phenomena of the Lenard rays, is the one usually accepted.

The value of $e/m$ was determined by two entirely different methods by J. J. Thomson, the results being published at practically the same time as those of Wiechert. In the first method used by Thomson, the kinetic energy of the particles was determined by measuring the heat developed when the rays fell upon the face of a thermopile, and the charge carried by them was measured by an electrometer. These two measurements, together with the magnetic deflection in a known field, make possible the computation of both $e/m$ and $v$. The values of $e/m$ obtained in the most reliable experiments by this method ranged from $14 \times 10^6$ to $10 \times 10^6$. The corresponding values of the velocity were about one-tenth the velocity of light. The second method, which is regarded by Thomson as more reliable, involved the determination of the electrostatic deflection in a known electric field, and the magnetic deflection of the same rays in a known magnetic field. This method gave values of $e/m$ ranging from $9 \times 10^6$ to $6.7 \times 10^6$, the velocity being about one-tenth that of light, as before. Thomson found that the ration $e/m$ was independent of the nature of the gas in the tube. This result has been confirmed by Kaufmann,* who found that the ration was also independent of the material of the kathode.

The conclusions naturally drawn from these results may be put into the following crude and provisional form: The kathode rays consist of negatively charged particles, or corpuscles, which are much smaller than the atom of hydrogen. These corpuscles are present as a constituent part of the molecule in all substances: whether only one such corpuscle is present for each molecule, possibly revolving about it like a satellite, or whether each molecule consists of an aggregation of corpuscles, it is not yet possible to say. Under the influence of the intense electrical field at the negative terminal of a vacuum tube, the corpuscles are in some cases freed from the forces that hold them to the remainder of the molecule, and shoot off at enormous speed to form the kathode rays.

Ernest Merritt.
Cornell University.

(*To be concluded.*)

* *Wied. Ann.*, 61, p. 545, 1897.

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*SOME TWENTIETH CENTURY PROBLEMS.**

It is never a bad plan to improve an anniversary occasion by comparative observations. In commercial and manufacturing lines, short intervals of time are marked by balancing books and checking off accounts, and an inventory is taken at the end of the year without exception. And so it happens that I am going to recognize to-day the fact that we stand at the end of a century, and what I have to say will be influenced to no small extent by the recognition of that fact.

Under ordinary circumstances, with this in mind, I could hardly avoid following the commercial example at the end of the year, and taking an account of stock, balancing accounts, and ascertaining the advance or retrogression in our branch of the scientific world during the period of time that represents three generations of human beings. I do not intend, however, to do this, partly because I do not wish to weary an audience with all that ought to be passed in review in such an important anniversary summation, and partly because, a few years since, Professor H. Marshall Ward, in resuming the botanical progress of the Victorian Era, gave the more important facts, while the vice-presidential addresses of several recent years before this Section have dealt with important advances in botanical thought in

*Address of the Vice-President, Chairman of Section G (Botany) of the American Association for the Advancement of Science, given at the New York meeting.

different directions, and of the progress of the early part of the century Sachs has given a sufficient epitome. I propose, therefore, that we shall consider the inventory and balance sheet as in hand, and that, like the thoughtful business man who has closed his books for the year after noting what he has on hand and what the balance sheet shows, we shall take a general view of the situation, in the hope that some hint of economy or conservatism or changed method may suggest itself as we do so, by which the work of the new century may be furthered.

I have felt some interest in looking over the present trend of botanical thought, as evidenced in a few recent journals and in the advance programs of this Association and the affiliated societies devoted to subjects in which botany figures directly or indirectly. Neglecting strictly economic botany, I observe that taxonomy and descriptive botany lead (42 per cent. in the particular examination made), followed at some distance by morphology and organography (25 per cent.) and physiology and ecology (20 per cent.), while the much smaller remainder (13 per cent.) consists in nearly equal parts of vegetable pathology, phytogeography and floras, and the evolution of plants either in a state of nature or under the hand of man. Though the percentages may vary considerably, the general distribution indicated above would probably apply in the main to the prevalent activity of purely botanical research.

A hasty scrutiny of not far from a thousand periodical publications received at the library of the Missouri Botanical Garden, and all containing at least occasional articles on pure or applied botany, shows, as might be expected, that the percentage of journals restricted to one branch of botany is much smaller than the average percentage contents of the current journals or programs. Even where botany is largely or exclusively represented, the contents of journals are usually very heterogeneous. Notes or longer papers on local floras or on the characters of one or a few species largely preponderate, and there are only a few journals which concern themselves entirely or chiefly with any other single component of botanical knowledge. Among these, vegetable pathology, and economic botany in one or other of its subdivisions, assume a comparable position with morphology and physiology, though, for the reasons stated, all are relatively lowered with reference to taxonomy, as compared with current papers included in the journals. Phytogeography and evolutionary matters appear to be more suitable for books than the other main subjects excepting floras, and they do not appear to have led as yet to the establishment of journals specifically devoted to them.

The preponderance of taxonomic work as indicated by publications calls for a little consideration. Human interest in plants, as in nature generally, appears to have begun in most cases by the observation of useful and injurious or mysterious things; but before the information of the individual could become public knowledge it was necessary to mark differences between things and to name or otherwise designate them intelligibly. It is therefore natural that taxonomy and nomenclature, in one form or other, and however they may have been designated, should have played an equal part with economic observation in even the earlier studies of plants; and it is not at all surprising that the first real science of botany should have been developed along these lines, nor that the awakening interest in other lines of botanical study should have failed as yet to attain an equal position as regards the number of botanists concerned with them.

It is also a very natural thing that the abstract idea of the distinguishable groups

of individuals that have been called species should have been ultimately all but personified, and erected into something supposed to have been realities, divinely established and immutable. Even those of us who have not passed middle age were alive when, as one of my geological friends has expressed it, a Species was treated almost like a thing that had legs and could walk; and even the younger of us have seen the idea grow, from Darwin and Wallace and Huxley and Gray, through the scientific circles into the world at large, that heresy and atheism are not necessarily implied in the belief that existing species are descended from different earlier species, and that their descendants, in all probability, will be considered as yet other species.

If the incident had been closed with a general acceptance of this idea of the mutability of species, we should probably have been spared some trouble which we are now experiencing and which we are actively accumulating for transmission to our followers on the stage; but the change in the theoretical way of viewing the question of species has involved many practical changes in the way of treating them.

In some pliable groups, the expert plant breeder is quite willing to take an order for a non-existent garden form that differs as much from all of the named and classified plants as one species does from another in nature, and, though he may not give a bonded guaranty that it will not revert to some other form after a few years, it is quite likely to transmit its characters for a considerable if indefinite time if bred true, a condition less readily applied in the garden than among species in a state of nature, but scarcely more negligible in the one case than in the other. Whether or not we are to call the most distinct cultivated forms, some of which have been deliberately evolved by the gardener and some of which have originated as sports or sudden variants of either wild or cultivated plants, species, is rather a matter of agreement than anything else, for such as are capable of perpetuation by ordinary natural means constitute, in fact, groups of similar individuals of common origin, reproducing their kind, which is about all that can be said now of natural species.

The growing knowledge of the great and immediate plasticity of species has led to a considerably greater change in the way of viewing them in the abstract than even that which the introduction of evolutionary views caused. That virtually left them as real concepts, though it opened a vaguely distant question as to their beginning and end; but this brings the beginning and end so close together as to cast doubt upon the existence of species at all as definable groups having any considerable stability in time.

I can distinctly recall the thrill of surprise with which, in my student days, I heard of the belief of a distinguished German professor, that species as known in other plants and animals probably did not exist among the bacteria. I felt grateful later that the American flora contains fewer representatives of *Hieracium* than are found in Europe, when I saw the desperate efforts that the Germans have made to distinguish these difficult plants; and the polymorphism of the European brambles made apparent equal reason for thankfulness that American institutions are simpler also in that genus. But the rehabilitation of synonyms and varieties in all groups that the last decade has witnessed, and the increasing rapidity with which the species-splitting knife is falling upon *Antennaria*, *Sisyrinchium*, *Viola*, *Cratægus* and many other genera, have removed any such misguided thankfulness, and the further separability of natural plants, even on the old lines of specific delimitation, appears to be coming into as strong evidence on the one hand as the gardener's power to

create equally distinct species or races is on the other.

There are several ways in which these admissions may affect our judgment and actions. Recognition of measurable parallelism between the operations of nature and of the gardener goes far toward removing a sentimental objection to considering as species the forms which the latter brings into being, but the treatment of both natural and garden forms on a uniform basis is likely to modify the extreme treatment which would otherwise be accorded to either. The garden forms of a given type of plant are often so numerous and so freely subdivisible as to threaten, when this is carried out, either a very undesirable polynomial nomenclature or, what is worse, the multiplication of barely separable genera, in order that the facts may be fully expressed. It is evident that too great a multiplication of genera can but result in unwieldy complexity of system, and it is equally evident that, the ultimate purpose of the systematist being to classify and describe for others the plants which actually exist—whether in the woods or the garden—he must not be content with distinguishing between the more easily separated only, but must provide for all of the forms which either the botanist or the gardener or the user of plants for manufacturing and other purposes needs the means of separating.

We are living through a transition period in our science, and should not close our eyes to the practical meaning of the changes in our beliefs. We are carrying on a movement for so classifying all groups of plants as to indicate their phylogeny by their position—or, otherwise stated, we are continuing the effort of our predecessors to secure a natural system based on real affinity rather than superficial resemblance—and at the same time we are beginning to recognize that the groups of individuals that we call species are of every-day value only in proportion to their simplicity and definability. Two years ago Dr. Farlow made a strong statement of the necessary utilitarian trend of the present attitude with respect to species. My own belief is that this will very shortly become a principal guiding thought in the work of all describers of plants, and that the old idea of something distinct in nature between the concepts of a species and a variety, which has suffered greatly in the changes that have already come about but is still leading to diverse practices, will be eliminated as a factor of any importance.

In the address referred to, Dr. Farlow likened the efforts of the descriptive botanist to those of the happy possessor of a kodak—snap-shotting the ever changing procession of nature. It is evident that if the facts shown have changed before the picture is developed, the latter can be of value for comparison and as a record of change only; but, fully as we may believe now in the changeableness of species, I think that most of us are convinced from our own experience that the span of human life is relatively short enough to prevent discouragement of the best work of which the taxonomist is capable, if, as we are more and more coming to believe necessary, it be conformed to utility as its first purpose—a purpose not at all inconsistent with phylogenetic expression.

One of the questions of daily growing interest and importance is that of the authentication and preservation of type material in descriptive natural history. It is probably and unfortunately true that many more species have been described originally from fragmentary and imperfect material than from adequate specimens, and it sometimes happens that the material of to-day makes possible a very satisfactory synopsis of a genus or family, although the greatest difficulty is encountered in attaching to the different species the names which were

originally given to them. This, of course, is particularly true of groups in which specimens are made with difficulty or are easily destroyed, and, as with Myxomycetes, it sometimes becomes almost or quite impossible to go further back in the application of names than some comparatively recent monographer's collections. A growing disposition is noticeable to subject what may be considered type specimens to more restricted use than was prevalent even a few years ago, and it is easy to see that with the daily increasing minuteness of classification, such preservative restrictions are likely to increase rather than diminish as time goes on. In some of the larger collections, the type material is already being removed from the general collections, and type collections are being formed. I have no doubt that a clear recognition of the meaning and importance of types, cotypes, topotypes, etc., as contrasted with ordinary specimens, will ultimately lead to the general adoption of this practice and to a prohibition of the mutilation of such specimens, even for purposes of minute study, as complete, if not as sensational, as that which the sealing of the cases containing Reichenbach's orchid types for a quarter of a century has effected in that family, possibly to the ultimate benefit of science, but certainly to the impairment of the work of to-day. What are to be regarded as types, cotypes and the like, for species, it is not difficult to see in most cases. A more debatable question, which indeed affects all the groups of plants superior to species, in which are to be expected ultimate upheavals quite as far reaching as those which we see to-day in the lower groups, is that referring to the types of genera and still higher groups. This may form the subject of a committee report at this meeting, and it is to be hoped that conservative and sound but far reaching and uniform action may be secured through the efforts of this committee of the Botanical Club, and of the Section.

In the vice-presidential address before this Section a year ago, Professor Barnes, speaking from the point of view of the physiologist, who often finds plants of very diverse physiological behavior pertaining to one species of the taxonomist, expressed the belief that the plasticity of plants, concerning which much has been learned in recent years, is really so great that it is almost impossible, for physiological purposes, to group together any individuals except those growing under identical conditions; and he hazards the suggestion that the present method of naming plants binomially as species must sooner or later give place to some other and radically different method.

The dependence of the morphologist and physiologist upon the taxonomist is indeed quite as great as that of the student of geographical distribution and the cultivator of plants, and any classification and nomenclature which are to persist as of permanent value must of necessity be alike useful to all who are interested in plants, from whatever point of view. Whatever value the studies of morphologists and physiologists possess to-day comes from co-ordination and generalization in the light of the existing classification of plants, and the future development of these studies is most intimately connected with the evolution of a system of classifying and naming plants which shall at once permit of the ready determination and intelligible designation of any desired group of comparable plants, —a result that alone can avert the very possible danger of a scattering of energy in the accumulation of information concerning untold myriads of individuals, the peculiarities of which, however much they may interest and occupy the student, can scarcely enter into science until co-ordinated and generalized on rational and reasonably permanent lines intelligible to all botanists.

The greater part of the species and varieties that pass the necessarily fine-meshed sieve of to-day are published and defined apart from their nearest relatives, so that their authors are commonly spared the difficulty of really arranging them in the system, and it is doubtful if some species which are now being published would really stand in the minds of their authors were the latter compelled to clearly differentiate them in a comprehensive treatment of the genus to which they belong.

Perhaps the most instructive current effort at a logical co-ordination of the groups of high and low degree is afforded by the Synopsis of the Middle-European Flora now being published by Ascherson & Graebner, who treat the broadly defined groups which Linnæus would have called species as 'collective species,' as subdivisions of which they then recognize species, subspecies, occasionally of several degrees, races, varieties, subvarieties and sports. To subspecies as well as species and collective species they give binomial designations, which unfortunately in a few cases, but not as a rule, are identical. A very good idea of the working of this system may be obtained from their treatment of the *Cystea angustata* of Smith, or the *Andropogon niger* of Kunth.

If the need of subdividing the groups of plants which have heretofore passed as species were no greater for any purposes than for the determination of, for instance, the wild plants of the Middle-European flora, it might not be worth while to follow this subject further or to modify a treatment which gives a possible trinomial for any form which the authors have desired to designate, and in the actual synopsis locates this form in its logical position. Unfortunately, however, unless botany for herborizers is to be a thing quite apart from botany for horticulturists, the general monographer of *Cystopteris*, *Athyrium*, *Andropogon*, *Rubus* or *Pyrus* must soon handle a far greater number of forms and subforms of all degrees than have been attempted even in the most comprehensive schemes yet attempted.

Horticulturists are trying to distinguish between their more transient artificial productions, and natural forms or those which are more closely comparable with such forms. For the former they are trying with more or less consistency and real desire to secure the uniform adoption of simple vernacular names, while for the latter, perhaps with equal consistency and earnestness, they are trying to follow the practice of the botanists, so far as they can ascertain what that is. The actual result of this effort is, for instance, to recognize, in the orchard and the market, a variety of Greening apple known as the Rhode Island, to which each farmer's son and each clerk in the commission house receives personal introduction as he would to a new neighbor or a new customer, and the distinguishing marks of which he familiarizes himself with as he would with those of a man whom he might want to know if he were to see him again.

This is not far different from the way in which men made themselves acquainted with herbs and simples before the day of books. It is very good so far as it goes, but it is neither scientific nor adapted to even the present complexity of that theoretical horticulture which every year is finding greater exemplification in practice. To advance on it, the gardener must fall back on the botanist, whose task will be to systematize what the gardener knows and what his own broader knowledge of plants may add. Now the simple matter becomes complicated. *Pyrus Malus*, for example, represents a species or collective species under which many hybrids and varieties now hopelessly jumbled are capable of arrangement in logical combinations, through which, when they shall have been made, the trained student can run down the Rhode Island or

the Golden Russet with just as great facility and certainty as he can now determine *Ranunculus septentrionalis* or *Trilliam viridiflorum*. For the garden name of the apple, Rhode Island does very well, but for its botanical designation the Latinized name of the last fairly marked form of *Pyrus Malus*, or whatever the species may be called, is wanted. In the case of *Cystopteris* and *Andropogon*, already referred to, this would be given by either the trinomial *Cystopteris fragilis angustata* or *C. eufragilis angustata*, in the one case, and *Andropogon sorghum niger* or *A. eusorghum niger* in the other; but the actual position of either is indicated only by saying *Cystopteris fragilis eufragilis pinnatipartita angustata*, for the one, and *Andropogon sorghum* (sp. coll.) *sorghum eusorghum obovatus niger*, for the other. I fear that the true expression of the facts in many genera, under the present system, would be likely to result either in a polynomial as long as those used before Linnæus' somewhat arbitrary but masterly and helpful simplification of nomenclature, and without the descriptive value of the old phrases, or in the erection of genera nearly on the lines of the Linnæan species.

Either of these results is unpleasant to contemplate, and we may well inquire if they represent the only possible solutions of the problem of even a much finer specific differentiation than is now prevalent. A generation ago the best botanists would not have looked with favor on a proposal to separate species on as fine lines as the more conservative botanists now see to be logical as well as desirable. Perhaps the botanists of to-day may not be prepared for even as radical a change as the separate nomenclature of collective species, species, subspecies, and varieties has already brought to them; but I am not sure that the botanists of the next generation will not carry out a simplification of the present system —which by that time promises to be most unwieldy—that shall be quite as helpful as that which won Linnæus the gratitude of his followers and which we could not do without in the present state of the science.

I have been tempted to enlarge on this point and to exemplify the idea that I have, by a concrete illustration based on some genus of plants in which the number of minute forms to be distinguished is already very large; but I shall content myself by saying that the idea that I have of such a reform is strongly foreshadowed in the practice already introduced of binomially designating collective species and subspecies as well as species; and it goes so far as the employment of binomials down to one remove from the ultimate subdivisions of cultivated plants designated by vernacular names. For many writers on the broader facts of plant distribution and plant properties, the Linnæan conception of species is and will be sufficient, and alone applicable. For such persons, for instance, the name *Cystopteris fragilis* or *Andropogon sorghum* is satisfactory. The necessary degree of subdivision will always vary according to the particular purpose and knowledge of the writer who may care to go further than this. For one, *Cystopteris eufragilis* will be sufficient; for another, *C. pinnatipartita* or an equivalent binomial; for another, *C. angustata;* while still another may find it desirable to specify by not to exceed a trinomial a subdivision of the latter of perhaps three or four degrees removal. The practical result that I foresee, then, is the ultimate uniform establishment of species of several grades, each binomially designated and its grade, perhaps, indicated by typographical means or the employment of a brief symbol connected with the name, unless, after the present nomenclature storm shall have blown by, as it surely will before this point is reached, it be indicated by the adoption of uniform endings for the specific names of each grade.

I can easily fancy a distinct protest at the violence that any such plan will do to our present treatment of species, and a further and greater protest against the possible modification of prior specific names in the interest of uniformity. A contemplation of the results of the current nomenclature reform makes me share in the feeling which could prompt such a protest, yet I venture to believe that the conservatism which opposed and still opposes the relatively trivial priority upheaval that was to have produced a uniformity in plant names that some botanists are still anxiously awaiting, rests upon qualities that are more likely to favor than oppose a far greater and even radical change in the way of naming plants, when such a change shall have become necessary as a matter of practical utility—as it is likely to sooner than most of us suspect.

One of the most serious tasks of the investigator of the twentieth century will be the utilization of the knowledge resulting from the work of his predecessors in the field which he may select for his own activity. The rapid increase in specialization compels him to begin his own productive studies at an advanced point, while the mass of material and the array of facts over and through which he must clamber before reaching his own starting point constitutes a growing handicap, against the beginner and likely often to discourage him and not infrequently to make him a loser from the start in the race for recognition and fame, but in his favor after he shall once have left it to his followers. Very probably, much that he has learned at the start will have to be unlearned later and no doubt might better not have been learned at all, for it is an unpleasant fact that little progress in any direction is made without the aid and embodiment of theories and hypotheses, many of which of necessity are tentative and sooner or later prove to be wrong, and that few wrong hypotheses fail to leave a long persistent trail of erroneous reasoning and even of observation so badly warped as to be absolutely misleading; but aside from what is faulty, there is being brought together daily an overwhelming mass of information of the greatest use, so that everything must be tested step by step as any piece of investigation proceeds, and the faulty detected and rejected, while the trustworthy is built into the foundation on which the author's own conclusions are to rest.

No doubt after assimilating the principal knowledge of the past, every original and really productive worker would feel a sense of relief if he could wipe out the records of this knowledge. Their existence virtually compels him to burden his own discussion of the subject with an analysis, commendatory or critical, of all that has been said of it by his predecessors,—failing in which, he leaves to those who follow him the conclusion either that he has not considered the facts and deductions of earlier students, or that none exist. The presumptive value of his own work must of necessity be greatly weakened if the first opinion is held, and in the other event he is likely to seem to pose as a leader when to the discriminating eye he is merely a follower.

No small part of the difficulty of reaching the point where one's own additions to science begin comes from the fact that the work of those who have gone before him is commonly fragmentary and disjointed. It is a first principle in research that no accurately observed fact is valueless, but its value lies chiefly in its comparability with other facts. As a rule, thought or observation on any subject stimulates the further elaboration of that subject, by drawing attention to minutiæ which any observant person may then note, though he might not have thought of connecting them himself. Science has been both advanced and re-

tarded by the observation and record of isolated facts,—advanced when observation has been followed by further study and the knitting to it of other pertinent observations or when it has proposed a new line of study awaiting a mind great enough to grasp it, but retarded when straws have merely been added to the burden carried by the world of learning.

The botany of antiquity and of the Middle Ages was chiefly a disjointed discussion of plants, largely with reference to their uses, and not a little mixed with mythology and the fables of travelers, whose talents in our time would have proved invaluable to the daily press. Without disparagement to the great men who went before him, Linnæus may be said to have been the first naturalist whose mind grasped numberless details with sufficient precision to really systematize them, just as in our own century Darwin stands far out from his fellows in the same respect, the power to handle and co-ordinate isolated facts which all his work shows being particularly evident in the treatment of the great mass of heterogeneous matter on which were based his generalizations as to the variations of animals and plants under domestication.

Ours has been a century of accumulation and of utilization. It would be unjust to ourselves and our immediate predecessors to say that great laws have not been reasoned out from observed facts in larger measure even than ever before, notwithstanding the advanced point at which science stood when the century opened. It would be also in obvious conflict with the truth to say that the world of manufactures and of commerce has not been most apt to seize upon and employ the more salient discoveries of science, often in a manner not dreamed of by the discoverers; but it may still be said that the century just closing, great as have been its advances, has been a century of accumulation beyond assimilation, a period of roughing out and of laying away lumber far in excess of its employment as joists and sills and boards in the great structure of human progress.

If the evidence of the times may be trusted, the next century is to be marked by a still greater productive activity. Specialization and the attendant division of labor can have no result more logical than this. Though it may suit our convenience to speak of centuries, we know the pure artificiality of such divisions of time, and although still in the nineteenth century, we may with all propriety count ourselves of the twentieth and project the activities and tendencies of to-day into the morrow; but the same drift of the straws which points to a still greater accumulation of minutiæ during the century we are so soon to enter on shows with equal probability that its passage is to be marked by a co-ordination of isolated observations and discoveries far greater than the world has ever before witnessed.

To this very desirable end we of the present day may contribute to no small degree. Our discoveries, as has been said already, are at once the handicap and the foundation stones of the men who are to take our places. The manner in which we leave the records of what we have done decides in large part the preponderance of its utility over its obstructiveness, and in many cases may even determine whether it might not better have been left undone. It is easy to justify ourselves to a certain extent when we do not do the right thing, by pleading that we did not know what the right thing was, because we interested ourselves only in a limited part of what ought to have been handled as a whole, and that posterity ought to be grateful for the substance of our contributions without being too critical as to their form and accessibility; but we are not likely to go far wrong if we assume that few of us who

contribute isolated and disjointed facts and observations will ever be called blessed by coming generations in more than an undertone, that appellation being reserved for those who have builded from as well as hewn out their material, and for those who, even without directly contributing to observed facts, have justly valued the facts ascertained by others and have grouped and shaped and utilized them.

If it could be done within the time that I have proposed to occupy, I should like to consider in detail the entire matter of publication, which is in need of much more thought and concerted action than has yet been bestowed upon it. I fear that the amount of time and thought devoted to the publication of the results of a given piece of research work is often disproportionately small, the fact that they are published at all apparently serving the author's purpose without much regard to the manner in which they are brought out. Publication facilities at one time were few and not readily obtained, but to-day the trouble is rather that they are so numerous and so generally available that even matter unworthy of publication can easily be brought out, and that the authors of meritorious articles are tempted not to look far before publishing their work, but to drop it, hit or miss, into the nearest press, without correlation with other comparable matter or even with the articles to which it stands in juxtaposition, and with too little thought of the convenience of those who are to use it. It sometimes happens, too, that in their zeal they issue simultaneously or otherwise copies of their manuscript to several societies or journals, so that the original place of publication of the article is now and then rendered very questionable.

I should not wish to seem captious in making these statements, for nothing is further from my purpose than destructive criticism; but in view of the growing amount and complexity of scientific publication, I believe that the real needs of the users of botanical literature demand more careful consideration than they have heretofore received, and that this consideration will easily lead to a number of reforms which are perfectly within the power of both author and publisher.

Reference has been made already to the fact that a majority of periodicals are of very mixed contents. So far as societies are concerned, the greater number of these bodies have originated primarily for the development of local interests, and of necessity these interests have been varied. For their own direct purposes, the heterogeneity referred to works very little harm, and for the bibliographer it is the less troublesome because the very condensation of the miscellaneous matter in a local publication places a large part of it where it would naturally be sought. The direct purpose of the publication provisions of nearly all such bodies being not only to secure the permanent recording of observation but to furnish the means of building up a library by way of exchange, it is probable that the partly undesirable mixed contents of the larger number of society publications will continue still for a very long time, but it is encouraging to notice that some of the greater foreign societies have long since differentiated along main lines in their publication, while within recent years a further specialization has been effected in a number of others, notably, for our own country, the California Academy of Sciences, and such differentiation is easily foreseen in others as their membership and activity increase through the formation of sections, each devoted to some particular science, the more strongly represented and active sections being almost certain ultimately to secure the separate publication of their matter.

For the journals which do not emanate from learned bodies, the problem is a simpler one. We already have numerous examples of a primary differentiation into popular and technical journals. The former can hardly fail to be, for the most part, of miscellaneous contents, because they are intended to keep all persons interested in science at large informed on the advances which are being made in its several departments. Familiar illustrations of successful journals of this kind are *Die Natur*, the *Naturwissenschaftliche Rundschau*, *Nature*, *Science Gossip*, *Science*, the *American Naturalist* and the *Popular Science Monthly*, not to mention others of a list which might be greatly extended. Even among these, however, as the examples named may serve to show, there is a considerable specialization on subject lines, and the present issuance of *Science* and the *Popular Science Monthly* under one editorial management may be taken as representative of a process of evolution in active progress, by which even the less technical journals are differentiating into classes adapted to readers engaged in active scientific work and persons having an interest in but not directly engaged with such work.

One further differentiation that is becoming a pressing necessity is that which shall result in a considerable improvement in the specialist's means of keeping himself informed on what has been done in his own specialty. I do not refer to the popular or general presentation of the more striking results of current activity which can be obtained from the general journals or those devoted to each particular branch of science, but to something which of necessity must be limited to that branch and which must be complete. Many of the proceedings of societies and of the journals publish very helpful bibliographies at short intervals, and the *Botanisches Centralblatt* is in large part devoted to this purpose, while the *Jahresbericht*, taking more time than is possible for a current periodical, summarizes and indexes with much greater fullness current botanical literature. Unfortunately, the *Jahresbericht* is so greatly delayed that a period of several years elapses before its pages afford information on any given piece of work, and it is difficult to see how this can be otherwise, in view of the care which is expended in the tabulation and co-ordination of its contents; but without this tabulation and co-ordination, it does not seem to be impossible to secure a very prompt synopsis of all that is issued in botanical literature. The machinery for doing this is already organized in the bureau of the *Centralblatt*, and it is difficult to see why all that is needed cannot be supplied through this channel, if the publishers can be convinced that the botanical public would much rather subscribe for a bibliographic journal, in which all abstracts are of short length and synoptic character, than for one in which many abstracts are entirely disproportionate in length to the importance of the papers they refer to, to the exclusion of others, while the introduction of original matter forces into a supplementary journal no small part of the reviews that are given. Professor Farlow has very well discussed this subject in a recent number of one of the botanical periodicals, and it is hoped that the action initiated at the Naturalists' meeting last winter, which is likely to be brought up by a committee report before this Section, may here find important support, so that either a separation may be secured, of the *Centralblatt* and its *Beihefte* into two journals capable of being subscribed for separately and permitting the desired completeness of bibliography, or other practicable means evolved for attaining this end.

Some years ago, the members of this Association listened with no little interest to Dr. Herbert Haviland Field's explanation of the purposes of his then proposed Con-

cilium Bibliographicum, which has since begun operations in Zürich and I understand is prepared to include botany among the subjects that it handles. It is a matter for regret that the Royal Society's proposal for an international catalogue of current literature has failed to materialize for the time being, but it is possible that if a satisfactory purely botanical bibliographic journal cannot be secured, this scheme can still be put into practical motion. In one way or another, in any event, it is certain that some provision of the kind must be secured within a very few years.

However specialized, publications considered as a whole are in need of far more careful editing than they commonly receive. The author who prepares manuscript for publication is more likely than not to cast it in final form with reference only to what he says in it or what he himself may have already published or may expect to publish at some future time, and the result of this disjointed treatment is perhaps most readily seen when some subsequent compiler, let us say of a popular flora, copies side by side the descriptions of a number of writers. The most diverse phraseology is at once evidenced, although the compiler, on the basis of his own information, may have attempted to simplify the matter somewhat. Comparable things are treated in different paragraphic location; similar facts are stated in dissimilar phraseology; and a character strongly emphasized under one species is not at all considered in another. In one paragraph a certain page of a certain book or journal is cited in one form, and in an adjoining paragraph in another form and perhaps under another author, and possibly even with a different page reference in case, as is often true, author's separates of the article quoted have been issued with individual pagination and even plate numbering.

At the Botanical Congress held in Madison in 1893, this and several other matters calling for uniformity of treatment in the interest of clearness were referred to committees, some of which reported at the next succeeding meeting of this Section or of the Botanical Club of the Association. The increase in intelligibility and simplicity of bibliographic citations noticeable of late years is an encouraging sign that botanists are quite willing to attempt to work out on uniform lines these matters which are of interest to all who have occasion to consult botanical literature, so soon as the method of procedure in each case shall have been carefully codified with reference to the practical difficulties which each writer has to confront.

Among the editorial matters to which really this question of citation pertains, although it practically falls back upon the author, should be mentioned a comparable treatment of comparable facts expressed by diagrams, curves, formulæ, and the like. The tendency of large volume in any publication is to economy of space by the employment of symbols or abbreviations, which must be learned and borne in mind by every reader before the facts which they stand for are intelligible. If these symbols could be standardized for all writers who use this means of expressing their facts, it would result in added value for their work and in a great saving of the users' time. What can be done for symbols, however, cannot always be done for what are treated as abbreviations, because of the fact that the word abbreviated is different in one language from what it is in another; and yet there is no doubt that much improvement can be effected in this direction, while a perfectly uniform result for the entire world may be ultimately attainable by falling back upon the Latin language for words which are to be abbreviated.

Detail matters of this kind are often considered too trivial to occupy the attention

of a body like a section of the American Association, but I am convinced that the numerous discussions which have taken place before the Botanical Club and our own Section have resulted in a much clearer general understanding of the proper meaning of many terms that most of us use almost daily, than would otherwise have been possible, and that each of us has profited to the benefit of his readers by the information elicited by these discussions; and I cannot conceive a more useful way of spending a part of the time of this body each year than in the discussion of subjects of this kind, carefully selected and referred in advance to members or committees capable of discussing them authoritatively from different points of view.

Some of the facts of plant distribution, whether referring to the occurrence of a given genus, species or variety over the earth's surface or at different altitudes, or to the minuter details of distribution demanded for an accurate presentation of some phases of ecology, demand the use of maps, more or less detailed according to the matter to be presented. Nothing is simpler than to so shade or color these maps as to indicate what the author desires to bring out, but, unfortunately, different maps dealing with the same general facts are usually colored very differently. Map evolution consists primarily in the indication of physiographic features, on which political boundaries are more or less artificially superimposed, the representation of geological structure, and the further indication on this foundation of the biological facts which are intended to be shown. The work of the physiographer and geologist is already done to the hand of the botanist, in most cases, and when it is not he is early confronted with the need of supplying deficiencies which exist. It is not many years since the geologists turned their attention to a standardization of their maps which is already simplifying geological literature. Will it not be better for botanists, who already know fairly well the main biological facts that are capable of expression on maps, to confer with the zoologists, who have comparable though different needs of map employment, and with the geologists and topographers, on whose work both can most profitably build, so as to secure an early standardization of method, than to wait until the otherwise necessary confusion due to independent individual practice shall have forced this upon them? I cannot conceive a better outcome of the conference to be held this summer on plant geography than the appointment of a committee to consider this question in detail, not only with reference to their own needs, but to the needs of botanists at large and in consultation with those in other parts of the world who are considering the same problem and the best way of solving it.

If I have confined my remarks thus far to details of internal editing, I should not wish it supposed that other and more general matters do not exist which are worthy of equal thought. No small part of the confusion in citing publications comes from the issuance of the same matter in several different places, either at the same time or at different times, either similarly or differently paged, not infrequently with different titles, and sometimes under a title so phrased as to give no indication of the contents. Books are always likely to undergo revision between different editions and, unfortunately, this is sometimes true of different issues which do not purport to be editions, and an article once published in a journal or book which is not copyrighted becomes by common acceptance the property of the world and may be reprinted legitimately under the author's name, and properly with the further citation of the original place of publication, for an indefinite number of times, during which process

it may undergo considerable modification. It is difficult to see how this can be avoided, and it is difficult to see how reprints can be cited otherwise than with reference to themselves and their original sources, but a great deal of confusion may be avoided if writers who have occasion to refer to reprints (in contrast to separates) will always indicate that they have done so.

We have fortunately in large part passed the age of secondary titles, and it is a matter for congratulation that it is now rarely necessary, when using a new book, to give a secondary or still more subordinate title as a means of specifying the particular work referred to; and the citation of older books makes the occasion for thankfulness that this is so, very evident to all who use the library. In one respect, however, a great improvement is needed. Librarians, who are a very practical set of people whose purpose now is to make any book quickly accessible to anyone who knows either its author, title or subject, have adopted somewhat arbitrary but very serviceable rules for cataloguing and cross-referring, intended to secure this end. With an isolated book comparatively little difficulty is found, but between distinct books, and articles in proceedings or other periodicals, there is an insensible intergradation, owing to the publication of series of various degrees of complexity, which are calculated either for the convenience of a certain class of readers, the glorification of the author or the emolument of the publisher, or are necessitated by the great development of institutional research and publication.

I do not wish to cite examples of terrible things to be avoided, which even a casual inspection of the contents of any large library reveals, but I should not wish to pass the subject by without calling attention to the very great need of editorial reform which devolves upon those who are charged with publishing series, and particularly those whose publication responsibility is so great as to force upon them the unquestionably necessary establishment of such differentiated series. In a late number of the monthly Public Libraries, Mr. Reinick presents a suggestive statement of a librarian's difficulties in the arrangement and cataloguing of the United States Government documents, which is worthy of perusal not only by librarians, but by persons who have occasion to cite such documents and those who are concerned with their publication. Some four years since, Mr. Frank Campbell, of the library of the British Museum, published a series of essays under the collective title 'The Theory of National and International Bibliography,' in which the question here raised is given instructive if perhaps not always final treatment. No one who has occasion either to arrange, catalogue or use the publications of the various branches of the Indian Government or of our own Government, or the publications of our several states, or of the agricultural experiment stations with which each of these states is now provided, or, finally, the contributions which are emanating from the more important research centers, chiefly in the form of separates or reprints of articles originally published in magazines or the proceedings of learned bodies, can fail to see at once the necessity for a collective treatment of all publications organically connected in their origin, and the fact that Mr. Reinick's device of stamps by which the librarian can supply necessary information not printed on the title page is necessitated if the members of a given series are to be unquestionably brought together, carries between the lines a suggestive commentary on the existing facts.

I hope that I have sufficiently brought out my own belief that the writer, the editor and the publisher, who frequently work independently of one another, are in real-

ity tied together by a very close bond, in so far as they are aiming at the real purpose of publication, its usefulness, and that the librarian, the indexer and the reviewer are no less necessary links in the chain between the publishing investigator and his numerous and increasing readers. The practical recognition of this intimate connection is no less necessary for the promotion of the rapid advance of science which the present activity of investigators promises than the unification of the methods of the investigators themselves, and can no doubt be secured in the same manner.

In conclusion, I wish to ask attention for a few minutes to a matter of prime interest to all botanists, since it will probably affect the very prosecution of many of their studies before the next century shall have been closed. I refer to the protection and preservation in every possible way of our native and natural vegetation. To the systematist, the physiologist, and the morphologist, this is alike of importance. Agricultural lands, in the main, of necessity must have their native plants replaced by others if the latter are more valuable to man, as surely as grazing lands have been stocked with cattle after the extermination of the less useful bison. But the erection of an agricultural practice, based on a preliminary clearing of the ground, is quite different from the denudation of the land without further purpose than the utilization of its native products. Primarily the question is an economic one and as such it interests the community at large; but it is also a question of the deepest concern to science. Climatology, the past, present and future geographical distribution of animals and plants, and ecology and evolution are so clearly connected that their devotees possess a common interest in the preservation of natural conditions at least until the factors in biologic nature shall have been directly ascertained and correlated; and I need scarcely add that what has thus far been done in this direction is little more than a rough blocking out for the future. Hence it is that local societies for the protection of animals and plants are worthy of general support in their efforts, and that the widespread forest protection movement, which is too commonly looked upon as simply an economic or sentimental matter, should receive the united encouragement and support of naturalists and meteorologists as a movement the success of which alone can perpetuate for any great time the conditions upon which much of their profounder study is to rest. This Association is to be asked to endorse an effort for the local preservation of the red-woods over a considerable area in central California, and the location of a forest reserve in the southern Appalachians. It is to be hoped that whatever action may be taken shall rest not upon hasty impulse, but upon such recognition of the vast scientific as well as utilitarian importance of this movement as shall ensure the permanence of our interest in every step of the kind which may originate in the future.

William Trelease.
Missouri Botanical Garden.

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## *THE STRUCTURE AND SIGNIFICATION OF CERTAIN BOTANICAL TERMS.*

While it is in some sense true that technical names are merely arbitrarily constructed vehicles for conveying ideas on special subjects, in the coining of such terms from the ancient languages for use in scientific description and discussion, it is desirable, at least from an educational point of view, that they should not only be appropriate, but that they should not involve any real etymological error in their construction. From a like point of view it is no less desirable that, when used antithetically, they should be strictly correlative in both con-