour is probably decomposed, when it forms clouds

which are distinctly visible : these float in the general atmosphere, which appears to be then a different fluid from these circumscribed clouds. Antiquity conceived a cloud to be a congeries of watery vapour, a conservatory, in which the rain is kept as "*in bottles.*"* As clouds become fuller of water they gravitate ; or are attracted by the loftiest mountains, when they pour upon them abundant rains. But, according to an ingenious chemist,† there are two steps of the process between evaporation and rain ; of which at present we are completely ignorant :

1st. What becomes of the vapour after it enters into the atmosphere ?

2d. What makes it lay aside the new form, which it must have assumed ; and return again to its state of vapour, and fall down in rain ?

And till these two steps be discovered by experiments and observations, it will be impossible for us to give a satisfactory, or a useful theory of rain. There are mountains so very large, that even provinces are found embosomed near their summits, as those of Quito. The tops of such mountains are constantly enveloped with clouds, especially during the night ;‡ and the waters are constantly dripping down through the crannies and crevices of the stones, forming kindred brooks ; when uniting with

* See Job. † Dr. I. Thompson.

‡ It rains perpetually among the Andes, while in Egypt seldom or never.

other streams, it rushes with accelerated force to the plains below, forcing a passage through every pliable thing in its way.

Resistless, roaring dreadful, down it comes,
From the rude mountains, and the mossy wild,
Trembling through rocks abrupt, and sounding far;
Then o'er the sandy valley floating spreads,
Calm, sluggish, silent; till again constrain'd
Between two meeting hills, it bursts away
Where rocks and woods o'erhang the turbid stream,
There gathering triple force, rapid and deep,
It boils and wheels, and foams and thunders through;
——Till pouring on, it proudly seeks the deep;
Whose vanquish'd tide, recoiling from the shock,
Yields to this liquid weight of half the globe. *Thomson.*

The river, after rolling its waters into the ocean, is destined to be again exhaled in vapours; and to re-enter afresh the channels of this magnificent circulation!

THE BOTANIST.

N°. XVI.

"Last the bright, consummate FLOWER
"Spirits odorous breathes." *Milton.*

ONCE more we hail with gratitude the returning spring!* In winter, when the earth is bound up with ice, and covered with a bed of snow; when the trees are divested of their leaves, and appear dead;

* April, 1808.

and the very herbage seems annihilated, then "the lord of the soil" casts his eyes over the barren waste with a sigh. As his reason alone could not lead him to believe, that the tree would ever again blossom; or the earth be again clothed with a beautiful carpet of vegetables; so his heart sinks within him, from a fearful apprehension, that the LORD OF ALL is unmindful of his necessities. This, ye Legislators! is the period, when you should, in imitation of the churches of Rome and of England, appoint your *days of humiliation and solemn fasts:* for it is at this gloomy season that man feels his dependency on *a power above him.* But when the sun so diffuses its warmth through the air, as to loosen the flinty brook, and edge it with green; and when the full bladed grass appears, and awakened nature sees a new creation, then the husbandman exclaims, with exultation, "MAN IS NOT FORGOTTEN! for here and there are pledges of an adorable reminescence, and traits of a wonderful renovation!" Then seize, Legislators! this season of returning spring for your *National Thanksgiving*, when every sense and every heart is joy.*

* Should this ever be read beyond the boundaries of New-England, it may not be superfluous to add here, that our ancestors instituted, at the first settlement of Massachusetts, a *Te Deum*, or *day of public* THANKSGIVING in the autumn; and a *day of Fasting and Prayer* in the spring of every year. The day for these solemnities is appointed by the Supreme Executive of the State, whose proclamation, in this case, has the effect of an Archbishop's circular. The idea here suggested is, that the *Thanksgiving* would be celebrated with more fervour at that season, when "awakened nature sees a new creation."

If in winter the husbandman

> " Marks not the MIGHTY HAND
> " That, ever busy, wheels the silent spheres;"

he cannot miss it in

> "The fair profusion that o'erspreads the spring."

The poets have conveyed their idea of spring, by describing this genial season as a youth of most beautiful air and shape, with a blooming countenance, expressive of satisfaction and joy; and cloathed in a flowing mantle of green, interwoven with flowers; a chaplet of roses on his head, a *narcissus* in his hand, while primroses and violets spring up under his feet.* The ornament and pride of spring, Milton's "*bright, consummate flower*," must therefore be the theme of our present number.

Every one may think that he knows precisely what is a *flower:* it is however remarkable, that botanists have been not a little puzzled in fixing their definition of it. The celebrated French botanist Tournefort, tells us, that "a flower is a part of a plant, very often remarkable for its peculiar colours, for the most part, adhering to the young fruit, to which it seems to afford the first nourishment, in order to explicate its most tender parts." Is this a definition? Pontedra, in his Anthology, tells us that "a flower is a part of a plant unlike the rest in form and nature." Jussieu says that "that is properly a

* The poets have described Spring, accompanied by Flora on one hand, and Vertumnus on the other; and immediately followed by a stern figure, in shining armour: this is *Mars*, who, they say, has long usurped a place among the attendants of Spring.

flower, which is composed of stamina and of a pistillum." But some flowers have no pistillum. Vaillant advanced one step beyond his predecessors, and asserts that "the flower ought, strictly speaking, to be reckoned the organs, which constitute the different sexes in plants: for that the petals, which immediately envelope them, are only the coats to cover and defend them;" but he adds, "these coats are the most conspicuous, and most beautiful parts of the composition; and therefore to these, according to the common idea, shall I give the name of flower." Martyn went a little farther, and defined "a flower to be the organs of generation of both sexes, adhering to a common placenta, together with their common coverings." Nay, if we consult Johnson's Dictionary for a definition, we shall find that "a flower is that part of a plant which contains the seeds," which definition is more applicable to a pea-pod. The early botanists meant by the term *anthos*, *flos*, or *flower*, what is now understood in common conversation by that term, namely, the rich and delicate painted leaves or petals, which adhere to the seed vessel, or rudiment of the future fruit. In truth botany was unknown to the antients as a science. They had no distinct term to express the petals of a flower, so as to distinguish it from the green leaves of the plant. Virgil, in describing his *amellus*, which is a species of aster; the flower of which has a yellow disk and purple rays, calls it a golden flower surrounded with purple leaves. All

his translators, excepting Martyn, the botanist, have mistaken his description,

> " Aureus ipse [flos] sed in foliis, quæ plurima circum
> " Funduntur, violæ sublucet purpura nigræ." *Georg. IV.*

Addison makes the *leaves* of the plant purple. Dryden makes the *bough* purple; and Trapp gives the *stem* a golden hue. All this confusion has arisen for want of a word in the Latin language to express the *petals* of the corolla, as distinct from the common *leaves* of the plant. Modern botanists have borrowed the word πεταλον from the Greek to express the beautiful rich leaves of the flower merely; and thus they avoid all ambiguity in description.* We make no apology for this dry discussion. Our aim is perspicuity rather than elegance. We wish to give the student of nature a less confused idea of a flower than he commonly finds in books of botany; and we hope we shall give him a distinct idea of the beautiful, but complicated thing before us.

Since the adoption of the sexual system, the petals, which excite the admiration of the florist, are considered by the botanist, as coverings only to the essential parts of the flower. A flower therefore, in modern botany, differs from the same term in former writers; and from the common acceptation of it; for the calyx, the petals, nay, the filaments of the stamina may all be wanting; and yet it is a flower, provided the anthers and stigma can be traced. The *essence* of a flower then consists in the anthera and

* See Lee's Botany. p. 4.

the stigma; and they constitute a flower, whether they be supported by a calyx, or surrounded by a petal, or petals, forming that chaplet, coronet, or little crown denominated in Latin, *corolla.* A patient observer may find these nice distinctions illustrated in *ferns*, *mosses*, *mushrooms*, *linchens* and *sea-weeds.*

Let us now examine a complete or perfect flower: and let us first look at

The CALYX; which originally meant the green bottom of a rose bud; but it is now extended to that green flower cup, which is generally composed of five small leaves; and which incloses, sustains and embraces the corolla, or painted petals, at the bottom of every flower, and indeed envelops it entirely before it opens, as in the rose. The calyx which accompanies almost all other flowers, is wanting in the tulip, the hyacinth, the narcissus, and indeed the greater part of the liliaceous tribe. The admirably accurate GREW called this part of the flower *the empalement;* and defines it to be the outermost part of the flower, encompassing the other two, namely, the corolla, or what Grew called *the foliature;* and the stamina and pistillum, which he called *the attire.*

The terms *perianthum*, *involucrum*, *amenthum*, *spatha*, *gluma*, *calyptra* and *volva*, are but different appellations of the varied calyx. LINNÆUS tells us, that the calyx is the termination of the cortical epidermis, or outer bark of the plant; which, after accompanying the trunk or stem through all its

branches, breaks out at the bottom of the flower, in the form of the flower cup. In the sexual system, or, as some will have it, the allegory of the illustrious Swede, the calyx is rarely one entire piece; but of several, one laid over the other. This structure serves to keep the whole flower or composition tight, and at the same time, allows it to recede, as the parts of fructification increase in size: it is like slackening the laces of the stays, stomachers or bodices, in cases and circumstances not entirely dissimilar. Flowers standing on a firm basis, as tulips, have no calyx; but where the foot of each petal is long, slender, and numerous, as in pinks, they are kept within compass by a double calyx. In a few instances, the calyx is tinctured with a different colour than green; and then it is not easy to distinguish the painted calyx from the painted corolla. Linnæus however gives this simple rule; the corolla, in point of situation, is ranged *alternately* with the stamina; whereas, the segment of the calyx stands opposite to to the stamina. Thus much for the calyx.

The Corolla is the circle of beautiful coloured leaves, which stands within the calyx, forming a chaplet, composed of a petal or petals; for so we call those delicately painted leaves, which excel in beauty every other part of the plant. In the piony, the petals are blood red; in our garden lily, a rich and delicate white; and in tulips and violets, charmingly variegated. The number of petals in a flower is to be reckoned from the base of the corolla; and

the number of the segments from the middle of it. If the petals are quite distinct at the bottom, the flower is said to be polypetalous, or to consist of more petals than one; but if the petals are united at bottom, though ever so slightly, then the flower is monopetalous, or consisting of one petal only; thus the cranberry is monopetalous, and not tretapetalous, because, though the petals fall off in four distinct parts, they were originally united at the base.* A bell-shaped flower consists of one petal, and is denominated *corolla campanulata*, and a funnel-shaped flower, *corolla infundibuliformis;* a gaping flower *corolla ringens;* but the *corolla cruciformis* consists of four petals; and the butterfly shaped flower, or *corolla papilionacea*, consists of five petals, as in the pea blossom. The number *five* is most remarkably predominant in the petals of flowers.

There are, moreover, irregular flowers, consisting of dissimilar parts, which are generally accompanied with a *nectarium*, as in the larkspur. The nectarium, so called from nectar, the fabled drink of the gods, is that part or appendage of the petals, appropriated for containing, if not secreting, the honey, whence it is taken by the bees. All flowers are not provided with this receptacle for honey, although it is probable that every flower has a honey-secreting gland. The irregularity of the form and position of this receptacle frequently puzzles young botanists. Sometimes the nectarium makes part of the calyx;

* Philosoph. Botan. Linnæi.

sometimes it is fixed in the common base, or receptacle of the plant. Plants in which the nectaria are distinct from the petals, that is, not lodged within their substance, are generally poisonous.* If the nectarium do not exist as a distinct visible part, it probably exists as a pore or pores in every plant.† It may hereafter be demonstrated, that this secretory apparatus is primarily necessary to the fructification of the plant itself. Rousseau says, that the nectaria are one of those instruments destined by nature to unite the vegetable to the animal kingdom; and to make them circulate from one to another. A flower and an insect have great resemblance to each other. An insect is nourished by honey. May it not be needful that the flower, during the process of fructification, should be nourished by honey from the nectaries? Sugar is formed in the joints of the canes, for, perhaps, a similar purpose.

THE STAMINA, AND THE PISTILLA.

Within the corolla stands, what Grew called the *attire;* but what are now called the *stamens* and *pistils*, which in the sexual system, and Linnæan hypothesis of generation, are the most important organs of a plant; for on the number and respective

* Philosoph. Botan.

† All the *grasses* have nectaries. In the Passion flower, it is a triple crown or glory.

position of the stamens and pistils, that prince of botanists has founded his famous *sexual system.*

The *stamina* are filaments or threads issuing from about the middle of the flower. Each stamen or thread is surmounted by a prominence or button, containing a fine powder. This protuberance is called the anthera; which is a capsule with one, two, or more cavities.* The summit of each stamina is called by way of pre-eminence, *anthera*, or *flower*. It contains the *pollen*, which term means in Latin the very fine dust in a mill. Some conceive this dust to be infinitessimally small eggs or seeds, or rather organic particles, or *molecules;* others compare it to the seminal fluid in animals. This pollen, or fecundating powder is very conspicuous in the tall, white garden lily. This powder is collected by the bees; and is formed by some secret process in their bodies into wax; which is a singular species of vegetable oil, rendered concrete by a peculiar acid in the insect.

The *pistillum*, which is the Latin word for a pestle, stands in the centre of the flower: this term has been adopted, from the fancied resemblance of a pestle in a mortar. It is placed on the germen, or seed bud; its summit is called stigma, and in many flowers resembles that bone of the arm, denominated the *os humeri;* but its form varies in different kinds of flowers. The surface of the stigma is cov-

* See Grew's graphic descriptions, from plate 55 to 64 inclusive, where these capsules, with their pollen are finely delineated.

ered with a glutinous matter, to which the fecundating powder of the anthera adheres.

The *germen* is then the base of the pistillum, and contains the rudiments of the seed; which in the process of vegetation swells and becomes the seed vessels. It answers to the ovarium, or rather uterine apparatus of animals. The pericarpium is the germen grown to maturity; or the plant big with seed.

The *receptacle* is the base, which connects the before mentioned parts together.

Fructification is a very significant term: it is derived from *fructus*, fruit; and *facio*, to make: we are not entirely satisfied with the definition, which our great master has given of this compound word: he says, it is a temporary part of plants appropriated to generation, terminating the old vegetable, and beginning the new. We have just described the seven parts of fructification; when recapitulated, they are in order, as follows:

I. The CALYX.

II. The COROLLA.

III. The STAMINA.

IV. The PISTILLUM.

V. The GERMEN, or *Pericarpium.*

VI. The SEED; and

VII. The RECEPTACLE.

Having described the seven several component parts of that beautiful offspring of a plant, denominated a *flower*, we have now leisure to make a few remarks on the whole composition.

We cannot readily believe, with most botanists, that the petals, or to take them collectively, the corolla, have no other use in the vegetable economy, than merely to cover and guard the sexual organs. It militates against one of the most conspicuous laws of nature, where we never see a complicated contrivance, for a simple end or purpose; but always the reverse. There is a pulmonary, or *breathing* system in every vegetable. An artery belongs to each portion of the corolla; which conveys the vegetable blood to the extremities of the petal, there exposing it to the *light* and to the *air*, under a delicate membrane; which covers the internal surface of the petal; where it often changes its colour, and is seen beautifully in party-coloured tulips and poppies.* The vegetable blood is collected at the extremities of, what Darwin calls, the coral arteries, and is returned by correspondent veins, exactly as he describes it in the green foliage.

It is presumed, that this breathing, and circulating structure, has for its end, the sustenance of the anthers and stigma; as well as for the elaboration of honey, wax and essential oil; and for perfecting the prolific powder. The poetical author of the *Botanic*

* See Darwin's Phytologia.

Garden imagines, that as the glands which secrete the honey, and perfect the pollen, and prepare and exalt the odoriferous essential oil, are attached to the petals, and always fall off and perish with them, it is an evidence that the vegetable blood is elaborated, and *oxygenated* in this pulmonary system of the flower, for the express purpose of these important secretions. I leave to the philosophic botanist to determine, whether there be more of hypothesis than demonstration in this assertion. We should, however, bear in mind this fact, that as the green leaves constitute the organs of respiration to the leaf-buds, so the *bractes* perform the same office to the flower buds.

Assuredly there are few things in nature, that delight the eye and regale the smell, like, what Milton calls, "*the bright, consummate flower.*" Some of them far exceed the finest feathers, the most brilliant shells; or the most precious stones, or costly diamonds. This appears to have been the judgment of the learned and tasteful, in all ages. The term *flower* has been always used to express the most excellent and valuable part of a thing; it is synonymous with embellishment, or ornament; it is used to express the prime, acme or perfection of an individual in the animal kingdom; as well as the most distinguished and most valuable mental acquirement; as the flower of the family, the flower of the army, the flower of chivalry. To say, that "he cropt the flowers of every virtue," is to express all that can be conceived of human perfection.

By the expressive term of *fructification*,* botanists mean, not only the evanescent flower, but the green or imperfect fruit; for they cannot well be separated; as a growing plant like a living animal, remains not a moment the same; but is continually changing: hence fructification is defined by Linnæus to be a temporary part of plants, terminating the old vegetable, and beginning the new. The perfection of the vegetable consists in its fructification; the essence of the fructification consists in the flower and fruit; the essence of the flower consists in the antheræ and stigma; and the essence of the fruit consists in the seed; and the essence of the seed consists in the corculum, which is fastened to the cotyledon; and the essence of the corculum consists in the plumula, in which is the *punctum vitæ* of the plant itself; very minute in its dimensions; but capable, by the combination of intrinsic caloric, with its innate oxygen, of increasing like a bud, to infinity.

From this view of the produce of fructification, the disciples of Linnæus have learnt the following principles;

1st. That every vegetable is furnished with flower and fruit; there being no species where these are wanting.

2d. That there is no fructification without anthera, stigma, and seed.

* Fructification comprehends the *new* state of the flower, and the *futurition* of the fruit.

3d. That the antheræ, and stigma constitute a a flower, whether the petals or corolla be present or or not.

4th. That the seed constitutes a fruit, whether there be a pericarpium or not.*

Linnæus's theory of fructification is this: he supposes, that the medullary part of a plant, that is to say, the pith, must be joined with the external, or cortical part, for the purpose of producing a new one. If the medulla be so vigorous as to burst through its containing vessels, and thus mix with the cortical part, a bud is produced, either on the branches or the roots of vegetables; otherwise the medulla is extended till it terminates in the pistillum, or female part of the flower; and the cortical part is likewise elongated, till it terminates in the antheræ, or male part of the flower; and then the fecundating dust, from the latter, being joined to the prolific juices of the former, produces the seeds, or new plants; at the same time, the inner rind is extended into the petals or corolla; and the outer bark into the calyx.† This view of a plant will illustrate the assertion in a former number, that the seven essential parts, discoverable in the section of a trunk of a tree, may be discerned in its blossom.

Plants, more especially, "the bright, consummate flower, *spirits odorous breathe.*" On what does

* See Lee's epitome of the works of Linnæus. Chap. ix.

† See Darwin. p. 83.

this agreeable odour depend? The chemists say on the oil; but this is not going far enough. The agitation of this matter must be postponed to next month.

THE BOTANIST.

N°. XVII.

In our sketch of the History of Botany, we spoke of that *par nobile fratrum*, *John* and *Caspar Bauhin*. We said that each of these indefatigable men undertook an universal history of plants; with a synonymy, or exact list of the names that every plant bore in all the writers which preceded them. Their works, which are examples of vast knowledge and solid labours, are still the guide to all those who wish to consult antient authors on botany. After their death, which happened between the years 1624, and 1630 scarcely any author wrote on medicine, but wrote more or less on botany.

Hyéeronymus Bouc, a German, was the first of the moderns who has given a *methodical* distribution of vegetables. In his history of plants, published in 1532, he divides the eight hundred species there described into three classes, founded on their qualities, habit, figure and size. *Clusius* endeavourde soon after to establish the natural distinction of

Theophrastus, which was into trees, shrubs, and undershrubs. Others attempted to characterize plants by the roots, stems, and leaves, but all were found insufficient. It was thirty years from this time, that *Gesner* suggested the first idea of a system founded on the *flower* and *fruit*. But the application of this suggestion was not made until twenty years afterwards by *Cæsalpinus*, a physician, and professor of botany at Padua. Yet this system of Cæsalpinus, founded on scientific principles, perished, or rather slept for nearly a century, when it was awakened by Dr. *Morison* of Aberdeen. The next systematical arrangement of plants was given by the learned and pious Mr. *Ray*. His general history of plants contains eighteen thousand six hundred and fifty-five species and varieties. He allows one division to such plants as grow at the bottom of the sea; or upon rocks that are surrounded by that element; but naturalists have now removed these from the vegetable to the animal kingdom. Then *Herman* of Leyden published his systematic arrangement; and soon after the famous *Boerhaave* favoured the public with his plan. About this time, or a little anterior, viz. the year 1700, the celebrated *Tournefort* came forth with his learned and extensive botanical system; then *Knaut*, *Ludwig*, *Pontedra* and *Magnolius*. It appears that Cæsalpinus followed Gesner; Morison Cæsalpinus; Ray improved upon Morison; Knaut abridged Ray; Herman formed himself partly on Morison, and partly on Ray, while Boerhaave took the indefatigable Her-

man for his guide. But it was *Tournefort* of France who surpassed all his predecessors in supplying a clue to the vegetable kingdom. Intricate as is this system, it was the most complete the world had ever seen. The French nation were proud of it; and gloried in giving an everlasting botanical system to an admiring world. Yet Tournefort did but clear the way for one still greater than himself; for in the year 1735 arose the sun of the botanical world, LINNÆUS; of whose system we can give here only a mere sketch or outline.

Excepting *Aristotle*, the antient writers on Natural History had no systematical arrangement; but described plants and animals as they came to hand. The boundaries of natural history have been so enlarged by modern enterprize and industry, that it has become necessary to class and sort this vast multitude, or the student of nature would be lost in the exuberance before him. It is natural enough, says that pleasant writer Goldsmith, for ignorance to lie down in hopeless uncertainty; and to declare, that to particularize each body is utterly impossible; but it is otherwise with the active, searching mind: no way intimidated with the immense variety, it begins the task of numbering, grouping and classing all the various kinds that fall within its notice; finds every day new relations between the several parts of creation, acquires the art of considering several at a time under one point of view; and at last begins to find that the variety is neither so great,

nor so inscrutable as was first imagined.* It is a difficult task to find out a particular man in an immense crowd, or mob of people; but if this promiscuous jumble of people be systematized, or arranged into brigades, regiments, companies, and platoons, we shall be able to find the individual without much difficulty. It is thus in a systematical arrangement of vegetables. *Bonnet* has, in a great measure, disregarded system; and *Buffon* has treated it with contempt. But the eloquent author of the "History of the Earth and Animated Nature" justly remarks, that books are written with opposite views; some only to be read; and some only to be occasionally consulted; that the methodists have sacrificed to order alone all the delights of the subject, all the acts of heightening, awakening, or continuing curiosity. But he adds, that systematical arrangements "have the same use in science that a dictionary has in language; but with this difference, that in a dictionary we proceed from the name to the definition; in a system of natural history we proceed from the definition to find out the thing. Without the aid of system, Nature must still have lain undistinguished, like furniture in a lumber-room; every thing we wish for is there indeed; but we know not where to find it."

The Botanist will not conceal that he attempted, some years ago, what some perhaps would call an heretical innovation against the Linnæan creed. It has

* See History of the Earth and Animated Nature, Vol. 2. Chap. xvi.

however served, like every other heresy, to fix more firmly the true doctrine. When he commenced these monthly essays, botany was scarcely known in our commonwealth. While he endeavoured to attract the attention of the youth of both sexes to this subject, he hoped to remove the objection, often urged by parents, against the Linnæan doctrine and phraseology. In fewer words; he hoped he could drop the Linnæan metaphor of generation; and substitute that of *nutrition*, and thereby obviate the objection just mentioned. In his first essay, his plan appeared plausible, and his progress pleasant. But as he went on, he found himself more and more encumbered with unmanageable and awkward materials. The Botanist knows no other distinguishing mark which divides the animal from the vegetable, than that the one has a stomach for receiving and digesting its food; and the other has none. But then, he found that his meditated innovation would trespass against a law which he had acknowledged.—To be more explicit—He communicated his delicate plan to a sensible friend;—whether *une sage femme*, or *une femme sage*, imports not. The answer determined its fate. "You "will be laughed at. If you refine too much, you "will create in young people, the very evil you ap- "prehend. Remember Rosseau's comment on the "fox, the crow, and the cheese. What you call the "the objectionable part of botany is the principal "stimulus to its study. Divest it of that charm, "and you will diminish the number of its admirers

"among the men. Then burn your nonsense, and "glorify LINNÆUS."

The opinion of Sir Joseph Banks had no small influence in diverting the Botanist from his project for while under the influence of it, he had written to that celebrated Naturalist. He in answer says :— "How can you and I correspond about a plant, which "you may have found in America, or I in Europe, "and is known but to one of us, unless we have "agreed on a technical language, by which we can "describe to each other the constituent parts; and "by that means agree to what known plant it bears "the greatest resemblance. The Linnæan system "is not certainly to be considered as free from "faults. All human contrivance will abound with "them. But still I cannot help allowing that, as "far as I know, it is the best hitherto invented, by a "great interval; and as such, is now, in a manner "invariably received by the whole learned world."

We therefore present our readers with a sketch of this famous system.

THE OUTLINES OF

LINNÆUS'S SYSTEM OF VEGETABLES.

THE sexual system, as invented and given to the world by Linnæus, is built or founded on the *male* and *female* parts of FRUCTIFICATION. By fructification is meant *flower* and *fruit;* and is disposed according to the number, proportion and sit-

uation of the *stamens* or *pistils*, or the male and female organs.

For the sake of brevity of expression, he has had recourse to the Greek language. *Andria*, from Ανηρ, a husband, he has applied to the stamen; and *gynia*, from γυνη, a wife, to the pistil. The STAMEN consists of two parts:—first, the *filament* is that part which elevates the anthera;—second, the *anthera* is the part that bears the pollen, or farina fæcundans, that impregnates the pistillum or germen.

First, The PISTILLUM consists of three parts; the *germen* or embryo of a future fruit;—second, the *style*, which elevates the stigma;—third, the *stigma* or summit, which is covered with a moisture, that dissolves the farina fæcundans of the anthera, fitting it for vivification.

Of the CLASSES and ORDERS, with the names of plants exemplifying them.

MONANDRIA

CONTAINS II. ORDERS.

One Stamen in the Hermaphrodite Flower.

Class I.	Order I. *Monogynia*	E. G.	Canna.
	Order II. *Digynia*		Blitum.

DIANDRIA

CONTAINS III. ORDERS.

Two Stamens in the Hermaphrodite Flower.

Class II.	Order I. *Monogynia*	E. G.	Monarda.
	Order II. *Digynia*		Anthoxanthum.
	Order III. *Trigynia*		Piper.

TRIANDRIA

CONTAINS III. ORDERS.

Three Stamens in the Hermaphrodite Flower.

Class III.	Order I.	*Monogynia*	E. G.	Crocus.
	Order II.	*Digynia*		Avenna.
	Order III.	*Trigynia*		Mollugo.

TETRANDRIA

CONTAINS III. ORDERS.

Four Stamens in the Flower with the Fruit.

(If two proximate Stamens are shorter, let it be referred to Class XIV.)

Class IV.	Order I.	*Monogynia*	E. G.	Dipsacus.
	Order II.	*Digynia*		Hammamelis.
	Order III.	*Tetragynia*		Potamogeton.

PENTANDRIA

CONTAINS VI. ORDERS.

Five Stamens in the Hermaphrodite Flower.

Class V.	Order I.	*Monogynia*	E. G.	Nerium.
	Order II.	*Digynia*		Anethum.
	Order III.	*Trigynia*		Turnera.
	Order IV.	*Tetragynia*		Parnassia.
	Order V.	*Pentagynia*		Crassula.
	Order VI.	*Polygynia*		Myosurus.

HEXANDRIA

CONTAINS V. ORDERS.

Six Stamens in the Hermaphrodite Flower.

(If of this, two opposite Stamens are shorter, it belongs to Class XV.)

Class VI.	Order I.	*Monogynia*	E. G.	Amaryllis.
	Order II.	*Digynia*		Oryza.
	Order III.	*Trigynia*		Rumex.
	Order IV.	*Tetragynia*		Petiveria.
	Order V.	*Polygynia*		Alisma.

HEPTANDRIA.

CONTAINS IV. ORDERS.

Seven Stamens in the same Flower with the Pistillum.

Class VII.
- Order I. *Monogynia*
- Order II. *Digynia*
- Order III. *Tetragynia*
- Order IV. *Heptagynia*

E. G.
- Aesculus.
- Limeum.
- Saururus.
- Septas.

OCTANDRIA

CONTAINS IV. ORDERS.

Eight Stamens in the same Flower with the Pistillum.

Class VIII.
- Order I. *Monogynia*
- Order II. *Digynia*
- Order III. *Trigynia*
- Order IV. *Tetragynia*

E. G.
- Oenothera.
- Galenia.
- Polygonum.
- Adoxa.

ENNEANDRIA

CONTAINS III. ORDERS.

Nine Stamens in the Hermaphrodite Flower.

Class IX.
- Order I. *Monogynia*
- Order II. *Trigynia*
- Order III. *Hexagynia*

E. G.
- Cassyta.
- Rheum
- Butomus.

DECANDRIA

CONTAINS V. ORDERS.

Ten Stamens in the Hermaphrodite Flower.

Class X.
- Order I. *Monogynia*
- Order II. *Digynia*
- Order III. *Trigynia*
- Order IV. *Pentagynia*
- Order V. *Decagynia*

E. G.
- Kalmia.
- Saxifraga.
- Stellaria.
- Oxalis.
- Phytolacca.

DODECANDRIA

CONTAINS V. ORDERS.

Stamens from twelve to nineteen in the Hermaphrodite Flower.

Class XI.	Order I.	*Monogynia*	E. G.	Asarum.
	Order II.	*Digynia*		Agrimonia.
	Order III.	*Trigynia*		Euphorbia.
	Order IV.	*Pentagynia*		Glinus.
	Order V.	*Dodecagynia*		Sempervivum.

ICOSANDRIA.

CONTAINS V. ORDERS.

The Stamens inserted (not in the Receptacle, but) in the inside of the Calyx.—Commonly twenty, often more.

Class XII.	Order I.	*Monogynia*	E. G.	Punica.
	Order II.	*Digynia*		Cratægus.
	Order III.	*Trigynia*		Sorbus.
	Order IV.	*Pentagynia*		Pyrus.
	Order V.	*Polygynia*		Rubus.

POLYANDRIA

CONTAINS VII. ORDERS.

The Stamens inserted in the Receptacle from twenty to an hundred, in the same with the Pistil in the Flower.

Class XIII.	Order I.	*Monogynia*	E. G.	Sarracenia.
	Order II.	*Digynia*		Fothergilla.
	Order III.	*Trigynia*		Aconitum.
	Order IV.	*Tetragynia*		Tatracera.
	Order V.	*Pentagynia*		Aquilegia.
	Order VI.	*Hexagynia*		Stratiotes.
	Order VII.	*Polygynia*		Ranunculus.

DIDYNAMIA

CONTAINS II. ORDERS.

Four Stamens, of which two are close together, and are longer.

Class XIV.	Order I.	*Gymnospermia*	E. G.	Melittis.
	Order II.	*Angiospermia*		Melianthus.

TETRADYNAMIA

CONTAINS II. ORDERS.

Six Stamens; four of which are long, the two opposite short.

Class XV. { Order I. *Siliculosa* / Order II. *Siliquosa* } E. G. { Lunaria. / Cheiranthus.

MONADELPHIA

CONTAINS V. ORDERS.

The Filaments of the Stamens grown together into one Body.

Class XVI. { Order I. *Pentandria* / Order II. *Enneandria* / Order III. *Decandria* / Order IV. *Dodecandria* / Order V. *Polyandria* } E. G. { Hermannia. / Dryandra. / Geranium. / Pentapetes. / Alcea.

DIADELPHIA

CONTAINS IV. ORDERS.

The Filaments of the Stamens grown together into two Bodies.

Class XVII. { Order I. *Pentandria* / Order II. *Hexandria* / Order III. *Octandria* / Order IV. *Decandria* } E. G. { Monnieria. / Fumaria. / Polygala. / Lathyrus.

POLYADELPHIA

CONTAINS III. ORDERS.

The Filaments of the Stamens grown together into three or more Bodies.

Class XVIII. { Order I. *Pentandria* / Order II. *Icosandria* / Order III. *Polyandria* } E. G. { Theobroma. / Citrus. / Hypericum.

SYNGENESIA

CONTAINS VI. ORDERS.

The Stamens with the Antheras grown together in Form of a Cylinder (having rarely Filaments.)

Class XIX.	Order I. *Polygamia Æqualis*	E. G.	Leontodon.
	Order II. *Polygamia Superflua*		Xeranthemum.
	Order III. *Polygamia Frustranea*		Helianthus.
	Order IV. *Polygamia Necessaria*		Calendula.
	Order V. *Polygamia Segregata*		Echinops.
	Order VI. *Monogamia*		Lobelia.

GYNANDRIA

CONTAINS VIII. ORDERS.

The Stamens inserted on the Pistil (not on the Receptacle.)

Class XX.	Order I. *Diandria*	E. G.	Orchis.
	Order II. *Triandria*		Sisyrinchium.
	Order III. *Tetrandria*		Nepenthes.
	Order IV. *Pentandria*		Passiflora.
	Order V. *Hexandria*		Aristolochia.
	Order VI. *Decandria*		Helicteres.
	Order VII. *Dodecandria*		Cytinus.
	Order VIII. *Polyandria*		Arum.

MONOECIA

CONTAINS XI. ORDERS.

The Male and Female Flowers on the same Plant.

Class XXI.	Order I. *Monandria*	E. G.	Zanichellia.
	Order II. *Diandria*		Lemna.
	Order III. *Triandria*		Tripsacum.
	Order IV. *Tetrandria*		Urtica.
	Order V. *Pentandria*		Parthenium.
	Order VI. *Hexandria*		Pharus.
	Order VII. *Heptandria*		Guettarda.
	Order VIII. *Polyandria*		Juglans.
	Order IX. *Monadelphia*		Pinus.
	Order X. *Syngenesia*		Momordica.
	Order XI. *Gynandria*		Andrachne.

DIOECIA

CONTAINS XIV. ORDERS.

The Male Flowers on a different Plant from the Female

Class XXII.	Order I.	*Monandria*	E. G.	Pandanus.
	Order II.	*Diandria*		Salix.
	Order III.	*Triandria*		Empetrum.
	Order IV.	*Tetrandria*		Viscum.
	Order V.	*Pentandria*		Humulus.
	Order VI.	*Hexandria*		Tamus.
	Order VII.	*Octandria*		Populus.
	Order VIII.	*Enneandria*		Mercurialis.
	Order IX.	*Decandria*		Kiggelaria.
	Order X.	*Dodecandria*		Menispermum.
	Order XI.	*Polyandria*		Cliffortia.
	Order XII.	*Monadelphia*		Juniperus.
	Order XIII.	*Syngenesia*		Ruscus.
	Order XIV.	*Gynandria*		Clutia.

POLYGAMIA

CONTAINS III. ORDERS.

Hermaphrodite and Male or Female Flowers on the same Plant.

Class XXIII.	Order I.	*Monoecia*	E. G.	Veratrum.
	Order II.	*Dioecia*		Fraxinus.
	Order III.	*Trioecia*		Ficus.

CRYPTOGAMIA

CONTAINS IV. ORDERS.

The Flowers within the Fruit; or in so singular a mode, as not to be perceptible to the eye.

Class XXIV.	Order I.	*Filices*	E. G.	Polypodium.
	Order II.	*Musci*		Bryum.
	Order III.	*Algæ*		Fucus.
	Order IV.	*Fungi*		Agaricus.

PALMÆ.

Class XXV. *Palms:* the flowers borne on a *spadix*, and within a *spathe*. E. G. Cocos.

The ORDERS are taken from the FEMALES, or PISTILS, as the CLASSES are from the MALES, or STAMENS; but in the classes of the Syngenesia the orders differ from the rest:

FOR EXAMPLE—

MONOGYNIA, DIGYNIA, TRIGYNIA, &c. Γυνή Femina, with the prefixing of the Greek number μόνος one, δις two, τρεῖς three, τεσσαρες four, &c.

Which means, The Pistil, 1, 2, 3, 4, &c.—Here the number of the pistils is taken from the basis of the styles; if the basis should be deficient, then the calculation is to be made from the number of the stigmas.

POLYGAMIA ÆQUALIS.

That is, Of many Flosculi furnished with stamens and pistils. Flowers of this sort are for the most part commonly called *flosculous*.

POLYGAMIA SPURIA.

That is, Where hermaphrodite flosculi occupy the disk, and that female flosculi surround the margin, which are deprived of stamina, and that in a three-fold manner.

SUPERFLUOUS.

That is, That when the flowers of the hermaphrodite disk are furnished with a stigma, and pro-

duce seeds, the female flowers also, that constitute the radius, produce seeds in like manner.

FRUSTRANEOUS.

That is, When the flowers of the hermaphrodite disk are furnished with a stigma, and produce seeds; but the flosculi constituting the radius, being deprived of a stigma, cannot produce seeds.

NECESSARY.

That is, When the hermaphrodite flowers, through a defect of the stigma or pistil, cannot perfect their seeds; but female flowers in the radius produce perfect seeds.

SEGREGATED.

That is, When several floriferous calyxes are contained in a calyx common to all, so as to form only one flower.

The young student of botany will understand the preceding sketch of the Linnæan System, if he have recourse to the "Letters on the Elements of Botany, addressed to a Lady," by the celebrated J. J. Rousseau, translated by Dr. Martyn. If to this pleasant guide, he should add John Miller's engraved illustrations of the sexual system of Linnæus, he will be soon able to proceed without the help of books; as it regards the system. It is superfluous to add a word to what has been said, throughout

these essays, respecting the botanical writings of Linnæus. But "botany is not to be learnt in the closet: you must go into the garden or the fields, and there become familiar with Nature herself; with that beauty, order, regularity, and inexhaustible variety, which is to be found in the structure of vegetables; and that wonderful fitness to its end, which we perceive in every work of creation."*

THE BOTANIST.

N°. XVIII.

THE bright, consummate FLOWER, says the most learned of poets, "*spirits odorous breathes.*" Let us now enquire on what this odour depends. The chemist tells us, that it depends on the *oil* of the plant. But we are dissatisfied with this vague answer. A vegetable distils two kinds of oil, differing very much from each other; the one is *fixed*, and the other *volatile*. The fixed oil is combined with mucilage; the volatile, with the *aroma*, or *spiritus rector* of the plant. The *fixed* oil is found only in the seeds; and is confined almost entirely to those which have two cotyledons, as in the flax-seed, almonds, and rape-seed. But the

* Martyn's preface to Rousseau's letters.

volatile oil is found in every part of a plant, except the cotyledons of the seeds, where it never occurs; and is distinguished pre-eminently in *Milton's* bright, consummate flower.

When we say that the fine fragrance of a flower depends on its *volatile* oil; or that its *aromatic* virtue is contained in it, and hence called its *essential* oil, we do not go quite far enough. We are so far from being admitted, says the profound LOCKE, into the secrets of nature, that we scarcely approach the first entrance. We overlook the operations of those invisible fluids, which encompass them, upon whose motions and operations depend those qualities,* for which they are most remarkable. Thus this essential oil contains something more subtile and active than itself; a *spirit*, an exceedingly minute, volatile, and scarcely ponderable spirit, which, when separated, leaves nothing peculiar in the remaining oil. This is the *spiritus rector* of the old chemists, the predominant, prevailing, paramount, or *ruling* spirit of the plant. This aëriform fluidity, gas, or spirit, denominate it which you will, and which is inimitable by art, imparts that smell, taste, and medicinal virtue to that peculiar species of plants, and is found in no other. The *fixed* oil of a plant is innate; but the *essential* oil is the effect, or the result of the vegetable economy, operating in perfect health, and in full perfec-

* What *Locke* calls "QUALITIES," *Aristotle*, and some other ancients, called FORMS.

tion, while drawing its sustentation from its native earth and air.

The essential oils of plants have their respective characteristics from their *aroma*, or spirits. The volatile oil serves, in some degree, for enveloping, arresting, and preventing a too sudden, and too copious expenditure of them; while the fixed oil serves only for connecting the solid parts together, like the oil or fat in animals. The difference in the nature of these two oils, is therefore very wide. How different must be the medicinal virtues of the root—the wood—the leaf—the flower—the fruit, and the seed of the same plant? Yet we physicians have been in the habit of pounding up an entire vegetable in a mortar, and squeezing out the juices of it, and of giving this mixture of every thing to the sick; and from its operation we pronounce on its predominant medicinal virtue. Those who filled our systems of *Materia Medica* with *Galenical* preparations, had no idea of the subtile structure and economy of a vegetable. While transforming a plant into an ointment, who ever thinks of its structure? And who that has attended closely to its structure and economy, can rely on its analysis by *fire*, which reduces every plant to the same *coal*, the same *earth*, and the same *salt?*

Some of our readers may be of the opinion, that by fixing our eyes too intently on the poetical flower of Milton, we have strayed from the enlightened path of modern chemistry, into such a thicket of odoriferous flowers as to become, if not stupified,

at least, so far bewildered as not to be able to find our way out. We are aware that the term *spirit*, is not fashionable. We mean by it, the finest and most subtile parts of bodies; the most active part of matter, with regard to its facility of motion, in comparison with the grosser parts: we mean that which is discoverable by its smartness to the smell; and that which rises first in distillation. The name of spirit, was formerly given to any subtile, volatile substance, that exhaled from bodies in a given degree of heat: and, by a sort of imaginary analogy, was transferred to the human system: hence the term *animal spirits;* which was ingeniously supposed to reside in the *nervous fluid*, as the *spiritus rector* resides in the essential oil of plants.

If the term *spirit* should displease the fastidious critic, we would remind him that *spirit*, in the German language, is *gaseht;* whence is derived the English word *ghost* or *spirit;* and hence our fashionable word *gas*, or *gaz;* by which we are to understand an exceedingly rare, highly elastic, and invisible fluid, not condensible by cold. Should the critic persist in refusing his imprimatur to the term spirit, or *spiritus rector*, we will compound with him, by giving him in its stead, the word *quintessence;* by which we mean the specific essence, the active principle, by the power of which medicines operate. By this term was meant the predominant, ruling, or distinguishing part of medicinal simples which can be separated, in imagination, from the tangible body, leaving its organiza-

tion entire. To be still more particular: The antient philosophers, and after them, our old chemists conceived that *fire—air—water*, and *earth* contributed to the composition of all vegetables; to all which was added a *fifth* thing, or *ens*, which enriched and distinguished the whole, by its own particular efficacy; and on which the odour, taste, and virtue of each plant depended: they therefore asserted, that each species of plants was made up of the *four* common elements; but to these was added a *fifth;* which, though small in quantity, was the most powerful, efficacious, and predominant of its component parts: this therefore they called the *fifth* essence; or, as expressed in Latin, the *quinta essentia.*

The knowledge of *quintessences* was considered two hundred years ago, as the utmost bounds, the *ne plus ultra* of chemical perfection. Is not this precisely the case, at present, with the knowledge of *gases*, or *spirits?*

We have said, that all aromatic plants contain a volatile oil; but this aromatic oil does not reside in the same part in every kind of plant: sometimes indeed we find it distributed through the whole plant, as in the *Bohemian angelica:* sometimes it exists only in the bark, as in *cinnamon. Balm, mint, rosemary,* and *wormwood* contain their essential oil in their leaves and stems; while the *elecampane* and *florentine iris* deposite it in their roots. All the *terebinthenate*, or resin-bearing trees, have it in their young branches; while the *chamomile* and

the *rose* have it in their petals. Many fruits contain it throughout their whole substance, as *pepper* and *juniper*. *Oranges* and *lemons* contain it in their rind or peel. The *nutmeg-tree* bears its essential oil in the nut, and its immediate envelopment, or rather its second envelopment, which is *mace*. The seeds of the *umbelliferous* plants, such as *fennel*, *cummin*, and *anise* have the vesicles of essential oil along the projecting lines of their skin.

Passing from the *aroma* of plants to those qualities which powerfully affect the organs of *taste*, we remark that the taste of essential oils is pungent, or hot. But it is curious that the taste of the plant does not always influence that of its essential oil; for the oil of pepper has no extraordinary acrimony; and that which is obtained from *wormwood* is not bitter: and so of *colour*; the oil of *red* roses is *white*; the oil of lavender *yellow*; and that of chamomile a fine *blue*. The oil of parsley is of a *bright green*, and that of millefoil a *sea green*. This is a valuable part of botany; and ought to be diligently pursued in this country.

Have not some devotees to system led students of botany to neglect the great use and end of this science? Far be it from us to slight system. We are its advocates; 'method is the soul of science.'* But we wish to remind some of our readers of the subordinate rank which it holds to the great and ultimate end of botany. Far be it from the Botanist

* Bacon.

to speak lightly of the pleasure derived from the sight of an elegant, and splendid plant. Amidst the insatiable variety of nature, few are its productions that can be placed in competition with a beautiful, odoriferous flower. The most gorgeous feathers captivate the sight merely by the richness of their colours; and the most brilliant gem but dazzles the eye by its splendour; but they are all blanks to the blind man; who is regaled by the fragrance of the rose and the violet; the lily and the jessamine.

THE BOTANIST.

N°. XIX.

If love be any refinement, conjugal love must be certainly so in a much higher degree. It is the parent of substantial virtues and agreeable qualities, and cultivates the mind while it improves the behaviour.

Spectator, N°. 525.

We dedicate the present number to such of our fair country women, as honour these essays with perusal. Our Flora, on this occasion, has bound her cheerful brow with *myrtle* and placed the *white rose* in her bosom.* We have moreover selected

* Plants sacred to love in ancient mythology.

for a motto, a passage from that accomplished scholar and friend of the sex, ADDISON, as containing a charming sentiment, every way proper to precede the history of a female, who not only shone with uncommon splendour as an artist and a botanist, but was rendered still more conspicuous by the additional lustre of conjugal affection, which virtue she exercised at the darkest periods, and during the most distressful pangs of human calamity.

Our fair readers will pardon us, if we should fail in celebrating conjugal affection, the ground work of all the domestic virtues. Teachers of righteousness themselves may excuse us, if we cast a look of regret to this too much neglected portion of moral philosophy. We have colleges for teaching every art and science. We have minute directions in gardening and agriculture. We have numberless books on the doctrine of business; on self policy, or the art of rising in life; on oratory, and on politics; while that which is worth them all, *the doctrine of domestic happiness*, is left comparatively uncultivated; yet this is that philosophy, spoken of by Lord BACON, which of all others "*comes home to men's business and bosoms.*"

The history of every civilized nation, nay every man's own recollection, affords abundant proofs, that the female mind is equally capable with that of the male. It is situation and circumstances that rouse the latent energies of the female soul. Whence is it, that the children of widows become generally better men and better women, than chil-

dren brought up in conjunction with the father? It is because afflictive circumstances have called forth the dormant energies of heroic woman, and perfected a virtue peculiar to the sex; a virtue, which originated in conjugal affection. Can this evanescent world, this anxious scene, exhibit a more interesting sight to the philosopher, than a virtuous widow weeping over her "*houseless child of want?*" Yes; there is one picture still more affecting. It is where the father and husband is worse than dead, through his folly and his crimes. Here, if conjugal love has not been ripened into maternal affection, and grown up into the highest of stoical virtues, nay more, sublimed into religion, the wretched woman sinks into intemperance, or is lost in despair. An over anxious and unrestrained fondness is not true maternal affection. The fowls of the air and the beasts of the field have also a blind and furious fondness for their young. Maternal affection is where judgement draws more closely the bonds of nature.

The happiness of the conjugal state appears heightened, says Addison, to the highest degree it is capable of, when we see two persons of accomplished minds not only united in the same interests and affections, but in their taste of the same improvements, pleasures, and diversions. Pliny, one of the finest gentlemen and politest writers among the Romans, has left us, in his letter to Hispulla, his wife's aunt, one of the most agreeable family pieces of this kind ever seen. We refer our readers to the

525th number of the Spectator for the letter itself, and hasten to give an account of an ingenious and excellent woman, who enlivened the dungeon of her husband with flowers, and entwined his fetters with the *white rose* and the *myrtle*.

It is a singular fact, says Dr. Pulteney, that physic is indebted for the most complete set of figures of the medical plants to the genius and industry of a lady, exerted on an occasion, that redounded highly to her praise. The name of

MRS. ELIZABETH BLACKWELL

is well known, both from her own merit and the fate of her unfortunate husband, who, condemned for crimes of state, suffered death on the scaffold in Sweden, in the year 1747.

We are informed, she was the daughter of a merchant in the neighbourhood of Aberdeen; of which city Dr. Alexander Blackwell, her husband, was a native, and where he received an university education, and was early distinguished for his knowledge. After having failed in his attempt to introduce himself into practice, first in Scotland, and afterwards in London, he became corrector to a printing press; and soon after commenced printing himself. But being prosecuted by the trade, and at length involved in debt, was thrown into prison. To relieve these distresses, Mrs. Blackwell having a genius for drawing and painting, exerted all her talents; and, understanding that an herbal of medicinal plants was greatly wanted, she

exhibited to Sir Hans Sloane, Dr. Mead, and other physicians, some specimens of her art in painting plants, who approved so highly of them, as to encourage her to prosecute a work, by the profits of which she is said to have procured her husband's liberty, after a confinement of two years. Dr. Issac Rand was at that time Demonstrator to the Company of Apothecaries, in the garden at Chelsea. By his advice she took up her residence opposite the Physic Garden, in order to facilitate her design by receiving the plants as fresh as possible. He not only promoted her work with the public, but, together with the celebrated Philip Miller, afforded her all possible direction and assistance in the execution of it. After she had completed the drawings, she engraved them on copper, and coloured the prints with her own hands. During her abode at Chelsea, she was frequently visited by persons of quality, and many scientific people, who admired her performances and patronized her undertaking.

On publishing the first volume, in 1737, she obtained a recommendation from Dr. Mead, Dr. Sherard, Dr. Rand, and others, to be prefixed to it. And being allowed to present, in person, a copy to the College of Physicians, that body made her a present, and gave her a public testimonial of their approbation; with leave to prefix it to her book. The second volume was finished in 1739, and the whole published under the following title: "*A curious Herbal, containing* 500 *Cuts of the most useful plants which are now used in the practice of*

Physic, engraved on folio copper-plates, after drawings taken from the life. By Elizabeth Blackwell. To which is added, a short description of the Plants, and their common uses in Physic. 1739." 2 Vol. fol.

The drawings are in general faithful; and if there is wanting that accuracy, which modern improvements have rendered necessary in delineating the more minute parts, yet, upon the whole, the figures are sufficiently distinctive of the subject. Each plate is accompanied with an engraved page, containing the Latin and English officinal names, followed by a short description of the plant, and a summary of its qualities and uses. After these occur the name in various other languages. These illustrations were the share her husband took in the work. This ill-fated man, after his failure in physic, and in printing, became an unsuccessful candidate for the place of secretary to the Society for the encouragement of learning. He was made superintendant of the works belonging to the Duke of Candos, at Cannons, and experienced those disappointments, incident to projectors. He formed schemes in agriculture, and wrote a treatise on the subject, which we are told was the cause of his being engaged in Sweden. In that kingdom he drained marshes, practised physic, and was even employed in that capacity for the king. At length he was involved in some state cabals; or, as some accounts have it, in a plot with Count *Tessin*, for

which he suffered death, protesting his innocence to the last.*

So respectable a performance as Mrs. Blackwell's attracted the attention of physicians on the continent. It was translated into German and republished at Norimburg, in 1750. To this edition was prefixed a most elaborate and learned catalogue of botanical authors. In 1773 a supplemental volume, exhibiting plants omitted by Mrs. Blackwell, was published under the direction of Ludwig, Rose, and Boehmer. In this form the work of this learned and ingenious lady surpassed all that had been published. We hope the patrons of botany, will gratify the ladies of America with a sight of these splendid books, not merely as a valuable treasure of botanical knowledge, but to show the men to what degree of perfection the other sex may ascend, when their talents are brought forth, and sublimed by conjugal affection.

Prior to the time of Mrs. Blackwell, flourished the very ingenious and indefatigable

MARIA SYBIL MERIAN,

Who was born at Francfort in 1647. Her father was a celebrated engraver; and from him she acquired a knowledge of drawing. He placed her under the instruction of an eminent painter, from whom she learnt a remarkable neatness of

* Dr. Pulteney's historical and biographical sketches of the progress of Botany in England.

managing the pencil, and delicacy of colouring. She was particularly fond of painting subjects of natural history; such as plants, reptiles, and insects, which she most commonly drew from nature; at the same time, she studied those objects with a curiosity, and with the inquisitive spirit of a naturalist; so that her knowledge of nature, and the work of her hands, rendered her every day, more and more celebrated. She most commonly painted her subjects on vellum; and in water colours; and she finished an astonishing number. She painted the caterpillar, in all its various changes and forms, in which they successively appear, from their quiescent state, till they become butterflies. Not contented with painting the plants, insects, and reptiles, of her own country, this enterprising woman crossed the Atlantic, and visited Surinam, to paint those plants, insects, and reptiles, which were peculiar to that climate. At her return to Europe, she published two volumes of engravings, which she executed from her own paintings; and which hold a high rank in that art. But they are not equal to her paintings; for her glistening serpents, her wet frogs, and her crawling spiders are executed with horrible precision. This celebrated woman died in 1717. She left a daughter, who painted in the same style; and who had accompanied her mother to Surinam. This young lady published a 3d volume in folio, collected from the designs of her mother; which complete work has

been always admired by the learned, as well as by the professors of painting.*

The Botanist cannot too strongly recommend to his fair readers the art of delineation or drawing. What a decided superiority does a facility in this art give to the person who possesses it, over the one who does not? If the time consumed by our young ladies, in learning to play tolerably ill on sundry musical instruments, were devoted to the charming art of copying nature, and acquiring some knowledge of her works, how beautifully would it embellish our system of female education? This art is not merely in itself amusing, but may be highly useful and important, in a change of fortune, and under the pressure of adverse circumstances, as has been illustrated in the history of the amiable, but unfortunate Elizabeth Blackwell.

THE BOTANIST.

N°. XX.

—Last the bright, consummate FLOWER.

Milton.

WE have already described the parts essential to every flower;† and have showed that botanists were, a long time, puzzled how to define one. A

* See Encyclop. Britan. † See number XVI.

flower is to the plant or herbage, what the human face is to the body ; being that part which particularly marks and characterizes the man. This was Milton's idea, who bestows upon it the epithet of *consummate*, as containing, and expressing an assemblage of all its virtues and excellencies. The antients appear to have had a similar notion of this bright countenance of a plant. Pliny says that blossoms are the joy of trees, in bearing which they assume a new countenance, or aspect, vying with each other in the luxuriance, and variety of their colours. Poets of all ages and nations have run a parallel between man and plants ; and have compared the most blooming and beautiful part of our species to those flowers that are the most charming for their aspect, and their fragrance. So also have the modern poets.

> Upon her head the various wreath;
> The flowers, less blooming than her face;
> Their scent, less fragrant than her breath.*

Throughout inanimate nature, is there any thing which unites so many delightful circumstances as certain flowers? They have a cool, a smooth and polished surface, very grateful to the touch: they have a beauty transcending almost every thing else in nature: they have a fragrance surpassing every thing in creation; and they exude a nectarious fluid, proverbial for its delicious sweetness. Here every sense, excepting the hearing, is regaled.

* Prior.

No part of a plant approaches so near animation as the flowers; and some think that the nectaria are those parts of it, destined by nature to unite the vegetable to the animal kingdom, and so to make them circulate from one to the other; the bee, in this case, being a link in the chain. Some plants discover a remarkable sensibility, or iritability in their stamina and pistilla, or rather in their anthers and stigma, as in our common barberry,* or in rue,† where their motions seem, at times, to mimic animal life.

The pollen and the stigma are always in perfection at the same time. If viewed through a microscope, each particle of pollen appears to be a membranous bag, or bladder, which remains entire till it comes in contact with water, and then it bursts with an elastic force, discharging a most subtile vapour, which we presume impregnates the pistillum, and gradually expands the germ. But, lest these minute capsules should burst, by coming in contact with any moisture, and prematurely emit their vapour, nature has guarded many flowers from its effect, by covering over the pollen with so perfect a *parapluîe*, as in our sarracenia, or *fore-father's-cup*, that it would not be extravagant to suppose, that it might have given the first idea of this instrument. The pollen of the blue iris‡ has a double covering of another kind. The pendant position of some flowers sufficiently guards them

* Berberis communis. † Ruta graveolens. ‡ Iris germanica.

from moisture, at that period of their existence when it would be injurious to them, as in the crown imperial.* Many flowers shew an instinctive sensibility of approaching rain; and in that state of the atmosphere which precedes it, shut up their corrolla, so as to cover completely their anthers and stigma.† Sometimes, indeed, a thunder storm overtakes them by surprise, before they are prepared to close.

Aquatic plants, or such as naturally grow in water, have their pollen carefully guarded from moisture, as we see in the family of Nymphœa. The *Lotos*,‡ celebrated through so many ages and countries, is one of them. This venerated plant closes its flowers, and sinks under water in the night; and rises again in the morning to salute the sun. But none of the aquatic plants is more curious than the *valesnaria spiralis*, which blossoms under wa-

* Fritillaria imperialis.

† The flower of the solanum tuberosum, or potatoe, is a remarkable instance.

‡ Sir William Jones, in speaking of Brimha, Vishnou, and Shiva, as emblematical representations of the Deity, says "the first operations of these three powers are evidently described in the different Pouranas by a number of allegories; and from them we may deduce the Ionian philosophy of primœval water, the doctrine of the mundane egg, and the veneration paid to the *nymphœa* or *lotos*, which was anciently revered in Egypt, as it is at present in Hindostan, Tibet, and Nepal. The inhabitants of Tibet embellish their temples and altars with it; and a native of Nepal made prostrations before it, on entering my study, where the fine plant and beautiful flowers lay for examination."

ter, yet is its fecundating powder secured from moisture.*

Although each bud and flower seems to be a complete system, or individual, yet are they but parts of a whole: for notwithstanding the distance, and difference between the roots of a tree and its flowers, there is a remarkable consent or sympathy between them; for when the roots are exuberant the flowers are defective; yet this is not more surprizing than that instance of sympathy, which subsists between our stomachs and our eyes; for we know that irritations in the alimentary canal (which corresponds to the roots of a plant) are discoverable in the organs of sight.

Enraptured as we often are with the splendour and fragrance of flowers, their transitory beauty frequently occasions the unconscious sigh. Their evanescent existence has so often been compared to the corresponding periods of human life, that they are seldom contemplated without a mixture of melancholy. The man who has unhappily imbibed the comfortless doctrine of a blind nature, that labours, through the whole of its wonderful works, without end or design, receives no cheering impressions on a sight of the transient flower: yet must he know, on a moment's reflection, that although the flower fleeth like a shadow, its species never dies; but contains within itself the principle

* A species of valesnaria is found in the ponds in the neighborhood of Cambridge.

of perpetual renovation. And he who has stopped short of saying in his heart "*there is no God!*" but having imbibed a notion that death is an everlasting sleep, is apt to compare himself with the plant, and to repine at the difference. He observes the pride of our forests, the oak, shedding his leaves in the autumn; and sees them renovated in the spring, and going on reclothing and flourishing through ages, while he, surveying his decayed and nerveless limbs, sighs out in despair—there is no returning spring for me! Every revolving sun but adds more marks of decay. My withered trunk shall never clothe itself with a smoother rind; nor my hoary locks be readorned with the auburn gloss of youth; nor will a more vigorous sap circulate through my nearly collapsed vessels! The plant is annually renovated, while the lord of the earth, with all his towering faculties, withers and sinks down to an everlasting sleep!*—But this is judging by sense and sight alone—

> Believe the muse: the wintry blast of death
> Kills not the buds of virtue; no, they spread,
> Beneath the heavenly beam of brighter suns,
> Thro' endless ages, into higher powers.†

The attempt to describe by words, that which in truth, requires the faithful pencil of the first of painters, may well be deemed a futile effort. Who would attempt to describe by words "*the gay carnation*"‡ The most eminent in the Belgian school

* A similar idea is to be found somewhere in the writings of Godwin.

† Thomson's Summer. ‡ Milton.

of painters, may throw his pencil by in despair of imitating even the *violet* or *apple-blossom;* for "*who can paint like nature?*" what colours on the painters pallet can express the richness of the *amaryllis formosissima;* or the *superbia gloriosa;* or the *dodecatheon* of Linnæus? Who could hope to succeed in the description of the *strelitzia regina,** adorned as it is, "with purple, azure, and speck'd with gold?" or the *Ixora coccinea,* the cluster of whose flowers are so brilliant that they resemble burning coals. The splendid *hæmanthus;* the red and blue *echium orientale;* the elegant *pancratium,* with its long and slender filaments; or the *lilio narcissus africanus,* whose petals are white as snow, with streaks of crimson: These, as well as the gorgeous *musa,* equally defy the power of paint and the art of the pencil.

If the painter can give but a faint picture of the violet, or the passion-flower, or the chalcedonian lily, what would he say, if requested to express with his colours some of the family of the *Cacti?* particularly the *Cactus grandiflorus,* or NIGHT-

* So called by Sir Joseph Banks, in honour of the queen of England. This plant is curiously formed, as well as pre-eminently splendid.

† The Botanist having published a picturesque account of the *cactus grandiflorus,* or *night-blowing cereus* in June, 1808, which was afterwards copied into some of the newspapers, has been induced, from the notice which that imperfect description attracted, to give a more particular history of this very curious family of plants, the *cacti.*

Not only Theophrastus, but Dioscorides, Athenæus, and Pliny have described a plant which they called *kactos,* which was said to have creeping

BLOWING CEREUS.† This stately flower is found in different parts of South America, and in some of

stems, with a broad and prickly leaf; and that it was not indigenous in Greece.

These plants appear to us of a strange and singular structure; and on that account they are cultivated in the stoves and green-houses of the curious. Of this genus of plants, there are more than forty species already described. They are natives of South-America and of the West-India Islands. The species cultivated in gardens are the cactus mamillaris, or melon-thistle; C. melo-cactus, great melon thistle, or *Turk's cap;* C. tetragonus, four angled upright torch thistle; C. hexagonous, six angled torch thistle; C. heptagonous, seven angled upright torch thistle; C. repandus, slender upright torch thistle; C. lanuginosus, woolly upright torch thistle; C. peruvianus, Peruvian upright torch thistle; C. Royeni, Royen's upright torch thistle; C. *grandiflorus*, great flowering, creeping cereus; C. flagelliformis pink flowering, creeping cereus; C. triangularis, triangular cereus, or strawberry pear. Then comes the *opuntia*, or Indian fig, or prickly pear; C. tuna, great Indian fig; C. curassavicus, the curassoa, least Indian fig, or pin pillow; C. spinosissimus, cluster-spined Indian fig; C. phyllanthus, spleenwort-leaved Indian fig; C. alatus, narrow long jointed Indian fig; C. moniliformis, neck lace, or Indian fig; C. pereskia, Barbadoes gooseberry.

Most of these curious *cacti* have been described by *La Mark* from the MM.S. of Plumier, at St. Domingo. Of these singular plants, the generic character is, *Calyx* superior, imbricated, tubular, deciduous. *Cor.* petals numerous, disposed in several ranks; the *outer* ones shorter, the *inner* rather larger. *Stam.* filaments numerous, inserted into the calyx; anthers oblong. *Pistil.* germ inferior; style cylindric; stigma headed, multified. *Peric.* berry oblong, umbilicated at its summit, one-celled. *Seeds* numerous, bedded in pulp.

Essential character; *calyx* superior, imbricated. *Corolla* of many petals. *Berry* one-celled. *Seeds* numerous. A numerous tribe of plants, which former botanists had distributed into separate genera, Linnæus has united in one genus. He says that the melocactus, is monocotyledinous; and opuntia dicotyledinous; but that nevertheless they are of the same natural genus.

Of this singular family of plants the *Echinomelocacti*, the TURK'S CAP is generally viewed as the most curious. It so resembles in size, in shape, and decoration, an elegant cap of Turkish fashion, that most people, on first

the West India Islands. It expands a most beautiful corrolla of nearly a foot in diameter: it has

sight of it, suppose it to be the work of art, and not a production of nature. It is a roundish mass, with fourteen angles, and sometimes more than three feet in circumference; consisting internally of a soft, green, fleshy substance, full of moisture; deeply divided into fourteen regular, smooth, flat-sided parts; the ridge of the ribs furnished with a row of clustered, stiff, straight, diverging spines, about an inch long, and red at their summit. Flowers red, situated at the top of the plant, which constitute the ornamental tuft of the cap; but the tuft is more remarkable in the fourth species, viz. the *coronatus*, where it is composed of a white, close, cottony down, interspersed with clusters of red spines. This is a native of South America, where they grow from apertures in the steep sides of rocks.

Among other singularities this odd family of vegetables have *no leaves*. The *cacti* are divided into the *melon-thistle*; the *torch-thistle*; the *creeping cereus*; and the *Indian figs*. Of the *erect* cereuses, or those which support themselves, the cereus peruvianus, or as the French call it *cierge epineux* is worthy notice. There is one now in the Imperial Garden at Paris, forty feet high. It was presented more than one hundred years ago, by Hotton, professor of botany at Leyden, to Fagon, first physician to Lewis XIV. when it was only four or five inches high. The growth of each year is distinguished by a contraction of the stem; each of these contractions is at first very deep, and remains nearly the same for years, when it gradually diminishes, and at length is entirely obliterated. This plant grew at first about a foot and a half in a year, and when it was fourteen years old, was twenty-three feet high, and seven inches in diameter. At the age of eleven, it produced its first two branches, about three feet from the ground; a year after it produced its first flowers, and has continued to flower ever since. See Dict. Agric. Nouv. Encycl.

The twenty-third species of this genus is CEREUS GRANDIFLORUS; or night flowering creeping cereus, with lateral roots; and is the superb plant mentioned in this number. 'Tis the cereus scandens minor Miller. Icon. Tab. 90. C. gracilis scandens ramosus, flore ingenti, &c. Trew Ehr. Tab. 31, 32. Eph. Nat. Curios. 1752. Vol. IX. app. 184. Tab. 11, 12, 13. C. Americanus, major articulatus, Volk. Hesp. l. 133. t. 134. Character. Creeping, with about five angles. *Stem* cylindric, branched, greenish; angles not very prominent; spines small, clustered, diverging. *Flowers* lateral, about six inches, sometimes near a foot diameter, sweet

twenty stamina surrounding one pistillum. The inside of the calyx is a splendid yellow, or bright

scented; calyx large, long, tubular, scaly below, composed in its upper part of straight, linear, pointed, yellowish leaflets, disposed in several rows, and forming a kind of ray to the flower; petals white, numerous, lanceolate, disposed in several rows, in a beautiful rosaceous form; style a little longer than the stamens; stigma with twenty divisions. The flowers begin to open between 7 and 8 o'clock in the evening, usually in the month of July, are fully blown by eleven, and by three or four in the morning they begin to fade, and soon after to hang down in a state of irrecoverable decay.

Darwin's "*refulgent Cerea*," or, as the flower is usually called *ceres*, has no allusion to the heathen goddess of that name, as is commonly imagined, but derives its name from *cera*, *wax*, from the resemblance of the stems to bay berry wax. Some have been called *torch*-thistles, because the natives use them as flambeaux; they have derived their name of thistles, from their numerous spines or prickles.

Of the *opuntias*, Indian figs, or prickly pears, there is one, viz. the C. *splendidus*, worthy particular notice. It is cultivated at Mexico for its delicious fruit. Its character is proliferously articulate; woody, very large; divisions ample, oblong, glaucus; those formed in the first years, spinous; the younger ones nearly unarmed: spines rigid and pungent. It is a large tree. The divisions numerous, thirty inches long; from twelve to fifteen, and even twenty broad, beset with tufts of stiff, red bristles which are very pungent. In the older divisions these tufts are accompanied by three spines of unequal size, very strong and sharp: the others have rarely more than one or two, and often none. The beautiful glaucous colour of this species, its immense size, the vigor, and richness of its vegetation, with the number and amplitude of its divisions, render it the most striking and most magnificent of all its family, and give it, in Mons. Thiery's opinion, a just right to the epithet *superb*.

The thirty-seventh species, viz. C. *Nopal* of Thiery, is the true cochineal Indian fig. It differs from the *splendidus* chiefly in colour. Mons. Thiery assures us, that this is the only species on which the true cochineal insect is bred in Mexico. He says it does not grow wild in that country; but is probably some unknown species, brought by cultivation to its present state of perfection. It differs from the C. *coccinellifer* of Linnæus and other botanists in being always found with long, sharp spines.

sulphur colour; the petals of the purest white; but viewing it in front, so as to look into its deep bell, whence issues its long trembling stamina, baffles all description; for in one shade, it is of an aurora color; viewed in another, it resembles the blaze of burning nitre; and as the eye plays over it, we think we see, at times, a bright reddish purple.

We may remark generally, that the most splendid flowers are of shortest duration: thus this grand flower expands its beautiful corol, and diffuses a most fragrant odour, for a few hours in the night, then closes to expand no more. It commonly opens about seven or eight o'clock in the evening usually in July in its native place; but later in England, and in this country; by two in the morning it begins to *wilt*,* and soon after to fade, droop, and

This very curious family of plants may be raised without much difficulty in our stoves and green houses. The *melon thistle*, or *Turk's cap*, may be raised from seed, sowed in pots of light earth, and plunged into a bed of tanner's bark. These plants should be placed on the top of the flues of the hot-houses in winter; and in the bark beds in summer.

The *cereus*, or *torch thistle*, is raised from cuttings placed in pots filled with light earth, a little sea sand, and sifted lime rubbish, and then placed in a bark hot-bed or a stove. The *night blowing cereus* is a tender plant, and requires a warm stove to protect it. The *opuntia*, or Indian figs, are also produced from cuttings, and thrive best in that degree of heat marked temperate on botanical thermometers. See on these various subjects Sloane Jam. La mark, from Plumier. Jussieu. Thiery's de Menonville. Nouv. Encyclop Miller's Dict. and a summary from them all in the Cyclopedia, art. *Cactus*.

* The author has ventured to use here a word, common among his countrymen, expressive of that state, or condition of a plant which precedes fading and withering. To fade is to tend from a brighter to a

wither; and before sun-rise it hangs down in a state of irrecoverable collapse and decay; and the next day this short lived *belle* resembles a soaked half grown ear of Indian corn. The first time the Botanist gazed at this transitory beauty, in the garden of *Fothergill*, and saw its sudden change, it was with sensations he never can forget. He confesses that in the vast assemblage of flowers that adorn the earth, this flaunting beauty caught his eye, and excited strongly his youthful admiration. Well might the poetical *Darwin* say of his "*refulgent Cerea*,"

> Bright as the blush of rising morn she warns
> The dull, cold eye of midnight with her charms;
> There to the skies she lifts her pencill'd brows,

weaker colour. To wither is to waste, to exsiccate, to become sapless, shrink and wrinkle: and to have lost the power of growth: thus Shakespeare;

> " —— When I have pluck'd the rose
> " I cannot give it vital growth again;
> " It needs must wither.

Some of our garden vegetables, the beet for example, will, in the hottest part of the hottest days (thermometer 95 or 98°) *wilt*: its leaves will decline from an erect posture to a horizontal one; yet will it not change from a brighter to a weaker colour, which is fading; neither does it become juiceless, and wrinkled which is withering, or verging to irrecoverable decay; neither do we understand by *wilting*, exactly the drooping of a plant, which is figurative, because drooping means sorrowful, and therefore derived from man; and when we apply the word *wilting* to man, we use it figuratively, as being derived from the condition of a leaf or flower. We therefore say, when speaking of a certain condition of a flower or leaf between its state of complete turgescence and utmost vigour, and its destruction, that a plant *wilts*, fades, droops, withers and decays. The Botanist has not hesitated in adopting a term that has merely floated on the breath of the people, because he knows no other, not even the Latin *marcidus*, that so exactly expresses his meaning.

Ope's her fair lips, and breathes her virgin vows:
Eyes the white zenith; counts the suns that roll
Their distant fires, and blaze around the pole;
Or mark where Jove directs his glittering car
O'er heaven's blue vault,—herself a brighter star!
Sweet maid of night! to Cynthia's sober beams
Glows thy warm cheek, thy polish'd bosom gleams.
In crowds around thee gaze th' admiring swains,
And guard in silence the enchanted plains;
Drop the still tear, or breathe th' impassioned sigh,
And drink inebriate rapture from thine eye.

All this is the rhapsody of youth, when the nerves are in a state of the most delicate susceptibility; and when every fibre vibrates with pleasure. At that period of high excitement, the attention is engrossed by a single object. An animating sun-shine then varies the appearances and hues of things.—Not so the man of age, whose indurated nerves sluggishly conduct his sensations; in whom habitual gratifications are coolly relished, and desires are feebly awakened.* Such is the difference between youth and age, in our perceptions of delicious fruit, fragrant smells, smooth glossy surfaces, vividness of colours, and the heavenly sweetness of sounds! The Botanist, sobered by age, cannot,—will not allow the flaunting "*Ceres*" to rival in his affections the blushing ROSE, "veil'd in a cloud of fragrance," whose qualities are often disregarded, because common. QUEEN of *flowers!* where is the poet that has not celebrated thy beauties? where the painter that has not aimed to imitate thee? and who that

* See note, p. 220.

has senses does not wish to take to his bosom "the fresh blown ROSES wash'd in dew?" Of the beautiful sex, we fondly compare the most beautiful to flowers. Were I then to renew my youth, and to live over again; and were I disposed to ransack creation for a comparison, I should compare—But—why this vain wish?—this melancholy reflection!

"No more the summer of my life remains,
"My autumn's lengthening evenings chill my veins!
"Down the bleak stream of years,———*
"Wing'd on, I hasten to the tomb's repose;
"The port whose deep, dark bottom shall detain
"My anchor, never to be weigh'd again!"

* The discontented *Camoens* adds here "by woes on woes."

END OF THE BOTANIST.

THE

PRINCIPLE OF VITALITY:

A

DISCOURSE,

DELIVERED IN THE FIRST CHURCH IN BOSTON,

TUESDAY, JUNE 8, 1790,

BEFORE THE

Humane Society

OF THE

COMMONWEALTH OF MASSACHUSETTS.

BY B. WATERHOUSE, M. D.

Professor of the Theory and Practice of Physic, and Lecturer on Natural History in the University at Cambridge.

OF ALL THE POWERS IN NATURE, HEAT IS THE CHIEF.

BACON.

COMMONWEALTH OF MASSACHUSETTS.

At a semiannual meeting of the Humane Society, held in Boston, June 8, 1790.

VOTED, That the Honourable the PRESIDENT, the VICE-PRESIDENT, and Monsieur DE LETOMBE, Consul of France, WILLIAM TUDOR, and LOAMMI BALDWIN, Esq'rs. be a committee to wait on BENJAMIN WATERHOUSE, Esq. M. D. and return him the thanks of this society for his ingenious Discourse delivered this day, and to request of him a copy for the press.

Attest, JOHN AVERY, jun. Secretary.

TO THE

HON. JAMES BOWDOIN, LL.D. F.R.S.

&c. &c. &c.

PRESIDENT;

THE HON. THOMAS RUSSELL, ESQ.

VICE-PRESIDENT;

AND THE OTHER TRUSTEES

OF THE

HUMANE SOCIETY

OF THE

COMMONWEALTH OF MASSACHUSETTS,

THIS DISCOURSE,

DELIVERED AT THEIR REQUEST,

IS MOST RESPECTFULLY DEDICATED,

BY

BENJAMIN WATERHOUSE.

PREFACE.

THIS Discourse was delivered before the HUMANE SOCIETY of the COMMONWEALTH OF MASSACHUSETTS more than twenty years ago.

The Society took its origin from the following occurrences :—In the summer of 1782, a number of young persons of both sexes were drowned in the harbour of Newport Rhode-Island, by the oversetting of a pleasure boat.— Four or five of these young people were taken up when they had been not more than ten minutes in the water, and yet they all perished ; for there was no mean used to resuscitate them. Thereupon the Author published in the Newport Mercury some account of the methods practised by the humane societies of Europe ; and exerted himself to form one at Rhode-Island ; but nothing was effected. Three years afterwards, viz. in 1785, when sailing through the harbour of Newport with the celebrated blind philosopher, Dr. Henry Moyes of Edinburgh, he related to him the sad accident, and lamented that we had no humane society in America for resuscitating the drowned ; and the ill success he experienced in attempting to establish one. "Do not be discouraged," said this extraordinary man ; "but let us set about it immediately ;—this very day." We accordingly did so ; and by the help of his intelligent serving man, who was a good amanuensis, we committed to paper a plan of our Humane Society, and took it with us to Boston ; and communicated it to a small assemblage of professional gentlemen in School-Street, whence arose *The Humane Society of the Commonwealth of Massachusetts*, which was incorporated in 1791.

In organizing this new society, in 1785, the Author discerned a mode of proceeding with which he had never been conversant ; for at that time, he was ignorant even of the meaning of the word "*caucus ;*" he therefore declined becoming an officer of it, and withdrew from the association. In the year 1790 the author was urged to rejoin the society previously to its incorporation, particularly by the late *Governour Bowdoin*, the *Hon. Thomas Russell*, *Bishop Parker*, and the present Reverend and worthy *Dr. Lathrop*, and thereupon he was appointed to deliver a Discourse before them. As the Author accepted this task more in compliance with the solicitations of his very honourable and reverend friends, than real inclination, so he protracted the composition to a late period ; and this he offers as an apology for its containing full as many indications of reading as traits of originality.

CAMBRIDGE, *July*, 1811.

O ART! thou *distinguishing attribute* and *honour* of *human* kind! Wide and extensive is the reach of thy dominion. No ELEMENT is there either so *violent*, or so *subtile*, so *yielding* or so *sluggish*, as by the powers of its nature to be superior to thy direction. Thou dreadest not the fierce impetuosity of FIRE, but compellest its violence to be both obedient and useful. Nor is the subtile AIR less obedient to *thy* power, whether thou willest it to be a minister to our pleasure or utility. Even WATER itself is by *thee* taught to bear us; the vast ocean to promote that intercourse of nations, which ignorance would imagine it was destined to intercept.

Harris's Dialogue concerning ART.

Discourse.

WERE the European Philosopher to turn his eyes on this new Empire, to see in what order and degree those dispositions and arts, which characterize polished humanity, arise among us, he would undoubtedly perceive that the extension of benevolence has kept exact pace with the diffusion of knowledge.

Our venerable ancestors early sowed the seeds of science in this land and watched their growth with pious care ; and it is not difficult to discover the diffusive spirit of benevolence following every where the increasing light of science.

Without being particular on this head, one instance of it honourable to humanity, is the cordial adoption, and generous support given to this *Humane Society*, which is formed on a very extensive scale of benevolence.

I decline giving a history of this or similar institutions; nor shall I descant on the beneficial influence of numerous humane associations, which mark and dignify the age in which we live. Suffice

it to say, that the success attending the societies established for restoring drowned persons at *Amsterdam*, *Hamburgh*, *London*, *Padua*, *Vienna*, *Paris*, and elsewhere, induced some respectable characters to form one in Boston. But they have gone beyond the European societies, and have extended their plan not only to the restoration of life, when apparently lost, but to the preservation of it when in imminent danger.*

It is scarcely necessary to say that the plan of this society is totally void of all private interested views. None of its members receive any other recompence than the sublime joy of doing good.

I shall avoid speaking of any particular mode of treating persons apparently dead, and shall confine myself to the great principle of VITALITY, ANIMATION, or LIFE. I feel the difficulty of doing justice to so copious a subject in the short space allotted to a discourse.

The subject of animation is not merely curious, but leads to usefulness. It has arrested the attention of Philosophers in almost every age of the world. Some of the antients reasoned thus on it: Matter of itself cannot move, yet it is evident all things change, and that nothing is lost; that the sum total of matter in the Universe remains perfectly the same; and as it was the work of OMNIPOTENCE to create something out of nothing, the same

* By constructing huts, or small houses, on the sea coast, for sheltering the shipwrecked sailor in the severity of winter. 1811.

Omnipotence is required to reduce any thing back to nothing.* It is apparent that there is an universal change, or mutation of all things into all, then must there be some ONE *primary matter*, common to all things out of which they were made—They went still further, and enquired into the *moving principle*, the *efficient cause*, that is to say, that *cause*, which associates the elements of natural substances, and which employs them when associated, according to their various and peculiar characters.† This moving principle they called the *Anima Mundi*, the *Soul of the World.*

THALES, one of the seven wise men of Greece, maintained, that *Water* was the subtile principle that moved all things. He concluded that matter was chiefly dealt out in moisture ; that the seeds of plants so long as they are in a growing state, are moist ; and that a vegetable will grow to a considerable size from water alone ; that the Earth is refreshed, recruited, and made fruitful by water :—that the Air itself is but an expansion, or expiration of water. He reminds us of the immense quantities in the subterraneous regions, whence fountains, and rivers, like so many veins in the body, convey water over the surface, and through the bowels of our globe, to vivify and sustain the whole.

HERACLITUS maintained a very different doctrine. He taught that *Fire* was the vivifying princi-

* See Bacon's accounts of antient opinions.

† See Harris, philos. arrang.

ple of all things. He allowed the truth of *Thales's* doctrine, but observed that *fire* had such an universal sway in nature, that water itself was not without a mixture of it; for that water grows hard and congeals into ice when fire leaves it, and is only restored to its fluidity by entering it again. He remarked that the whole mass of waters in the sea, was actually an ocean of fire, seeing there were not two distinct drops of water, which do not owe their fluidity to some portion of fire enclosed within them. So deeply rooted was the doctrine that fire was the first or animating principle, that there were, and still are whole nations who worship it as a Deity.*

ANAXIMENES contradicted both these philosophers; and contended that *Air* was the vivifying principle and first mover of all things. He observed that although the water of *Thales* could not subsist without the fire of *Heraclitus*, yet fire itself could not exist without *Air*, which was the very spirit of flame, and the breath of life: that no seed of vegetables, eggs of animals, be they ever so ripe,

* That venerable sect of Philosophers, the *Stoics*, taught that there was one infinite, eternal, almighty mind, which, diffused through the whole universe of well ordered and regularly disposed matter, actuates every part of it, and is as it were the soul of this *vast body*. The parts of this body they say, are of two sorts, viz. the *Celestial*, as the planets and fixed stars: and the *Terrestrial*, as the earth, and all the other elements about it. The celestial continue without change, or variation. But the whole sublunary world, is not only liable to dissolution, but often hath been, and shall again be dissolved by *fire*: and that the reciprocal deaths, dissolutions and digestions, which support by turns all the substances which we see, are the effects of *fire*.

See CREECH's *preface to the translation of* C. MANLIUS.

or pregnant, and cherished with ever so kindly a warmth, will ever bring forth the embryos contained in them, if they be totally deprived of air. We shall see hereafter the necessity of attending to these powerful agents, *fire* and *air*, in the resuscitation of those apparently dead by suspension, submersion, or frost.

Let us now examine the subject of animation with the light afforded us by more modern Philosophers.

From them we learn that matter is inert; that any one particle of matter left to itself will continue always in the same state, with regard to its motion or rest. There are, however, certain powers, which *two* particles of matter have of acting on one another, as in gravitation and cohesion. We learn also that there is an attraction of *crystallization*, by which bodies when fluid become in time solid, and assume a particular figure; that there is an attraction of *magnetism*, by which a piece of iron, in certain circumstances, attracts another piece of iron; that there is an attraction of *electricity*, by which a substance charged with more electric matter flies to another charged with less. There is moreover, *chemical attraction*, by which two particles of different bodies rush together, and form one. If we add that most of these have their opposite repulsions, we can say that they are all the known properties of mere matter; and there is nothing in them that can merit the name of *vitality*.

But there is in a growing vegetable a power beyond all this, viz. a power which *first moves*, and then *conducts* that latent process by which a seed becomes a plant.

Now, every body capable of growing, has a certain internal adjustment, disposition, or arrangement of its matter, which is called *organization;* and being capable of increasing in bulk, has a certain degree of *vitality*. There is a scale of life, stretching in uniform gradation from human excellence downwards, till it disappears in a shade of ambiguity, in the living state of vegetables.* Life, says the *Bishop of Landaff*, belongs alike to both the animal and vegetable kingdom; and seems to depend on the same principle in both. Stop the motion of a fluid in an animal limb, by a strong ligature, the limb mortifies beyond the ligature and drops off; a branch of a tree, under like circumstances, grows dry and rots away.—Both animals and vegetables are subject to be frost-bitten and to consequent mortifications; both experience extravasation of juices from repletion, and pinings from inanition; both can suffer amputation of limbs without being deprived of life, and in a similar manner both from a callus; both are liable to contract disease by infection; both are strengthened by air and motion.

Every seed of a Plant is an organized body endowed with vessels, and contains under several membranes the plant in minature.† If this seed be

* Brown.

† Look at the engravings in *Grew's anatomy of plants.*

be put into the *moist* earth and a certain degree of *heat* applied, with access of *air*, the three principles of the antient Philosophers, the juice in these vessels will expand by the warmth ; and being thus once put in motion gradually increase, and grow up into a plant ; which plant produces a similar seed capable of propagating its kind forever.

In like manner, an egg is an organized body, which contains under several envelopments the chicken in miniature ; and may be considered as a womb, detached from the body of the parent animal, in which the embryo is just beginning to be formed ; if warmed to a certain degree, whether by the parent animal, or by art, the fluids which surround that speck in the egg called the *punctum vitæ*, expand, and the little vessels swell and extend themselves ; and the motion or oscillation once began, it develops, by degrees, until it becomes a perfect animal, capable of all the functions common to its kind.

The seed of the vegetable, and the egg of the animal would remain, or rather *become* effete and inanimate, unless some stimulus, some agent *from without*, excited or began a motion in them. But what is this agent, or stimulus ? For that is the question.——

This stimulus, or animating principle in a natural body, does not depend on its organization, nor its figure, nor any of those inferior forms, which make up the system of its visible qualities ; but it is the

power, "which not being that organization, nor that figure, nor those qualities, is yet able to produce, to preserve, and to employ them. It is therefore the *power*, which departing, the body ceases to live, and the members soon pass into putrefaction and decay."*

From an attentive observation of animated nature, we discover that life is caused, and continued by something which acts from without; and this something is, as far as we can discover, *heat*, acting on the seed or egg.† I say *heat*, according to the com-

* Harris Phil. Arrang.

† DESCRIPTION OF A HEN'S EGG; WITH THE HISTORY OF THE GROWTH OF THE ANIMAL CONTAINED IN IT.

Immediately under the shell, lies that common membrane, or skin, which lines it on the inside, adhering closely to it every where, except at the broad end, where a little cavity is left, that is *filled with air*; which increases as the animal within grows larger. Under this membrane are contained *two whites*, though seeming to us to be only *one*; each wrapped up in a membrane of its own, one white within the other. They differ from each other in specific gravity. In the midst of all is the *yolk*, wrapt round likewise with its own membrane. At each end of this are two ligaments, called *chalazæ*, which are white dense substances, made from the membranes, and serving to keep the white and the yolk in their places. They are called chalazæ from their resemblance to hail.

The *cicatricula* is the part where the animal first begins to shew signs of life; it resembles a vetch or small pea, lying on one side of the yolk and within its membranes. The outer membranes and ligaments preserve the fluids in their proper places, the white serves as nourishment; and the yolk with its membranes after a time, becomes a part of the chicken's body. This is the description of the *hen's egg*, and answers to all others, how large or how small soever.

Previously to putting the eggs to the hen, *Malpighi* and *Haller* first examined this cicatricula, which they consider as the most important part of the egg. This, which some call the *punctum saliens*, or *punctum vitæ*, was found in those that were impregnated by the male to be large,

mon acceptation of the term : but to speak more philosophically, it is *that subtile electric fluid, which fills the immense space of the whole Universe, per-*

but in others small. Upon examination with the microscope it was found to be a kind of bag, containing a transparent liquor, in the midst of which the *embryo* was seen. The embryo resembled a composition of little threads, which the warmth of future incubations tended to enlarge.

Upon placing the egg in a proper warmth, after six hours the *vital speck* begins to dilate like the pupil of the eye. The head of the chicken is distinctly seen, with the back-bone something resembling a tadpole floating in its ambient fluid, but as yet seeming to assume none of the functions of animal life. About six hours more the little animal is seen more distinctly; the head becomes more plainly visible, and the vertebræ of the back more easily perceivable. All these signs of preparation for life are increased in six hours more; and, at the end of twenty-four, the ribs begin to take their places, the neck begins to lengthen, and the head to turn to one side.

At this time, the fluids in the egg seem to have changed places; the yolk which was before in the centre of the shell, approaches nearer the broad end. The watery part of the white is diminished, the grosser part sinks to the small end; and the little animal appears to turn towards the part of the broad end in which a cavity has been described, and with its yolk seems to adhere to the membrane there.

At the end of forty hours the great work of life seems fairly begun, and the animal plainly appears to move; the back bone thickens; the first rudiments of the eyes begin to appear; the heart beats, and the blood begins already to circulate. The parts, however, as yet are fluid; but, by degrees, become more and more tenacious. At the end of two days, the liquor in which the chicken swims, seems to increase; the head appears with two little bladders in place of eyes; the heart beats in the manner of every embryo where the blood does not circulate through the lungs. In about fourteen hours after this, the chicken is grown more strong; the veins and arteries begin to branch, in order to form the brains; and the spinal marrow is seen stretching along the back-bone. In three days, the whole body of the chicken appears bent; the head with its two eye-balls, with their different humours, now distinctly appear; and five other vesicles are seen, which soon unite to form the rudiments of the brain. The out-lines also of the thighs, and wings, begin

vades all bodies, and actuates every particle of matter. *Heat* is only one effect of its motion.

to be seen, and the body begins to gather flesh. At the end of the fourth day, the vesicles that go to form the brain approach each other; the wings and thighs appear more solid; the whole body is covered with a jelly like flesh; the heart that was hitherto exposed, is now covered up within the body, by a very thin transparent membrane; and at the same time, the umbilical vessels, that unite the animal to the yolk, now appear to come forth from the abdomen. After the fifth and sixth days the vessels of the brain begin to be covered over; the wings and the thighs lengthen; the belly is closed up, and turned; the liver is seen within it, very distinctly, not yet grown red, but of a dusky white; both the ventricles of the heart are discerned, as if they were two separate hearts, beating distinctly; the whole body of the animal is covered over, and the traces of the incipient feathers are already to be seen. The seventh day the head appears very large; the brain is entirely covered over; the bill begins to appear betwixt the eyes, and the wings, the thighs, and the legs, have acquired their perfect figure. Hitherto, however, the animal appears as if it had two bodies; the yolk is joined to it by the umbilical vessel that comes from the belly; and is furnished with its vessels, through which the blood circulates, as through the rest of the body of the chicken, making a bulk greater than that of the animal itself. But towards the end of incubation, the umbilical vessel shortens the yolk, and with it the intestines are thrust up into the body of the chicken by the action of the muscles of the belly, and the two bodies are thus formed into one. During this state, all the organs are found to perform their secretions; the bile is found to be separated, as in grown animals; but it is transparent, and without bitterness; the chicken then also appears to have lungs. On the tenth, the muscles of the wings appear, and the feathers begin to push out. On the eleventh, the heart which hitherto had appeared divided, begins to unite, the arteries which belong to it, join into it, like the fingers into the palm of the hand. All these appearances, come more into view, because the fluids the vessels had hitherto secreted, were more transparent; but as the colour of the fluids deepen, their operations and circulations are more distinctly seen. As the animal thus, by the eleventh day, completely formed, begins to gather strength, it becomes more uneasy in its situation, and exerts its animal powers with increasing force. For some time before it is able to break the shell in

In whatever manner a susceptible, or irritable body is operated upon by this exciting power, a certain quantity of it, or a certain energy, is assigned and belongs to every individual system upon the commencement of its living state.*

Now a living animal has, besides those attributes common to all bodies, as solidity, extension and gravity, a *peculiar something*, which distinguishes it from a dead one; for a muscular fibre will contract, and that not by the power of gravitation, cohesion, crystallization, magnetism, or chemical attraction.

That state of an animal fibre in which a contraction, or oscillation, is produced by the influx or con-

which it is imprisoned, it is heard to *chirrup*, receiving a *sufficient quantity of air for this purpose*, from that cavity which lies between the membrane and the shell, and which must contain air to resist the external pressure. At length upon the 20th day, in some birds sooner, and later in others, the enclosed animal breaks the shell within which it has been confined, with its beak; and by repeated efforts, at last procures its enlargement.

From this history we perceive, that those parts which are most conducive to life, are the first that are begun; the head and the back-bone, which no doubt enclose the brain, and the spinal marrow, though both are too limpid to be discerned, are the first that are seen to exist; the beating of the heart is seen soon after; the less noble parts seem to spring from these, the wings, the thighs, the feet, and lastly the bill. The resemblance between the beginning animal in the egg, and the embryo in the womb, is very striking. An egg may be considered as a womb, detached from the body of the parent animal, in which the embryo is but just beginning to be formed. It may be regarded as a kind of incomplete delivery, The similitude between the egg and the embryo in the womb has induced many to assert (and with great probability) that all animals are produced from eggs.

Goldsmith's History of the Earth and Animated Nature, Vol. II. See also Malpighi, Haller, Graff, and Buffon.

* Brown.

tact of a stimulus, is called *irritability*, or *susceptibility*, and *excitability*.

That principle in animals, on which sensation, motion, and all the animal powers depend, is called the *Vis Vitalis*.

By the action of stimuli on the solids, particularly *heat*, the *vis vitalis* is excited and preserved; when diminished it may be increased, and *when suspended it may be restored.*

Within every one of us, there is an *innate* and *active power*, which ceases not its work, when sense and appetite are asleep; which without any conscious co-operation of the man himself, carries him from a seed or embryo, to his destined magnitude. This is strictly speaking the *Animal Œconomy*, and is as perfect in the brutal Hottentot, as in the brightest genius of human kind.

All this depends on a principle which some call the *Vis Actuosa*, others the *Impetum Faciens*. This power is *innate*, and is that by which man lives; it forms him, it nourishes him, moves him, animates him. By it he feels, he desires, refuses, sleeps and wakes; nevertheless, it is totally different from the *Mind;* For,

In our bodies is found something of quite a different nature from what has been mentioned; a power of thinking, reflecting, comparing, choosing, and representing to itself past, present and to come. This power in relation to its several operations, is termed comprehension, understanding, reason, mind, will, freedom, or collectively, by the single word

Soul.* But to return to the innate principle of animation in man.

Every body knows that although the child is formed, and lives, and grows, and moves in the womb of its mother, it never breathes there. It receives its animating principle, its heat, motion and life, from the mother, by a nerve and artery, which enters at its navel and conveys the blood to the heart of the infant, *without ever passing through the lungs.* The blood in this case goes directly on through the body of the heart, by an opening called the *Foramen Ovale*, and from thence to the *Aorta*, or great artery, by which it is driven to every part of its body; so that the circulation, nutrition and life, are kept up with the mother, as if they were not two bodies but one. It is remarkable that the fruit of vegetables is, in like manner, nourished, and supported by a slender stalk issuing from the parent stock.

When the child is born it becomes dependent on a *new* principle for the continuance of its existence. When it passes from the watery habitation into the atmosphere, a new determination takes place; and instead of the *umbilical cord* from the mother, the common air becomes the *main-spring* of all its actions and functions. When the child opens its mouth to cry, in rushes the air, and expands the lungs. The blood, which had hitherto passed *through* the heart, now takes a wider circuit, and the *foramen ovale* closes forever. The lungs which had, till this time, been inactive, now first begin their

* See Herpert.

functions, and they cease not their motion as long as life continues.

Hence then it appears, that next to the expanding power of heat, *Respiration*, or *breathing* is the *primum mobile* in the human machine.

Atmospheric air contains a certain *vivifying spirit*, which is necessary to continue the lives of animals, and this, in a gallon of air, is said to be sufficient for one man during the space of a minute, and not much longer. Air that has lost this vivifying spirit, deadens fire, extinguishes flame, and destroys life.*

It is well known that there is a set of vessels in the lungs which contain air, and another which contain blood.

The air in the lungs is in constant motion; for either that which is at present contained in the cells, is passing through the wind-pipe into the atmosphere; or a fresh parcel is passing from the external atmosphere through the wind-pipe into those cells. The whole of this compound motion is called *Respiration*.†

If the air continue at rest in the lungs for many minutes; or if a man continue to respire the same air; or if he breathe air that has served for the inflammation of fuel; or pure fixable air, or any other vapour, excepting respirable air, he dies†.

From the organs of respiration; or rather from what may be called the *systema spirituale pneumo-*

* Ferguson. † Fordyce.

nicum, all the actions of the body, and all the power which it exerts are ultimately derived.

It appears from a train of experiments, that the common air communicates a vivifying something to the blood, when drawn into the lungs, and gives to it a stimulating quality, by which it is fitted to excite the heart to action; and that the chemical quality, which the blood acquires in passing through the lungs, is necessary to keep up the action of the heart, and consequently the health of the animal. For no sooner are the lungs quiescent than the heart ceases to contract, the blood stops, all the intellectual operations cease, sensation and voluntary motion are suspended, and all external signs of life disappear. All which are admirably explained by Dr. *Edmund Goodwin.**

When the fluids in the human machine are thus at rest, what do we see?—a mere carcase—We see the person dead!† But after what manner? Here are all the solids, and all the fluids too. What then is lacking? A gentle oscillation, or motion of the fluids, a circumgyration of the liquors; for let there be by what means soever an oscillation, a con-

* See his experimental Enquiry, &c.

† There are several instances of people buried alive, even in this country.

Oh reader! ——— But that I am forbid
To tell the secrets of *the* prison-house, ‡
I could a tale unfold, whose lightest word
Would harrow up thy soul, freeze thy young blood,
Make thy two eyes, like stars, start from their spheres.——

‡ The Grave.

cussion, or excitement of the nervous energy, which may impel the fluids to move the lungs and heart, life immediately returns, with the usual circulation of the blood and other fluids, heat, colour, agility, *cogitation*, and every vital, natural, and human action.

If it be asked, *what is that vivifying something which, through the medium of the atmosphere, gives this oscillation or concussion, and continues life ?*

I answer ; *it is a portion of that subtile electric fluid, which fills the immense space of the whole universe, pervades all bodies, and actuates every particle of matter. By it the phenomena of magnetism, fire, and light are produced ; and on it the various and astonishing phenomena of* VEGETATION *and* ANIMATION *depend.* If it be asked further, what and where is the source of this all powerful agent ? I answer, the SUN *is the efficient cause of the motions of this fluid, and the various phenomena of our system are the effects of these motions.*

> *Soul* of surrounding worlds !
> Without whose quickning glance, this cumbrous earth
> Would be a lifeless mass, inert and dead,
> And not, as now, the green abode of life.*

I am aware that analogical arguments are probable, but not conclusive ; and that plausible inferences from well known facts in brutes, have occasioned many errors respecting man. Yet I cannot but believe from what we observe in the resuscitation of

* Thomson's summer.

swallows, after lying four months in the bottom of a pond; of snakes frozen stiff as a stick; of flies corked up in a bottle of Madeira in Virginia, and brought to life again in Great-Britian; † I say, I cannot help believing from these and similar facts, that it is possible to restore to life a human being who has been frozen some days. We have well authenticated accounts of not only birds frozen to death (as it is called) but of the human species too, who were even for days, without pulse, breathing, or the least natural heat, and yet resuscitated.*

In this case, the application of heat should be conducted, says Dr. *Goodwin*, on the same plan, which nature points out for the hybernating, or torpid animal; that is to say; it should be applied gradually and uniformly. It may be raised to 98 degrees of Farenheit, but not above 100. To blow one's own breath into the lungs of another, is an absurd and pernicious practice.

The consideration of the facts just related, have led some to conceptions of the *Soul*, which have puzzled them, and created doubts rather unfavourable to the opinions entertained by the majority of christians. "What is the condition, say they, of the soul all this time."—In animal bodies there are only two general conditions, *life* and *death;* and if by *death* we understand the privation of life, there can be no intermediate state between them, says

† See Dr. Franklin's letter to Mons. Dubourg.

* See the writings of *Redi* and *Whytte*. The Flora Siberica. Also Peyer anatom.

Dr. Goodwin; for no human art can communicate life to *dead* matter. Dr. Whytte thinks it is not only probable, but even demonstrable, that the soul does not immediately leave the body upon a total stoppage of the heart's motion, and of the circulation of the blood, that is, upon what we usually call *death*, but that it continues for some time at least present with it, and ready to actuate it. He thinks, with Gassendi, Dr. H. More, Sir Isaac Newton, Dr. S. Clarke, and some other of the greatest philosophers of the last and present age, that the soul is extended.

The apparently dead carcase, therefore, which has lain three or four hours under water, is as much alive as a sound hen's-egg; * they would both putrify and dissolve if let alone; but apply a due and uniform degree of *heat* to either, and you change the *seemingly* dead body into a live and active animal.

The union of soul with body, is the most abstruse contemplation that can exercise the mind of man. "How is it that one painful idea alters the course of the blood! Who can explain how the blood in return, carries its irregularities to the mind! What incomprehensible mechanism has subjected the organs to sentiment and thought! What, says Voltaire, is that unknown *fluid*, which is quicker and more active than light, and flies in the twinkling of an eye, through all the channels of life; produces memory, sorrow or joy, reason or frenzy, recalls with hor-

* See page 242.

ror what one would wish to forget, and makes of a thinking being, an object of admiration, or a subject of pity and tears !"

The intellectual scheme, says the author of *Hermes*, which never forgets DEITY, postpones every thing *corporeal* to the PRIMARY MENTAL CAUSE. It is here it looks for the origin of intelligible ideas, even of those, which exist in human capacities. For though *sensible* objects may be the destined medium, to *awaken* the dormant energies of man's understanding, yet are those energies themselves, no more contained in *sense*, than the explosion of a cannon in the spark which gave it fire.

This then, like all other sound philosophy, leads us at last, up to the GREAT FIRST CAUSE, the ENS ENTIUM, the SUPREME AUTHOR OF ALL, who is ever to be adored with the most profound reverence by the reasonable part of this creation.*

* It would seem that the *Parent of Universal Nature* has ordained, that to a certain degree of exquisite organization the soul should adhere; for between organization and function there exists a connexion proportioned and inseparable. When that subtile organization is ruined, the soul flies back again, like quenched fire, to the source whence it came. If so, then are not our bodies vessels, immersed in the vivifying spirit, the "anima mundi ?" If the materials, which compose these vessels be arranged after a certain manner, life, or the spirit adheres to us. If the vessel is cracked, to a certain degree, it can hold no water. If the body be to a certain degree marred, it can hold no life. If the deranged organization banish life, for fifteen or twenty minutes, as in persons who have lain that time under water; and if, by communication of warmth, and agitation of the lungs, and of the heart, life should be restored, what shall we say then? where? and in what state was the soul, or immortal part? We can only say, that being still immersed in the anima mundi, the body is rendered, by

Thus much towards investigating the important subject of *Vitality* or *Animation*. The narrow limits of a discourse prevent my pursuing the matter further at this time. I pass on to a more general and pleasant theme, *the Progress of Humanity*. Perhaps we may discover the causes which produced that spirit of benevolence, which gave birth to this society.

It is very common to praise antient times and condemn our own; yet, if we cast our eyes back on the history of mankind, the view will shock us. Of six and twenty centuries, wherein the memory and learning of mankind have been exercised, scarcely six can be culled out as fertile in the sciences, or favourable to humanity! * On a modest computation, the destruction of the human race in building up tyranny by *Sesostris*, by *Semiramis*, by *Xerxes*, by *Alexander*, the *Romans*, the *Sicilians*, by *Mithradates*, the *Goths* and *Vandals*, the *Crusaders*, and by the *Spaniards* in *Mexico* and *Peru*, amount to forty times the number of mankind now on the face of the earth.

the means used, capable of imbibing again the needful portion of that spirit in which "we live, move, and have our being." I say, imbibing *again*; for in the beginning "*He breathed into man the breath of life*, and the consequence was, "*he became a living soul.*"

We are confident that there is *something* in us that can be without us, and will be after us; what it was before us we know not; nor can we tell how it entered us. Thus *Cicero*, who wrote before life and immortality were brought to light by the gospel, says "*Quidquid est illud quod sentit, quod sapit, quod vult, quod viget, cæleste et divinum est; ob eamque rem æternum sit necesse est.*"

* See Novum organum. Bacon.

The Roman name strikes us with such veneration, that we are apt to include *humanity* among their virtues. But the most celebrated virtue of the most renowned Roman would pass without much eulogium in this day. The truth is, their natural roughness of temper, their adoration of *Victoria*, that Deity so dear to the Romans, made them neglect and trample upon their fellow men, whom they scarcely distinguished from brutes.* And when the glory, greatness, strength, and learning of that famous people were extinguished, and when their Empire was finally overturned, the cause of humanity was still less regarded.

It was worse, when a northern swarm of barbarians, the *Goths*, quitting their inhospitable regions spread through the more fertile parts of the world, and extinguished the small light of learning which remained.†

And when *Mahomet* and his successors carried their victories, with the rapidity of a torrent, over most parts of *Asia*, *Africa*, through *Persia*, *Arabia*, *Egypt*, and *Palestine*, they completed the destruction the Goths began.

When the barbarians embraced christianity, they made it bend to their prejudices, rather than subject their prejudices to its principles; and from the mixture of christianity with the antient customs of barbarians sprang a discord in manners. From a mixture of the rights of sovereigns with those of

* Millot. † Boerhaave's Academ. Lec.

the nobility, and of the priesthood, sprang a discord in politics and government. And from a mixture of the Pagans and Mahometans with the Christians, sprang a discord in religion. Anarchy and confusion were the consequences of so many contrasts:—Europe was one large field of battle, and ignorance and brutal force quenched almost every ray of knowledge, while the noble faculties of the soul were absorbed by fear.*

The extension of benevolence, keeps exact pace with the diffusion of knowledge, and the exertions of the one are circumscribed by the limits of the other.

Whenever the PARENT of UNIVERSAL NATURE chooses to make a mighty change in the affairs of men, he seems to effect it by, what we call, mean and humble instruments.

Two seemingly inglorious mechanical discoveries, changed the face of the world more than any conqueror, sect, or empire ever did. I mean the *mariner's compass*, and the *art of printing*.† These inventions gradually banished barbarism, and humanized the world. The antients were acquainted with but a very small part of the globe. They called all the northern nations, *Scythians*, and all the western, *Celtæ*, indiscriminately. They had no knowledge of *Africa* beyond the nearest part of *Æthiopia;* nor of *Asia* beyond the *Ganges;* and

* See Robertson, Ch. v. and Millot's Element. of Gen. Hist.

† See Novum Organ.

as for our quarter of the world, *America*, they had not even a tradition about it.†

Commerce is a cure for the most destructive prejudices. It has every where diffused a knowledge of the manners of all nations. The multiplication of books by the *art of printing*, and of drawings and pictures by the *art of engraving*, produced a radiance of knowledge that made tyranny tremble; and will effectually secure the human race from those horrid shocks of barbarism and tyranny, that once nearly laid waste the old world. *The mariner's compass* then *opened the universe*, and *printing displayed it.*

At this time, superstition, and an odious ecclesiastical despotism, received a fatal wound. Astronomical improvements, by discovering worlds besides our own, expanded the human mind. So that when the Christian religion began again to be taught in its purity, the universe seemed to extend itself to do it homage. Then did KNOWLEDGE raise weeping HUMANITY from the dust, and point with her blazing torch the way to happiness and peace! Then did RELIGION, instead of daggers, racks, and fetters, wear upon her graceful brow this everlasting motto, "*My ways are ways* "*of pleasantness, and all my paths are peace.*"

Need I say a word to prove to such an audience as this, that the present prevailing spirit of benevolence is principally owing to the diffusion of a re-

† Bacon.

ligion, as much above all others, as heaven is above the earth? Let him who doubts, compare it with the next best system the world ever possessed. Did not Moses bring famine and other plagues on the Egyptians? Elijah deprived the earth of rain, and destroyed with fire those who opposed him; as did Elisha those who mocked him. Did not David kill and curse those he hated or envied? But the FOUNDER *of the religion of humanity* came without judgement, anger, or revenge. All his transactions were for the benefit of man. He allayed the winds which threatened destruction to the mariners; he restored limbs to the lame, sight to the blind, speech to the dumb, clean flesh to the leprous, a sound mind to the insane, and *life to the dead.*† All his, were works of beneficence, diffusing charity and good will to men, accompanied too, with a spirit so sublime and friendly, that the human heart, with unbidden veneration, bows down before it.

While we consider *this* HUMANE SOCIETY as a *stream* deriving its source from the inexhaustible "*River of Joy,*" the *ministers of religion* may be considered its principal guardians. They have been its chief supporters; and so long as they continue to inculcate the precepts of the *religion* of *humanity*, with that benevolent, gentle, pious, charitable, tolerating spirit, which so eminently distin-

† See Bacon's Essays.

guishes those before whom I now speak, they will be regarded among its brightest ornaments*

Then will CHARITY, that bright constellation of christian virtues, always be present with us; under whose fostering influence, we hope, this yet infant society, this *standing committee of humanity*, will extend, so far and wide, its salutiferous effects, that future generations will have reason to commemorate its exertions with grateful admiration!

* The author rejoices in this public opportunity of rendering a just tribute to the Clergy of *Boston*. He hopes it will not be less grateful, in coming from a person who was educated in that religious persuasion, which teaches every man to be his own priest.

APPENDIX.

The following letters are inserted here to shew the interest which the renowned WASHINGTON took in the prosperity of the first *Humane Society*, established in the nation over which he presided. Although a part only of his letter to the Reverend *Dr. Lathrop* relates to the Humane Society, yet I cannot resist the impulse of publishing the whole; because every thing that contributes to the consolidation of the union of these states is as dear to humanity as the life of man itself. B. W.

Cambridge, July 4, 1811.

Mount Vernon, June 22d, 1788.

REVEREND AND RESPECTED SIR,

YOUR acceptable favour of the 16th of May, covering a recent publication of the Humane Society, has within a few days past, been put into my hands.

I observe, with singular satisfaction, the cases in which your benevolent institution has been instrumental in recalling some of our fellow creatures (as it were) from beyond the gates of eternity, and has given occasion for the hearts of parents and friends to leap for joy. The provision made for shipwrecked mariners is also highly estimable in the view of every philanthropic mind, and greatly consolatory to that suffering part of the community. These things will draw upon you the blessings of those who were nigh to perish. These works of charity and good-

will towards men reflect, in my estimation, great lustre upon the authors, and presage an æra of still farther improvements. How pitiful, in the eye of reason and religion, is that false ambition which desolates the world with fire and sword for the purposes of conquest and fame; when compared to the milder virtues of making our neighbours and our fellow men as happy as their frail conditions and perishable natures will permit them to be!

I am happy to find that the proposed general government meets with your approbation, as indeed it does with that of most disinterested and discerning men. The convention of this state is now in session, and I cannot but hope that the constitution will be adopted by it, though not without considerable opposition. I trust, however, that the commendable example exhibited by the minority in your State will not be without its salutary influence in this. In truth it appears to me that (should the proposed government be generally and harmoniously adopted) it will be a new phenomenon in the political and moral world; and an astonishing victory gained by enlightened reason over brutal force. I have the honour to be with very great consideration,

Reverend and respected sir,

your most obedient, and humble servant;

GEORGE WASHINGTON.

THE REV. JOHN LATHROP, D. D.

Mount Vernon, November 19*th*, 1790.

SIR,

I beg you to excuse the delay, which my avocations in the country have occasioned in answering your letter of the 28th of August.

I am persuaded of the happy influence, which the Discourse, that accompanied it, must have in promoting the interests of humanity;* and I request you to accept my thanks for your polite attention in favouring me with this mark of your regard.

I am, sir,
your most obedient servant,
GEORGE WASHINGTON.

BENJAMIN WATERHOUSE, M. D. and Professor in the University at Cambridge, Massachusetts.

* The preceding Discourse on the Principle of Vitality.

ERRATA.

Page 88, line 8 from bottom, in a few copies, for *Calvis* read *Clavis*.

FINIS.