Philosophical Magazine Series 3

ISSN: 1941-5966 (Print) 1941-5974 (Online) Journal homepage: http://www.tandfonline.com/loi/tphm14

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To cite this article: Rev. Patrick Keith F.L.S. (1837) X. On the classification of vegetables , Philosophical Magazine Series 3, 10:58, 37-42, DOI: 10.1080/14786443708649069

To link to this article: http://dx.doi.org/10.1080/14786443708649069

X. *On the Classification of Vegetables. By the Rev.* PATRICK KEITH, *F.L.S.**

CLASSIFICATION may be defined to be the arranging of the productions of nature in a system, so as either to show the mutual relation which the several subjects or groups of subjects bear to one another in the scale of being, or merely to facilitate our ascertaining of the names which have been imposed upon them by their discoverers or others. In the former case the classification is natural, and is exemplified, as far as regards plants, in the arrangements of Jussieu. In the latter case the classification is artificial, and is exemplified, as far as regards plants, in the arrangements of Linnæus. After all, this distinction, as M. Raspail well observes †, is more trenchant in expression than in reality, as every good classification will have something in it both of the one quality and of the other.

Linnæus, as every one knows, founded his classes chiefly upon the number of the stamens, and his orders upon the number of the styles. But as distinctions arising from number merely are of themselves entirely artificial, so is the system that is founded upon them. They do not necessarily give any indication of natural groups, and yet it is singular enough that this artificial system has brought together several tribes of plants that are perfectly natural, as the Grasses, the Papilionaceæ, the Cruciferæ. Still the study of it gives the disciple but little knowledge of a plant beyond the name. He counts his stamens and pistils, and becomes a perfect master of classes and orders; but of the interior and more recondite parts and properties, whether of stem or of flower, by which different genera are allied and connected together, that is, of the natural affinities of plants, he knows nothing. Yet this, as Linnæus himself admitted, is the grand end and aim of all botanical investigation. "*Methodus naturalis, hinc, ultimus finis Botanices est et erit* ‡." If he had put *fuit* into his maxim it would still have been equally true, for all inventors of systems, even from the earliest times, have had an eye to a natural method. The very division of plants into herbs, shrubs, and trees, the oldest and most popular of all, as well as the most humble in its pretensions, is founded upon a presumed or apparent affinity between the subjects of its different groups. This division is at least as ancient as the age of Theophrastus, if not, rather, as ancient as that of Moses, who speaks of grass, herb, and tree as comprehending and exhausting the whole of

* Communicated by the Author.

† *Chim. Organ.*, p. 84.

‡ *Phil. Bot.*, p. 137.

the vegetable kingdom. In later times,—that is, after the period of the decline of learning, and interval of the dark ages,—when science began to revive and the seeds of sound investigation to take root, botanists began also to introduce into their lovely study the principles of sound arrangement. Cæsalpinus, Ray, and Tournefort may be named as individuals who contributed much towards the introduction of a natural system, although they were not fortunate enough to stumble upon the true foundation on which alone it can be made to rest. Linnæus himself lent his able aid, and in his Fragments of a Natural Method exhibited to the botanical world the proofs of his qualification for the task. There is no saying how far he might have proceeded in the prosecution of his plan, if it had not been that he was so much occupied in the perfecting of his artificial method,—a mere stepping-stone to his natural method,—that he could not find time for the perfecting of both. But by thus showing his disciples an easy and royal road to learning, he unfortunately, and without thinking of it, adopted the very means of preventing the student from entering upon, or following up, the intricate and uninviting path that leads by slow degrees to the elevated station from which he may discern the beauties, and appreciate the value, of a natural arrangement.

Yet this laborious and uninviting task was at last undertaken, and prosecuted with a success beyond all that could have been expected. The principal part of the achievement is usually ascribed to M. Bernard de Jussieu, and a subordinate part to his nephew, M. A. Laurent de Jussieu, who is represented as being merely the editor of the writings of his uncle. This erroneous notion seems to have been taken up hastily by the contemporary botanists of this country, and handed down from one to another without much inquiry, till at last it attracted the notice of M. Adrien de Jussieu, as occuring in the Introduction to the *Flora Indica* of Messrs. Wight and Arnott, and called forth a statement that settles the respective claims of the uncle and nephew, and corrects the error that had become too prevalent with regard to them. (*Annales des Sci. Nat.*, Nov. 1834.)

From this we learn that the uncle suggested indeed some of the grand outlines of the *Genera Plantarum*, but gave no filling up. He adopted the germination of the seed and the relative disposition of the sexual organs as the only true ground of all systematic arrangement. He formed families, but not classes, and left, in short, nothing in writing but the manuscript catalogues of the garden of Trianon. He died in 1777.

But the *Genera Plantarum secundum Ordines Naturales dis-*

posita, as published in 1789, is something more than a mere catalogue, and M. A. Laurent de Jussieu is something more than its mere editor: he is, in fact, its author. He could not have been the editor of the writings of one who wrote nothing. He could not have gathered all that was necessary to the composition of the *Genera Plantarum* from a few occasional conversations with his uncle. He could not have produced that *chef-d'œuvre* of botanical and logical arrangement without years of close and previous study. Besides, many facts necessary to its final completion were not even known at the time of his uncle's death. Hence we see why the work was not ready for publication before 1789. Hence we see what portion of it is to be ascribed to the uncle and what to the nephew; and we must beware of detracting from the merits of the one for the purpose of enhancing the merits of the other.

In this profound and elaborate work the subjects of the vegetable kingdom are distributed into three grand groups, Acotyledonous, Monocotyledonous, and Dicotyledonous plants. The sections are founded on the peculiarities of the corolla, and the classes on the insertion of the stamens. Still the advocates of the sexual system say that the method of Linnæus is not more artificial than that of Jussieu, whom they accuse of founding his sections merely on number, as Linnæus founds his classes and orders *. But it should be recollected that it is under very different circumstances. Linnæus selects a single species of organ,—the stamens—and all plants furnished with the same number of stamens are thrust into the same class without reserve, let their natural affinities be what they will. Indeed, natural affinities are not so much as looked for. Thus you have the Asperifoliæ and the Umbelliferæ, the Bugloss and the Bulbocastanum, associated in the same class, without any connecting link, apparent or presumptive, beyond that of their having the same number of stamens; and thus you are under the necessity of separating the single genus Anthoxanthum from the natural family of the Grasses, because it happens to have but two stamens to its flower instead of three, which the rest of the grasses have. In the class Dodecandria the stamens should be twelve, but by special allowance they may be from eleven to nineteen. The orders exhibit the same incongruities. In Diandria Monogynia, you have Enchanter's Nightshade and Common Ash placed side by side; and in Pentandria Digynia, you have Cuscuta and Ulmus. The styles of Icosandria Pentagynia are by special privilege also allowed to be from two to five. Yet these incongruities are not to be se-

* Roscoe on Arrangements, Linn. Trans., vol. xl. [or Phil. Mag. and Annals, N.S., vol. vii.—Edit.]

verely censured, seeing that the sexual system is actually and professedly artificial.

But in the system of Jussieu several important traits of affinity are already determined before the class is fixed. All plants composing the classes of the first grand group are already connected by the link of their being cotyledonous, that is, by a character founded on the structure of the embryo, and its mode of growth. All plants composing the classes of the Dicotyledons and Monocotyledons are further connected by their being respectively exogenous or endogenous, accordingly as they belong to the former or to the latter division, that is, by a character founded on the structure of the stem and its mode of growth. These characters are evidently and essentially natural. The Dicotyledons are subdivided into minor groups, upon the ground of their being furnished with a calyx and corolla, or with a calyx only, a character found to be of the greatest importance in bringing together natural orders, though not infallible; and the subdivisions are distributed into sections, upon the ground of their being polypetalous, monopetalous, apetalous, or anomalous. If these last characters are not absolutely natural, they are at least absolutely necessary to give facility to the investigations of the student, and are to be admitted till better characters are discovered; and if you say that they are founded on number merely, it is not exactly so. It is upon structure rather than upon number, a character of more value. For the distinction lies between a corolla, the petals of which are free, and a corolla, the petals of which are united, or it depends upon the absence of a corolla altogether.

Lastly, from the several sections, the classes themselves, which are fifteen in number, derive their immediate origin, upon the principle of the insertion of the stamens, as being hypogynous, perigynous, or epigynous, characters evidently affinial*, and very available to Linnæus in the circumscription of his 12th, 13th, and 20th classes; for how, without their aid, could he have brought together so many plants connected by natural affinities where his styles and stamens might not have been easily counted? Number is no doubt the work of nature, as well as other characters, but it is found to be liable to great mutability, by an abortion, or by an undue multiplication of parts, and is consequently not to be depended upon in the circumscribing of orders or of genera. It is but a fallacious mark at the best, if taken by itself; for although the genera belonging to a natural order may have all the same number of styles and stamens, yet all plants having the same number of styles and stamens do not belong to the same natural order. Hence

* [See Lond. and Edinb. Phil. Mag., vol. v. p. 206, note.—Edit.]

it is not from any single trait of resemblance that natural orders are to be determined, but from the sum of the affinities discoverable in the number, form, structure, and position of the several organs composing the stem, leaf, flower, fruit, or seed, the organs last developed being regarded as the most important.

Such is the sure foundation on which the system of Jussieu is built; but still its merits were not at first duly appreciated, whether in France or in other countries. The *éclat* which the name of Linnæus gave to the sexual system was such that no system standing in opposition to it was likely to succeed. Its novelty, its facility, its beauty, were attractions that could not be resisted. Hence Jussieu had many prejudices to encounter, and a host of adversaries to discomfit, before he could divest the natural system of the dreaded difficulties which the study of it seemed to involve, and to present it to the botanical student in a fair and favourable light. Yet, in spite of all obstacles, its superiority to every other system forced itself at last upon the notice of botanists, and began to make converts even from among the disciples of Linnæus. In France, the late M. Richard, the Chevalier Aubert du Petit Thouars, M. Mirbel, and the *élite* of the French school were among the first to enrol themselves under the standard of Jussieu; in Germany, Kunth, Von Martius; and in Switzerland, M. DeCandolle. But the botanist whom we regard as having distinguished himself the most conspicuously in the elucidating and perfecting the system of Jussieu, is our celebrated countryman and fellow-Linnæan Dr. Robert Brown, as may be seen by consulting his *Prodromus Floræ Novæ Hollandiæ*, or his papers published in the Linnæan Transactions, particularly that on the Proteaceæ of Jussieu, and on the organs and mode of fecundation in the Orchideæ and Asclepiadeæ; together with that on the genus Rafflesia, followed by a paper read at a meeting of the Society, June 17, 1834, in which he completes his account of *Rafflesia Arnoldi*, and creates a new order, which he denominates Rafflesiaceæ*; all discovering a profundity of research, an acuteness of discrimination, and a peculiarity of tact in seizing the essential character that connects or disunites the subjects of his investigation, which, without his assuming anything of bold or of arrogant pretension, have elevated him to a rank beyond that of all his competitors, and established his claim to the compliment that was formerly paid to Linnæus, namely, that of his being emphatically, and in the estimation of botanists themselves, *Botanicorum facile princeps*†. We

* [An abstract of Dr. Brown's paper was given in Lond. and Edinb. Phil. Mag., vol. v. p. 70.—Edit.]

† Arnott, *Encyc. Brit.*, art. Bot.

cannot on this occasion pass by without notice Mr. Professor Don, of King's College, London, whom we regard as occupying a very elevated station among the botanists of this country, and second only to Dr. Brown in the number of valuable contributions with which he has enriched the Transactions of the Linnæan Society, all tending to advance and to illustrate the system of Jussieu.

[To be continued.]

XI. *On the Laws of Crystalline Reflexion.* *By* JAMES MACCULLAGH, *Fellow of Trinity College, Dublin.**

IN a Number of Poggendorff's *Annalen* (No. 6, for 1836,) which reached Dublin late in November, there are some remarks by M. Seebeck on a paper of mine which appeared in the last February Number of this Journal, (vol. viii. p. 103). That paper contains a general theory of reflexion at the surfaces of crystallized media; and M. Seebeck, in comparing the results with his own experiments, has fully confirmed some of my formulæ, while he has shown that others are defective. I have therefore been obliged to revise my theory, and I have ascertained that it was vitiated by the introduction of a certain relation among the quantities denominated pressures, which, following the example of M. Cauchy, I had supposed to be concerned in the problem. This relation I had observed to hold in the case of singly refracting media, and I concluded, without any other reason, that it would hold good generally. But though it led to the correct formula for the polarizing angles in different azimuths, it was nevertheless arbitrary and unfounded; and therefore it is now banished entirely from the investigation, the place which it occupied being supplied by the natural and simple law of the preservation of *vis viva*, while everything else remains as before. I hope the imperfection of my first essay will be excused, when it is considered that the erroneous proposition bears but a small proportion to the whole theory, and moreover, that the general problem, which I undertook to resolve, is one that has not been attempted by any other person, although the want of a solution has long been felt. The difficulties which we have to deal with, in entering upon this problem, are not mere mathematical difficulties, but difficulties arising from the want of first principles; and, in physical questions of this kind, where we must, at the outset, have recourse to conjecture, in order to supply the very principles of our reasoning, it can hardly be expected that the whole truth should be divined at once. I think, however,

* Communicated by the Author.