

- Ammonites Jason*, Rein. 990 feet.  
*A. Sedgwickii*, Pratt (var. of *A. Jason*). 972 feet.  
*A. Lambertii*, Sow. 1000 feet.  
*Ammonites*, ? sp. (with tubercles). 979, 998 feet.

- Fish. 1001 feet.  
*Hybodus*. 1004 feet.

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*On the Recent Progress and Present State of Systematic Botany.*  
 By GEORGE BENTHAM, F.R.S.

[A communication ordered by the General Committee to be printed *in extenso*.]

It is now some years beyond half a century since I took up the pursuit of systematic botany—at first as a mere recreation, rather later as a study either subservient to or as a diversion from others which my then social position rendered more important, but for the last forty years as the main occupation of my life. During that long period the science has undergone various vicissitudes. At one time generally regarded as constituting the whole or nearly the whole of botany, subsequently reduced by some to a mere technical cataloguing of names, it became the fashion, especially among physiologists, who arrogated to themselves the exclusive title of scientific botanists, to sneer at it as a trivial amusement; it has now again vindicated its importance, especially since, by the promulgation of the great Darwinian theories, it has become absolutely necessary to include in it, not only the life-history and distribution of races, but also the results at least of the investigations of physiologists and palæontologists, whilst physiologists themselves have but too frequently been led astray by their neglect of the labours of scientific systematists. Having in my early days personally conversed with one of Linnæus's active correspondents (Gouan of Montpellier), having received many useful hints on the method of botanical study from the great founder himself of the Natural System (Antoine Laurent de Jussieu), having been honoured with the intimacy of the chief promoters and improvers of that system (Auguste Pyrame De Candolle, Robert Brown, Stephan Endlicher, John Lindley), having enjoyed the friendly assistance either personally or by correspondence of almost every systematic botanist of note of this nineteenth century (whether followers or, in earlier days, antagonists of the Jussieuan methods), I had from the first taken some part in the controversies which ensued, and always watched them with an interested eye. And now at the close of my career I had sketched out a review of the position this, my special branch of the science, has occupied in relation to the others for my valedictory address to the Linnean Society. My premature resignation of the Presidency having rendered unnecessary the drawing-up of that address, I have put my notes into a form which I have thought might not be unacceptable to the Association, as some compliance with the request made to me at its Meeting at Cambridge in 1833.

Before the days of Linnæus, the attempts to scale and explore the steep and rugged acclivities of the Parnassus of Science on the side of Natural History, and especially in the district of Systematic Botany, had been many, but vague and unsuccessful. Some general ideas of the direction to be

followed had, indeed, been formed by Ray, and after him by Tournefort, Allioni, and others of undoubted eminence; but it was reserved for the master-mind of the immortal Swede to mark out a clear, safe, and definite road along the first great ascent, and to fix on its summit, by the establishment of genera and species upon sound philosophical principles, a firm stage to serve as a basis and starting-point for further progress and exploration. Such further progress under the guidance of the same principles was indeed contemplated and to a certain degree sketched out by Linnæus himself, but the territory forming the next acclivity was too little known to disclose the best paths for ascending it. Among the eight or ten thousand species known to Linnæus, chiefly from the northern hemisphere or from the Cape of Good Hope, a sufficient number of genera were exhibited to him in their entirety to enable him to fix the relations of genus and species; but of the higher groups, the orders or natural families, too large a proportion were as yet undiscovered or were too sparingly represented to encourage any immediate attempt to define them. A further knowledge of the territory was necessary in order to clear the ground for its regular ascent, and yet it was necessary to ascend in order to effect its survey; as a temporary assistance, therefore, Linnæus devised the scaffolding, known under the name of the sexual system, with its artificial and easy though frail ladders, the twenty-four classes and their subsidiary orders.

The progress was now wonderfully rapid. A very few years doubled the number of plants known, and after the commencement of the present century new discoveries and more accurate studies of those previously known were being published in all parts of Europe in an increasing ratio. It was, however, rather earlier, and not long after the death of Linnæus, that Antoine Laurent de Jussieu, following in the footsteps of his uncle Bernard, with a methodical mind yielding but little to that of the great Swedish master, having all the advantages of the additional materials at his disposal, and having to start from the elevated platform so firmly established by his predecessor, was enabled, in his '*Genera Plantarum*' (begun in 1778 and finally published in 1789), to carry the high road up the next rising, marking it out perhaps at first rather vaguely, but upon principles so sound that it was warmly taken in hand by the French school in the first instance, soon to be followed up in this country, and later and less willingly in Germany. Among the earliest and most important contributors to the perfecting the work were Robert Brown and the elder De Candolle; and their labours had already been sufficiently advanced to enable me, when I first came upon the stage, to avail myself of the road thus established and ascend with ease to the higher platform. The great Linnean thoroughfare to species and genera had long been universally followed, and my apprenticeship to the science, from 1817 to my first botanical publication in 1826, was entirely under the guidance of De Candolle's '*Flora*' and '*Théorie*;' so that I had no occasion to make use, or even to take any notice, of the Linnean scaffolding and ladders. I never learnt the twenty-four classes till after the publication of my '*Catalogue des Plantes indigènes des Pyrénées et du Bas Languedoc*.' Easy as they were supposed to be, I found, for purposes of reference, alphabetical indexes still easier.\*

Towards the close of this same year (1826), in which I had thus entered my name in the roll of working botanists, I returned to England after a twelve years' residence in France; and although logic, law, and law-making were at first the chief subjects of my studies and publications, I gradually gave up more and more time to botany, and having spent two vacations

among the naturalists of Germany, I had by the year 1832 become acquainted not only with the principal continental botanists, but also with the practical working of the botanical establishments of Paris, Berlin, Vienna, Munich, and Geneva; and as this was a period when the gradual substitution of natural to artificial systems had given a general impulse to the scientific study of plants, I take this year as the starting-point for comparing the state of systematic botany with that of future periods.

In France, under the guidance of De Candolle of Geneva, and of Brongniart, the younger Jussieu, and other Professors of Paris, it was now universally taught, and it had become generally acknowledged, that the main object of systematic botany was not the finding out the name of a plant, but the determining its relations and affinities, the making us thoroughly acquainted with its resemblances and differences, with those properties which it possessed in common with others or which were peculiar to itself, whether these properties consisted in outward form, inner structure, physical constitution, or practicable applicability to use, all of which had to be taken into account in the formation of orders, genera, and their subdivisions. As textbooks, De Candolle had developed his 'Théorie' into the five volumes of his 'Cours de Botanique' ('Organographie Végétale,' two vols., 1827, and 'Physiologie Végétale,' three vols., 1832), while Richard, in the successive editions of his 'Éléments de Botanique,' then in general use by teachers of the science, was substituting an elaborate exposition of the natural orders for the somewhat modified Linnean classes he had in the first instance adopted; and for practical use, although De Candolle's admirable 'Flore Française' was already out of print, Duby's synopsis of it and a few local floras drawn up under the natural method had expelled from the market all technical works which adhered to the sexual classification. For the general botanist, De Candolle's 'Prodromus' had already reached its fourth volume, describing under the natural arrangement about 19,000 species, or nearly one third of those then known\*.

In England considerable progress had also been made in the substitution of the scientific instead of the technical arrangement of plants for study, but only among the more advanced followers of the science. Owing in a great measure to the influence and persevering labours of Sir James Smith, whose possession of the Linnean collections and long Presidency of the Linnean Society gave him great and generally acknowledged authority in the country, the cataloguing of plants under the twenty-four classes was still adhered to in our botanical schools and examinations, and in the standard British floras as well as in all local ones. But this was not to be of long duration. The great advances made by Robert Brown, although better known on the Continent than at home, were beginning to have their influence in England also. The example and teaching of Sir William (then Dr.) Hooker, whose vast collections and library had already, from the liberal use he made of them, become of national importance, had caused the natural method to be regarded as the only one for illustrating exotic botany and for the useful arrangement of herbaria. Lindley had commenced that series of works which more than any others tended to that final acceptance of the natural method in this country which it had obtained in France. The first edition of his 'Introduction to the Natural System' was published in 1830; and he was much

\* For further details on the origin and progress of this great work I may refer to an article I contributed to the 'Natural-History Review' for October 1864, and to that recently published by Alphonse de Candolle in the 'Bibliothèque de Genève,' entitled "Réflexions sur les Ouvrages généraux de Botanique descriptive."

engaged in the preliminary labour of a 'Genera Plantarum' he contemplated. Monographs also of individual natural orders or large genera which De Candolle always strongly recommended, not only as the best exercise for young botanists, but as the best means of promoting the science for those whose circumstances prevented their undertaking more general investigations, were in some instances being prepared in England as on the Continent. Hooker, Greville, Arnott, and others had devoted special works to Ferns and Mosses; Lindley had made considerable progress with his 'Genera and Species of Orchideæ,' and at his suggestion I had taken up the Labiatae. Even for the British flora S. F. Gray's 'Natural Arrangement' and Lindley's 'Synopsis' were intended to bring the natural orders into use by our local botanists; but owing to defects in form and to the want of any artificial Clavis, neither of these works was calculated to overcome the prejudices then prevailing in favour of the Linnæan classes.

In Germany the progress had been slower. The country abounds in those plodding minds which revel in the working out minutiae of detail, and, to find their way, are satisfied with a sexual, alphabetical, or any other artificial index, as well as in pure speculators, who, in developing the conceptions of their brain, will not be bound by any system. The advantages of the natural method were long in overcoming the force of habit, kept up as it was by the number of works which the German press supplied for the use of collectors and technical botanists. The most important of these took the form of new editions of Linnæus's 'Systema Vegetabilium' or of his 'Species Plantarum.' The last two of these had a very general circulation in the botanical world: Sprengel's, completed in four volumes from 1817 to 1820, would have been useful from its compactness had it been a conscientious compilation, and actually served for the arrangement of herbaria in the charge of mere librarians\*; but it was so carelessly and recklessly worked out as to be soon rejected by all true botanists who attempted to use it. Roemer and Schultes's 'Systema,' continued through eight volumes from 1817 to 1830, was the result of great labour and was generally accurate in detail, and would have been really useful had it been brought to a conclusion within a short time. But by the time it had reached the end of Hexandria, the progress of De Candolle's 'Prodromus' had even in Germany driven it out of the market, leaving it, in its incomplete state, nothing but a long succession of disconnected genera, the confusion of which was still further increased by a series of 'Mantissas' and first and second Additamenta to 'Mantissas.' Neither the ability of the younger Schultes, the author of the last two and best volumes (Hexandria), nor the arguments of Roemer (who in the preface justified the use of the sexual system, first on the authority of Linnæus, secondly because it was easy, and thirdly because, like nature, it never changed) could any longer sustain the crumbling fabric. The Natural Orders were becoming generally taught, and Bartling, in his 'Ordines Naturales Plantarum,' 1830, had proposed one of those speculative rearrangements of the Jussieuan and Candolleian Orders which have since been so frequently indulged in to so little purpose. But as yet there was no flora of the country or other practical work calculated to place the natural or scientific method within reach of the beginner.

Other more distant countries showed still fewer outward signs of the spread of the philosophical teaching of botanical systems, which, however, through the influence especially of French works, was gradually gaining ground in

\* Even at Paris the rich herbaria of Delessert were to the last arranged according to Sprengel, to the thorough disgust of all working botanists who had to consult them.

Sweden, Russia, and North America, whilst in Southern Europe Spain and Italy, which during the preceding half century had produced so many eminent botanists in various branches, seemed now disposed to limit themselves to local floras and the sexual classes.

We may take as the next period in the progress of systematic botany the seventeen years that elapsed from 1832 to 1859, during which the advance had been wonderfully successful. The change from the technical to the scientific study of plants, which during the preceding period had been working its way through so many obstacles, was now complete. The Linnean platform, established on the relations of genera and species, had now been so long and so universally adopted as the basis or starting-point, that the credit due to its founder was almost forgotten in the triumphant destruction of the sexual scaffolding he had erected for the ascent of the higher stages, and now completely superseded by the progress of the Jussieuan roads, although it was chiefly by the consistent following out the principles laid down by Linnæus himself that the change had been effected. No would-be botanist was allowed any longer to eschew the labour of the methodical study of plants, or to indulge in the belief that their technical sorting constituted the science. At every stage he was taught that plants must be grouped upon a philosophical study of their affinities, whether morphological, structural, or physiological. The natural orders, as well as genera, were exhibited to him in every work prepared for his use. Their exposition formed part of the admirable text-books of the De Candolles (father and son), Adrien de Jussieu, Lindley, and others; Endlicher's 'Enchiridion' and, above all, Lindley's 'Vegetable Kingdom' exhibited the rich stores of knowledge disclosed by their study. As systematic guides, Endlicher's 'Genera Plantarum' was complete, and De Candolle's 'Prodromus' for Dicotyledons and Kunth's 'Enumeratio' for Monocotyledons were far advanced, the gaps being also partially filled up by numerous monographs of various degrees of merit; whilst in Cryptogams the works of Hooker, Mohl, Mettenius, Montagne, Fries, Tulasne, Berkeley, Agardh (father and son), Harvey, Thuret, Kützing, and many others were already showing that for their discrimination and study it was no longer sufficient to rely upon outer characters alone, but that their inner structure and physiological changes must be taken into account; and monographs or "species" of Ferns, Mosses, Hepaticæ, Lichens, Fungi, and Algæ, arranged upon principles more or less philosophical, were prepared for the use of the student in these several branches. For more local botanists and amateurs most European countries, and a few distant ones, had now their standard floras in a more or less advanced state, arranged according to the natural method, the more important of which I shall presently have occasion to refer to.

It would seem, therefore, that at this advanced stage of our progress the guide-posts indicative of the principal paths had become so firmly established, the principles upon which plants should be scientifically classed so clearly laid down and so far carried into practice, that little remained to be done towards completing the survey of the territory, towards a general distribution of species according to their natural affinities, beyond the more accurate delineation of details and the interpolation of newly discovered species, and that the systematic botanist could already look towards that summit, upon reaching which his labours in aid of the general advance of the science might come to a close. But there was a rock a-head which had long been looming in the distance, and which on a nearer approach opposed a formidable obstacle, to most minds apparently insurmountable. What is a species?

and what is the meaning of those natural affinities according to which species are to be classed? were questions which in 1859 it was generally thought vain to discuss, or the answers to which, given to us by doctrinal teachers, unsupported by or independent of facts, it was considered as sacrilegious to doubt. We were taught, and some may still believe, that every species, such as we now see it, was an original creation, perpetuated through every generation within fixed limits which never have been and never will be transgressed. We were less authoritatively told that resemblances of different species were owing to their having been formed upon one plan variously modified. To the question why they were so modified, the ready answer was, such was the will of the Creator; and in order not to suppose that that will was influenced by mere caprice, it was suggested that the modifications were either to suit the plant to the circumstances it was placed in, or to remedy defects in the original plan, or we were simply told that the subject was beyond our powers of comprehension\*.

One consequence of this apparent impossibility of proceeding further in the investigation of the causes of affinities and of this necessity of taking species as separate creations in enormous numbers, with resemblances and differences in endless variety according to the inscrutable will of the Creator, was the encouragement it gave to arbitrary classifications and interminable disputes as to the limits of individual species. It was, indeed, generally admitted that plants should be arranged in genera, orders, &c., in groups of higher and higher grades according to the importance of the characters they had in common, and that the test of species was the persistence of its characters through two or more generations; but there were no means of estimating the importance or value of characters except by such vague standards as the number of species in which they had been observed to prevail, no means of determining what degree of variation and persistence actually distinguished the species from the variety. The botanist who affirmed that *Rubus fruticosus*, *Draba verna*, or *Sphagnum palustre* were each one very variable species, and he who maintained that they were collective names for nearly four hundred, for at least two hundred, or for some twenty separately created and invariably propagated species, had each arguments in their favour to which no definite reply could be given; and systematic botany was in too many cases beginning to merit the reproach of German physiologists, that it was degenerating into an arbitrary multiplication and cataloguing of names and specimens, of use to collectors only, and serving as impediments instead of aids to the extension of our scientific knowledge of the vegetation of the globe.

It is true that long before the period under consideration some indications by which this great obstacle to further progress might be surmounted had

\* In my frequent intercourse during the above period with foreign botanists, I heard more than one German Professor affirm that a type-form was created for each natural order (the common clover, for instance, being that for Papilionaceæ), that Nature set to work to modify this type-form in framing species of a more complicated structure, till, tired of the exertion, she next produced new species by the simple omission of some of the complications. A French botanist of great eminence, to account for the number of plants in cultivation which are not known to exist in a wild state, observed that we could not suppose that man would have been created without a simultaneous creation of plants for him to cultivate for food, quite independent of the wild vegetation which existed before him for the food of animals. And many other still wilder theories were propounded to account for facts inconsistent with the presumed independent creation and absolute fixity of species. The best authorities went no further than defining affinity as correspondence of characters, physiological or structural, and estimating the value of characters and the importance of peculiarities or modifications of character according to their known connexion with the phenomena of life.

been vaguely given, and the theory of a common descent of modern species had been broached, or generally proposed as a solution of some of the difficulties; but not in a manner sufficiently plausible to overcome the prejudices against following up any such track, nor supported by facts and observations sufficient to awake the attention of the more anxious pursuers of the science. It was reserved for the publication of the 'Origin of Species' in 1859 to mark out a practicable path by which the higher summits might be attained. The doctrine of evolution of species, according to laws originally fixed, instead of arbitrary intervention upon each and every occasion, was in this remarkable work clearly traced out, supported by powerful arguments, and founded upon facts and observations the accuracy of which no one could doubt; and a way was thus opened up to a pinnacle, which in a wonderful degree enlarged the range of vision of those who had the courage to follow its propounder up the giddy height. It was immediately and successfully taken to by several of the most eminent of our naturalists accustomed to philosophical deductions from ascertained facts; it was blindly accepted, but misused, by some German and Italian speculators, who, in their hurry to adopt Darwinism before they well understood it, and in their eagerness to go beyond the point to which the road had been securely marked out by the author, or to diverge into by-paths which led to precipices and pitfalls, added to the alarm of the timid; whilst it was not only shunned, but denounced as fraught with the utmost danger by the great majority who were accustomed to place tradition above reasoning. We systematists hesitated at first to advance in a direction so contrary to that which we had determinedly followed for so long a period; but after a careful study of the facts and arguments upon which the new course was founded, and of the guide-posts which had been set in it, we most of us have felt but little doubt of its safely leading us over difficulties, which we had so long reckoned as insurmountable, into a vast and entirely new field of observation, calculated to give a stability to the results of our labours, of which we had hitherto formed no conception. The last of the eminent observers of nature who persistently maintained the independent creation and absolute fixity of species (the late distinguished Professor Agassiz) has recently gone from among us; and it may now be given as a generally received doctrine, that all natural methods must be founded on affinities as dependent on consanguinity. Fifteen years have sufficed to establish a theory, of which the principal points, in as far as they affect systematic botany, may be shortly stated as follows:—

That although the whole of the numerous offspring of an individual plant resemble their parent in all main points, there are slight *individual* differences between them.

That among the few who survive for further propagation, the great majority, under ordinary circumstances, are those which most resemble their parent, and thus the *species* is continued without material variation.

That there are, however, occasions when certain individuals with slightly diverging characters may survive and reproduce races in which these divergences are continued even with increased intensity, thus producing *Varieties*.

That in the course of an indefinite number of generations circumstances may induce such an increase in this divergency, that some of these new races will no longer readily propagate with each other, and the varieties become *New Species*, more and more marked as the unaltered or less altered races, descendants of the common parent, have become extinct.

That these species have in their turn become the parents of groups of species, i. e. *Genera*, *Orders*, &c., of a higher and higher grade according to the

remoteness of the common parent, and more or less marked according to the extinction or preservation of unaltered primary or less altered intermediate forms.

As there is thus no difference but in degree between a variety and a species, between a species and a genus, between a genus and order, all disputes as to the precise grade to which a group really belongs are vain. It is left in a great measure to the judgment of the systematist, with reference as much to the use to be made of his method as to the actual state of things, how far he should go in dividing and subdividing, and to which of the grades of division and subdivision he shall give the names of Orders, Suborders, Tribes, Genera, Subgenera, Sections, Species, Subspecies, Varieties, &c., with the consequent nomenclature. In the limitation of his orders, genera, species, &c. he must carefully observe those cases where the extinction of races has definitely isolated groups having a common parentage; and in other cases where the preservation of intermediate forms has left no such gaps, he is compelled to draw arbitrary lines of distinction wherever it appears to be most convenient for use. In the pre-Darwinian state of the science we were taught, and I had myself strongly urged, that species alone had a definite existence, and that genera, orders, &c. were more arbitrary, established for practical use, and founded on the combination of such characters as appeared the most constant in the greater number of species, and therefore the most important; we must now test our species as well as genera or other groups, by such evidences as we can collect of affinity derived from consanguinity.

In valuing these evidences, in estimating the comparative value of characters, a new difficulty has arisen, that of distinguishing the two classes of characters to which Professor Flower has appropriately given the names of *essential* and *adaptive*, the former the result of remote hereditary descent, the latter the more recent effect of external influences. This distinction is often the more difficult, as the essential ones are often only to be found in embryos, in the early stages of organs, or are merely indicated by slight rudiments requiring close observation to detect them; whilst the adaptive ones, of comparatively small systematic importance, are often developed in external form, in ramification, spinescence, foliage, &c., and are the most striking to the eye. One consequence is, that the systematist of the present day sees more and more the necessity of preparing a double arrangement of his genera, species, and other groups—a natural one according to the best evidences of affinity for the purpose of scientific study, and an artificial *clavis* by which the student can be led to identify genera or species by the more readily observed characters, which may only form part, or be but chance accompaniments, of the essential ones. The greatest change, however, which the adoption of the doctrine has effected in the methodical study of plants is the having rendered it necessary, in the case of every genus or other group, to take into account and specially to estimate the value of all the characters observed—no one can be taken as so absolute as to obviate the need of considering others, no one can be passed over as theoretically worthless; and whilst this adds immensely to the labour of the systematist and to the calls on his judgment, it gives equal increase to the value of the results obtained.

The principal works through which the systematic botanist contributes to the scientific study of the vegetable kingdom are:—1. General treatises or descriptive reviews of the natural orders (*Ordines Plantarum*); 2. Methodical enumeration and descriptions of genera (*Genera Plantarum*); 3. Methodical enumeration and descriptions of species (*Species Plantarum*); 4. Monographs of separate orders or genera, subgenera or species; 5. Floras of separate



countries or districts ; 6. Detached and miscellaneous specific descriptions. Before considering how far the works now complete or in progress answer our requirements under each of these heads, a few general remarks are suggested with regard to the languages in use.

In the pursuit of my systematic studies, and especially in the preparation of my reports and addresses to the Linnean Society, I have had to consult or refer to botanical publications in no less than fifteen different languages\*. This, to say the least of it, entails the use of a series of dictionaries which but a small number of botanists can have access to ; and many an important observation or discovery recorded remains, for this reason alone, long unknown to the general botanist. That works intended for the use of the beginner or local amateur, or exclusively teaching the well-known botany of a particular country, should be in the familiar language of the country, is a rule that every one will admit the expediency of ; but for purely scientific treatises and technically descriptive works which all botanists may have to take cognizance of, and for which the commercial demand may be too limited to ensure their translation into various languages, it is essential that that one should be selected which is most likely to be intelligible to the greater number of students of all countries. With this view Latin had been very generally adopted during the last and the early portion of the present century. It was taught in all European schools, and served even as a vehicle for general interchange of ideas between the votaries of science of different countries where the study of modern languages was exceptional ; and even now it is found to be the best suited for technical diagnoses and descriptions from its concise character and from its susceptibility of being subjected to technical forms, without jarring upon the conventionalities of living languages in familiar use. Every botanist must still, therefore, learn to read, and every descriptive botanist to draw up, these Latin formulæ, notwithstanding the character of dog-Latin which the scholar may be disposed to charge them with ; but general descriptions, treatises, and discussions require a language more thoroughly understood and in familiar use for other purposes. A classical education is now much less common than it was, and almost unknown in some countries where science is eagerly pursued. Modern languages are, on the other hand, much more frequently taught for general use ; and there are three which at the present day every botanist ought to understand, and in one of which he ought to be able to write—all three having a rich literature in every branch to repay the labour of learning them, independently of science ; these are, French, English, and German.

French has long been considered the one among modern languages forming the nearest approach to a common one ; it is easy, comparatively simple in construction, not overburdened with redundant words, and, above all, is readily broken up into short phrases, an invaluable qualification for clearness of methodical exposition. It has long been the recognized diplomatic language, and the first foreign one taught in most European schools ; and although within my own recollection national animosities may have from time to time thrown it into disfavour in Germany and Eastern Europe, yet it always appears to recover its prestige there in general society. At the meetings of the botanists of various nations congregated at Florence last May it was the general medium of intercourse, although the Frenchmen present were in a very small minority. And in every branch of science or literature to which I have paid more or less attention, it possesses more

\* Latin, English, French, German, Dutch, Danish, Swedish, Russian, Polish, Bohemian, Hungarian, Portuguese, Spanish, Italian, and modern Greek.

instructive elementary works, more readily intelligible treatises and clear expositions of abstruse subjects, than any other language I am acquainted with. For the botanist, therefore, as well as for all naturalists, its study is still, and I believe will long remain, of first-rate importance.

The English language has of late years been recommended by more than one continental naturalist for general adoption as a vehicle for international scientific intercourse. It partakes of some of the advantages of both the French and the German. Though less brilliant, it offers more variety than the former, it is less involved than the latter, and it appears to be capable of giving more precision and force to argument than either. It is now the national language of the largest proportion of the civilized population of the globe, and its use continues steadily to spread out of Europe generally, and to a certain extent among European naturalists and other educated classes, especially in eastern and northern Europe. They begin to admit the necessity of consulting our untranslated treatises and memoirs, and our German and east European botanical correspondents, at least, accept English letters as readily as French. In southern Europe French is still much more generally understood; but even there the objections to the extended use of our language for botanical works have now, I believe, lost much of their force.

The German is a more difficult language, much more difficult, indeed, for the Latin nations of southern and western Europe than for ourselves. Its construction is involved, its extraordinary copiousness occasions a strain upon the memory; but it affords great facilities for giving expression to minutely distinguished details, whether of fact or of thought. It may thus frequently give greater solidity to their theoretical expositions than the French, but is infinitely more difficult to translate; and to those who are not thoroughly used to its intricacies it seems to foster, if not to create, confusion of ideas. Germany has now, however, so long included so many publishing centres of scientific importance, and its language has been so generally used by Scandinavian and Slavonian, as well as by their own naturalists, that a sufficient acquaintance with it, to study the very numerous works it produces, can no longer be dispensed with by the general botanist.

The Dutch language, notwithstanding the number of scientific working naturalists the country has fostered, both at home and in its Malayan colonies, has too limited a range to be generally studied, and is not likely to extend. It is much to be regretted, therefore, that it should have been so much made use of for works intended for the use of others as well as of their own subjects. Some of the late Professor Miquel's most valuable essays (that, for instance, on the vegetation of Sumatra with relation to its physical conditions) remain a sealed book for the botanical community at large. I perceive now, however, that their more important papers in the 'Archives Néerlandaises' and some other journals are being printed in French as well as in Dutch, and we must hope that so commendable a practice may in future be generally adopted.

The Scandinavian nations, Denmark and Sweden, whose men of science have included a large proportion of the most eminent naturalists, have always felt the objections to the publication of the results of their labours in their own language. Linnæus conducted his foreign correspondence and edited all such works as were intended for foreign use in Latin, and his example was much followed. In the first half, however, of the present century, both Danes and Swedes began to indulge more in the use of their native languages, and some important essays, especially on geographical botany and on the cryptogamic section of systematic botany, have appeared in that disguise.

More recently the botanical papers in the Copenhagen Transactions and Journals are frequently accompanied by a French abstract; and in Sweden some of their Natural-History memoirs, such as Morell's 'Monograph of Spiders,' have been printed exclusively in English. German is also a language very generally understood by Swedish men of science, more so amongst some of them than French or English; and it cannot be too strongly recommended to them to bear in mind that, at the present day, the study of Swedish and Danish is not usually treated as more necessary to the general botanist than that of Dutch.

Still less is it the case with the Russian language, which, notwithstanding its poetic beauty, its conciseness, and many other intrinsic advantages, besides the extent of territory over which it is officially spoken, is far too uncongenial with those of Western Europe to give any prospect of its being generally learnt, and the publication in it of any works intended for foreign circulation cannot be too strongly deprecated. The Academy of Sciences of St. Petersburg and the principal Natural-History Society of Moscow accordingly admit in their Transactions and Bulletins memoirs in French, German, or Latin; but still there are a few important ones issued by these bodies as well as by a second Moscow Society, and others at Kazan and Odessa, entirely in Russian. These are of course ignored by the rest of the botanical world until translated or abstracted in one of the western languages. Such is also the fate of the fortunately very few botanical papers which I have met with in Polish, Bohemian, and Hungarian publications.

The Portuguese and Spaniards, with the vast possessions they formerly held in America, where their languages have persisted as national, and those they still retain (the former in tropical Africa, the latter in the Philippines and West Indies), have in their time done good work in botany, and have generally had the good sense to publish in Latin. There are some floras, however, of their present or former colonies, more used by foreigners than by themselves, which are entirely in their own languages. But these languages, are, I believe, not now spreading further, and in America, at least, English is gaining upon them for business transactions. For the Portuguese language I have little sympathy, for it has always appeared to me harsh and disagreeable; but one cannot but feel some regret that so noble and powerful a language as the Spanish should now be applied to so little purpose.

Italian botanical publications are rather numerous and of some importance, especially in physiological and theoretical botany (their floras are mostly in Latin); the language is also so generally and deservedly admired in a literary point of view, and so far from difficult to those who are acquainted with Latin and French, that some knowledge of it might be recommended to botanists. Yet such general acquaintance with it ought not to be too much relied upon; and Italian botanists will do well in continuing to resort to Latin or French for such works as are intended for the use of foreigners. And, lastly, with regard to modern Greek, we can only hope that its use will be closely restricted to purposes of local instruction, which is indeed the character of the few botanical publications I have seen in that language.

We may now proceed to consider the principal works in systematic botany recently published or now in progress, under the several heads above enumerated.

#### 1. ORDINES PLANTARUM, or General Expositions of the Orders and Sub-orders constituting the Vegetable Kingdom.

It is to these 'Ordines Plantarum' that we are now obliged to limit our

demands for single general histories of all plants. Alph. de Candolle, in the "Réflexions" above referred to, has shown how hopeless it is to expect the completion of any single 'Species Plantarum,' even if limited to the technical elaboration of the 150,000 or more species and subspecies now known, and a 'Genera Plantarum' has now become a long and tedious labour. But we have a right still to hope that a general account of the Vegetable Kingdom, such as pre-Linnean botanists used to edit, but keeping pace with our advanced knowledge, may still be issued from time to time, in a single volume, as the work of a single author, provided he limit himself to the higher groups, to orders and suborders in number not above a few hundred, neglecting the lower groups, genera, and species, except for illustration or exemplification.

In such a work we should expect, for each order or other group illustrated, the following particulars:—

(1) A diagnosis or short indication of its most important or most generally prevailing character.

(2) A more detailed technical description of its general characters, with indication of known exceptions.

(3) A discussion of its affinities, including an indication of the line of demarcation adopted for its separation from the orders into which it may pass insensibly, as well as of such aberrant or isolated forms as may lie between it and some order otherwise separated by a wide gap.

(4) Its geographical distribution and the modifications of its characters which prevail in different countries.

(5) Its connexion with extinct forms.

(6) Its properties and applied relations, industrial, economical, or pharmaceutical.

Such a general history of plants is so useful not only to all classes of botanists, but to the followers of other branches of natural and other science, that it is most desirable that it should be drawn up in one or more of the most widely diffused modern languages, and accompanied by well-selected explanatory illustrations.

We have two works which have fulfilled the greater number of the above conditions, bringing the science down to the comparatively recent periods when they were first prepared:—Lindley's 'Vegetable Kingdom,' published in 1845, in English, somewhat modified in Endlicher's 'Enchiridion Botanicum' in Latin in 1846, and reissued by the author, with many additional notes, in 1853; and Le Maout and Decaisne's 'Traité de Botanique,' published in French in 1868, translated into English by Mrs. Hooker, with considerable additions and some modifications by Dr. Hooker, in 1873.

Lindley's 'Vegetable Kingdom' was chiefly founded upon a large number of original observations, notes, and other materials he had collected and partly worked up in contemplation of a 'Genera Plantarum,' a work which the increasing calls upon his time and thoughts obliged him in the first place to postpone, and which he finally gave up on the appearance of the first parts of Endlicher's 'Genera.' These materials were elaborated with great care into his 'Natural System of Botany,' 2nd edition, 1836, and afterwards extended, chiefly by compilation, but always under the guidance of his very extensive practical knowledge of plants, into the 'Vegetable Kingdom,' which long remained a most valuable *résumé* of all that was important to know of the 303 orders into which the subject matter was divided. This work, however, is now nearly thirty years (or the greater part of the original matter nearly forty years) old, and is thrown quite out of date by the great progress the science has made during that period. The present proprietors

have, I understand, made proposals for the preparation of a new edition; but this would scarcely be fair to the memory of the talented author. There are many errors in it which he would have corrected and which must be corrected, there are many views which he would now have modified and which must be modified, but it would be impossible to tell to what extent he would have admitted such corrections and modifications; and they at any rate would bear so important a part upon the whole plan, that the new editors would not be justified in issuing the altered work under the sanction of his name. It must be in a great measure rewritten, as will clearly appear on consideration of the following particulars:—

The technical characters of each order would be carefully checked in every particular. They were often taken from some one or two genera supposed to be typical, and in some instances have been proved inapplicable even to the great bulk of the order, or to have been founded wholly on error. In many cases they may require considerable extension as to particulars which have proved to be more important than they were originally estimated.

The affinities given require reconsideration throughout. Lindley insisted on the principle, which was at that time generally prevalent amongst the first naturalists, that affinity was no more than correspondence in structure, more or less modified in proportion to its connexion with the phenomena of life, and that an absolute scale of the relative value of characters founded on their degree of constancy could be drawn up, so as to form a practical test of natural affinities; and it was from an adherence to this rule that, in grouping his orders, he was led to dissociate such natural allies as Apocynæ and Asclepiadæ or Ericacæ and Vacciniæ in order to class them with others universally acknowledged to be more remote. The new light thrown on the subject by the doctrine that affinity is the result of consanguinity, would, there is very little doubt, have been taken fully advantage of by Lindley himself. He would have acknowledged that there is no character which may not be of very different importance in different orders or genera, or even in different countries in one and the same order or genus, and that the true characters of all natural assemblages are not so extremely simple as he then believed them to be (see 'Veg. Kingd.' Introd. p. xxix). The adoption of this theory would entail the rewriting and extending the important paragraphs introduced by Lindley immediately after the technical characters of each order, and destined to indicate the most generally constant features and the most important aberrant forms exhibited in it, and their connexion, near or distant, with other orders or isolated genera or species.

Geographical distribution has, since Lindley wrote, acquired great importance with reference to natural method, as well as forming now an essential item in the general history of plant-races. Although never neglected in the 'Vegetable Kingdom,' it requires much further development, with a *résumé* of such evidences as the recent progress of the science has collected, respecting the presumed origin and extension of the several orders. And to this should be added a reference to the localities and the presumed geological periods among the remains of which well-authenticated representatives of any order may have been found. This, however, should only extend to the few cases where the evidences are really satisfactory. The numerous palæontological identifications derived from impressions of leaves only, upon which so many expositions of ancient distribution have been founded, are for the most part mere guesses, more likely to lead astray by giving a false support to preconceived theories than to supply any sound data for the history of plant-races.

The properties and applied relations, the “*qualitates et usus*” of Endlicher’s ‘*Enchiridion*,’ are very fully exhibited by Lindley, and would only require revising in conformity with the advance of the science of applied botany, much promoted of late by various important works and essays, and in no small degree by the establishment of the Kew Museum.

The sequence of orders adopted in the ‘*Vegetable Kingdom*’ is a very objectionable one. The practical convenience of following the Candollean sequence in its main features, until some other one shall have been propounded which shall prove to be such an improvement as to ensure its general adoption, has been too clearly brought forward by Dr. Hooker and others to make it necessary for me to repeat the reasons adduced. Lindley felt its defects, as we all do, but failed in his repeated attempts to remedy them. He was, indeed, so little satisfied with any of the four different systems he successively proposed, that he adopted none of them for his own herbarium, in which he arranged the orders alphabetically. Brongniart’s arrangement has found its way into a few French works, and Endlicher’s into a few German ones; but the very numerous ones proposed by other French, German, and Swedish systematists have rarely been followed by more than the individual authors, and many of them have only been broached in text-books without ever having been put into practice. The Candollean series is so generally adopted in floras, that these attempts to interfere with its universality have hitherto only produced confusion.

To sum up, it appears to me that the most useful work a competent botanist could now apply himself to would be a new ‘*Vegetable Kingdom*,’ founded on that of Lindley, but extended and modified according to the above suggestions.

Le Maout and Decaisne’s ‘*Traité de Botanique*’ is an excellent and most valuable work, bringing down the science, in most respects, to the year 1868, taking well the place of Lindley’s ‘*Vegetable Kingdom*,’ and now our standard history of plants. With great original merit it is still further improved by Hooker’s notes and additions, including a rearrangement of the 293 orders according to the Candollean sequence; and the illustrations, many of them original, from Decaisne’s own drawings, may be thoroughly depended upon for that most essential of all qualities, their correctness. Yet in some respects it seems to require rewriting, which of course could not be done by an editor. Independently of a few oversights and accidental errors, there are some partial views which are more or less out of date, and the general principles followed are essentially pre-Darwinian. How far the French authors may or may not be prepared to adopt the theory of evolution does not appear, it is not in any manner alluded to; but the old doctrine that affinities are to be determined by a calculation of resemblances, estimated according to a fixed scale of the relative value of characters, is as absolutely insisted upon by Decaisne and Le Maout as it was by Lindley, and is to a certain degree practically carried out in this and others of the principal author’s excellent systematic works, with the usual result. Some of the groupings of species or genera, which, when tested by the value assigned *à priori* to the characters used, ought to be highly natural, have proved, on the contrary, to be purely artificial. This, however, is not frequently the case with Decaisne; he knows too well how to appreciate natural affinities to follow strictly in practice the rules so stringently inculcated in theory.

I can scarcely include Baillon’s ‘*Histoire des Plantes*’ amongst methodical ‘*Ordines Plantarum*,’ for there is no method in it; it is rather a series of essays or notes on the principal genera of various orders taken at random,

intended, in the first instance, to illustrate Payer's views on organogenesis, and thence enlarged into desultory reviews of the orders, exhibiting in many instances undoubted talent, containing a number of shrewd observations, accompanied by beautiful illustrations, and followed by technical characters of genera, in which but very little is original, being mostly transcripts from our 'Genera Plantarum' and some other works. The result is a work not sufficiently concise, exact, or methodical for scientific reference, too much encumbered with technical matter for general popular use, although it may well adorn a scientific drawing-room table. It was begun in 1867, and four volumes and a half are now completed. These, however, scarcely embrace one sixth of the vegetable kingdom; and if the same plan is followed throughout, the work must ultimately extend to some five and twenty to thirty volumes. An English translation is in progress, two volumes being already published. That Baillon should have undertaken so cumbersome a work, with so little of that clear method for which his countrymen are justly celebrated, is the more to be regretted, as the theory of organogenesis, which it has been his great object to develop, is one of the greatest aids recently introduced into the investigation and determination of natural affinities, wherever it has been critically applied and properly checked by other classes of observations.

## 2. GENERA PLANTARUM, or Systematic Descriptions of all the Genera constituting the Vegetable Kingdom.

This is the utmost extent to which we can expect to see all known plants methodized and described within the limits of a single work by a single author; and even in that work they can only be treated of scientifically and technically for the use of the botanist, without the generalities and accessory details which adapt the 'Ordines Plantarum' to a wider circulation. Taking for genera those groups of species, those plant-races of an intermediate grade between the order and the species, which appear to be the best defined in the present state of nature, and to which the generic nomenclature can be applied with the greatest practical advantage, we should estimate them as rather above eight thousand for Phenogams and vascular Cryptogams, and at least a thousand more for cellular Cryptogams. Such a work can still be brought within the compass of about three manageable volumes. Indispensable as it always is for the working botanist, the demand for it would never be sufficient to admit of its being simultaneously issued in the three generally diffused modern languages, and it therefore usually has been, and will still be, most usefully drawn up in botanical Latin.

Since the introduction of the natural method, there have been but two good complete 'Genera Plantarum,' the original one of Jussieu in 1789 and that of Endlicher, with its supplements ranging over the five years from 1836 to 1840; the latter was the work of a clear methodical head, applied with great care and assiduity to a stock of materials very fair for the time, and the general plan is good. But it was necessarily in a great measure a compilation, and it affords no means of judging how far the characters given had been confirmed by actual observation. This would have been the more useful, as it is evident that in many cases ordinal characters are repeated under each genus upon no other authority than that the genus had been referred by its proposer to the order in question. The work had, moreover, become quite out of date; and the need of a new one was so much felt, that Dr. Hooker and myself undertook the preparation of a 'Genera Plantarum' on a plan which long experience had led us to hope might be an improved

one. The first part was published in 1862, and the whole of the first volume (completing the Polypetalous Dicotyledons) was, with the aid of a supplement, brought down to the year 1867. The first half of the second volume, issued last year, contains nearly half the Gamopetalous Dicotyledons, the remainder of which, completing the second volume, will, we hope, be in the printer's hands early next winter. Monochlamydous Dicotyledons and Monocotyledons will probably fill a third volume.

The plan which we have set to ourselves has been to prefix to each volume a methodical diagnosis or short conspectus of the most striking characters of the several orders contained in the volume, and under each order to give the following particulars:—

- (1) The general characters of the order.
- (2) A short sketch of its geographical distribution.
- (3) An equally abridged sketch of its affinities.
- (4) An enumeration of the aberrant forms observed in individual genera, an addition which is, I believe, here introduced for the first time, we having both of us long felt the want of it in general works.
- (5) A conspectus of the genera—that is, a short and as much as possible contracted exposition of the most salient characters of each genus, as a guide to the determination of plants. Where the order is large enough, or heteromorphous enough, to be subdivided into distinct suborders or tribes, the tribal characters are given in this conspectus; and where the tribes are numerous, as in Leguminosæ, Umbelliferæ, Rubiaceæ, and Compositæ, a short conspectus of them precedes that of the genera. This arrangement into tribes has been everywhere thoroughly investigated, and in the case of most of the large orders entirely recast.

(6) An enumeration of genera which are either so nearly allied that they might be supposed to belong to the order, or which have been erroneously included in it, or have been so imperfectly described as to be wholly doubtful.

(7) Then follow the detailed characters of each genus, with an evaluation of its extent, its geographical distribution, a full synonymy, references to plates illustrating it, and such occasional notes as appeared necessary on affinities, on genera confounded with it, or in our opinion unadvisedly separated from it. Where the genera are sufficiently large or varied, the characters of its primary sections are entered into.

We have taken care to indicate the genera, very few in number, of which we have been unable to examine any specimen, and the characters which we have not personally investigated, indicating always the sources whence those we give have been taken; and we have also thought it necessary to pay particular attention to the typographical details of the work, an element of clearness which is sadly neglected in many German and some French systematic works.

### 3. SPECIES PLANTARUM, or Systematic Enumeration and Descriptions of all known species.

In the above-quoted article in the 'Natural-History Review' for October 1864, I gave a sketch of the last attempts made to publish a complete 'Species Plantarum,' including a detailed history of the great work of modern days, De Candolle's 'Prodromus,' which I need not now repeat. This work has now been brought to a conclusion by the issue, last autumn, of the seventeenth volume, forty-nine years after the publication of the first. Its celebrated originator began in 1818 a 'Systema Vegetabilium,' with all the details of the so-called new editions of Linnæus, but drawn up and arranged



according to the principles of the natural method. After the issue of the second volume in 1821, he found himself obliged to give up the task as already far beyond the means of a single life, and substituted an abridged 'Prodromus,' which he long continued, almost unassisted, at first with a vague idea of its being preliminary to a more detailed work. As that hope was finally extinguished, and especially since the elder De Candolle's death, the 'Prodromus' has been gradually extended into a series of concise monographs by different authors, differing much in merit, but drawn up as nearly as could be according to one plan, and uniformly printed in the successive volumes of a single work—the younger De Candolle, besides working up many of the orders himself, having gone through the tedious labour of editing them, giving to the botanical world a splendid monument of industry and perseverance, which will long be of great practical utility. It is now nominally complete, but only as to Dicotyledons, and the first volumes are quite out of date. They are, however, to a certain degree, supplemented by Walpers's 'Repertorium' and 'Annales;' and the botanist has thus, in thirty volumes, a very fair repertory of all described Dicotyledons up to a recent date. For Monocotyledons he has only Kunth's 'Enumeratio,' which extends to little more than half the class, having been put an end to by the author's death in 1850. For the remaining portion of Monocotyledons, for Cryptogams, and for all recently discovered species or recent methodizations of old ones, he must have recourse to detached monographs and floras, which are henceforth likely to be his only resource for the history of species. Alphonse de Candolle, in the above-quoted "Réflexions," has shown how little chance there is of a uniform 'Species Plantarum' being again undertaken with any prospect of its being brought to a successful conclusion. He calculates that it would require fifteen or sixteen years' labour of some five-and-twenty botanists, working under the direction of about eight to ten editors, a combination which it is highly improbable will ever be practically brought to bear. His calculations may, however, be a little overcharged. He supposes that each botanist would not work up more than 300 species in a year; that may be the case in a monograph when every detail is to be gone through from personal observation, but this would not now be necessary in a general 'Species Plantarum,' which would be most useful as a concise methodical compilation. Much of the labour expended on the 'Prodromus' and on detached monographs and floras need not be repeated. As pre-Linnean synonyms, upon which so much time was formerly expended, have now been generally given up, so, for post-Linnean synonyms, there would now be no use in repeating those given in the 'Prodromus' and other works compiled from, unless where errors have been detected; and this alone would save a great deal of time, labour, and expense. And with regard to the greater number of the orders or genera contained in the recent volumes of the 'Prodromus' and the best modern monographs and floras, a careful and intelligent abridgment of the specific characters without reexamination is all that would be necessary.

It might be useful to consider what would be the requisites of any such abridged 'Species Plantarum' or 'Synopsis,' restricted within limits which should render it possible, at least as to phenogamous plants.

We might expect it to follow the sequence of orders the most generally adopted, that of the 'Prodromus' and of our 'Genera Plantarum,' with such slight modifications only as the progress of science has rendered necessary, without attempting hypothetical improvements.

To each order and to each genus should be given short diagnostic cha-

acters, abridged from the last 'Genera Plantarum' or other best sources, selecting chiefly those which are most essential and contrasted, but including also the most striking or the most general amongst the adaptive ones, and a general indication of geographical range, with careful reference to the works where more details are to be found.

Where the orders or genera are large, a synopsis or conspectus of the principal divisions and subdivisions would be useful.

To each species should be given :—

(1) The name.

(2) The diagnosis, specific character, or abridged description, which are but different names for the same thing, and which it appears to me would be always more satisfactory in the nominative than in the ablative case. After the example of Linnæus, and based upon the doctrine of the fixity of species, it has been almost universally the custom to distinguish the specific diagnosis and description, the former to contain the absolutely distinctive characters (any deviation from which would exclude a plant from the species), the latter to aid the student in identifying a plant by the enumeration of characters which, though general, might vary in the same species, or which it may possess in common with other species. In order to mark the more strongly this difference, the diagnosis, when in Latin, has been given in the form of the ablative absolute, the description in the ordinary nominative form. There is, however, nothing really absolute in nature. There is no class of characters which may not occasionally admit of exceptions; and although care should be taken to select the most important and constant ones, yet, in some instances, those which are generally discarded as too variable for a diagnosis, such as dimensions, colour, &c., may yet be most useful, or even essential, for the distinction of species or even of genera. These diagnoses, moreover, to be useful should be short. We cannot now restrict them to the twelve-word law of Linnæus, but a twelve-line ablative diagnosis is an absolute nuisance.

(3) Reference to the source whence the diagnosis is taken, to the work where a further description, the synonymy, and history of the species are to be found, and to any plates where it may be satisfactorily represented; and all further synonymy should be avoided, except where it may be necessary to refer to descriptions, names, or modifications published since the one specially abstracted from.

(4) The habitat of the species.

(5) Occasional notes on affinities or other points in the history of the species should be very sparingly indulged in, and only when they may assist essentially in the provisional determination and elucidation of a plant. All discussions on doubtful points and all details should be reserved for monographs or separate papers, where alone they can really tend to the advancement of the science.

Each volume of the 'Synopsis' would of course be accompanied by a full index of genera, species, and such synonyms as it may have been found necessary to give.

The whole work would be so indispensable to botanists of all nations, that, like the 'Genera Plantarum,' it should be entirely in botanical Latin, which, moreover, from the number of conventional expressions to which a technical meaning has been assigned, is specially suited for short diagnoses.

No new species should be first published in this 'Synopsis.' Nothing has tended more to produce confusion in systematic botany than the publication of real or supposed new species, with short diagnoses, unattended by any full

description or detailed indications of its affinities, &c. However carefully the diagnosis may be worded so as to distinguish the species from those previously published, it would be insufficient for its identification, and full descriptions would be inadmissible from the plan of the work. At the same time it is to be expected that the author, in preparing the 'Synopsis,' should meet with new forms, which he may be desirous to make known, in order to render his work as complete as possible. But his course should be to give their full history in a separate monograph, to which, *when published*, he could refer in the 'Synopsis.' He should here not only thus avoid all addition to the numerous puzzles with which the science is overloaded from insufficient description, but strictly abstain from all mention of manuscript and other names which, according to the recognized rules of nomenclature, are not admitted as sufficiently published.

The grade of plant-race to which the specific name and diagnosis should be attached, would be the species in the Linnean sense, which, though not susceptible of a strict definition, is pretty generally understood amongst botanists, whether they may designate it as a true species, a Linnean, or a compound species. The 'Synopsis' might also distinguish marked varieties whose admission or rejection as species might be doubtful; but the innumerable forms variously termed varieties, subspecies, or critical species should be passed over in silence, as their admission would simply render a general work impossible, and a more partial one comparatively useless. The enumeration and distinction of the various forms of *Brassica campestris* and *oleracea*, of *Pisum sativum*, *Viola tricolor*, &c. may be serviceable to the agriculturist or gardener, that of the forms of *Rubus fruticosus* may be interesting to the investigator of the flora of a limited district, but they are only useless encumbrances to the general systematist as well as to the naturalist in other branches who would have to make use of the 'Synopsis;' and the names and diagnoses of two hundred forms of *Draba verna* would be a simple nuisance, of no use whatever to any one\*.

Taking the species, therefore, in the Linnean sense, we should, with Alph. de Candolle, estimate the number of Phenogams now published, or in the course

\* The mode of dealing with species which in the present state of vegetation pass into each other through a series of intermediate forms which cannot fairly be supposed to be hybrids, is well discussed by Nägeli in a series of papers in the 'Sitzungsberichte' of the Munich Academy for 1866, the result of careful observation chiefly of the genus *Hieracium*. After admitting himself to have been originally a firm believer in the fixity of species and a strong advocate of the hybrid parentage of the large number of intermediate forms observed, he acknowledges his conversion to the doctrine of evolution. "In the present state of the science" he sees "no other possibility than the assumption that the species of *Hieracium* have arisen by transmutation either from extinct or from still surviving forms, and that there are still persistent a great number of the intermediate stages (races) formed either by the original differentiation of the extinct species, or in the course of the transformation of one yet living species into the diverging forms."—*Sitzungsber.* 1866, i. 330.

In a subsequent paper he shows that the genus *Hieracium* affords instances of great diversity in the degree to which differentiation has attained and in the definiteness of the species established by the extinction of intermediates. He instances, amongst those to which he would in their present state assign the rank of species:—

1. Aggregate forms, such as *H. pilosella*, which cannot as yet be separated into distinct groups. *H. Hoppeanum*, Schult., *H. Pelleterianum*, Mérat, *H. pseudopilosella*, Jen., are not yet sufficiently isolated by the disappearance of intermediate forms to be ranked as species.

2. Forms which, by the disappearance of closely allied ones, have attained sharper and more fixed limits, and yet between which isolated intermediates may still be found, are exemplified by *H. auricula*, *H. aurantiacum*, and *H. pilosella*, or by *H. murorum*, *H. villosum*, and *H. glaucum*. On the other hand, it is uncertain whether the relations of

of publication; from materials already in our herbaria, at between 110,000 and 120,000. A competent botanist would readily get through three or four thousand in a year. In the 'Flora Australiensis' I had no difficulty in preparing a thousand to twelve hundred in the year, and that was all original work, entailing the personal examination of every species often in numerous specimens, and a long and tedious investigation of synonyms. Such a compilation as I have above characterized would require, it is true, a competent knowledge of plants and occasional verifications; but still the labour would be reduced by at least two thirds; and 300 species a month, with a month or six weeks' vacation, would be no great strain upon the mind. Thus three or four botanists might complete the synopsis of ten thousand species in the year; and the general synoptical enumeration of all known Phenogams would not be beyond the range of possibility, however little chance there may be of my living to see it commenced.

Cryptogamic details require the cooperation of more special botanists, who have already furnished us with monographs or synopses of some of the primary groups. In Ferns, Hooker's 'Species Filicum' is very complete, and is brought down to the present day by his 'Synopsis Filicum,' edited by Baker, of which a new edition is now ready. For Mosses, the last general work is Carl Mueller's 'Species Muscorum,' completed in 1851, since which date the number of species described has been at least doubled. Modern muscologists have, however, so much lowered their generic and specific standards, that they have placed the study of this most interesting class of plants almost beyond the reach of the general botanist. A monographer who would boldly reestablish the species according to Linnean principles, and group them in a manageable number of genera, treating the lower grades as subspecies only, disencumbering the binomial nomenclature from them, would render a great service to science. In Hepaticæ there has been no general 'Species' since that of Gottsche and Lindenberg, begun in 1844, and, by means of supplements, brought down to 1847. Lichens are still more in arrear. Nylander began, indeed, a new 'Synopsis' in 1867, but it has never been continued. In Algæ, Agardh's 'Species Algarum,' commenced in 1848, was completed in 1863; and Kützing's 'Phycologia' and 'Species Algarum,' issued in 1849, have, through the nineteen volumes of his 'Tabulæ,' been brought down to 1869. The enormous class of Fungi is much more complicated, and their study much more specialized than any other branch of systematic botany; and although mycologists, no more than phenogamists, have at present any general comprehensive systematic work, they have the advantage of Streinz's 'Nomenclator,' a convenient general index to the numerous detached monographs and papers descriptive of fungi.

#### 4. MONOGRAPHS of Orders and Genera.

Monographs, like 'Ordines Plantarum,' are general histories of plants; but the field being limited to single orders or genera, the author can descend to

*H. auricula* and *H. glaciale*, or of *H. murorum* and *H. vulgatum*, should be included in this stage, or are still in the first-mentioned category.

3. Species between which no constant intermediates survive, but which still are capable of producing intermediate hybrids, are represented by *H. alpinum* and *H. villosum*, by *H. alpinum* and *H. glaucum*, by *H. murorum* and *H. umbellatum*, &c.

4. Lastly, the three sections *Pilosella*, *Archieracium*, and *Stenotheca* are races which have become so far distanced from each other that hybrid fertilization no longer takes place between them.—*Sitzungsab.* 1866, i. 472.

species and primary varieties instead of limiting himself to orders and tribes. They are at the present day amongst the most important botanical works. They are required by the systematist for the identification of plants, and by the general naturalist as the source whence he is to derive the data he requires respecting individual species in theoretical, geographical, physiological, or applied botany. This preparation has been recognized as the best exercise for the young botanist; and monographs of difficult orders have been received as most valuable contributions from some of the most eminent heads of the science.

Our requirements for a complete monograph are analogous to those we expect in 'Ordines' and 'Genera Plantarum,'—methodical arrangement, technical diagnoses and descriptions, indications of geographical distribution, "qualitates et usus," and occasional notes on affinities and systematic limits, including an investigation of synonyms, well selected illustrations adding always to the practical value. The technical diagnoses and descriptions for the use of the systematist ought invariably to be drawn up in botanical Latin; the more general matter would usually be more readily written, and often much more intelligible, in one of the three general modern languages.

This similarity required in the histories of orders, genera, and species has not, however, been hitherto generally acknowledged, and could not even have been admitted so long as it was believed that there was an essential difference between the groups—between the definite fixity of species and the more arbitrary limitation of genera and orders. In early systematic works, therefore, whilst the definitions of orders and genera were single and in ordinary phraseology, it was thought necessary, in the case of species, to give a double definition—a diagnosis containing the supposed fixed characters, by which the species could be absolutely tested, and therefore expressed in the ablative absolute, and a description admitting all classes of characters in the ordinary form of phraseology. As the number of species increased, greater extension was habitually given to both diagnosis and description, till they became unwieldy for use, without some short indication of the most striking points to be attended to. This has been done in two ways, either by prefixing to the group of species described a tabular clavis or a short conspectus of the contrasted characters to which attention is specially called, or by italicizing them in the long diagnosis. The former course entails often the useless repetition of the same characters three times over, in the clavis, in the diagnosis, and in the description; the latter, seeing that the italicized words are usually adjectives, often occasions confusion and loss of time in searching for the substantives to which they belong. Now that it is laid down that there is no more absolute fixity in a species than in an order or genus, the complication is no longer necessary; there is no more need of an absolute test in the one case than in the others. In all we want a short indication of the most prominent contrasted characters for approximate or preliminary determination, prefixed to the detailed description for subsequent verification.

These short characters are given in three different forms:—1st, a tabular clavis, more or less on the dichotomous principle, as is now frequently exemplified in local floras; 2ndly, a conspectus prefixed to the whole group of species; 3rdly, the short character prefixed to each description. In elaborate monographs, where the descriptions are long, the conspectus is probably the most satisfactory form; in more concise ones, where the descriptions are short, the tabular clavis will be found more useful. In synopses, where the descriptions are reduced to occasional notes or limited to new

species, the short characters or diagnosis (which, I think, should never be omitted) would form the body of the work, and the notes and descriptions, when they occur, should be given under each diagnosis.

It should always be borne in mind by the monographist that the great test of the quality of a descriptive work lies in short descriptions, diagnosis, and conspectus or clavis. Any tyro with a little practice can draw up long descriptions of *specimens*, fairly detailing every organ; but the selecting the characters necessary to give a good idea of a *species* in a short description requires a thorough knowledge of the subject and a methodical mind. Still more difficult is it to prepare a good clavis. After half a century of experience in using as well as in making these keys, I find that I have failed in some of those on which I had spent the greatest pains; and in some floras I have met with tabular keys which are in many respects rather impediments than aids to the determination of plants. At the same time a successful clavis or contrasted conspectus is an excellent test of the quality of a method—of the appropriate grouping into genera, sections, and species.

Really good monographs are not very numerous, and several of them not very recent. Some of the best among complete monographs have proceeded from the French school; and I may refer as models to Richard's *Coniferæ*, Adrien de Jussieu's *Malpighiaceæ*, Decaisne's *Mistletoe* and *Lardizabaleæ*, Weddel's *Urticeæ*, Tulasne's *Monimiaceæ*, and others. Their illustrations also, as well as some of the German ones, far exceed our own in neatness, clearness, and correctness of analytical detail. For more concise and technical monographs some of the recent volumes of the 'Prodrômus' afford good examples. Amongst the worst I have had occasion to refer to are De Vriese's detailed monograph of *Goodenovicæ* and Steudel's more concise synopsis of *Glumaceæ*. The Germans have of late years done but little in this respect beyond what has been incidental to the 'Flora Brasiliensis.' In England the principal recent ones have been Hiern's *Ebenaceæ*, remarkable for the scrupulous care with which the minutest details have been worked out, and Miers's *Menispermaceæ*, the value of which we fully recognize, although we do not accept the low grades to which he assigns the rank of genera and species respectively. Some good partial ones have appeared in the Swedish and Danish as well as our own Transactions; and we have had excellent Russian and North-American monographic memoirs, limited, however, to plants of their own territories, and therefore scarcely coming under the present head.

The orders now most in need of the labours of able and methodical monographists are, in the first place, the *Monocotyledonous* ones. The largest of them, that of the *Orchideæ*, was once well worked up by Lindley; but the enormous additions made to it since these curiously diversified plants have been brought into fashion by horticulturists have thrown the '*Genera et Species Orchidearum*' quite out of date. The next two in point of number, *Gramineæ* and *Cyperaceæ*, have been undertaken chiefly by Germans; and if Trinius, Kunth, and Nees von Esenbeck had partially cleared up the confusion which prevailed among them, Steudel has in a great measure contributed to throw them into a worse chaos than before. Munro, who has long made the *Gramineæ* a subject of special study, has as yet only published his monograph of *Bambuseæ*. In *Cyperaceæ*, Bœckeler's desultory descriptions of those of the Berlin Herbarium are sometimes perhaps rather obstacles than aids to a general systematic acquaintance with the order. Masters's monograph of *Restiaceæ* is limited to the African species. Klatt's *Iridææ* do not very well bear the test of practical use. Martius's splendid work on Palms requires already much supplementing. Baker is now rendering good service in working

up the Liliaceous groups; but some of the remaining orders appear to have been almost entirely neglected.

Among Dicotyledons the orders which I would particularly recommend as the subject of specific monographs are those which are contained in the first volume of the 'Prodromus,' and more especially such as comprise a large number of plants from the temperate and mountain-regions of the northern hemisphere (*e. g.* Ranunculaceæ, Cruciferae, many genera of Papilionaceæ, Rosaceæ, &c.); and this not only for the purpose of methodizing the data supplied by the numerous writers on local floras, but with a view to the careful and intelligent, but merciless excision of the overwhelming numbers of races of lower grades which have, to the great detriment of science, been allowed to rank with those legitimately deserving the name of species. Tropical and southern orders are so much within the scope of the great floras now in course of publication, that special monographs, except as connected with those works, are not in such immediate demand.

Monographs of variable or ill-defined *species* have also their importance, if worked out with a view to ascertaining the extent to which, and the circumstances under which, a species varies or is connected with others, and not for the sole purpose of dividing and subdividing it into races of a lower grade, to receive the same binomial nomenclature as the normal or compound species. Such a monograph should comprise the history of the species throughout the area it occupies, the investigation of the modifications which its several organs undergo in different localities, of the extent to which the divergencies are carried out under different circumstances, of the relative numbers (that is, of the frequency or rarity) of the divergent forms, of the extraneous circumstances (such, for instance, as the vicinity of allied species &c.) which may be supposed to have influenced these divergencies—every thing, in short, which might tend to show whether the variability is an indication of a progressive differentiation of a flourishing race, or a temporary result of hybrid fertilization, or the immediate effect of climatological or other conditions affecting the individual rather than the race. The working out such a monograph in some one or two species would be highly instructive to the general botanist, and the data obtained might consolidate the foundations of more general speculations. It may even be useful to define and to give subordinate names to those varieties which approach the state of distinctness which might entitle them to rank as species; but the technical defining of the slight diversities of form assumed by a species in a limited locality, however constant those varieties may there be found, can be of little interest but to the inhabitants of that locality, and the giving them names as of species to be received by general botanists is only adding to the encumbrances with which the science is overloaded, without a single corresponding advantage.

##### 5. FLORAS, or Histories of the Plants of particular countries or districts.

Floras, like monographs, are histories of plants so limited that the author can descend to species; but the limit is geographical instead of systematic. The general requirements as to their contents are the same as in respect of Ordines Plantarum and Monographs, but with greater variety in the details, according to the class of persons for whose use they are intended. If the country of which the flora is given is large and the civilized inhabitants comparatively few, the work is chiefly useful to the general botanist, and requires special attention to the technically systematic portion in botanical Latin. Where the geographical extent is more limited, or the science generally cultivated amongst its inhabitants, the general description and history should be

more extended, and the local language may be admitted or preferred according to circumstances. The more botany is cultivated in a country, the more variety may be given to its floras—a scientifically morphological one for a text-book in classes, an easy descriptive one for the beginner and amateur, a very fully detailed one for study at home, an abridged synopsis for a companion in the field. In all, correctness and clearness of method and language are the first qualities requisite; and wherever any instruction or information beyond the means of determining plants is the object, geographical distribution (without as well as within the special area of the flora) is a most essential point to be attended to. It is to local floras that the general botanist must have recourse for most of the data he requires for the investigation of the history and development of plant-races; and his reliance upon the correctness of the facts supplied depends much upon the intrinsic evidence of a careful comparison on the part of the author of his plants with those of countries adjoining to or otherwise connected with his own. It tends also very much to enlarge the ideas of a local botanist to learn how very widely spread are species which he has been accustomed tacitly or expressly to consider rare local creations, and how very differently plants may be distributed or varied in other countries from what he has observed at home. Exotic distribution is, however, a point very little attended to in many of our best modern floras. I well recollect the interest that it gave to the first in which I met with it, Cambessedes's enumeration of the plants of the Balearic Islands, published in 1827; but his example was but rarely followed. More recently, I believe, I was the first to introduce it into British floras. Dr. Hooker has paid particular attention to it in all his systematic works; it is one of the conditions introduced by the late Sir William Hooker in his plans for the series of Colonial Floras, and has been partially attended to by some of the contributors to the great work on Brazilian plants. We may hope, therefore, to see it gradually included in the standard continental floras, as well as in more local ones. It is gratifying to observe that in that of Dorsetshire, just published by Mr. Mansel-Pleydell, special indications are given of the species which extend to the opposite coast of Normandy.

In several of my Linnean Addresses, especially in those of 1866 and 1871, as well as in two articles in the 'Natural-History Review' (one on Maximowitz's "Amur Flora" in April 1861, the other on "South-European Floras" in July 1864) I had occasion to enter into many details relating to the Floras recently published or in progress, which it would be superfluous now to repeat. I may only state generally that those of the central and northern States of Europe are well kept up. Lange and Willkomm's Prodrômus of Spanish Plants has very recently made a step in advance by the issue of the first part of the third and last volume, which it may be hoped will be now soon complete. Parlatore's Italian Flora gives no such promise, though it still drags its long pages slowly on. The vegetation of the eastern portion of the vast Russian empire is being thoroughly and scientifically investigated by Maximowitz. Boissier's much-wanted 'Flora Orientalis' has reached the end of Polypetalæ in its second volume, and a third is said to be far advanced. The still more important 'Flora Indica' is at length fairly afloat; two parts, by various authors, under the enlightened editorship of Dr. Hooker, are on sale, and a third is nearly ready. The 'Flora Australiensis' reached its sixth volume last summer; and if health and strength be spared me, I hope to complete the seventh and last next summer. Weddell is, I understand, preparing the third and last volume of his 'Chloris Andina;' and that splendid monument to systematic botany, the great 'Flora



Brasiliensis,' thanks to the munificent patronage of the Emperor and his Government, and to the unwearied zeal and energy of the present able editor, Dr. Eichler, has so far advanced, that its completion, once thought hopeless, may now be fairly reckoned on at no distant period.

Turning to the desiderata in this branch of systematic botany, besides the completion of the above-mentioned works in progress, and of the remaining colonial floras begun or contemplated according to the plans of Sir W. Hooker, there are three which are much in need of a thorough investigation and re-working up on sound scientific as well as practically useful principles. These are the European, the Russian, and the North-American. The three together comprise the whole vegetation of the temperate and cold zones of the northern hemisphere, by far the most extended continuous flora of the globe, and the most closely connected with what we know of the vegetation of the latest preceding geological periods. Its present continuity, with only a gradual east-and-west change in the northern portion, but more and more marked divergencies as it recedes from the arctic regions, and the evidences we have of that continuity having been as great at a former period and in some instances perhaps yet wider extended, would suggest that it ought to be treated as one whole. That would, however, be too great an undertaking for a single hand; and there are other advantages in dividing it into three separate floras, provided the three are carried out according to one plan, with a uniform estimate of specific and generic grades, and each one always in close connexion with the other two. The different materials which each of the three investigators would have to work upon would require some differences in their treatment, besides that each one ought to be an inhabitant of the region he investigates, so as to have some personal experience of its living flora.

The writer of the European flora would be much more bewildered by a superabundance of data than at a loss on account of any deficiency. His first great difficulty would arise from the enormous number of names published by local botanists, and the consequent call upon him to carry out on a large scale that judicious excision of insufficiently differentiated species which I have above urged in the case of monographs. His work would be more in the hands of the general than of the local botanist, and conciseness, method, and accuracy would be more important than minuteness of detail. Innovation would be avoided unless upon very strong grounds. The most useful sequence to be adopted in the present state of the science would be, without doubt, the Candollean, the genera and species restricted to the higher grades sanctioned by the best modern monographists and other systematists. In the majority of cases he would have little difficulty in this respect; and when he comes to such involved genera as *Ranunculus*, *Hieracium*, *Rubus*, &c., where there are really so many indefinite species, he would limit his specific names and descriptions to the 'Hauptformen' of Nägeli, which one set of botanists may designate as Linnean or legitimate and another as compound species. Isolated intermediate forms, whether hybrid and evanescent or more or less constant, and a few of the principal subspecies, varieties, critical or, in the Jordanian view, true species, may require mention by name, with a few descriptive notes where the low grade may be doubtful; but the great majority may be dismissed with a general statement of their having been proposed by dozens or by hundreds, as the case may be, with a careful indication, however, in so far as possible, of the degree in which the species admitted have been observed to vary, and of any difference in this respect in different parts of the area of the flora. The language of such a European flora should be,

without doubt, botanical Latin for the technical descriptions; French or English might be better suited for the occasional notes and geographical distribution.

This geographical distribution would be a most essential feature in the general flora of Europe, which exemplifies the gradual extinction southwards of the arctic plants, and eastwards of a very interesting western flora, whilst a certain number of Asiatic plants enter its eastern limits, but fail to reach the western States; and much interest attaches to the botanical connexion of the Pyrenean and Alpine floras with the north and with each other. Accurate data are much wanted for the inquiry into the history of the dispersion of plant-races, their origin, progress, decline, and final extinction; and to supply these data all general floras will be expected to record for each species the area it occupies within the flora, distinguishing the localities where it is most common and the direction in which it becomes rare, and its ultimate limits if within those of the flora, or if not, noting generally its extension into adjoining regions in identical or representative forms. For the European flora the limits are well marked on three sides:—To the westward, the Atlantic opposes an insurmountable obstacle to any gradual extension of European plants, except in the extreme north. To the south, the Mediterranean and Black Seas and the ridge of the Caucasus give a good natural boundary; for though many of the European forms are still prevalent on the African coasts and in Asia Minor, yet they are very soon arrested southwards by climatological conditions. To the north, the limits of the European flora are those of all vegetation. To the east only is there no definite limit, and an arbitrary line must be drawn to separate it from the North-Asiatic region; that of the Ural, though no better marked botanically than physically, is on the whole the most convenient.

For the Russian, or rather the North-Asiatic, flora (for it ought to include or to be drawn up in close connexion with that of Japan) a methodical and geographical work, by one who should have the intimate acquaintance with the vegetation and the sound views of Maximowitz, would be a great boon. Here, again, the northern limits are those of all vegetation, and the southern ones at present fairly defined by the comparatively unexplored mountain-masses of Central Asia, beyond which the northern plants are replaced by a totally different vegetation; but besides the actual continuity with the European flora to the westward, there is a close connexion with that of North America to the east, notwithstanding the definite limits interposed by the Pacific—a connexion which has been already exhibited by Asa Gray from an American point of view, and by Maximowitz on the part of East Russia and Japan, but still requires a much fuller development. Ledebour's 'Flora Rossica' would form a very good basis for the new work: it is the best complete flora of so large a tract of country which we possess; but it now requires a thorough revision, with the insertion of the numerous additions made by recent explorations, and the geographical data must be entirely remodelled and extended to meet the above-mentioned requirements. With regard to the Japanese flora, abundant materials have been collected and published in various works, chiefly by Dutch botanists; but the absence of all method in Miquel's 'Prolusiones,' where they profess to be enumerated, renders that work of little use to the general botanist, and a geographical flora is very much needed. The connexion, indeed, between Asia and America cannot be studied without constant reference to Japan.

For the North-American flora we must look to Asa Gray. The Americans have for many years past been most active in the exploration of their vast

territory, and its botany has been partially worked up monographically by A. Gray, geographically by Sereño Watson, Porter, and others; but the great mass of data collected are scattered over so great a variety of publications as to render them almost useless to the general botanist. We cannot even approximately fix upon the boundary-line to separate the North-American from the very different Mexican flora to the south-west. Northward it should, if it is wished to make it really instructive, extend, like the two other great floras, to the limits of vegetation; eastward and westward the Atlantic and Pacific afford definite boundaries. But the comparative degree in which the external connexion with Europe and Asia is broken off by the two oceans, the causes of the difference observed, as further illustrated by recent palæontological discoveries, the effect of the north-and-south ridge of mountains and other causes in separating eastern and western races within the territory, and many other important elements in the history of plants can only be satisfactorily investigated with the aid of such a comprehensive, methodical, and geographical flora as we are in hopes the distinguished Harvard-University botanist is now preparing.

#### 6. SPECIFIC DESCRIPTIONS, detached or miscellaneous.

Had I to report only on the progress, and not on the present state also, of systematic botany, I should here stop, for the great majority of recent detached and miscellaneous descriptions are almost as much impediments as aids to the progress of the science. I have too often in my Linnean Addresses, especially in those of 1862 and 1871, animadverted on the mischief they produce to enter now into any details; I can only lament that the practice continues, and is even rendered necessary by considerations not wholly scientific. Horticulturists must have names for their new importations. It is due to travellers who, under great perils and fatigues, have contributed largely to supplying us with specimens of the vegetation of distant regions that the results of their labour should be speedily made known; it is even important to science that any new form influencing materially methodical arrangements should be published as soon as ascertained. But all this is very different from the barren diagnoses of garden-catalogues, and the long uncontrasted descriptions hastily got up for the futile purpose of securing priority of name. I own that I have myself erred in the want of sufficient consideration in the publication of some of the species of 'Plantæ Hartwegianæ;' and some descriptive miscellanea, even by men who stand very high in the science (such as Miquel's 'Prolusiones,' above referred to, and Baron von Mueller's 'Fragmenta'), are rendered comparatively useless from their utter want of method. Whilst, therefore, discouraging as much as possible all such detached publications of new species, I would admit their occasional necessity, but suggest the following rules as the result of a long practical experience:—

No detached description of a new species should be ventured upon unless the author has ample means of reviewing the group it belongs to; and if any doubts remain of its substantive validity, he should refrain from giving it a name till those doubts are cleared up.

The description, when given, should be full, but contrasted, and accompanied by a discussion of affinities with previously known species, and an indication of the place the new one should occupy in the several monographs and floras in which it would be included.

An illustration of the new plant, with analytical details, should never be neglected where circumstances admit of it.

In conclusion, if I am correct in the views I have taken of the desiderata

under the six heads above detailed, I hope it may be admitted that, notwithstanding recent progress, there is still a wide field open for the researches of the systematic botanist, and that his branch of the science is not the mere child's play or herbarium amusement it has been charged with; for no thorough knowledge of plants can be satisfactorily obtained or successfully communicated without scientific method, and no such method can be framed without a thorough study of the plants methodized in every point of view.

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*Report of the Committee, consisting of Dr. PYE-SMITH, Dr. BRUNTON (Secretary), and Mr. WEST, appointed for the purpose of investigating the Nature of Intestinal Secretion.*

For some time the opinion has prevailed among physiologists that the nervous system not only exerts an influence upon the calibre of the vessels supplying glands with blood for secretion, but that the secreting cells themselves are excited to action by nervous stimuli. So firmly, indeed, has this opinion been held, that Pflüger's discovery of nerves terminating in the secreting cells has been almost universally accepted, notwithstanding his failure to demonstrate these structures to others. Partly, no doubt, this belief has been due to the high personal consideration in which this distinguished physiologist is justly held, but it is also due in part to the conviction which prevails that such structures must exist.

A distinct proof to this effect has been afforded by the researches of Heidenhain, on the effect of atropia upon the secretion of the submaxillary gland.

When one of the nerves going to this gland (*viz.* the chorda tympani) is stimulated, two effects usually follow:—First, the vessels going to the gland dilate, the blood flows quickly through them, and a free supply of lymph is poured out into the lymph-spaces surrounding the gland; secondly, the cells of the gland absorb this lymph, convert it into saliva, and pour it out into the duct of the gland.

If the animal be partially poisoned with belladonna (or its active principle atropia), or if atropia be injected into the vessels of the gland itself so as to exert its poisonous action upon the branches of the chorda tympani ending in the gland, a very different result takes place.

When the nerve is then irritated the vessels dilate as before, the blood pours rapidly through them, but not a drop of saliva is secreted. That part of the chorda tympani which acts on the vessels has not been affected by the poison, but those fibres which go to the secreting cells and stimulate them to secrete have been paralyzed by it.

It is obvious, however, that the salivary secretion is only exceptionally induced by direct irritation of the chorda tympani nerve, lying as this does far below the surface and well protected from external influences. Usually secretion is induced reflexly from the mucous membrane of the mouth or tongue, the impression made by sapid substances upon the sensory nerves of these parts being transmitted up to the brain and then reflected outwards along the chorda tympani to the gland.