

ON THE TECHNIQUE OF INSERTING PUBLISHED DATA IN THE HERBARIUM

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BEGINNING with volume eighteen, number one, January, 1937, a small special edition of the *Journal of the Arnold Arboretum* has been prepared printed on one side of the paper only. The objective is to provide a form, without sacrificing two complete copies of each issue, for the preparation of "herbarium clippings" whereby pertinent taxonomic data may become available for insertion into herbaria in association with the actual specimens representing the species described or discussed. This special edition is available only on an exchange basis for similar material that may be used for preparing herbarium clippings for use at the Arnold Arboretum.

Those familiar with the older herbaria realize that individual botanists in the past have occasionally attached copies of their original descriptions to the herbarium sheets, but nowhere does one find any considerable number of these. In my own experience in the Philippines previous to 1923 I occasionally had typed and inserted into the herbarium copies of original descriptions, but like most busy botanists elsewhere I never found time to clip and insert copies of my own published descriptions. It was only after my transfer to the University of California in 1923 that it occurred to me that a more comprehensive plan of inserting actual descriptions into the herbarium would be advantageous. Thus over a period of nearly six years many thousands of such items were incorporated in the herbarium, the great advantage being that even where authentically named specimens were not available, the actual description was in place. Special attention was given to published data on the floras of China, the Philippines, and Malaysia. This trial, involving perhaps 40,000 entries, convinced me of the great utility and the eminent practicability of the scheme, although while engaged on this task I was seriously assured by some of my colleagues that the project was an impracticable one.

On my transfer to the New York Botanical Garden in 1930, I there initiated the same system on a small scale in the early part of the year, but I always had the feeling that some of my associates there considered the matter of slight value and perhaps some of them even thought that

I was to a slight degree mentally unbalanced in initiating what was a most radical innovation. In November, 1930, when unexpectedly it became possible to secure the services of numerous individuals through the privately supported Emergency Work Bureau, it became immediately necessary to plan productive projects whereby the talents of this supplementary force could be utilized to advantage. Starting with six temporary employees, the number was rapidly increased until within two months about 100 extra employees were at work. The further development of the preparation of published data for herbarium inserts was made an important project. A certain number of assistants, under supervision, were assigned to the task of preparing the clippings, utilizing two printed copies of the volume or article that it was desirable to clip. Others were assigned to the task of typing original descriptions and critical notes from the older periodical literature. Because of lack of interest on the part of certain staff members, not accustomed to the advantages of the system, the geographic areas first stressed were the same as those selected at the University of California. Later this was extended to cover all fields in which the New York Botanical Garden was actively interested, North, Central, and South America, the West Indies, Asia, Malaysia, and Polynesia.

No record of the number of items incorporated in the herbarium was kept. A very conservative estimate is that the number is now over 700,000 and it may well be greatly in excess of that number. Some idea of the extent of the operations may be gained by the statement that among the periodicals from which practically all pertinent taxonomic data have been excerpted, either by clipping or by typing, are complete sets of the following:

Bulletin de l'herbier Boissier; Journal of Botany, British and Foreign; Kew Bulletin of Miscellaneous Information; Notes from the Royal Botanic Garden, Edinburgh; Notizblatt des Botanischen Gartens und Museums, Berlin; Linnaea; Philippine Journal of Science; Sunyatsenia; Sinensia; Lingnan Science Journal; publications of the Fan Memorial Institute of Biology, Metropolitan Museum (Academia Sinica), Science Society of China, and the Peking Natural History Society; Bulletin de la Société botanique de France, Notulae Systematicae (Paris), Notulae Systematicae (Leningrad), Bishop Museum publications in botany; Field Museum publications in botany; nearly all of the official publications of the botanical garden, Buitenzorg; all of the official publications of the New York Botanical Garden, including the North American Flora; Records of the Botanical Survey of India; Annals of the Missouri Botanical Garden; Contributions from the Gray Herbarium; Contribu-

tions from the United States National Herbarium; Journal of the Arnold Arboretum; the Hookerian series of botanical periodicals preceding the establishment of the Journal of Botany, British and Foreign; Hooker's *Icones Plantarum* (the first ten volumes reproduced by photostat); Proceedings of the Biological Society of Washington; Mededelingen van's Rijks Herbarium, Leiden; Bulletin mensuel de la Société Linnéenne de Paris; Bulletin du Muséum d'histoire naturelle (Paris); Bulletin de l'Académie internationale de géographie botanique; *Acta Horti Gothoburgensis*; *Candollea*; *Annuaire du Conservatoire et du Jardin botaniques de Genève*; *Gentes herbarum*; Transactions of the Linnean Society, University of California Publications, Botany, and others.

Much of the systematic data have also been excerpted from another long series of periodicals, including the *Botanische Jahrbücher*, Fedde's *Repertorium* and its *Beihefte*, *Beihefte zum Botanischen Centralblatt*, *Annales des sciences naturelles*, *Le monde des plantes*, *Botanical Gazette*, *Bulletin of the Torrey Botanical Club*, *Rhodora*, *Acta Horti Petropolitani*, *Gardeners' Chronicle*, *Botanische Zeitung*, *Bonplandia*, *Hedwigia*, *Journal de botanique* (Morot), *Flora*, *Journal of the Washington Academy of Science*, *Bulletin de la Société impériale des naturalistes de Moscou*, *Mededeelingen van het Botanisch Museum en Herbarium van de Rijks Universiteit de Utrecht*, and scattered articles in a large number of other periodicals.

Supplementing these data, many thousands of clippings were prepared from miscellaneous reprints from a wide variety of sources, various modern and even some older monographs, independently published volumes, the numerous original descriptions in Kuntze's *Revisio generum plantarum*, and from such extensive works as those of Maximowicz on the floras of Japan and Manchuria, and the more recent ones of Handel-Mazzetti on the flora of China, *Plantae Wilsonianae* and similar works. The work is still being continued, now supported by federal and state relief funds.

The hundreds of thousands of items from sources indicated above, some the original printed data, some typed copies, some reproduced by the photostat method, are actually incorporated in the herbarium of the New York Botanical Garden, thus making this great reference collection a most outstanding one in which resident and visiting investigators can prosecute intensive work without the great loss of time entailed in other institutions where a very high percentage of one's time must of necessity be devoted to library search. Under this system, the library to a remarkable degree has been made an actual part of the herbarium, with

original descriptions, critical notes, illustrations, redescriptions, extensions of ranges, etc., actually associated with the reference specimens. Here in many groups, and for almost entire floras in some cases, the systematist finds before him practically everything that he needs, in the way of the printed record, without the necessity of having, in each case, to spend hours, or days, or even weeks, searching for the needed references in the tremendously scattered source literature that he may need to consult in connection with the problem under investigation. In other words, within limits, the herbarium is not only an herbarium in the generally accepted sense, but it is an herbarium, a card catalogue and a library, all combined in one working unit.

Since this large scale work was undertaken, first at the University of California in 1923, later at the New York Botanical Garden in 1930, and more recently at the Arnold Arboretum, modifications or adaptations of the same idea have been adopted at the United States National Herbarium, the Philadelphia Academy of Natural Sciences, and at several institutions in China. To make currently published data available for this purpose special editions of certain periodicals are now being issued, printed on one side of the paper only, such as "Sunyatsenia," the Berlin "Notizblatt" and Fedde's "Repertorium"; to this short list is now added the "Journal of the Arnold Arboretum." In the past at least some parts of "Das Pflanzenreich" have been so printed in limited editions.

There is little agreement as to how such data should be incorporated into the herbarium. When I first commenced inserting occasional descriptions into the herbarium many years ago, they were automatically treated like herbarium specimens, and mounted on standard herbarium sheets. Occasionally they were pasted on the sheet bearing the type specimen. These are apparently the first methods that one thinks of. Both have certain obvious and serious disadvantages. I then developed the idea of pasting the description inside of the specimen cover so that in studying the included botanical material, one would have both the description and the specimen or specimens before him. Soon this scheme was found to be faulty and it was quickly abandoned for the one adopted at California, New York, and the Arnold Arboretum, i.e., to paste the description or the clipping rather lightly by its corners on the outside of the specimen cover, on the lower left hand corner of the folded sheet.

A serious objection to mounting single descriptions in the middle of a standard herbarium sheet, aside from the relatively high cost of mounting paper, is that such a sheet may become misplaced among the mounted specimens. In any case, if the first sheet of a series bears

merely a printed or typed description it effectively obscures the actual specimens, a point that needs consideration when one is making hurried comparisons. If the slips are firmly pasted, as unfortunately they are in most cases, they cannot be easily removed. Again, if they are placed in the middle of a standard sheet, as is usually the case, there is inadequate space for adding other descriptions, such as those of species reduced to synonymy, redescriptions, and later critical notes; for such data as well as for original descriptions of species reduced to synonymy, one is forced to use an extra sheet for each. One could cite cases, where with one description to a sheet it might conceivably be necessary to prepare and insert not one or two or three sheets, but literally scores of them, for many "recognized" species are burdened with scores of synonyms. This system, consistently followed, adds a tremendous amount of needless paper to the herbarium and results in a very great waste of expensive herbarium storage space. The chief objection to pasting an original description on the type sheet itself is that frequently adequate space is not available unless a part of the specimen itself be obscured by the clippings.

The reason I soon abandoned pasting the descriptions on the inside of the cover was because hurried or careless herbarium workers tended to discard frayed, torn, or stained covers without glancing inside to see whether or not there were contained data in the form of clippings or typed descriptions. Specimen covers that contain no data other than a description pasted on the inside are particularly apt to be discarded, for without glancing inside, one cannot determine whether or not there are included clippings.

Having stated some of the serious objections to the first two methods, it is well to indicate the advantages of the third method with which I have now had over twelve years' experience; and not one based on a limited, or even a local use of the system, but rather with a world view-point, involving hundreds of thousands of items. As indicated above, one of the consistent criticisms of any method of making these herbarium inserts has been that it "adds too much paper" to the herbarium. With the herbarium sheet method I agree fully with this criticism. With the specimen cover system, utilizing a rather thin, tough, durable paper, such as Nibroc Duracel 40 lbs., and adding from one to many clippings to a single sheet, no just criticism can be made, for the space taken does not equal that needed for a single average mounted botanical specimen. The system, however, does involve the acceptance of the specimen cover plan, i.e., all sheets of a single species to be included in a single thin cover within the stiffer genus cover; few to many specimen covers

with their included sheets may be inserted within a single genus cover. If this be adding too much paper, then the specimen cover system is condemned at the outset by individuals, perhaps, who have never used it. The specimen covers serve another purpose in that they very greatly protect mounted specimens from undue breakage.

In practice a high percentage of the sheets will have but a single description, this the original one. For common, widely distributed, and variable species, and especially those that have a complicated synonymy, the sheets will eventually bear from two or three to very numerous items. The first item should be placed about a half inch above the lower margin in the left hand corner of the folded sheet, lightly gummed by the corners only. Additional items are added in sequence of their preparation above the first one. To the same sheet should be attached original descriptions of species that have been reduced, if such occur, as is frequently the case. To the sheet should also be attached re-descriptions, critical considerations by later authors, and especially those items that contain literature references, synonymy, and important extensions of range; in fact, all pertinent data of importance that may have been published by various authors that appertain to the species under consideration. In extreme cases a sheet may be so thoroughly covered by supplementary published data of one type or another that all available space is taken. In this case a single sheet of the same stock as the specimen cover may be utilized for the overflow, this to be inserted inside the first cover. As incorporated material relating to supposedly distinct species is found to appertain to a single species, the two covers may be "telescoped" one within the other, or the data may be removed from one sheet and attached to the other.

This brings up a most important point for those who use either the herbarium sheet method, or the species cover system. The clippings should not be pasted firmly to the carrying medium under any circumstances, but rather they should be pasted lightly by their corners so that, as necessary, they may readily be removed for transfer to other positions. Only narrow strips, that might be easily torn if pasted only by their ends, should receive more adhesive. This is a most important point and any curator adopting this clipping system or any modification of it, should give careful consideration to the simple problem of attaching the slips before a system has been adopted that may eventually be found to be very disadvantageous. Whether typed data be attached to standard herbarium sheets or to specimen covers, they should be prepared on thin paper of good quality, such as onion skin paper rather than on the heavier standard paper, this to save space in the storage

cases, for when one contemplates the addition of tens of thousands of typed entries into the herbarium, the problem of space becomes distinctly important.

The general and preferred method of preparing clippings is to take two copies of the work to be clipped, arrange the sheets as page proof, and to each entry add in the text or at the margin, an abbreviated but clear reference to the author, periodical or title, volume, page and date; these to be either typed, written long hand, or stamped. For standard periodical references the citations may be greatly abbreviated, such as JOB. instead of Journ. Bot.; BG. instead of Bot. Gaz.; BJ. instead of Bot. Jahrb.; KB. instead of Kew Bull.; BTBC. instead of Bull. Torr. Bot. Club; and JLSB. instead of Journ. Linn. Soc. Bot. When only one copy of a paper desirable for clipping is available, every other page must be typed, photographed or photostated, the citations to be added as part of the typing task. For older periodicals, rare items, and important articles where reprints are unavailable, all entries should be typed. In some cases entire volumes may be reproduced by the photostat method and these sheets then clipped. Obviously the original printed data or a photographic reproduction of it, is preferable to a typed copy.

When a sufficient number of clippings or typed slips are available, they are systematized by families and genera, and then inserted into the herbarium in their proper places. Normally the best procedure to follow is for some botanist familiar with the flora, or the group, to examine the entries and indicate obvious reductions to synonymy, thus avoiding the undue scattering of items appertaining to a single species under different names in the herbarium.

In special cases, such as the preparation of a monographic work or a revision of a special group, all original descriptions and critical notes for every species may be prepared. This, however, involves a very great amount of bibliographic work, other than straight routine, and generally involves a considerable amount of supervisory time by staff members, the ordinary routine employee not being equipped to find the references needed. On the whole this method of compiling data is wasteful in the extreme, and is in general impracticable unless a trained botanist be willing and ready to devote a very large amount of time to the project.

Some curators who have recently adopted this plan restrict their herbarium insertions to copies of original descriptions. From my standpoint, and based on my own extensive experience, while this is better than nothing, yet a serious error is made in not including data where synonymy with literature references and citations of specimens are given. Not infrequently a later author's consideration of a species is

distinctly more illuminating than is the original description. It is particularly important that all pertinent additional data, redescriptions, critical notes, supplementary data on type specimens, and significant extensions of range be preserved and incorporated on the sheet or sheets with the original description. Except in those cases where new names appear in current literature, important published data may be entirely overlooked, for manifestly it is impossible for the average botanist to master and keep in mind the tens of thousands widely scattered and unindexed observations. References check against each other, and automatically in examining long series of assembled data regarding this or that species, one often detects errors, some perhaps relatively unimportant, but frequently most exasperating, particularly when they include incorrect volume numbers, page references, dates of publication, and occasionally even wrong periodical titles; many botanists apparently do not check their cited references on the originals, and an error once made in a standard work may automatically be repeated over and over again. When discrepancies are noted in a series of published references, it is a simple matter to determine which is correct by consulting the original publication. As a side issue to this work scores of binomials overlooked by the compilers of *Index Kewensis* and its supplements were detected.

So much of the criticism of the principle of making herbarium inserts has come from individuals unfamiliar with its extensive recent development in a few institutions that I have become impervious to it. To early criticisms to the effect that the scheme was impracticable, I believe that it has been abundantly proved that the reverse is the case. To those who criticize without the basis of actual experience little attention need be given. To those who utilize the data and then criticize the system because not all the needed and published data have been incorporated, or because some non-technical assistant has filed a reference in the wrong place, the answer is obvious; cooperate in helping to complete the records. Those interested in the printed page may look on me as a vandal, because annually I clip many hundreds of pages of technical descriptions. If a library has a complete set of a periodical, I see little reason for considering that all reprints from that periodical are sacred and must be maintained on the shelves as separate items. I frankly believe that frequently the best place for the reprint is in the herbarium in association with the plants to which the data appertain rather than on the library shelf.

One great handicap is the attitude of the average herbarium worker. He has so much productive work to accomplish that he cannot afford

to take the time to prosecute the necessary routine in preparing and inserting herbarium clippings covering his own contributions much less those of numerous other botanists. He forgets that what is accomplished is of benefit not only to himself but to all who in the future may have occasion to utilize the herbarium reference facilities, and that what he accomplishes, no matter how little, is a contribution to the efficiency of his own future work as well as to the efficiency of others.

When one is dealing with the problems of identification of collections coming from little known parts of the world, particularly from areas not covered by published floras or even systematic lists, one must of necessity spend a disproportionate part of his time locating the widely scattered published descriptions and critical notes, which he must, or at least should, consult and compare critically with his material. To find these data assembled and arranged in advance, and actually in the herbarium, whether specimens representing the named species are available or not, adds tremendously to one's efficiency and should tend to more accurate, complete, and dependable work.

After over twelve years' experience with this innovation in herbarium practice and particularly with the large scale demonstration as developed at the New York Botanical Garden I became more and more enthusiastic regarding its merits as the increasing number of references *in situ* in the herbarium demonstrate its extreme utility. I feel safe in asserting that no large herbarium can safely ignore the challenge and avoid the issue of incorporating in its working collections at least those current items published by its own staff members. I am convinced that this innovation is one of the most important advances made in herbarium technique in the last few decades. Objections invariably come from individuals long accustomed to standard, or better, static technique. They claim that the work cannot be done with their present resources; that of the specimens, the literature in the form of a library, and comprehensive indices are available, it is not necessary to take the time to incorporate such data in the herbarium; that the plan involves putting too much paper into the herbarium; that they have too much productive work to do to warrant taking the time to accomplish this routine task; and (never having done it) they believe that it is impracticable. These are some of the current but invalid objections.

Several years ago when I was directing the work of several typists engaged solely in copying original descriptions from the older literature, the curator of one of our large herbaria courteously but firmly declined to accept my offer to supply him gratis with a carbon copy of each description thus reproduced. He had access to extensive herbarium

facilities, to a great botanical library, and to comprehensive indices and card catalogues, and could see little to be gained by having the original descriptions incorporated in the herbarium. How many thousands of steps might have been saved within a single year, and how much time have been conserved in the endless consulting of hundreds or even thousands of descriptions in the library made no impression. In searching for objections to an obviously important innovation the average herbarium executive, handicapped by a long established and static routine, forgets that those who come after him will not have his intensive knowledge of a special flora, a special group, or of a special literature, but that each worker must, to a certain degree, forge his own tools. The work of all future investigators is made infinitely easier if the current worker would but incorporate, from time to time, in association with the specimens, at least his more important contributions. It is noteworthy how objections fade when a botanist accustomed to the old method of botanical specimens plus a card-catalogue or an index, plus a library, borrows all the material in a special group, specimens and covers with incorporated printed or typed data, from an institution in which the system has been well established, and finds to his surprise that his bibliography for this or that group is largely done for him; that he has before him most of the published descriptions he needs, whether represented by authentically named specimens or not; and not infrequently he finds references from obscure sources of which he had no previous knowledge.

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