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

often obscured rather than elucidated by the sample print-outs. In trying to purify the lists by eliminating all except "operative" names, Gould is making a serious mistake. In the algae, at least, yesterday's taxonomic synonym is likely to become tomorrow's accepted name. Flowering plant taxonomy, while not as fluid, is surely not sufficiently static to guarantee a long life of usefulness for any list of accepted names. Although every name must be assigned a taxonomic position in order for retrieval to be meaningful, all names must be entered equally if the index is to serve as a universal tool. For use by specialists or regional botanists, on the other hand, the basic index may be modified and enriched by programming any amount of taxonomic opinion or other types of information desired.

A critical aspect of Gould's project is the preparation of entries for coding, as the output of a computer is only as accurate and as comprehensive as its input. Bearing in mind the enormous amount of scholarly research that has gone into the preparation of the Index Nominum Genericorum (21,000 printed cards to date) and the Index Nominum Algarum (more than 130,000 entries so far), one can see that collaboration of many taxonomists is essential if the task is to be completed. Now is the time to put our ledgers in order, once and for all, with allowance for the correction of past errors at any future time; now is also the time to establish a standardized and computerized system of bookkeeping for future additions to our vast store of taxonomic documentation. The International Bureau for Plant Taxonomy and Nomenclature at Utrecht is the logical place for centralized data processing; it must be given greater responsibility, power, and support. Gould should be commended for his self-sacrificing and persistent efforts to develop the computerized index. At the same time, it seems clear that the project would benefit greatly from constructive criticism, if such were to be offered by the community of taxonomists.

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Illinois Biological Monographs, No. 34

In preparing **A Monograph of Lemnaceae** (University of Illinois Press, Urbana, 1965. 118 pp. Paper, $3.50; cloth, $4.50), the author, E. H. Daubs, presents an excellent summary of the suspected phylogeny within the family and possible relationships with other taxa. The diverse interpretations of the vegetative "frond" of the duckweeds, especially with respect to the origin of lateral pouches and their enclosed meristems, are adequately reviewed on an anatomical basis.

The author gives no indication, even in the bibliography, that this monograph is based wholly on his Ph.D. dissertation completed in 1962. In fact, the citation of abbreviations from the 1964 edition of *Index Herbariorum* creates the impression that the systematic treatment of duckweed taxa represents an up-to-date summary. Such is hardly the case in light of the chromatographic analysis of the Lemnaceae undertaken by J. W. McClure at the University of Texas and the growth-response analysis of *Spirodela* taxa undertaken by D. E. Harrison at North Carolina State University, both of which were available in thesis form prior to 1965. Furthermore, pertinent papers, published both before and after 1962, have somehow escaped inclusion in the bibliography. Thus, the data and concepts of duckweed taxonomy developed within recent years have not been considered by the author in his delineation of duckweed genera and species. We must, therefore, consider his systematic treatment in terms of the information available prior to 1962.

In this context, Daub's delineation of duckweed taxa is admirable from a typological point of view, especially since the duckweeds are extremely difficult, if not impossible, to identify from dried specimens, and it does provide an illustrated record of gross variability within the family, along with worldwide distribution data. His frequent use of quantitative (and overlapping) terminology, in keys and descriptions, does somewhat nullify the statement that " . . . identification can generally be readily made by following the keys presented herein. . . ." The following statement adds additional doubt about the accuracy of the taxonomic treatment: "These two species [*Lemna minima* and *L. valdiviana*] do, however, intergrade in form and in flowering and fruiting characteristics. . . ." Furthermore, the statement that "No one has seriously questioned the generic status of *Spirodela* since its establishment by Schleiden [1839] . . ." is certainly in error because several botanists [for example, A. R. Clapham and others, in *Flora of the British Isles* (1962), and R. W. Butcher, in *A New Illustrated British Flora* (1961)] seriously consider the genus *Lemna* to include the taxa often segregated under the genus *Spirodela.* These are matters of subjective evaluation, however, and Daubs has presented his systematic treatment of the family in a form that is more inclusive and as realistic as any presently available.

It is unfortunate that the author chose to ignore approaches to duckweed taxonomy completed between 1962 and 1965. Had brief reference to these approaches been made, even as a postscript, the reader of the 1965 monograph would not be lulled into the typological complacency so typical of this and many other monographs. At least, the reader could take with a grain of salt one of the author's " . . . more significant findings . . . [that] . . . the validity of determining species primarily on the basis of vegetative structures is examined and accepted."

Despite obvious faults, this monograph contains sufficient information on the anatomy, phylogeny, and distribution of the duckweeds, and on the literature, to be of considerable reference value to students of duckweed taxonomy.

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Nucleic Acid Research in India

The following statement is made on the flyleaf of this book, **Nucleic Acids: Structure, Biosynthesis, and Function** (Council of Scientific and Industrial Research, New Delhi, India, 1965. 372 pp., $6), " . . . the primary objectives of the symposium were to provide an opportunity for a close and informal contact between workers on nucleic acids in India and abroad; to take stock of the work being done in this field in India in the context of the extensive investigations being carried out else-