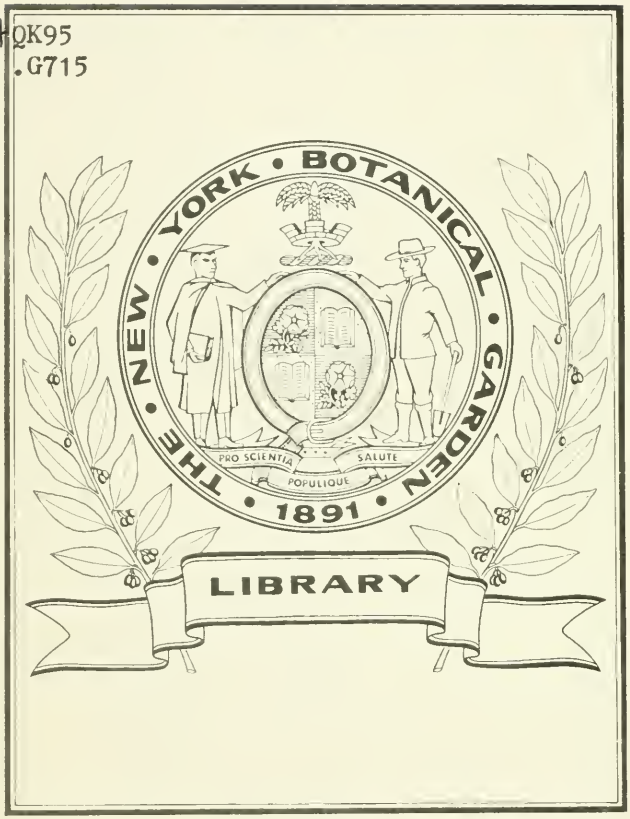
Gray, Asa

A natural system of Botany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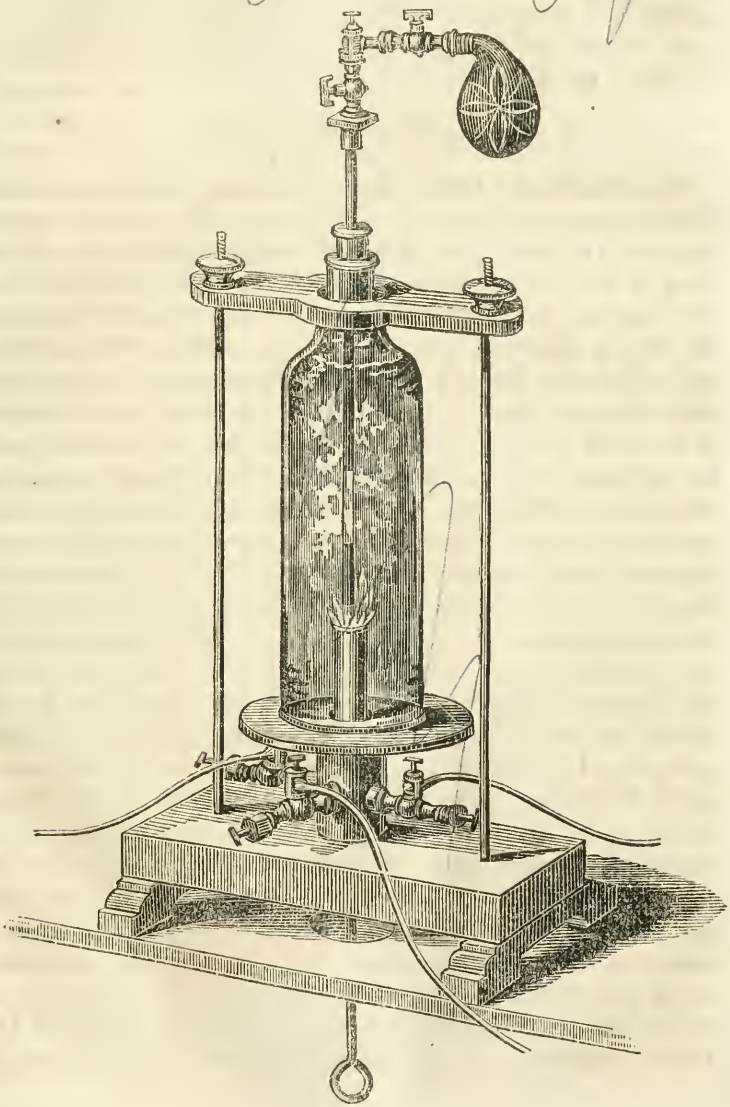
communicating with the bag of oxygen is opened, an intense combustion ensues; since the oxygen, emitted in a jet from the capillary orifices of the tube, reaching the melted phosphorus excites it into an active combustion, which the nitrous oxide afterwards sustains with great energy.

Combustion of Phosphorus in Nitrous Oxide illustrated.



ART. VIII.—*A Natural System of Botany; or a systematic view of the Organization, Natural Affinities, and Geographical Distribution of the whole Vegetable Kingdom; together with the uses of the most important species in Medicine, the Arts, and rural or domestic economy;* by JOHN LINDLEY, Ph. D. &c. *Second edition, with numerous additions and corrections, and a complete list of genera, with their synonyms.* London: Longman, Rees, &c. 1836. pp. 526. 8vo.

(Communicated for this Journal.)

THE cultivators of Botany in this country are generally acquainted with the former edition of this work through the American reprint, edited by Dr. Torrey, and published by the Messrs. Carvill of New York, in the spring of 1831. Dr. Lindley's treatise was at the time of its appearance, the only introduction to the Natural System in the English language, if we except a translation of Achille Richard's *Nouveaux Elemens de la Botanique*, which was published about the same period. It is unnecessary to state that a treatise of this kind was greatly needed, or to allude either to the peculiar qualifications of the learned and industrious author for the accomplishment of the task, or the high estimation in which the work is held in Europe. But we may very properly offer our testimony respecting the great and highly favorable influence which it has exerted upon the progress of botanical science in the United States. Great as the merits of the work undoubtedly are, we must nevertheless be excused from adopting the terms of extravagant and somewhat equivocal eulogy employed by a popular author, who gravely informs his readers that no book, since printed bibles were first sold in Paris by Dr. Faustus, ever excited so much surprise and wonder as did Dr. Torrey's edition of Lindley's Introduction to the Natural System of Botany. Now we can hardly believe that either the author or American editor, of the work referred to, were ever in danger, as was honest Dr. Faustus, of being burned for witchcraft; neither do we find any thing in its pages calculated to produce such astonishing effects, except, perhaps, upon the minds of those botanists, if such they may be called, who had never dreamed of any important changes in the science since the appearance of the good Dr. Turton's translation of the Species Plantarum, and who speak of

Jussieu as a writer who "has greatly improved upon the natural orders of Linnæus."* We have no hesitation, however, in expressing our conviction that no single work has had such a general and favorable influence upon the advancement of botanical science in this country, as the American edition of Dr. Lindley's Introduction to the Natural System. This treatise, however useful, was indeed not absolutely indispensable to the favored few, who, aided by the works of Jussieu, Brown, De Candolle, the elder and younger Richard, &c. were already successfully and honorably pursuing their investigations; but to the numerous cultivators of botany throughout the country, who could seldom be expected to possess, or have access to, well furnished libraries, and to whom the writings of these great luminaries of the science were mostly unknown except by name, this publication was a truly welcome acquisition, conferring advantages which those alone who have pursued their studies under such unfavorable circumstances can fully appreciate.

A second and greatly improved edition of this work having appeared within the past year, it occurred to the writer of these remarks, that a cursory notice of it might not be unacceptable to the readers of the American Journal of Science. We do not intend, in these observations, to engage in a defense of what is called the Natural System of Botany; but take it for granted, that the science can by no other method be successfully and philosophically pursued: or,

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* Dr. Lindley is quite right in his remark that the chief difficulties the student has to encounter in the study of botany, upon the principles of the Natural System, have been very much exaggerated by persons who have written upon the subject without understanding it. To refer to a single instance. In the fifth edition of the Manual of Botany, by Mr. Eaton, an account of the Natural Orders of Jussieu is given, in which the genera Ambrosia and Xanthium are referred to Urticeæ; and in a note it is added, "*Some botanists place the last two genera in the order Corymbiferæ, also in the Linnæan class Syngenesia. I see no good reason for these innovations.*" Now Linnæus, in his artificial arrangement, certainly did place these genera (and also Parthenium and Iva,) in Monœcia Pentandria; but the *innovator* in this instance, is Jussieu himself, who never referred these two genera to Urticeæ, but places them in his order *Corymbiferæ*, (Compositæ,) where they truly belong. The descriptions of Natural Orders in Eaton's Manual, purporting to be taken from Jussieu, bear a very remote resemblance indeed to the ordinal characters of the admirable *Genera Plantarum* of that author, while the occasional criticisms on its supposed errors afford the clearest proof that the work was not understood by the author alluded to. It should be recollected that, previously to the reprint of Dr. Lindley's Introduction, Mr. Eaton's Manual was the only work professing to give a view of the Natural System, within the reach of the great majority of the botanical students of this country, excepting, perhaps, the American edition of Smith's *Grammar* of *Botany*.

to employ the forcible language of Linnæus, "*Methodus naturalis primus et ultimus finis botanices est et erit,*".....*"Primum et ultimum in hoc botanicis desideratum est.*" The few persons who remain at this day unconvinced of its advantages are not likely to be affected by any arguments that we could adduce. A somewhat larger number may perhaps be found in this country who admit the importance and the utility of a natural arrangement in the abstract; but decline to avail themselves of the advantages it affords in the study of plants, because, forsooth, it is too much trouble to acquire the enlarged views of vegetable structure which are necessary for the application of its principles. It would almost seem, from the views and practice of such botanists, that they considered it the chief object of a classification to afford the means of ascertaining the name of an unknown plant by the slightest examination of its structure, and with the least possible expenditure of thought.

In the first edition, Dr. Lindley entered into some detailed explanations to show the fallacy of the common opinion that the artificial system of Linnæus is easy, and the Natural System difficult of application. The sentiments of the public having undergone so great a change upon this subject within the last five or six years, that he finds it no longer necessary to adduce these considerations, and accordingly commences at once with a developement of the principles on which the Natural System is founded, viz. "That the affinities of plants may be determined by a consideration of all the points of resemblance between their various parts, properties, and qualities; that thence an arrangement may be deduced in which those species will be placed next each other which have the greatest degree of relationship; and that consequently the quality or structure of an imperfectly known plant may be determined by those of another which is well known. Hence arises its superiority over arbitrary or artificial systems, such as that of Linnæus, in which there is no combination of ideas, but which are mere collections of isolated facts, not having any distinct relation to each other."—(*Preface, p.* vii.)

We have never met with a more clear and succinct account of the principles on which the primary divisions of the vegetable kingdom rest, than that comprised in the following extract. Those acquainted with the first edition will perceive that the author has changed his opinions respecting the number of these primary divisions, or classes; the *Gymnospermæ*, or Flowering plants with naked ovules (comprising the Coniferæ, Cycadeæ, and, according to Brongniart and Lind-

ley, the Equisetaceæ,) and the *Rhizanthæ*, as originally established by Blume, being here admitted to the rank of independent classes. Their claim to this rank, however, can as yet be hardly considered as fully established.

"One of the first things that strikes an enquirer into the structure of plants, is the singular fact, that while all species are capable of propagating their race, the mode in which this important function is accomplished is essentially different in different cases. The great mass of plants produce flowers which are succeeded by fruits, containing seed, which is shed or scattered abroad, and grows into new individuals. But in Ferns, Mosses, Mushrooms, and the like, neither flowers, nor seeds properly so called, can be detected; but propagation is effected by the dispersion of grains or spores which are usually generated in the substance of the plant, and seem to have little analogy with true seeds. Hence the vegetable world separates into two distinct groups, the *Flowering* and the *Flowerless*. Upon examining more closely into the respective peculiarities of these two groups, it is found that flowering plants have sexes, while flowerless plants have none; hence the former are called *Sexual*, and the latter *Asexual*. Then again the former usually possess a highly developed system of spiral or other vessels, while the latter are either altogether destitute of them, or have them only in the highest orders, and then in a peculiar state: for this reason flowering plants are also called *Vascular*, and flowerless *Cellular*. More than this, all flowering plants, when they form stems, increase by an extension of their ends and a distention or enlargement of their sides; but flowerless plants appear to form their stems simply by the addition of new matter to their points; for this reason while the former are principally *Exogens* or *Endogens*, the latter are called *Acrogens*. Flowering plants are also for the most part furnished with respiratory organs or stomates, while flowerless plants are to a great extent destitute of them. No one then can doubt that in the vegetable kingdom, two most essentially distinct divisions exist, the *Flowering* and the *Flowerless*, and that these differ not in one circumstance only, but are most essentially unlike in many points both of organization and physiology.

"In like manner, *Flowering plants* are themselves divisible into equally well marked groups. Some of them grow by the addition of new woody matter to the outside of their stem beneath the bark; these are *Exogens:* others grow by the addition of new woody mat-

ter to the inside of their stem near the centre; those are *Endogens.* But Exogens have two or more cotyledons to their embryo, and hence are called *Dicotyledons;* while Endogens have only one cotyledon, and are, therefore, *Monocotyledons.* Exogens have the young external wood connected with the centre by medullary processes; Endogens having no occasion for such a provision, are destitute of it. In Exogens the leaves have their veins disposed in a netted manner; in Endogens the veins run parallel with each other. The number of parts in the flower of an Exogen is usually five, or its multiples; in an Endogen it is as usually three, or its multiples. In germination the young root of Exogens is a mere extension of the radicle; but of Endogens it is protruded from within the radicle; hence the former have been named *Exorhizæ,* and the latter *Endorhizæ.* In this case then, as in the last, we have two groups differing entirely from each other in their germination, the structure of their stem and leaves, their mode of growth, the arrangement of the parts of the flower, and in the organization of their embryo. It is impossible, therefore, not to recognize such groups also as natural.

"To this separation of the vegetable kingdom into Exogens, Endogens, and Acrogens, or by whatever synonymous names these groups may be known, many botanists confine themselves. But there are two others, of subordinate importance perhaps, but nevertheless characterized by circumstances of a similar nature, and, therefore, I think, to be esteemed of equal dignity with them. In true Exogens and Endogens, the fertilizing principle is communicated to the young seeds through the medium of a stigma which terminates a case or pericarp in which they are enclosed. But in some plants otherwise Exogens, the fertilizing principle of the pollen is applied immediately to the seeds, without the intervention of any pericarpial apparatus, and they bear the same relation to other Exogens as frogs and similar reptiles to other animals. These plants, therefore, are separated as a distinct class, under the name of *Gymnosperms.* Like the other groups of the same grade, these are also found to possess peculiarities of a subordinate nature. For instance, they have in many cases more cotyledons than two, whence they have been called *Polycotyledons;* their radicle usually adheres to the albumen in which the embryo lies, and that circumstance has given rise to the name *Synorhizæ.* The veins of their leaves, when they have any veins, are either simple or forked; in which respect they approach Endogens on the one hand, and Acrogens on the other.

And finally, their vascular system is very imperfect compared with that of other Exogens of an equal degree of development.

The other group, called *Rhizanthæ*, is far less correctly known, but it seems to stand as it were between Endogens and Acrogens of the lowest grade; agreeing with the latter in the absence or very imperfect state of the vascular system, in a general resemblance to Fungi, and in the apparent seeds being mere masses of sporules; but apparently according with Endogens in the ternary number of their floral envelopes, and in the presence of fully developed sexes.

"Certainly there is no possibility of obtaining such important primary groups as these by any kind of artificial contrivance."—(*Preface*, *p.* x.—xii.)

The grand natural divisions of the vegetable kingdom are, therefore perfectly obvious, and may be very clearly defined. With our present knowledge of vegetable structure no great difficulty is experienced in characterizing the orders or natural families, and all subordinate groups. The great desideratum has ever been to effect such an arrangement of the orders under the primary classes, that each family should be placed next to those which it most nearly resembles. This might easily be accomplished, if the idea once so strongly insisted upon by poets and metaphysicians, of a chain of beings, a regular gradation, by a single series, from the most perfect and complicated to the most simple forms of existence, had any foundation in truth. On the contrary, nothing is more evident, than that almost every order, or other group, is allied not merely to one or two, but often to several others, which are sometimes widely separate from each other; and, indeed, these several points of resemblance or affinity, are occasionally of about equal importance. A truly natural lineal arrangement is therefore impracticable, since by it only one or two out of several points of agreement can be indicated. As this method is, however, the only one that can be followed in books, all that can be done is to arrange the orders in such a manner as to offer the least possible interruption to their natural affinities. The number of orders is so large that practical convenience seems to require their arrangement into groups subordinate to the primary classes; and when manifestly natural assemblages cannot be recognized, we are obliged to employ those which, being less strongly marked, and distinguished by a smaller number of characters, are apparently of a more artificial nature. The arrangement employed by the learned Jussieu, in his celebrated *Genera Planta-*

rum, although to a considerable extent artificial, has been almost universally adopted, until within the last few years.

In this method Dicotyledonous plants are primarily divided into three groups; the first including those with a polypetalous corolla; the second, those with a monopetalous corolla; and the third, those destitute of a corolla. These sections are subdivided, (as also the monocotyledons) by means of characters taken from the insertion of the stamens (or corolla,) whether hypogynous, perigynous, or epigynous. The arrangement here pursued, which is too well known to require further notice, is substantially adopted by De Candolle, the difference being more in appearance than reality. Dr. Lindley discarded these subdivisions in the first edition of his work; but the new distribution of the orders therein proposed possesses few advantages, and, indeed appears not to have satisfied the author himself. In the same year with the publication of the work just mentioned, the *Ordines Plantarum* of Bartling appeared, in which a more natural arrangement of the orders is attempted by the formation of aggregate or compound orders, as originally proposed, and in several instances successfully accomplished, by Robert Brown. An analogous plan was pursued by Agardh in his *Aphorismi Botanici*, (1817,) and again in his *Classes Plantarum*, (1825;) but these attempts, however ingenious, do not seem to have obviated, in any considerable degree, the inconveniences of a lineal arrangement.

We now return to our author, whose views upon this subject have been materially modified since the original publication of his Introduction to the Natural System. The method now employed was first sketched in the *Nixus Plantarum*, (1832,) and afterwards in the *Key to Structural, Physiological, and Systematic Botany*,* (1835,) and is more fully developed and illustrated in the work before us. He now admits, as we have already seen, five primary classes, two of which, however, are much smaller than the others and of subordinate importance, and may be considered as transition classes, viz. *Gymnospermæ*, which connect Exogens with the higher Acrogens, and *Rhizanthæ*, which form the transition from Endogens to Acrogens of the lowest grade. The great class *Exogenæ* (*Dicotyledones* of Jussieu,) is divided into three subclasses, viz.

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* This excellent little work consists of an augmented edition of the author's *Outlines of the first principles of Botany*, with a revised translation of the *Nixus Plantarum*.

1. *Polypetalæ;* those with the floral envelopes consisting of both calyx and corolla, the latter composed of distinct petals.

2. *Monopetalæ;* those with the petals combined in a monopetalous corolla.

3. *Incompletæ;* those always destitute of a corolla, the calyx also often incomplete or absent.

Thus far this mode of subdivision is nearly the same with that of Jussieu; Dr. Lindley, however, neglecting altogether the characters afforded by the insertion of the stamens, divides the polypetalous orders into seven, and the monopetalæ and incompletæ each into five sections, or *groups*. As a specimen of this plan, we copy the names of the groups of the first subclass, with their synoptical characters.

1. *Albuminosæ.* Embryo very considerably shorter and smaller than the albumen.

2. *Epigynosæ.* Ovary inferior, usually having an epigynous disk.

3. *Parietosæ.* Placentation parietal.

4. *Calycosæ.* Calyx incompletely whorled; two of the sepals being exterior.

5. *Syncarposæ.* None of the characters of the other groups, and with the carpels compactly united.

6. *Gynobaseosæ.* Carpels not exceeding five, diverging at the base, arranged in a single row around an elevated axis or gynobase. Stamens usualy separate from the calyx.

7. *Apocarposæ.* None of the characters of the other groups, but with the carpels distinct, or separable by their faces, or solitary.

Next, every group is divided into smaller groups, each of which includes one, two, or several orders. These minor groups are called *Alliances*, and are distinguished by the termination *ales*. Thus, under the Albuminose group, we have

Alliance 1. *Ranales*, comprising the Ranunculaceæ, Papaveraceæ, (with its suborder, as Lindley, following Bernhardi, considers it, Fumarieæ,) Nymphæaceæ, (to which Hydropeltideæ is improperly joined,) and Nelumbiaceæ;

Alliance 2. *Anonales*, which comprehends the Nutmeg tribe, the Anonaceæ, Magnoliaceæ, &c.;

Alliance 3. *Umbellales*, including the Umbelliferous tribe, with the nearly allied Araliaceæ;

Alliance 4. *Grossales*, consisting chiefly of the Grossulaceæ or Currant tribe; and lastly

Alliance 5. *Pittosporales*, which strikes us as a singularly heterogeneous assemblage, bringing together into one group the Vitaceæ, Pittosporaceæ, Olacaceæ, Francoaceæ, and Sarraceniaceæ!

All the subclasses and groups, both of Exogens and Endogens, are subdivided in a similar manner; but we cannot here proceed further with our enumeration. It will be borne in mind that the chief object of an arrangement of this kind, is to facilitate the study of the natural orders, by dividing the extensive primary classes into sections of convenient size, and to dispose these groups, and the orders they comprise, as nearly in accordance with their respective affinities and relationships as a lineal arrangement will allow. It is impossible, in the present state of our knowledge, to say how far the views of our author will ultimately be approved. Every attempt of the kind must necessarily be very imperfect, so long as the structure of only a limited portion of the whole vegetable kingdom has been attentively and completely examined; and the author is well aware "that this part of the work will require many great changes and improvements before it can be considered at all established." Notwithstanding the objections to which it is liable in many particulars, we agree with the author in the opinion, "that even in its present state it will be found to be attended with numerous advantages, and that every step which may be taken in determining the limits of natural groups subordinate to the primary classes, must be a decided gain to the science. So rapid is the advance of our knowledge of the vegetable kingdom, and so numerous are the new types of structure that present themselves to the systematic botanist, that it is to be feared lest another chaos should be brought on by the masses of imperfectly grouped species with which the science will soon abound."

The names of natural orders, as first established, do not appear to have been framed in accordance with any uniform rule, as to derivation or mode of termination. They were sometimes intended to express some characteristic feature, (Ex. *Leguminosæ*, *Labiatæ*, *Cruciferæ*, *Umbelliferæ*, *Coniferæ*, &c.) but more commonly some genus was selected as the type of the family, which was designated either by the plural of the genus simply, (as *Myrti*, *Lilia*, *Irides*, *Euphorbiæ*,) or with a slight prolongation, (as *Orchideæ*, *Jasmineæ*, &c.) or with the termination still further modified, (as in *Cyperoideæ*, *Aroideæ*, *Boragineæ*, or *Ranunculaceæ*, *Rosaceæ*, *Cucurbitaceæ*, &c.) The derivation of the name of an order from some prominent genus is now the universal practice; and for the sake of uniformity,

as well as to distinguish such names from those of genera in the plural number, the termination *aceæ* is given to orders, and that of *eæ* to suborders, &c. The advantages of uniformity in this respect are manifest, and Dr. Lindley therefore insists upon the adoption of the rule in all cases. In the *Key to Botany*, published the year previous to the appearance of the second edition of the present work, the termination in *aceæ* is employed, not only in names of orders formed from those of genera, but also in the few still in use which relate to some peculiarity in the habit of the family. Thus, instead of Cruciferæ, Umbelliferæ, Coniferæ, &c. we have *Cruciaceæ*, *Umbellaceæ*, and *Conaceæ*. These are, however, very properly abandoned in the work before us, in which the author inclines to give up the old and familiar names of these orders, and to substitute those formed in the customary manner from well known genera. *Brassicaceæ*, *Apiaceæ* and *Pinaceæ* may certainly be as good names as any other when we once get accustomed to them, but it seems hardly necessary to make any change in the case of names of this kind. Dr. Lindley, as we have already seen, gives to the names of Alliances the termination *ales*, and to the groups that of *osæ*. The chief advantage of this system is, that the name of any group at once indicates its rank and importance.

The value of this work is greatly increased by the complete list of genera, (so far as known at the time of its publication,) with the principal synonyms, appended to each order and properly arranged under their several sub-orders, sections, &c. This laborious and difficult task is upon the whole very faithfully executed. We observe, however, several errors, typographical and otherwise, which are not noticed in the appendix, and in a few instances the same genus is referred to two different orders. The whole catalogue will doubtless be rendered more perfectly accurate in a future edition.

The whole number of genera comprised in this enumeration, exclusive of synonyms, is 7840. Sprengel's *Systema Vegetabilium*, which was finished in 1827, contains (exclusive of the appendix) only 3593 genera, or not quite half the number now known; while the 12th edition of *Systema Naturæ* (the last of Linnæus himself) comprises 1228 genera, or only about a third more than are now known in a single family.

This great and rapid increase is perhaps chiefly owing to the discovery of new plants; but it is also attributable in a good degree to the more accurate knowledge of those already known. In either

case, it is the natural result of the progress of discovery; and instead of embarrassing the student, as is often supposed, does in reality render the study of the science much more clear and satisfactory.* Notwithstanding the great increase of genera within the last few years, it may be safely said that at no previous period could a really useful knowledge of the vegetable kingdom be acquired with so little labor. In hazarding this remark, it is of course taken for granted that the student will avail himself of all the advantages of modern physiological botany and of the natural system: for so rapid has been the discovery of new and strange forms of structure, for which the artificial arrangement of Linnæus makes no provision, that the student who takes that system as his guide has indeed a hopeless task before him.

The essential characters of the orders appear to have been very carefully revised in this edition, as also the remarks upon their affinities, geographical distribution and sensible properties. Did our limits allow, we might call the attention of our readers more particularly to this part of the work. We cannot bring our remarks to a close, however, without suggesting what we consider a very desirable improvement upon the manner in which the seed is described not only in this, but in almost all modern systematic works. It is very necessary that an organ which affords such important characters, both as to its situation in the fruit, and particularly as to its internal structure, should be described with the greatest possible clearness and precision, and in an uniform manner. The prevalent fault of which we complain is thus noticed, as long ago as the year 1811, by that most acute botanist, the late L. C. Richard.

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* This remark rests upon the supposition that proposed genera are clearly distinguished from their allies by essential differences of structure, and are not such genera as those often proposed by Mr. Rafinesque, or Mr. Spach. (Vid. *Ann. Sci. Naturelles*, New Ser. *vol.* 4.) We cannot avoid here noticing a remark in Mr. Eaton's Manual of Botany, (ed. 7, p. 84,) intended as a severe criticism upon one of the most eminent botanists of the age. After giving, from De Candolle's Prodromus, the character of the genus *Enemion* (in which "antheris subrotundis" is translated "*with rough anthers*") the author subjoins—"*A doubtful genus; but De Candolle requires very little authority for a new genus.*" Now the genus Enemion was established by Rafinesque, upon what is now well known to be a species of *Isopyrum*; and De Candolle, who never saw the plant of Rafinesque, but merely copies his published description, prefixes the mark of a doubtful genus, and remarks that it seems to be the same as Isopyrum! The critic who could hazard such a remark must have presumed that the *Prodromus* of De Candolle was not likely to fall into the hands of his readers.

"Cæsalpinus, Adanson, Jussieu, and Gærtner, always take into view the direction of the embryo relative to the pericarp merely. This method appears to me improper; first, because it does not indicate with precision that direction which is most important to be understood; secondly, because the *pericarpic* direction of the embryo is often difficult to be ascertained, and is sometimes variable or even wholly different in the seeds of the same fruit. I have already shown by numerous examples in my *Analyse du fruit*, that the best method is to indicate the direction of the *seed* relative to the pericarp, and of the *embryo* relative to the seed."*

In very many descriptions, the direction of the embryo relative to the seed can only be inferred from the *pericarpic* direction, or which is still more objectionable, the same structure is described by very different language in different instances, thus rendering unnecessarily complicated an investigation which of itself is not usually difficult. We may adduce as an example the five orders comprised in the alliance *Ranales*, which stands at the commencement of Dr. Lindley's treatise. We have no means of ascertaining, from the essential character of any one of these orders, either the *spermic* direction and position of the embryo, or the situation of the chalaza and micropyle relative to the hilum, from which the former may be inferred. It is commonly stated that the embryo is situated at the base of the albumen; but it is not specified whether the radical is next the hilum, (as in Papaveraceæ, Nymphæaceæ, &c.) or points in the opposite direction, (as in Nelumbiaceæ and Cabombaceæ;) a matter of essential importance, since the seeds result in the one case from the ripening of *anatropous*, and in the other of *orthotropous*, ovules.

The students of botany in this country are greatly indebted to the learned editor and the enterprising publishers of the first American edition of this work. May we hope to have our obligations increased by the reprint of this greatly improved edition? A. G.

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* Ann. Du Museum, vol. 17, p. 446.

Art. IX.—*Electro-Meteorological Observations;* by Jas. Swaim.

1836.	Dry thermometer.	Wet thermometer.	Dew point.	Barometer.	Perpendicular height of the kite when the leaves of the electrometer touch the side.	Length of wire out.	Wind.—Lower current.	Wind. Upper and middle current.	State of Weather, &c.
P. M. *h. m.*									
Oct. 23.	61.50	53.00	44.99	30.17			S. W.	W. by N.	Clear—clear.
" 24.—4	67.00	57.00	48.76	30.25	276	308	S. E.—S. W.	W. by N.	Clear—clear.
" 25.	43.50	36.00	22.05	30.29			N.	Clear.	Clear—clear.
" 26.—3 30	15.00	36.50	21.02	30.20	55	60	W.—N. W.	W.	Clear—cloudy.
" 27.	40.50	36.00	27.63	29.76			N. W.	W.	Cloudy—cloudy.
" 28.—4	46.00	39.00	27.52	30.05	44	52	S.—N. W.	Clear.	Clear—cloudy.
" 29.	51.50	42.50	29.69	29.93			N. W.	N. W.	Hazy—cloudy.
" 30.	42.50	38.50	31.80	29.22			N. by E.	W.	Light clouds—cloudy.
" 31.	40.50	35.00	24.32	29.34			E.	Clear.	Clear—cloudy.
Nov. 1.	48.00	43.00	36.03	29.14			N. N. E.	Clear.	Clear—clear.
" 2.				29.69			N. N. E.	N. N. E.	Cloudy—rain.
" 3.	45.50	40.50	32.79	29.84			N. W.	N. W.	Cloudy—clear.
" 4.—2 30	44.00	37.50	26.15	30.20	127	158	W.—N. W.	N. W.	Cloudy—clear.
" 5.—2 45	40.00	34.00	21.83	30.25	74	84	W.—N. W.	N. W.	Partially cloudy—cloudy.
" 6.	43.00	38.00	29.45	30.04			W. S. W.	Clear.	Cloudy day.
" 7.	51.00	43.50	33.25	30.09			S. W.	W. S. W.	Cloudy day.
" 8.	51.50	46.00	39.19	30.14			N. W.	Clear.	Cloudy—hazy.
" 9.—3 40	53.00	47.75	41.68	30.65	58	68	N. E.—E. N. E.	W. by N.	Clear—cloudy.
" " 3 50	52.25	48.00	43.13	30.65	82	112	N. E.—E. N. E.	W. by N.	
" " 4 7	53.50	49.00	44.04	30.65	151	266	N. E.—E. N. E.	W. by N.	
" 10.—2 35	54.50	50.25	45.79	30.57	476	700	E.	E. by S.	Clear, cloudy, rain at night.
" 11.	65.00	61.00	58.25	30.07			S. by E.	S. by W.	Cloudy—rain.
" 12.—3 25	62.25	58.50	55.65	30.05	136	200	W.—N. W.	S. W.	Clear day.
" 13.	50.00	44.00	35.96	30.02			N. N. W.	W. by S.	Clear day.
" 14.				29.80			E. N. E.	E. N. E.	Rainy day.
" 15.	46.00	42.20	36.75	29.90			N. by W.	S. by W.	Cloudy—clear.
" 16.	44.50	40.00	32.92	29.88			N. W.	W.	Cloudy—clear—rain.
" 17.	42.50	38.00	30.31	30.19			N. W.	N. W.	Clear—flying clouds.
" 18.	43.50	38.50	30.13	30.37			N. by W.	Clear.	Clear day.
" 19.	40.50	36.00	27.63	30.50			N. E.	W. S. W.	Clear day.
" 20.	51.50	48.50	45.13	30.21			N. E.	S. W.	Partially cloudy.
" 21.—3 10	58.50	55.00	51.95	29.95	415	564	N. W.—W.	W. S. W.	Rain—flying clouds.
" 22.—3 20	47.50	45.00	41.78	30.15	111	140	W.	Clear.	Clear—flying clouds.
" 23.—4 25	36.50			29.85	65	92	W.	W.	Clear—cloudy.
" 24.—2 45	41.00	38.50	34.32	29.08	134	148	W.—W. by S.	W. by N.	Clear—snow squalls.

The preceding experiments were made with common three stick kites two feet six inches long and two feet four inches wide, tapering from the middle to the top. Wire No. 30 was used, which was wound on a reel four feet in circumference, having a glass axle running on a frame about three feet high, which was made in the same manner as the one used by the Franklin Kite Club of Philadelphia.

An electrometer (5.) was connected with an iron ring (6.) through which the wire passed, and which was suspended by means of silk, in front of the reel for the purpose of preventing the wire from running off in winding up rapidly.

Also an instrument was used for finding the height of the kite, which I constructed in the following manner. Two stationary arms