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About the Institute
The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

of interspecific variations. Butler and Woolpy, and Thompson explore the types of visual stimuli, social and otherwise, that are rewarding to cockerels and monkeys. McConnell's well-known paper on memory transfer through cannibalism in planarians is reprinted. As an example of learning in a naturalistic context that has evolutionary implications, the Browers demonstrate stimulus generalization in avoidance learning by toads. Having learned to avoid bumblebees, toads also refrain from feeding on robber flies, which have evolved as harmless mimics of the bumblebee. Still further removed from psychological learning theory is Hinde's critical review of the energy motivation models of Freud, McDougall, Lorenz, and Tinbergen, which perhaps would have been better placed in the introductory readings.

The section on social behavior, ethology, and evolution is prefaced by Scott's discussion of social organization and processes of socialization. King writes on interspecific competition between deermice and a strain of domestic house mice, Shaw on the development of schooling in fishes. Dilger's study of captive love birds serves well to introduce methods of observing and describing social behavior and is complemented by DeVore's field study of mother-infant relations in baboons. Tinbergen presents evidence that the gulls' habit of removing broken egg shells from the nest has survival value in that it reduces predation.

The bias of this collection is, if anything, psychological rather than zoological. Some issues that loomed large in the S.E.B. Symposium in 1950 —such as the embryology of behavior and the analysis of behavioral rhythms —are not included. Modern research on circadian rhythms can provide excellent illustrations for many of the principles underlying behavior, and I would want to assign the Cold Spring Harbor Symposium on biological clocks as a companion to these readings. But, if all such suggestions were added to the book, it would soon become too cumbersome and too expensive to serve its purpose. In its present form, as an introduction to the recent works and theories of some of the more vital contributors to animal behavior, it will be a boon to teacher, students, and librarians alike.

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Machine Data Processing and Plant Taxonomy

A few years ago we were told that the handwriting was on the wall; some even saw it: "Taxonomy by the numbers!" Among biologists today, despite widespread distaste for even simple mathematics, fear of sacrificing individuality to bureaucracy and technology, and suspicion of change *per se*, its instruments and advocates, there is an accelerated conversion to the belief that electronic processing of numerically coded data can contribute to the solution of taxonomic problems to such a degree that to ignore or disregard it is unthinkable. Even those who reject machines as a partner in making taxonomic decisions (a baseless fear of displacement, or a well-based fear of "speed-up"?) must admit that primitive filing and indexing methods are no longer capable of storing and retrieving the vast amount of biographic, bibliographic, biogeographic, and nomenclatural data necessary to document taxonomy. In the Index Nominum Algarum being prepared at Berkeley, the diatom genus *Navicula* is represented by more than 4000 specific and infraspecific names. Let anyone who can demonstrate his ability to do taxonomic work in *Navicula* without resorting to machine data processing step forward to receive well-deserved kudos. The usual practice is to make a superficial search through the literature and, if a suitable description or figure does not happen to be encountered, to describe the material at hand as a new taxon. Thus, large genera become disproportionately larger.

In the face of deeply rooted prejudice as well as sound criticism, Sydney W. Gould has persisted in his zealous attempt to bring the importance of electronic processing of documentary data to the attention of plant taxonomists. So far two parts of a monumental program have been published as the first two volumes of the **International Plant Index**: vol. 1, *Family Names of the Plant Kingdom* (122 pp., $2.50) by Sydney W. Gould; and vol. 2, *Authors of Plant Genera* (336 pp., $6) by Gould and Dorothy C. Noyce. Both volumes were published by the New York Botanical Garden and the Connecticut Agricultural Experiment Station.

The volumes should not be mistaken for definitive indices; rather, they are the results of pilot-plant operations and thus are intended to serve as procedural guides as well as to inform the public of the purpose, scope, and methodology of the project. Taxonomists are urged to read carefully the introductory material to both volumes before criticizing the work.

If the typography of the first volume is crude, the second is handsome. Printing was accomplished by electronic copysetters using programmed magnetic tapes. Of the two volumes, the first, which presents alphabetical and phylogenetic lists of familial and ordinal names, is most immediately useful. *Authors of Plant Genera* may evoke the initial response, "Who cares?" Perhaps the alphabetical author index, which constitutes the bulk of this volume (pp. 17 to 240), was an unfortunate choice of a print-out to introduce to the public at this time. This list is of use mainly to Gould's group. The author code index (pp. 241 to 302), on the other hand, is a key to a code and hence essential for any user of the *International Plant Index*. The coverage of authors is not clear; some of the workers listed have named neither genera nor any other taxon.

It would be unrealistic to expect universal agreement on the details of coding, but taxonomists hopefully will save their thought and energy for a consideration of the principles and expected results. Some conceivably useful print-outs that can be obtained from the stored data are suggested by Gould (vol. 1, p. 10-R). At the moment, I would greatly appreciate having a print-out of all species of marine algae with type localities in California.

But, after agreeing that machine data processing offers tremendous advantages and after granting Gould's group freedom of choice of coding details, there is a residual feeling that something is amiss. The clue lies in Gould's writings, in which there is abundant evidence of a failure to distinguish taxonomy from nomenclature and a lack of understanding of the principles of both. The potential uses of computerization in the documentary aspects of taxonomy are remarkable, but are

Critique of Gould's system

From TAXON XII (1)
1963

MEMORANDUM
9/27/63

TO; Dr. Steere

FROM: D. J. Rogers

SUBJECT: Procedures for machine handling of botanical nomenclature

The criticisms that are leveled at the present machine methods for botanical nomenclature and associated bibliographic materials fall into three general categories: first, the inadequacy of the card methods; second, the confusion between nomenclature and taxonomy, and third, the arbitrary decisions of the personnel doing the work.

The first criticism carries with it I think, an unexpressed criticism of the coding that appears in the printed work; but more important, to restrict the data to the limitations of the entry mechanism, the punched card, is a serious error. An IBM card used as a final document prevents the incorporation of the full entry, particularly when the card must carry with it a relatively complicated code. Even without the code entry, the card is so limited that it becomes imperative to make abbreviations. The abbreviations are new to most users, and when there is an imposition of learning both a code and a new set of abbreviations, there is no gain in botanical information.

To circumvent, or better, eliminate, these criticisms, a different type of entry mechanism should be employed. The most practical (and least expensive) device available for several kinds of computers is the paper tape. There are no limitations whatsoever on the length of an entry, bu it a name, a bibliographic cita-

tion or other information. The value to be accrued by the inclusion of the complete bibliographic reference and the complete author's name(s) should be considered more important than the amount of space required to print this information. The paper tape works from a standard typewriter keyboard with appropriate hole-punching devices. The tape may be proof-read in the same way that cards are proofed. The continuous tape does not have the storage problems of the punched card. From the paper tape, the information may be transferred to punched cards, if such a requirement is made. The paper tape is not the final place of storage of the information, but is just the input device. All information is transferred either to magnetic tape or to disc packs that are the permanent storage devices.

The most important factor in the use of paper tape is the program employed to direct the storage of the information in such a way that all the information is available. The development of the program should precede the decision as to the kinds of hardware necessary to perform the operations. In the program, one should develop a well defined list of objectives, considering all possible uses of the information. Thereafter, one may use the information in a variety of ways and derive data from a number of different entry points. The program will require that specific information be given an address (or code), but the code is internal to the processing of the computer and is never a part of the final print-out for a user.

The second criticism, confusion between nomenclature and taxonomy, can be eliminated by appropriate procedures. The present system does impose a taxonomy, a serious error that taxonomists have pointed out many times, starting with the first supplements to the Kew Index, and continuing through several other attempts to "straighten out" nomenclature. It is likely that the most non-committal type of indexing is alphabetical, and the print-out should not have with it any type of numbering system (alphamedic). Perhaps there will be a time when people will look at such numbering systems without the present emotional reactions, even as the Dalle Torre & Harms numbering of Engler's system now gives no emotional kicks.

Without question, some sort of system must be employed to efficiently store the incorporated information. This should be an internal system and should be used only for purposes of finding an item required in a particular sequence. This internal system, however, is advantageous only to the compiler, and not to the user. If, at a later date, someone wishes to investigate the system used as to its merit for classification, then the individual may have open access to the system, but only at his request.

Those not immediately connected with computer operations may have a tendency to forget the intellectual endeavor that must precede the actual application of the computer. The most important factor is the trained individual. Training in taxonomy and the problems of nomenclature is by far the most critical aspect

of the establishment of a sound system for nomenclatorial indexing. If the individual also has familiarity with computer operations, this is indeed beneficial. It is important that those in charge of the computer operation be aware of the needs of the botanist so that the design of the operation will give the degrees of freedom required by the nomenclatorial expert. Both types must recognize the need for experiment in the most appropriate methods, rather than establishing of the system without testing various procedures. Such testing can best be accomplished if the two types of individuals can work together, at a center where there are satisfactory facilities and environment.