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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.

INTRODUCTION

1. The following paper describes the procedures used to do a cost/effectiveness analysis. This analysis relates the costs of operation of a given system to its effectiveness: in other words, what it costs a given system to do a certain set of tasks.

This enables us to compare one system to another, or to look carefully at the components of one system.

2. Information about the TAXIR system is then presented.

SYSTEMS ANALYSIS: COST/EFFECTIVENESS

I. Systems Analysis: the Major Steps

A. All aspects of the system under study are observed by the systems analyst. Each portion of the system is flow charted. When fitted together these portions constitute a procedural flow chart of the system.

The flow chart(s) indicate how the system operates; exactly what is done and the order in which tasks are faced.

Flow charts (at this stage) do not necessarily indicate optimal (in terms of efficiencies, costs, completeness, etc.) procedures, but only what the analyst has observed.

B. Once flow charts are established, costs are analysed for each procedure in the system as displayed. Essentially the amount of time needed for any given procedure is analysed, as well as the time needed to complete all procedures in the flow chart.

To obtain money costs, time used is multiplied by the rate of return for the input under consideration. If for example, we use 3 hours of a biologist's time (Ph.D. level), 3 hours is multiplied by the rate of return to the Ph.D. biologist which may be $8.00 per hour. Thus the cost for that procedure is 3 hours X $8/hour - $24.00).

It should be obvious that 1) breaking down costs to its components (time used, rate of return) is more instructive than merely using money terms, and

2) money costs can always be computed.

C. That which is accomplished by the various portions of the system and the system as a whole is analyzed. A set of criteria is established to test how well the system puts out desired material from what was put in. For an information retrieval system we may use as criteria

1. How user oriented is the system in terms of
   a. data preparation
   b. the types of answers to the queries?
2. How flexible the system is, for example
   a. can new data be added and old data deleted (updating)
   b. can corrections be made once the system is operating, etc.?
3. Can the system be changed once installed?
4. Does it aid in administering large information collections (as in a museum) or does it make the task of administration more difficult?

D. Finally we have an analysis for a system:

1. the procedural flow charts
2. the costs for each procedure
3. the effectiveness of the system as held up to a set of criteria

a. From these data we can generate combined information on the costs of putting data in and getting information out relative to the attributes and drawbacks of the system;

b. The system under study can be scrutinized and changed to make it more efficient (less costly) and/or more effective. Efficiency in operation and effectiveness are optimized with respect to each other.

c. Then the system under study can be compared to other systems (related or not) which have been analysed in the same way

4. The final product should be a system which will optimally fill a user's demands given his set of problems and his resources. Where necessary a system is altered to meet the individual user's demands. Technically this is not part of a cost/effective analysis but is a problem of systems design and implementation. The cost aspect, though, does place a constraint on a system the user can adopt and is essential to get optimal use from limited resources.

II. Systems Analysis: Cost/Effectiveness for TAXIR (studied from 8.23.68 thru 10.5.68)

A. Notes on preparing data for input and computer operations.

1. Please note:

a. The analysis which follows is drawn from observations of one system, TAXIR. That system has been tested on 27 curatorial characteristics of one data bank, the collection of herbarium sheets of the genus Manihot. To date only a portion (1990 specimens of 6000) of the entire bank has been used as input to the system.

b. The information which follows is interesting and if used correctly is instructive. It is not meant to be used as a basis of comparison of any other system with TAXIR, nor of any other data bank for use in any system including TAXIR. Information issued in the future will allow for these comparisons.

c. The procedures (which appear on the enclosed flow charts entitled "Preparation of Data for Input to TAXIR") were developed by Mr. S. G. Appan, Dr. David Rogers, and Mr. Henry Fleming, all of the Taximetrics Laboratory.

2. The flow charts are color coded red, red-magenta, green and blue.

a. The red lines

(1) represent the first major iteration. This procedure is repeated for each specimen (item) under consideration. Thus input data to TAXIR contains 1990 items.

(2) Information was abstracted from (i) the notations and physical specimen on the herbarium sheets, and (ii) file records consisting of 3 x 5" index cards previously prepared by Dr. Rogers. For all entries most information was taken from the specimens. (It is possible that other institutions might use their file records [such as catalog] for direct input.)

b. The red-magenta lines. If a specimen was though to be a TYPE, a literature search was done. This occurred in approximately 25% of all specimens studies.

c. The green lines

i. represent the second major iteration. This was repeated for each of the 26 descriptors for each specimen under study. (27 descriptors less the descriptor entitled "Type Designation" already processed.)

ii. The condition of the notations on the herbarium sheets (specimens) varied in quality. In 5% of all specimens the notations were poor (illegible, confused, incorrect, etc.) but in 95% of the specimens the notations were good to fair.

iii. The 'instantaneous recording process" used

(a) Data from 40% of the specimens were directly recorded on coding forms (FORTRAN 80-column). These were then sent to professional key-punch operators for the punching of cards.

(b) Data from 60% of the specimens were keypunched directly by Mr. Appan as he worked.

d. The blue lines represent procedures for

i. getting all data on punched cards
ii. having the card deck duplicated and stored for security reasons (in case of loss or destruction of the working deck.

3. Data verification and correction

a. These procedures are relatively straightforward. A good deal of research is being done on this section to develop a fast and efficient system. At present, most verification is done by the worker.

b. Checking the data back to the herbarium sheets was not done at this time.

c. All other procedures were carried out completely and very carefully. This is a must for effective use of the TAXIR system.

d. Once a clean bank is obtained it is recorded on tape (or disk) for computer input. A tickler file is used to assure that the tape is reprocessed every 3 months to insure against deterioration.

4. Computer operations

a. Accessioner

i. The cost of "building" Accessioner is incurred only initially, or each time that it is updated.

ii. After building Accessioner it is stored on tape (or disk) and can be queried when desired.

b. Book: once built Book is stored on tape and printed. Printing costs here indicate rates charged for an on-line, high speed printer. This is expensive, for the tape can be run to a slower speed printer at lower costs.

B. Cost Analysis

1. All figures are expressions of time in seconds except where indicated.

2. Rates

a. All worker input time was by a highly trained biologist (M.A. in Agronomy and two years toward a Ph.D. in Botany)
b. Key punching was done on an IBM 26.
c. All computer work was done on a CDC 6400 at the University of Colorado Computing Center. Standard operating rates applied. ($300/450 per hour CPU, $60/90 per hour PPU, where the first figure is for use of less than half of core storage, the second for half or greater core storage.)

3. Times: Data preparation for input

a. Red-magenta lines. Literature search for "Type Designation" 225 ± 180 sec.

b. Green line iteration

i. From file record and herbarium sheet
(a) Good notations 185 ± 15 sec.
(b) Poor notations 360 ± 60 sec.
ii. From file records only. 155 ± 15

c. i. Additional time required for worker to key punch directly 25 ± 10 sec.
ii. Approximate rate of professional key punching, in columns/minute, 145 ± 10 (the average item was expressed in 230 columns)

d. Red lines - all other than above 90 ± 30 sec.

e. To locate and correct data approximately 40,000 seconds were expended. About 5% of all specimens contained a mistake. Over-all data verification and correction cost 20 seconds/item in the entire data bank.

4. Times and money costs for computer operations

BOOK				ACCESSIONER			
1990 Items, 7 Descriptors				1990 Items, 20 Descriptors			
	CPU [a]	PPU	Money Cost		CPU	PPU	Money Cost
Build	23.2	145.0		Build	147.4	113.5	
Sort	1.8	1.4		Store	0.5	2.3	$13.41
Store	0.5	2.3		Query [b]			
Print	18.1	13.0		Type I	0.2	0.1	$0.017
Subtotals	43.6	161.7	$9.49	Type II	0.6	0.4	$0.06
External charges [b]			$8.30				
		TOTAL	$17.79				
Entire core				Accomplished in 1/2 core			

a. Here a sample query was run a number of times, and average times expended are reported. The query was more complex than the average would be.

b. Cost per lines printed and pages of paper consumed.

C. Effectiveness of TAXIR

1. TAXIR is a highly user oriented Information Retrieval system. The user must determine:

a. what specimens will come under analysis;

b. what characteristics (descriptors) will be used

c. the form in which the data is entered into the machine is up to the user - it can be in English, or any such "natural" language, it can be highly biologically (or chemically or mathematically, etc.) oriented; or it can be in any other code or contrived language. This is solely the user's option.

d. Any hardware input system can be used: cards, tapes, etc.

e. There is not fixed format prescribed. The user may determine his input format. (A fixed format is not precluded.)

2. The procedural flow chart for data preparation is opened to the user's needs. But a highly efficient system is suggested and has been developed.

3. The TAXIR language (for querying) is simple and very close to user oriented English.

4. Dependent on the user's needs the data, once entered, can be quickly and inexpensively and completely manipulated. Large quantities of usable information can be put out rapidly at relatively low cost.

a. Books can be prepared relatively inexpensively to serve as very well cross-indexed catalogs. Such books could be for in-house, and shared with other institutions and scientists. They enable a wider knowledge of what material is available where, for research.

b. The Accessioner can be used by the individual research scientist in his work, for analysis of material, or to facilitate getting the material necessary for research.

c. The administrator can make use of either Book or Accessioner to keep daily track of the institution's holdings.

5. In general the entire system has several advantages to the institution's administrator:

a. The system enables the use of other techniques which will assist the institution in making optimal use of its present resources, and plan and program the use of future resources.

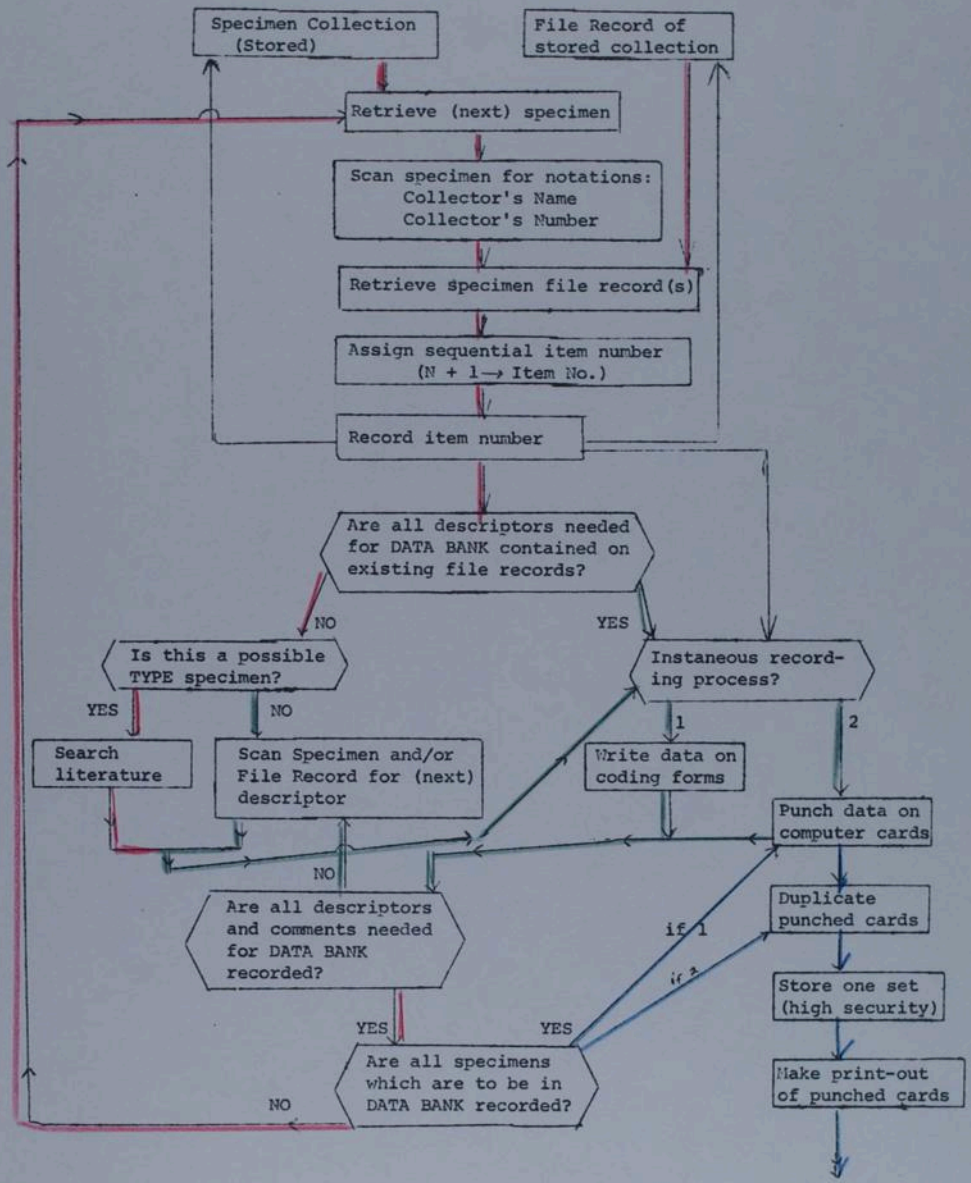
b. Administrators can know expenses as they correspond to outputs; thus can keep tighter control of the various operations and work in progress.

c. Administrators as scientists can better plan expansion of research once they know what they have in their institutions, and the kinds of problems that can be handled by the system.

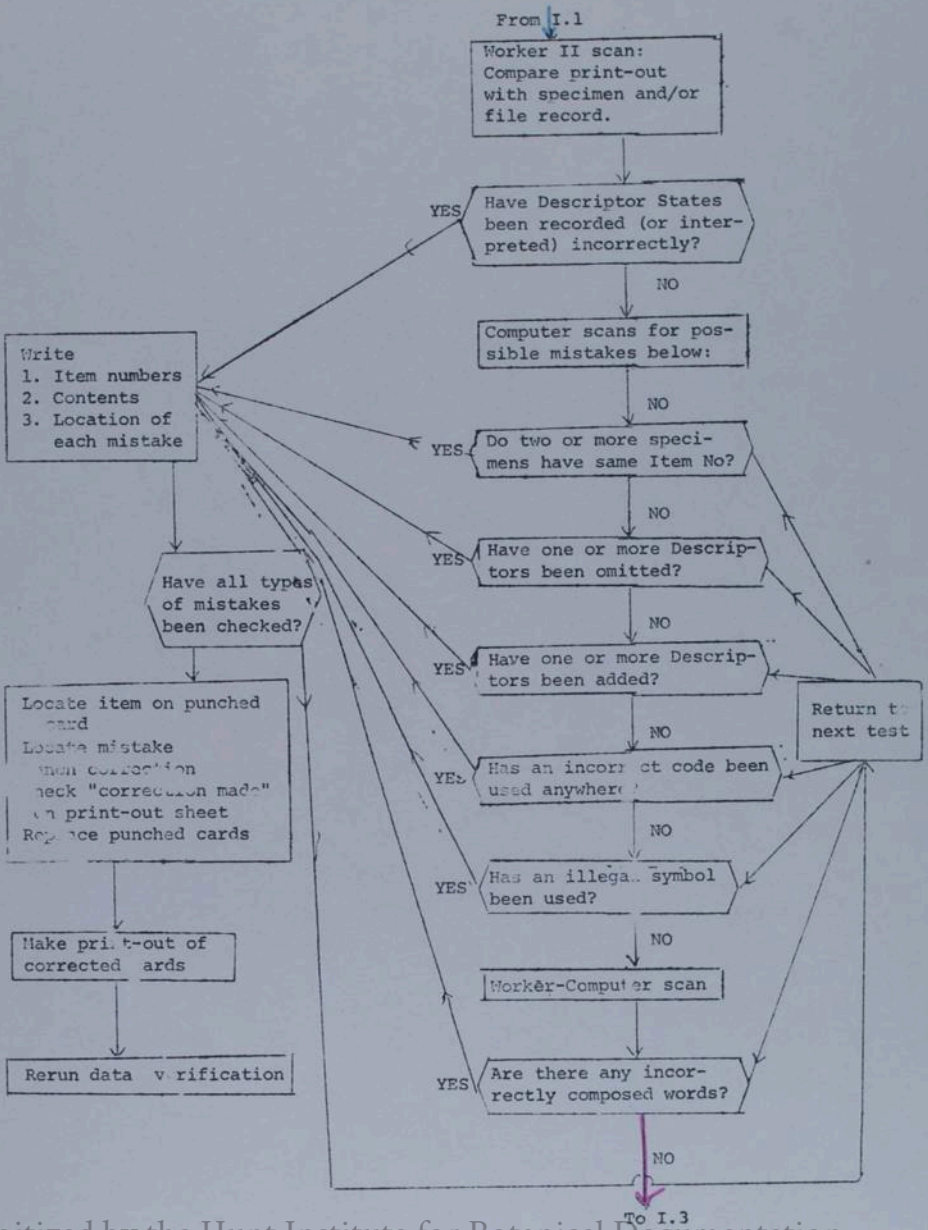
More on TAXIR will be available in the near future. If you have specific questions, please do not hesitate to submit them.

I. Procedural Flow Chart to Prepare the DATA BANK for Input to TAXIR

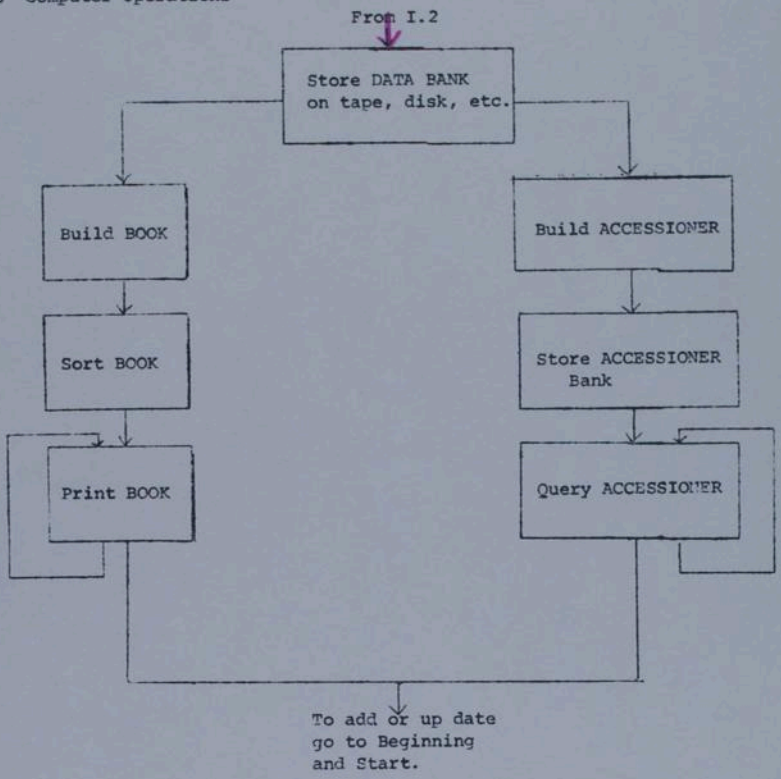
1. Gathering and Recording



I.2 DATA BANK Verification and Correction



I.3 Computer Operations



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I. I/R in BIOLOGY

The concept of information retrieval, although a topic of much recent interest, is not new to the biological community. Systematic biologists have been contending with the problem of information retrieval for hundreds of years. So, too have librarians and others in various positions, such as inventory control specialists. Many workable solutions to this problem have been developed, not the least of which is our taxonomic system. This system enables us to store and retrieve vast amounts of biological information. In this sense, many of us are already experts in information storage and retrieval and it is altogether fitting that modern advances in this field should come from a discipline whose traditional objective has been to create better information storage/retrieval systems for biology, agriculture, and medicine.

And our taxonomic system does not serve merely to embody conceptual information about the natural affinities of living organisms. It further serves us for curating small and large collections of biological specimens as well. It is to the problem of managing the information attendant with biological collections that we feel our present systems contribute.

There are essentially two types of biological collections which are amassed: those large collections found in museums or herbaria, and those smaller collections compiled by monographers or floristic workers. These two types overlap. In either type, specimens are arranged in cabinets, on shelves, etc. For this collection to be useful, certain subsets of it must be capable of abstraction with moderate ease. It is the curator who is largely responsible for guaranteeing this usefulness. Given the limited funds and restricted facilities which characterize many museum operations these men do remarkable jobs, but of course at a sacrifice to their own research.

In meeting this charge, curators make heavy use of the taxonomic information storage retrieval system. By physically arranging specimens in the museum in

accordance with a taxonomic system, specimens whose taxonomic names are known may be recovered with ease. By physically arranging specimens in the museum in accordance with the geographical location of the place of collections, specimens whose places of origin are known may be recovered with ease. By combining these two, which is a common practice, the museum becomes a very workable information storage retrieval system for the collections which it houses.

For this reason, it is not our purpose or intent to discard this already extant system. Rather, we accept this system as our working base, and make it an object of study and inspiration.

II. THE FUNCTIONS OF AN I/R SYSTEM

Any information retrieval system must serve two functions. It must serve as a repository for information, and as an accessioner to abstract from the repository the information stored there. As the names imply, one of these functions is a passive one, to serve as a resting place for information, while the other of these functions is active, to abstract from the repository some of the information that is there.

Let us consider the biological museum as an information retrieval system. It must serve as both repository and accessioner. It serves as repository insofar as it houses specimens each of which is itself a storehouse of information. It serves as an accessioner insofar as the physical arrangement of the specimens is in accordance with useful locating criteria such as taxonomic name or geographic location of collection.

Occasionally additional accessioner facilities are employed in museums. These often take the form of a card file. A card file is an information storage retrieval system very analogous to the museum itself. It acts as a repository for a small subset of the information attendant with the specimens. This

repository function of a card file is met insofar as some of the information about a given specimen is recorded on a given card. The card file acts as an accessioner in the same way as does the museum: the physical arrangement of the cards reflects some locating criterion of interest. Since the cards in the card file may be physically arranged in a way different from the arrangement of the specimens in the museum, items may be found in the card file with different locating criteria than that by means of which specimens are located in the museum. Whenever it is possible to establish a correspondence between cards in the card file and specimens in the museum, the locating criteria reflected in the physical arrangement of the card file may be used to locate specimens in the museum as well. In this way a card file may serve as an additional accessioner for the museum itself.

Since a card file admits only one physical arrangement at a time, there must exist a complete and distinct card file for each auxiliary locating criterion which is to be used to locate specimens in the museum. For this reason museums, where time and funds permit, maintain two or three separate card files arranged on such criteria as taxonomic name, geographical location of collection, collector, etc.

In some museums, where not only are time and funds limited but also collections tend to be extremely large, the museum must serve as its own accessioner facility with no help from auxiliary card files. For example, the curators of the entomological collections at the U. S. National Museum do a remarkable job of maintaining a collection of over 15 million specimens with no comprehensive card files at all.

III. INTRODUCTION TO THE TAXIR SYSTEM

TAXIR stands for TAXonomic Information Retrieval. It is a system designed to help systematic biologists organize and manipulate their collections and the

information they embody easier, faster, and more comprehensively.

The TAXIR system embraces, among other things, a language which enables the biologist to communicate directly with it in a manner natural and familiar to him. The TAXIR language closely resembles English and its grammar and syntax can be mastered with a few hours' effort. The translating capacity of TAXIR enables the biologist to use this language directly. The need for a computer specialist to intermediate between the biologist and his information system is thus obviated.

The information manipulating and organizing capacity of the TAXIR system enables the biologist to take fuller advantage of the vast amounts of information which present day museums represent. In this way we can reap greater returns on the investment which has already been made in the amassing and curation of our collections. The justification for this investment which our museums represent is realized in the extent to which they are used.

It is further envisioned that the TAXIR system will relieve the curator of many of the tasks now required of him which compete for his time with the pursuit of professional research interests. With the information currently represented in museums more readily available to the biological community through the TAXIR system the curator's function as go-between for the biologist and the museum is greatly reduced.

Much discussion, some of it in what would seem an almost fanciful vein, has been made concerning information exchange by means of intricate networks of computers located throughout the country and the world. The need for greater information exchange is real, but through the TAXIR system this need can be met now; and in a way perhaps more natural to this generation of professional biologists.

When information retrieval is discussed, one generally has in mind an enormous and highly complex information bank, administered by a heavily funded organization. "If we can't do the full-blown, bang-up job, then it just doesn't

pay," we think. But the TAXIR system is relatively inexpensive and sufficiently adaptable that it can be employed at all levels of complexity. It can even be made to behave as a personal scratch-pad system for an individual monographer or floristic worker.

IV. THE MODULES OF THE TAXIR SYSTEM

The TAXIR system exists in many essentially independent but related modules. Some of these modules are:

1. Accessioner - fully developed in prototype
2. Display - under development
3. Book - fully developed in prototype
4. Data Vet - under development

These modules, functioning alone or in combinations, serve to strengthen the repository and accessioner facilities of biological collections.

1. THE ACCESSIONER

Stored in the accessioner is that subset of the information, attendant with the specimens in a collection, which might be used as locating criteria by means of which we may locate those items in the collection which are of interest.

The accessioner functions very much like the auxiliary card files discussed in Section II. Here, however, all the locating criteria may be embodied into one integrated system and the criteria may be used independently of each other, as with multiple card files; or it may be used simultaneously in any conceivable logical combination.

As with auxiliary card files, whenever there exists a correspondence between the specimens in the museum and their associated locating information as stored in the accessioner, the accessioner may function to relieve the collection of its former need to provide locating information about the specimens which it houses.

2. DISPLAY

As the accessioner serves the active function of an I/R system, display serves the passive function associated with a repository. A collection which has been relieved of its accessioner function by the availability of the accessioner module of the TAXIR system is now responsible only for the repository function of information retrieval. So relieved of part of its traditional role, the collection may now exist to serve its residual repository function more completely. Its only specific restriction is that it must maintain the correspondence between its specimens and the associated locating information in the accessioner. This correspondence may be maintained in a wide variety of ways; some extremely nontraditional and worthy of further empirical study.

The display module of the TAXIR system is designed to serve the repository function which the collection itself now serves. It will be particularly important when the biological collection is itself not accessible to the biologist. For this reason completion of the development of this module has been postponed to enable the completion of the more desperately needed modules.

3. BOOK

The Book module of the TAXIR system might most properly be thought of as a combination of the accessioner and the display modules. Book functions as a little of each.

There is much information associated with the specimens in a collection which will be of interest to us either without or before actually looking at and handling the specimens in the collection. In fact, presently, much unnecessary handling of specimens occurs because this information is not now readily available without direct involvement with the collection itself.

On the other hand, many of our locating criteria, particularly at the onset of our involvement with a museum collection, are relatively simple and do not

require sophisticated logical combinations to express them adequately. Such locating criteria as taxonomic name, geographical location of collection, collector name, time of year of collection, and others are of this type.

The Book module accepts a small number (six or so) of criteria for comparison, or descriptors as our information carrying units are called, organizes this information as associated with the specimens in the collection in an hierarchical manner, and prints a book of the information reflecting this organization.

The book so printed is a list of all the specimens in the collection (or items, the more general term by which they are known to the TAXIR system), together with the appropriate previously stipulated half dozen pieces of information respectively associated with each item, and is arranged in an hierarchical order determined by this associated information itself.

By means of the TAXIR language the biologist communicates his desired hierarchical order to the Book module, usually indicating locating criteria (accessioner descriptors) such as taxonomic name or geographical location of collection as primary criteria for the hierarchy, and indicating display information (display descriptors) such as herbarium number, collector number, or completeness of the specimen, as secondary criteria for the hierarchy. In this way a book with hierarchy family, genus, geographical location, collector, collector number, species, would arrange items in the collection first alphabetically by family name, within groups of items with the same family name, alphabetically by genus, within groups of items with the same family and genus name, alphabetically by geographic location of collection, etc. With this book information about family, genus and geographical location can be used to discover information about collector, collector number and species.

Once the Book module has created such a book, it can be readily printed from computer tape several times at little extra expense. In this way museums

may exchange information arranged in a useful way, in familiar hard copy form. (See Section III, paragraph 5)

The book (or indeed system of books) further provides the members of the biological community a more direct access to biological collections and partially relieves curators of the barrage of queries to which they would otherwise have to respond.

4. DATA VET

The Data Vet module of the TAXIR system is presently under development. The function of this module is to check or proof-read the information before incorporation in the other modules. Whereas the two functioning modules of the TAXIR system are liberally interlaced with user error messages the need for a DATA VET module is very real for the quality of any system is always limited by the quality of the information which it embodies. Experience with the Accessioner and Book modules will reveal the types of errors to be encountered. Until the Accessioner and Book modules of this system have undergone more extensive field testing, the Data Vet module cannot be completed.

V. HOW TO USE THE TAXIR SYSTEM

The concepts and terms needed to understand more fully the TAXIR system (Section III) are not completely foreign to the biologist for the system derives much of its structure from the already extant principles of museum curation. We do use some of the fundamental principles of logic in the TAXIR query language and it will be necessary for the user to become familiar with these if he is not already.

1. DEFINITION OF TERMS

i. ITEM: This is the general term which is used to refer to the basic units comprising the collection. The term specimen has been used earlier in

this exposition. However, in some collections, item may refer to lots, jars, populations, or any other conceptual unit which may be under study.

ii. DESCRIPTOR: this term refers to the information carrying unit in the system. There are many ways of envisioning this concept. Let me discuss two.

a. A descriptor is a basis for comparing any two items in the collection. With respect to this basis for comparison, it must always be possible to decide if two items are similar or different. An example of a descriptor which has already been mentioned in this exposition is the Family to which an item belongs. Two items are similar with respect to the families to which they belong if they each belong to the same family; and different if they each belong to different families. Similarly, country of collection, collector, genus, species, storage location in museum, month of collection and many more could be considered as useful bases for comparison or descriptors.

b. A descriptor is a partition, or a dividing into exclusive and exhaustive subsets, of the collection of items. The notion of similar and different, discussed in (a), is derived from this partition in a natural way: items which belong to the same subdivision of the partition are similar, and those which belong to different subdivisions are different. Any partition can be a descriptor; however to be useful, the notion of similar and different associated with the partition must be interpretable in a meaningful way.

This notion of similar and different is known mathematically as an equivalence relation. A theorem in mathematics teaches us that there is a bi-unique correspondence between equivalence relations and partitions. However, a moment's reflection should convince us that concept (a) and concept (b) are indeed the same thing.

iii. DESCRIPTOR STATE: In analogue with the two equivalent concepts of descriptor, there are two concepts of descriptor state. If we think of a

descriptor as a partition then we may think of a descriptor state as one of the "classes" or subdivisions of the partition. If we think of a descriptor as a basis for comparison, then we may think of a descriptor state as one of the possible conditions of that basis. In this way, a description of the common property shared by all the items which belong to the same subdivision of a partition may be considered a descriptor state. To continue our earlier example, the descriptor 'Family' would have for its states the names of the families represented by the items in the collection.

iv. DATA BANK: To design an information retrieval system using the TAXIR modules, it is necessary to have a specific collection of items of interest in mind. This collection may be enlarged, decreased, or altered at any time, but it is necessary to have some specific collection under consideration at the onset. It is further necessary to designate at the onset some number of descriptors for this collection. These, in turn, may be changed, deleted, or enlarged. The Data Bank is the totality of items with the associated descriptor states for each respective item.

v. CONTROL VOCABULARY: This is the totality of all descriptor names together with all descriptor state names. It is with this vocabulary, enriched slightly by the addition of a few special words, expressed through the grammar and syntax of the TAXIR language, that we communicate with the TAXIR system.

2. THE TAXIR LANGUAGE

The TAXIR language is comprised of basic statement types. Some of these basic statement types are:

i. I.D.: This statement enables you to identify yourself to the system. Your identifying comments will be associated with each response you receive from the system.

ii. ACCESSIONER MODULE STATEMENT: By means of this statement you describe

to the Accessioner module the basic structure of the accessioner you wish to design. It is through this statement that the system learns the names of the descriptors you wish to use as locating information. In response to this statement, the system establishes the necessary tables and dictionaries, and makes available the appropriate processors required to create an accessioner meeting your specifications.

iii. BOOK MODULE STATEMENT: This statement is the analogue, in the Book module, of the Accessioner module statement.

iv. DEFINE ITEM: By means of these statements, one per item, the data bank is described to the system. The Define Item statement is the means by which we associate an item with the descriptor states to which it belongs.

v. PRINT BOOK: Statements (iii) and (iv) enable us to make available to the TAXIR system the information required to create a Book. The statement causes the Book to be created and printed.

vi. PRINT CONTROL VOCABULARY: Statements (ii) and (iv) enable us to create an accessioner. This statement asks the system to provide us with that portion of the control vocabulary which is needed in order to communicate with the accessioner.

vii. QUERY: There are essentially two types of Queries, known as Query 1 and Query 2.

a. Query 1: By means of Query 1 we can provide a logical combination of locating information to the Accessioner. The Accessioner responds by providing the list of items which meet this locating criterion. To illustrate this let us assume that we are interested to see what specimens in the genus Manihot from Arizona and New Mexico were collected between 1940 and 1968 by persons other than Dr. D. J. Rogers. The Query would look like:

QUERY, Please list items with genus, Manihot AND state of collection, Arizona OR New Mexico AND year of collection, FROM 1940 TO 1968 AND NOT collector, D.J.Rogers*

b. Query 2: This statement is very similar to Query 1 except that it requests additional information be associated with each item in the response list.

viii. KEY TO: This statement enables us to use the TAXIR accessioner as an identifying device.

ix. MEMO: If we wish to include with the response additional comments, it can be done by means of this statement.

These are not all of the statement types in the TAXIR language. This brief list does, however, serve to illustrate the power and flexibility of the TAXIR system. An exhaustive exposition of the TAXIR language is inappropriate in this introductory document. This information will be found in the Users' Manual, "The TAXIR Primer," which is presently under development.

3. BUILDING A DATA BANK

To use the TAXIR system to aid the management of information represented in a biological collection it is necessary to build a Data Bank. There are three parts to the process.

First it is necessary to decide what descriptors are desired. These will depend on the nature of the material to be described and the purpose to which the system will be put. This choice of descriptors may be made without considerations of whether they will be used in the Accessioner, in any of the Books, in Display or in any combination of the three. Further, with but few exceptions, it will not be necessary to decide on states for the chosen descriptors at this time. When the descriptors have been chosen they are arranged in a fixed but arbitrary order, called DEFINE ITEM order.

Second it is necessary to design a means of assigning item identification numbers to the items in the collection (see Section II, par. 3; Sect. IV, 1, par. 3; Sect. IV, 2, par. 1) in such a way that the item identification number enables one to locate the specimen in the collection. Frequently museum accession numbers

serve this purpose already. In other cases, a new item identification number may prove useful. In other cases, an item identification number directly interpretable in terms of row, cabinet, shelf, etc. would be convenient. Some consideration has been given to the advantages of a sequential assignment of item identification number.

The final phase, and indeed the most costly in time and money, is the description of the items in the collection. By means of TAXIR Define Item statements each item must be described (1) by associating it with the appropriate states of the descriptors established in the first phase, and (2) by assigning to it an item identification number in accordance with the scheme established in the second phase. These Define Item statements, one per item, are then punched into computer cards (or for that matter any machine readable medium) to be read by the TAXIR system.

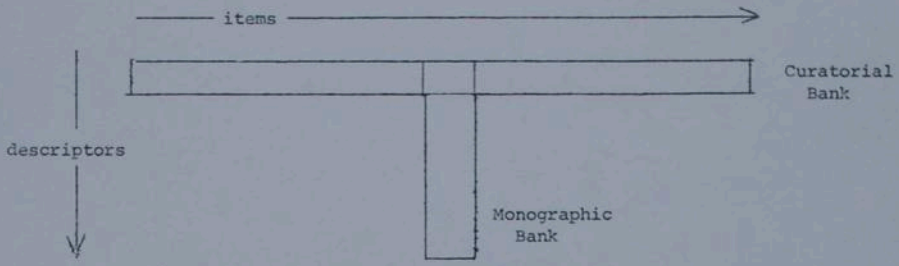
The Define Item statement begins with the words DEFINE ITEM and continues with the item identification number for the item being defined. This is followed with a comma; then the name of the appropriate state for the first descriptor (first in the Define Item order); then another separating comma; then the name of the appropriate state for the second descriptor; then a comma and so forth until the name of the last descriptor state is entered. This last is followed not with a comma but with an asterisk which indicates the end of the statement.

The Data Bank has been defined when a Define Item statement has been constructed for each item in the collection. These Define Item statements may now be used to describe the Data Bank to any of the modules in the TAXIR system.

4. APPLICATIONS OF THE MODULES OF TAXIR

There are two basic applications of the TAXIR system (Sect. I, par. 3); the museum application and the monographic application. In the museum application, the data bank is characterized by many items but relatively few descriptors. In the monographic application the data bank is characterized by relatively few items

but a depth of descriptors. (See figure.)



It is anticipated that the monographer who will need to describe his items in depth, recognizing descriptors of morphology, cytology, ecology, as well as the essential curatorial descriptors, will be able to take full advantage of the information manipulating powers of the TAXIR accessioner.

The curator, whose concern is a larger collection, which, at least in the short run, does not possibly admit description in such depth, will find the Book module a useful application of the TAXIR system.

The anticipated DATA VET module will be useful in either application.

VI. CONCLUDING REMARKS

The TAXIR system is an automated tool which, when taken together with the modern principles and practices of biological museum curation, can be used to render the information storage/retrieval methods in biology more complete, more flexible, and easier to use. It can in no way be construed to replace the museum, the curator, or the biologist. Rather, it recognizes the immense contribution which museums make to the advancement of biological science, and exists to defend and strengthen the position of the museum in the biological community.

TABLE OF DESCRIPTORS

FOR CURATING MANIHOT SPECIMENS

Number of Descriptor	Name of the Descriptor	Option	Module	Comments (See Control Vocabulary)
1	Uses	NAME	Accessioner	Here should appear
2	Vernacular name	NAME	Accessioner	conventions adopted
3	Most recent identification	NAME	Accessioner & Book	by the user.
4	Most recent identifier	NAME	Accessioner & Book	
5	Other identifications	NAME	Book	
6	Rogers et Appan identification	NAME	Accessioner & Book	
7	Type designation	NAME	Accessioner	
8	Author	NAME	Accessioner	
9	Original name of type	NAME	Book	
10	Collector	NAME	Accessioner	
11	Collector number	NAME	Book	
12	Duplicate Specimens	NAME	Accessioner	
13	Year of collection	ORDERED NAME	Accessioner	
14	Month of collection	CODE	Accessioner	
15	Day of collection	CODE	Accessioner	
16	Country of collection	NAME	Accessioner & Book	
17	Province/State of collection	NAME	Accessioner & Book	
18	Precise locality of collection	NAME	Book	
19	Herbarium	NAME	Accessioner & Book	
20	Herbarium accession #	NAME	Book	
21	Condition of flowers	CODE	Accessioner	
22	Condition of fruit	CODE	Accessioner	
23	Condition of roots	CODE	Accessioner	
24	Mature seeds	CODE	Accessioner	
25	Condition of specimen	CODE	Accessioner & Book	
26	Additional comments	CODE	Accessioner	
27	Comments	NAME	Display	

These are sample queries as posed in the TAXIR language and responded to by the TAXIR Accessioner:

The first requests the types from Mexico. It is a Query 1.

The second requests the Palmer E. collections. It is a Query 2 and further requests information on geography and date.

The third is to discover the quality of the collections from herbarium ARIZ.

The fourth query is one which might be posed in preparation for a field trip to the Sonoran Desert region of Mexico.

The next queries are posed to a new data bank of the morphology of the Central American species. These queries illustrate how the TAXIR Accessioner may be used as a simultaneous key.

The fifth query attempts to identify the unknown M. tomatophylla Standley. The description here made was rich enough to eliminate all but three species.

The sixth query uses the "Result" feature of the TAXIR Accessioner to include another criterion in the description. This was sufficient to make the determination unique.

In the seventh query our unknown specimen consisted of nothing more than a single seed. A simultaneous key, such as the TAXIR Accessioner, allows us a best possible guess.

The eighth, ninth and tenth queries show the simultaneous key identification of the unknown M. isoloba Standley. These show how the Result feature of the TAXIR Accessioner may be iterated as often as is needed.

QUERY LIST ITEMS WITH COUNTRY OF COLLECTION,
MEXICO AND NOT TYPE DESIGNATION,SP*

RESPONSE:

6	2	8	4	3	1	60	5	69	165
209	211	210	208	354	330	358	356	355	331
359	351	367	357	491	435	431	502	487	437
433	489	436	432	488	455	438	434	490	683
750	746	786	744	685	784	748	772	788	743
684	751	747	771	787	678	745	785	682	749
794	826	822	830	796	828	824	795	827	823
831	789	797	829	793	825				

NO. OF ITEMS IN QUERY RESPONSE = 76

QUERY - GIVE INFORMATION ON: COUNTRY OF COLLECTION, PROVINCE/STATE OF COLLECTION, AND YEAR OF COLLECTION FOR COLLECTIONS WHICH HAVE COLLECTOR, PALMER E.*

(2)

RESPONSE:

ITEM NO.	REQUESTED STATES
49	MEXICO, JALISCO, 1886
53	MEXICO, JALISCO, 1886
51	MEXICO, JALISCO, 1886
55	MEXICO, JALISCO, 1886
50	MEXICO, JALISCO, 1886
54	MEXICO, JALISCO, 1886
52	MEXICO, JALISCO, 1886
56	MEXICO, JALISCO, 1886
137	MEXICO, SONORA, 1887
135	MEXICO, SONORA, 1887
134	MEXICO, SONORA, 1887
136	MEXICO, SONORA, 1887
225	MEXICO, SINALOA, 1897
223	MEXICO, SINALOA, 1897
224	MEXICO, SINALOA, 1897
342	MEXICO, COLIMA, 1890
334	MEXICO, COLIMA, 1890
332	MEXICO, COLIMA, 1890
344	MEXICO, GUERRERO, UNKNOWN
343	MEXICO, GUERRERO, UNKNOWN
333	MEXICO, COLIMA, 1890
438	MEXICO, CHIHUAHUA, 1885
683	MEXICO, SINALOA, 1891
786	MEXICO, DURANGO, 1896
685	MEXICO, SINALOA, 1891

2, Cont.

784 MEXICO, DURANGO, 1896
788 MEXICO, DURANGO, 1896
684 MEXICO, SINALOA, 1891
787 MEXICO, DURANGO, 1896
785 MEXICO, DURANGO, 1896
682 MEXICO, SINALOA, 1891
842 MEXICO, TAMAULIPAS, 1907
838 MEXICO, TAMAULIPAS, 1907
840 MEXICO, TAMAULIPAS, 1907
843 MEXICO, TAMAULIPAS, 1907
839 MEXICO, TAMAULIPAS, 1907
789 MEXICO, DURANGO, 1896
837 MEXICO, TAMAULIPAS, 1907
841 MEXICO, TAMAULIPAS, 1907
NO. OF ITEMS IN QUERY RESPONSE = 39

QUERY PROVIDE INFORMATION ON: CONDITION OF FLOWERS, CONDITION OF FRUIT, CONDITION OF ROOTS, MATURE SEEDS, AND CONDITION OF SPECIMEN FOR SPECIMENS WITH HERBARIUM, ARIZ.

(3)

RESPONSE:

ITEM NO.	REQUESTED STATES
37	PRESENT, ABSENT, ABSENT, ABSENT, FAIR
97	PRESENT, MATURE, ABSENT, UNKNOWN, FAIR
113	PRESENT, IMMATURE, ABSENT, ABSENT, FAIR
95	PRESENT, ABSENT, ABSENT, ABSENT, FAIR
79	ABSENT, MATURE, ABSENT, UNKNOWN, POOR
94	ABSENT, MATURE, ABSENT, UNKNOWN, FAIR
118	ABSENT, MATURE, ABSENT, PRESENT, FAIR
114	PRESENT, IMMATURE, ABSENT, ABSENT, FAIR
106	ABSENT, MATURE, ABSENT, PRESENT, FAIR
112	ABSENT, ABSENT, ABSENT, ABSENT, POOR
104	ABSENT, MATURE, ABSENT, PRESENT, FAIR
120	ABSENT, MATURE, ABSENT, PRESENT, FAIR
125	PRESENT, IMMATURE, ABSENT, ABSENT, FAIR
155	PRESENT, ABSENT, ABSENT, ABSENT, POOR
127	PRESENT, IMMATURE, ABSENT, ABSENT, FAIR
130	PRESENT, ABSENT, ABSENT, ABSENT, POOR
126	ABSENT, ABSENT, ABSENT, ABSENT, POOR
142	PRESENT, IMMATURE, PRESENT, ABSENT, FAIR
128	ABSENT, MATURE, ABSENT, PRESENT, FAIR
225	PRESENT, IMMATURE, ABSENT, ABSENT, FAIR
243	PRESENT, ABSENT, ABSENT, ABSENT, POOR
295	PRESENT, IMMATURE, ABSENT, ABSENT, POOR
297	ABSENT, ABSENT, ABSENT, ABSENT, POOR
293	PRESENT, ABSENT, ABSENT, ABSENT, POOR
304	ABSENT, MATURE, ABSENT, PRESENT, FAIR

3, Cont.)

```
        284   PRESENT, ABSENT, ABSENT, ABSENT, FAIR
        292   PRESENT, ABSENT, ABSENT, ABSENT, POOR
        308   ABSENT, ABSENT, ABSENT, ABSENT, POOR
        286   ABSENT, IMMATURE, ABSENT, ABSENT, POOR
        313   ABSENT, MATURE, ABSENT, UNKNOWN, POOR
        477   PRESENT, MATURE, ABSENT, UNKNOWN, FAIR
        760   ABSENT, MATURE, ABSENT, PRESENT, POOR
        748   PRESENT, ABSENT, ABSENT, ABSENT, POOR
        747   PRESENT, ABSENT, ABSENT, ABSENT, FAIR
        820   PRESENT, ABSENT, ABSENT, ABSENT, FAIR
        807   ABSENT, MATURE, ABSENT, PRESENT, FAIR
        815   PRESENT, ABSENT, ABSENT, ABSENT, FAIR
        797   ABSENT, MATURE, ABSENT, PRESENT, FAIR
        801   ABSENT, ABSENT, ABSENT, ABSENT, POOR
NO. OF ITEMS IN QUERY RESPONSE =   39
READ INPUT FROM CARDS*
```

QUERY STATE: MONTH OF COLLECTION, DAY OF COLLECTION, PROVINCE/STATE OF COLLECTION, CONDITION OF FLOWERS, AND CONDITION OF FRUIT FOR COLLECTIONS WITH PROVINCE/STATE OF COLLECTION, CHIHUAHUA OR DURANGO OR SINALOA OR SONORA*

RESPONSE:

(4)

ITEM NO.	REQUESTED STATES
101	AUG., 10, CHIHUAHUA, ABSENT, ABSENT
85	JUNE, 30, CHIHUAHUA, PRESENT, ABSENT
97	AUG., 10, CHIHUAHUA, PRESENT, MATURE
89	UNKNOWN, UNKNOWN, SONORA, PRESENT, ABSENT
95	SEPT., 2, SONORA, PRESENT, ABSENT
103	JULY, 12, SINALOA, PRESENT, ABSENT
87	UNKNOWN, UNKNOWN, SONORA, ABSENT, ABSENT
99	AUG., 10, CHIHUAHUA, ABSENT, IMMATURE
91	SEPT., 13, SONORA, ABSENT, ABSENT
94	SEPT., 2, SONORA, ABSENT, MATURE
102	AUG., 10, CHIHUAHUA, PRESENT, MATURE
86	JUNE, 30, CHIHUAHUA, PRESENT, ABSENT
98	AUG., 10, CHIHUAHUA, PRESENT, MATURE
90	JULY, 25, SONORA, PRESENT, ABSENT
96	SEPT., 2, SONORA, ABSENT, MATURE
88	SEPT., 9, SONORA, ABSENT, ABSENT
100	AUG., 10, CHIHUAHUA, PRESENT, MATURE
137	UNKNOWN, UNKNOWN, SONORA, ABSENT, MATURE
133	SEPT., 12, SONORA, ABSENT, ABSENT
131	SEPT., 12, SONORA, ABSENT, MATURE
135	UNKNOWN, UNKNOWN, SONORA, ABSENT, ABSENT
146	UNKNOWN, UNKNOWN, SONORA, PRESENT, ABSENT
134	UNKNOWN, UNKNOWN, SONORA, ABSENT, MATURE
132	SEPT., 12, SONORA, ABSENT, MATURE
128	OCT., 5, SINALOA, ABSENT, MATURE

136 UNKNOWN, UNKNOWN, SONORA, ABSENT, ABSENT

225 SEPT., VARIABLE, SINALOA, PRESENT, IMMATURE

223 SEPT., VARIABLE, SINALOA, PRESENT, ABSENT

235 UNKNOWN, UNKNOWN, SINALOA, ABSENT, MATURE

224 SEPT., VARIABLE, SINALOA, PRESENT, IMMATURE

303 SEPT., 1, SONORA, ABSENT, MATURE

245 AUG., UNKNOWN, SINALOA, PRESENT, ABSENT

299 SEPT., 1, SONORA, ABSENT, MATURE

307 SEPT., 25, SINALOA, ABSENT, MATURE

305 AUG., 17, SINALOA, ABSENT, MATURE

301 SEPT., 1, SONORA, ABSENT, MATURE

293 JULY, 17, SONORA, PRESENT, ABSENT

309 NOV., 23, SINALOA, ABSENT, MATURE

304 SEPT., 1, SONORA, ABSENT, MATURE

246 JULY, 28, SINALOA, PRESENT, IMMATURE

262 JULY, 10, SINALOA, PRESENT, ABSENT

300 SEPT., 1, SONORA, ABSENT, MATURE

308 AUG., 25, CHIHUAHUA, ABSENT, ABSENT

244 AUG., UNKNOWN, SINALOA, PRESENT, ABSENT

306 AUG., 17, SINALOA, ABSENT, IMMATURE

302 SEPT., 1, SONORA, ABSENT, MATURE

294 JULY, 17, SONORA, PRESENT, ABSENT

346 SEPT., 21, SINALOA, ABSENT, IMMATURE

311 NOV., 23, SINALOA, ABSENT, MATURE

350 SEPT., 21, SINALOA, ABSENT, IMMATURE

348 SEPT., 21, SINALOA, ABSENT, MATURE

313 NOV., 23, SINALOA, ABSENT, MATURE

360 UNKNOWN, UNKNOWN, SINALOA, PRESENT, ABSENT

347 SEPT., 21, SINALOA, ABSENT, MATURE

4, Cont.

4, Cont.

312 NOV., 23, SINALOA, ABSENT, MATURE

310 NOV., 23, SINALOA, ABSENT, MATURE

349 SEPT., 21, SINALOA, ABSENT, ABSENT

314 SEPT., 21, SINALOA, ABSENT, MATURE

345 SEPT., 22, SONORA, ABSENT, MATURE

438 UNKNOWN, UNKNOWN, CHIHUAHUA, ABSENT, MATURE

675 AUG., 22, SINALOA, PRESENT, ABSENT

677 AUG., 22, SINALOA, PRESENT, MATURE

676 AUG., 22, SINALOA, PRESENT, ABSENT

674 AUG., 22, SINALOA, PRESENT, IMMATURE

735 JULY, 11, SINALOA, PRESENT, ABSENT

774 AUG., 6, CHIHUAHUA, ABSENT, ABSENT

683 UNKNOWN, VARIABLE, SINALOA, PRESENT, MATURE

782 SEPT., 5, CHIHUAHUA, ABSENT, MATURE

679 JULY, 12, SINALOA, PRESENT, ABSENT

778 AUG., 6, CHIHUAHUA, PRESENT, MATURE

786 UNKNOWN, UNKNOWN, DURANGO, PRESENT, MATURE

776 AUG., 6, CHIHUAHUA, PRESENT, ABSENT

685 UNKNOWN, VARIABLE, SINALOA, PRESENT, ABSENT

784 UNKNOWN, UNKNOWN, DURANGO, PRESENT, ABSENT

681 AUG., 30, SINALOA, ABSENT, MATURE

780 SEPT., 5, CHIHUAHUA, ABSENT, MATURE

788 UNKNOWN, UNKNOWN, DURANGO, PRESENT, MATURE

775 AUG., 6, CHIHUAHUA, PRESENT, ABSENT

684 UNKNOWN, VARIABLE, SINALOA, ABSENT, ABSENT

783 OCT., 29, CHIHUAHUA, ABSENT, MATURE

680 AUG., 30, SINALOA, ABSENT, MATURE

779 SEPT., 5, CHIHUAHUA, ABSENT, MATURE

787 UNKNOWN, UNKNOWN, DURANGO, PRESENT, MATURE

678 JULY, VARIABLE, SINALOA, PRESENT, ABSENT

(4, Cont.)

777 AUG., 6, CHIHUAHUA, PRESENT, ABSENT

785 UNKNOWN, UNKNOWN, DURANGO, PRESENT, MATURE

682 UNKNOWN, VARIABLE, SINALOA, PRESENT, ABSENT

781 SEPT., 5, CHIHUAHUA, ABSENT, MATURE

730 JULY, 10, SINALOA, ABSENT, ABSENT

773 AUG., 6, CHIHUAHUA, ABSENT, ABSENT

818 JULY, 6, SONORA, PRESENT, ABSENT

802 SEPT., 6, SONORA, ABSENT, MATURE

794 AUG., 10, CHIHUAHUA, ABSENT, MATURE

810 JULY, 7, SONORA, PRESENT, MATURE

790 SEPT., 24, CHIHUAHUA, ABSENT, MATURE

806 OCT., 14, SINALOA, ABSENT, MATURE

798 SEPT., VARIABLE, SONORA, ABSENT, MATURE

814 JULY, 30, SONORA, PRESENT, IMMATURE

820 JULY, 6, SONORA, PRESENT, ABSENT

804 OCT., 14, SINALOA, ABSENT, MATURE

796 AUG., 10, SONORA, ABSENT, MATURE

812 JULY, 7, SONORA, PRESENT, IMMATURE

792 AUG., 23, CHIHUAHUA, PRESENT, MATURE

808 OCT., 7, SONORA, ABSENT, ABSENT

800 SEPT., 23, SONORA, ABSENT, ABSENT

816 JULY, 6, SONORA, PRESENT, ABSENT

819 JULY, 6, SONORA, PRESENT, ABSENT

803 OCT., 14, SINALOA, ABSENT, MATURE

795 AUG., 10, CHIHUAHUA, ABSENT, MATURE

811 JULY, 7, SONORA, PRESENT, ABSENT

791 SEPT., 24, CHIHUAHUA, ARSENT, MATURE

807 OCT., 14, SINALOA, ABSENT, MATURE

4, Cont.

799 SEPT., VARIABLE, SONORA, ABSENT, MATURE

815 JULY, 31, SONORA, PRESENT, ABSENT

789 UNKNOWN, UNKNOWN, DURANGO, PRESENT, MATURE

821 NOV., 1, SINALOA, ABSENT, MATURE

805 OCT., 14, SINALOA, ABSENT, MATURE

797 AUG., 10, SONORA, ABSENT, MATURE

813 AUG., VARIABLE, SONORA, ABSENT, MATURE

793 AUG., 10, CHIHUAHUA, ABSENT, MATURE

809 OCT., 7, SONORA, ABSENT, ABSENT

801 SEPT., 23, SONORA, ABSENT, ABSENT

817 JULY, 6, SONORA, PRESENT, ABSENT

900 SEPT., 4, CHIHUAHUA, ABSENT, MATURE

NO. OF ITEMS IN QUERY RESPONSE = 124

MEMO: I WOULD LIKE TO PLAN A FIELD TRIP TO THE SONORAN DESERT.

TO: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

KEY TO ROGERS ET APPAN IDENTIFICATION:
LEAF VENATION, CAMPTODROMOUS AND
BASE OF LAMINA, NARROWLY PELTATE: 0.2 - 0.5 CM.

(5)

RESPONSE:

ITEM NO.	REQUESTED STATES
22	M.MICHAELIS MCVAUGH
14	M.TOMATOPHYLLA STANDLEY
11	M.CAUDATA GREENMAN
104	M.MICHAELIS MCVAUGH
13	M.CAUDATA GREENMAN
506	M.CAUDATA GREENMAN
508	M.TOMATOPHYLLA STANDLEY
507	M.MICHAELIS MCVAUGH

NO. OF ITEMS IN QUERY RESPONSE = 8

ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

(6)

KEY TO ROGERS ET APPAN IDENTIFICATION:
RESULT AND OUTLINE OF MEDIAN LOBE.
PANDURATE: BASAL PORTION ROUNDED.

RESPONSE:

ITEM NO.	REQUESTED STATES
14	M.TOMATOPHYLLA STANDLEY
508	M.TOMATOPHYLLA STANDLEY

NO. OF ITEMS IN QUERY RESPONSE = 2

ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

KEY TO ROGERS ET APPAN IDENTIFICATION:
SEED SIZE/SHAPE, VERY LARGE: > 2 CM.

(7)

RESPONSE:
ITEM NO. REQUESTED STATES

501 M.FOETIDA [H.B.K.] POHL

NO. OF ITEMS IN QUERY RESPONSE = 1

ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

(8)

KEY TO ROGERS ET APPAN IDENTIFICATION:
LEAF VENATION, CAMPTODROMOUS AND BASE OF LAMINA,
NON-PELTATE.

RESPONSE:

ITEM NO.	REQUESTED STATES
63	M.AESCULIFOLIA [H.B.K.] POHL
50	M.PRINGLEI WATSON
177	M.AESCULIFOLIA [H.B.K.] POHL
60	M.CHLOROSTICTA STANDLEY ET GOLDMAN
7	M.PAUCIFLORA T.S.BRANDEGEE
71	M.AESCULIFOLIA [H.B.K.] POHL
103	NEW OAXACA SPECIES
381	M.ESCULENTA CRANTZ
45	M.ISOLOBA STANDLEY
36	M.LUDIBUNDA CROIZAT
248	M.CHLOROSTICTA STANDLEY ET GOLDMAN
171	M.AESCULIFOLIA [H.B.K.] POHL
39	M.ISOLOBA STANDLEY
201	M.AESCULIFOLIA SSP. INTERMEDIA STAT.NOV.
218	M.CHLOROSTICTA STANDLEY ET GOLDMAN
79	M.AESCULIFOLIA [H.B.K.] POHL
33	M.CHLOROSTICTA STANDLEY ET GOLDMAN
383	M.ESCULENTA CRANTZ
150	M.AESCULIFOLIA [H.B.K.] POHL
512	M.AESCULIFOLIA [H.B.K.] POHL
74	M.AESCULIFOLIA [H.B.K.] POHL
52	M.PRINGLEI WATSON
183	M.AESCULIFOLIA [H.B.K.] POHL
61	M.CHLOROSTICTA STANDLEY ET GOLDMAN
8	M.PAUCIFLORA T.S.BRANDEGEE

ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

8, Cont.

78	M.AESCULIFOLIA [H.B.K.] POHL
19	M.CHLOROSTICTA STANDLEY ET GOLDMAN
382	M.ESCULENTA CRANTZ
49	M.ISOLOBA STANDLEY
35	M.LUDIBUNDA CROIZAT
27	M.DAVISIAE CROIZAT
513	M.LUDIBUNDA CROIZAT
5	M.FOETIDA [H.B.K.] POHL
77	M.AESCULIFOLIA [H.B.K.] POHL
58	NEW OAXACA SPECIES
43	M.ISOLOBA STANDLEY
268	M.AESCULIFOLIA [H.B.K.] POHL
245	M.CHLOROSTICTA STANDLEY ET GOLDMAN
80	M.AESCULIFOLIA [H.B.K.] POHL
57	M.CHLOROSTICTA STANDLEY ET GOLDMAN
519	M.ESCULENTA CRANTZ
153	M.AESCULIFOLIA [H.B.K.] POHL
510	M.CHLOROSTICTA STANDLEY ET GOLDMAN
502	M.PAUCIFLORA T.S.BRANDEGEE
504	M.PRINGLEI WATSON
352	M.AURICULATA MCVAUGH
505	M.ISOLOBA STANDLEY
509	NEW OAXACA SPECIES
501	M.FOETIDA [H.B.K.] POHL
511	M.DAVISIAE CROIZAT

NO. OF ITEMS IN QUERY RESPONSE = 50

ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

KEY TO ROGERS ET APPAN IDENTIFICATION:
OUTLINE OF MEDIAN LOBE, LINEAR AND RESULT.

(9)

RESPONSE:

ITEM NO.	REQUESTED STATES
45	M.ISOLOBA STANDLEY
39	M.ISOLOBA STANDLEY
382	M.ESCULENTA CRANTZ
49	M.ISOLOBA STANDLEY
43	M.ISOLOBA STANDLEY
505	M.ISOLOBA STANDLEY

NO. OF ITEMS IN QUERY RESPONSE = 6

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ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

KEY TO ROGERS ET APPAN IDENTIFICATION:
SHAPE OF MEDIAN LOBE APEX, FIG. 8 AND RESULT.

RESPONSE:
  ITEM NO.   REQUESTED STATES
        45   M.ISOLOBA STANDLEY
        30   M.ISOLOBA STANDLEY
        49   M.ISOLOBA STANDLEY
        43   M.ISOLOBA STANDLEY
       505   M.ISOLOBA STANDLEY

NO. OF ITEMS IN QUERY RESPONSE =     5

READ INPUT FROM CARDS

END
ELAPSED TIME IN SECONDS SINCE LAST TIME STATEMENT
CENTRAL PROCESSOR:   11.570     PERIPHERAL PROCESSOR: 1406.429
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(10)

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ID: MANTHOT CURATORIAL DATA BANK - 30 SEPT. 68

ACCESSION MODULE:
USES (1, NAME, 3),
VERNACULAR NAME (2, NAME, 6),
MOST RECENT IDENTIFICATION (3, NAME, 9),
MOST RECENT IDENTIFIER (4, NAME, 7),
TYPE DESIGNATION (7,NAME,4),
AUTHOR (8,NAME,5),
COLLECTOR (10, NAME, 9),
DUPLICATE SPECIMENS (12, NAME, 9),
YEAR OF COLLECTION (13, BOTH, 1753, 1754, 1755, 1756, 1757, 1758, 1759, 1760,
1761, 1762, 1763, 1764, 1765, 1766, 1767, 1768, 1769, 1770, 1771, 1772, 1773, 17
74,1775,1776,1777,1778,1779 1780,1781,1782,1783,1784,1785,1786,1787,1788,1789,
1790,1791,1792,1793,1794,1795,1796,1797,1798,1799,1800,1801,1802,1803,1804,1805,
1806,1807,1808,1809,1810,1811,1812,1813,1814,1815,1816,1817,1818,1819,1820,1821,
1822,1823,1824,1825,1826,1827,1828,1829,1830,1831,1832,1833,1834,1835,1836,1837,
1838,1839,1840,1841,1842,1843,1844,1845,1846,1847,1848,1849,1850,1851,1852,1853,
1854,1855,1856,1857,1858,1859,1860,1861,1862,1863,1864,1865,1866,1867,1868,1869,
1870,1871,1872,1873,1874,1875,1876,1877,1878,1879,1880,1881,1882,1883,1884,1885,
1886,1887,1888,1889,1890,1891,1892,1893,1894,1895,1896,1897,1898,1899,1900,1901,
1902,1903,1904,1905,1906,1907,1908,1909,1910,1911,1912,1913,1914,1915,1916,1917,
1918,1919,1920,1921,1922,1923,1924,1925,1926,1927,1928,1929,1930,1931,1932,1933,
1934,1935,1936,1937,1938,1939,1940,1941,1942,1943,1944,1945,1946,1947,1948,1949,
1950,1951,1952,1953,1954,1955,1956,1957,1958,1959,1960,1961,1962,1963,1964,1965,
1966,1967,1968),
MONTH OF COLLECTION (14, CODE, JAN., FEB., MAR., APR., MAY, JUNE, JULY, AUG.,
SEPT., OCT., NOV., DEC., JAN.-FEB., FEB.-MAR., MAR.-APR., APR.-MAY, MAY-JUNE,
JUNE-JULY, JULY-AUG., AUG.-SEPT., SEPT.-OCT., OCT.-NOV., NOV.-DEC., DEC.-JAN., ,
VARIABLE ),
DAY OF COLLECTION (15, CODE, 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
21,22,23,24,25,26,27,28,29,30,31,VARIABLE),
COUNTRY OF COLLECTION (16, NAME, 4),
PROVINCE/STATE OF COLLECTION (17, NAME, 7),
HERBARIUM (19, NAME, 5),
CONDITION OF FLOWERS (21, CODE, ABSENT, PRESENT),
CONDITION OF FRUIT (22, CODE, ABSENT, IMMATURE, DAMAGED, MATURE),
CONDITION OF ROOTS (23, CODE, ABSENT, PRESENT),
MATURE SEEDS (24, CODE, ABSENT, PRESENT),
CONDITION OF SPECIMEN (25, CODE, POOR, FAIR, GOOD),
ADDITIONAL COMMENTS (26, CODE, ABSENT, PRESENT).

NO. OF DESCRIPTORS 27.

READ INPUT FROM TAPE.

DEFINE ITEMS:
1, ,  ,M.PAUCIFLORA BRANDEGEE  , ,NO  , ,TYPE  ,BRANDEGEE T.S.  ,M.PAUCIFLOR
A T.S.BRANDEGEE  ,PURPUS C.A.  ,3418  ,1  ,1908  ,6  ,  ,MEXICO  ,PUEBLA  ,
   VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
UC  ,131175  ,2  ,4  ,1  ,2  ,2  ,1  ,NA.

2, ,  ,M.PAUCIFLORA BRANDEGEE  , ,NO  , ,TYPE  ,BRANDEGEE T.S.  ,M.PAUCIFLOR
A T.S.BRANDEGEE  ,PURPUS C.A.  ,3418  ,1  ,1908  ,6  ,  ,MEXICO  ,PUEBLA  ,
   VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
UC  ,178785  ,2  ,2  ,1  ,1  ,2  ,1  ,NA.

3, ,  ,M.PAUCIFLORA BRANDEGEE  , ,NO  , ,TYPE  ,BRANDEGEE T.S.  ,M.PAUCIFLOR
A T.S.BRANDEGEE  ,PURPUS C.A.  ,3418  ,1  ,1908  ,6  ,  ,MEXICO  ,PUEBLA  ,
```

ID: SAMPLE BOOK RUN-1 OCT. 68

BOOK TITLE A SAMPLE BOOK OF A FEW MANIHOT SPECIMENS

BOOK MODULE: COUNTRY OF COLLECTION (16), PROVINCE/STATE OF COLLECTION (17), HERBARIUM (19), MOST RECENT IDENTIFICATION (3), COLLECTOR (10), COLLECTOR NUMBER (11), HERBARIUM ACCESSION NUMBER (20).

NO. OF DESCRIPTORS 27.

DEFINE ITEMS:

1, , ,M.PAUCIFLORA BRANDEGEE , ,NO , ,TYPE ,BRANDEGEE T.S. ,M.PAUCIFLOR
A T.S.BRANDEGEE ,PURPUS C.A. ,3418 ,1 ,1908 ,6 , ,MEXICO ,PUEBLA ,
VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
UC ,131175 ,2 ,4 ,1 ,2 ,2 ,1 ,NA.

2, , ,M.PAUCIFLORA BRANDEGEE , ,NO , ,TYPE ,BRANDEGEE T.S. ,M.PAUCIFLOR
A T.S.BRANDEGEE ,PURPUS C.A. ,3418 ,1 ,1908 ,6 , ,MEXICO ,PUEBLA ,
VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
UC ,178785 ,2 ,2 ,1 ,1 ,2 ,1 ,NA.

3, , ,M.PAUCIFLORA BRANDEGEE , ,NO , ,TYPE ,BRANDEGEE T.S. ,M.PAUCIFLOR
A T.S.BRANDEGEE ,PURPUS C.A. ,3418 ,1 ,1908 ,6 , ,MEXICO ,PUEBLA ,
VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
NY ,0 ,2 ,2 ,1 ,1 ,1 ,1 ,NA.

4, , ,M.PAUCIFLORA BRANDEGEE , ,NO , ,TYPE ,BRANDEGEE T.S. ,M.PAUCIFLOR
A T.S.BRANDEGEE ,PURPUS C.A. ,3418 ,1 ,1908 ,6 , ,MEXICO ,PUEBLA ,
VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
US ,841146 ,2 ,2 ,1 ,1 ,1 ,1 ,NA.

5, , ,M.PAUCIFLORA BRANDEGEE , ,NO , ,TYPE ,BRANDEGEE T.S. ,M.PAUCIFLOR
A T.S.BRANDEGEE ,PURPUS C.A. ,3418 ,1 ,1908 ,6 , ,MEXICO ,PUEBLA ,
VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
MO ,1771294 , 2 ,2 ,1 ,1 ,1 ,1 ,NA.

6, , ,M.PAUCIFLORA BRANDEGEE , ,NO , ,TYPE ,BRANDEGEE T.S. ,M.PAUCIFLOR
A T.S.BRANDEGEE ,PURPUS C.A. ,3418 ,1 ,1908 ,6 , ,MEXICO ,PUEBLA ,
VIC. OF SAN LUIS TULTITLANAPA/NEAR OAXACA.
F ,276352 ,2 ,2 ,1 ,1 ,1 ,1 ,NA.

7, , ,M.PAUCIFLORA BRANDEGEE ,NEWCOMB G.B. ,NO , ,SP ,NA ,NA ,KIMNACH M
. ET DORAN R. ,161 ,NO ,1959 ,11 ,17 ,MEXICO ,OAXACA ,4.8 MI. BEYOND TEO
TITLAN TO TECOMAVACA,UC ,M 184602 ,2 ,2 ,1 ,1 ,1 ,2 ,3350 FT. OR M.

8, , ,M.PAUCIFLORA BRANDG. , ,NO , ,SP PHOTO ,NA ,NA ,SMITH C.E. ,S.N.
,NO ,1962 ,0 , ,MEXICO ,PUEBLA ,VENTA SALADA/S OF TEHUACAN,NO ,NO ,0
,0 ,0 ,0 ,0 ,2 ,SPEC. NOT YET DEPOSITED .

9, , ,M.PAUCIFLORA BRANDG. , ,NO , ,SP ,NA ,NA ,CONZATTI C. ,4130 ,NO
,1921 ,5 ,25 ,MEXICO ,OAXACA ,CUESTA DE SAN BERNARDINA ,US ,1081208 ,2
,2 ,1 ,1 ,1 ,1 ,NA.

10, , ,M.PAUCIFLORA BRANDG. , ,NO , ,SP ,NA ,NA ,SMITH C.E. ET PETERSON
F.A. ET TEJEDA H.,3563 ,13 ,1961 ,7 , ,MEXICO ,PUEBLA ,TEHUACAN AREA/NEA
R COXCATLAN ON CERRO AJUEREADO,F ,1556223 ,1 ,1 ,1 ,1 ,1 ,2 ,CA 1000-180
0 M. .

11, , ,M.PAUCIFLORA BRANDG. , ,NO , ,SP ,NA ,NA ,PURPUS C.A. ,5841 ,N

ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

PRINT CONTROL VOCABULARY*

1. OUTLINE OF MEDIAN LOBE
   OPTION=CODE NO. OF STATES= 8
   1. LINEAR
   2. TRUNCATE
   3. OVATE - OBLONG
   4. OVATE - OBLONG/PANDURATE
   5. PANDURATE: BASAL PORTION ROUNDED
   6. PANDURATE: BASAL PORTION PRODUCED WITH ROUNDED APEX
   7. PANDURATE: BASAL PORTION PRODUCED WITH POINTED APEX
   8. HASTATE/GLADIATE

2. LEAF VENATION
   OPTION=CODE NO. OF STATES= 2
   1. CAMPTODROMOUS
   2. CRASPEDODROMOUS

3. BASAL LOBULE APEX TERMINATION
   OPTION=CODE NO. OF STATES= 3
   1. SPINE
   2. NO SPINE
   3. NO BASAL LOBULE

4. SHAPE OF BASAL LOBULE APEX OF CRASPEDODROMOUS LEAVES
   OPTION=CODE NO. OF STATES= 3
   1. ACUMINATE
   2. CUSPIDATE/DILATED
   3. CAMPTODROMOUS LEAVES

6. NUMBER OF LOBES/COMPARATIVE SIZE
   OPTION=CODE NO. OF STATES= 7
   1. 3
   2. 3 + OCCASIONALLY 2 SMALLER
   3. 3 + 2 SMALLER
   4. 3 + 2 SLIGHTLY SMALLER
   5. 3 + 2 SMALLER + OFTEN 2 MINUTE
   6. 3 + 2 SLIGHTLY SMALLER + 2 SMALLER
   7. 5 - 9 OCCASIONALLY MORE

7. SIZE OF THE MEDIAN LOBE
   OPTION=CODE NO. OF STATES= 11
   1. LENGTH < 2.5 CM: WIDTH 1 - 2.5 CM
   2. LENGTH 2.5 - 5 CM: WIDTH 1 - 2.5 CM
   3. LENGTH 5 - 12 CM: WIDTH 1 - 2.5 CM
   4. LENGTH 5 - 12 CM: WIDTH 1 - 2.5 CM: DEEP INDENTATION
   5. LENGTH 5 - 12 CM: WIDTH > 2.5 CM
   6. LENGTH 5 - 12 CM: WIDTH > 2.5 CM: SHALLOW INDENTATION
   7. LENGTH 5 - 12 CM: WIDTH > 2.5 CM: DEEP INDENTATION
   8. LENGTH > 12 CM: WIDTH 1 - 2.5 CM
   9. LENGTH > 12 CM: WIDTH > 2.5 CM
   10. LENGTH > 12 CM: WIDTH 1 - 2.5 CM: INDENTATION
   11. LENGTH 5 - 12 CM: WIDTH < 1 CM

8. LOWEST LOBE SHAPE
   OPTION=CODE NO. OF STATES= 7
   1. SAME AS MEDIAN LOBE

(CONTINUED ON NEXT PAGE

2. SLIGHTLY SMALLER THAN MEDIAN LOBE: NON-SYMMETRIC
3. ABOUT 1/2 AS LONG AS MEDIAN LOBE: APEX CUSPIDATE
4. ABOUT 1/4 AS LONG AS MEDIAN LOBE: APEX ATTENUATE
5. ABOUT 1/2 AS LONG AS MEDIAN LOBE: S - SHAPED
6. VARIABLE: USUALLY SAME AS MEDIAN LOBE
7. ABOUT 1/4 AS LONG AS MEDIAN LOBE: APEX ROUNDED

9. BASE OF LAMINA
OPTION=CODE NO. OF STATES= 5
1. NON-PELTATE
2. NON-PELTATE: RUDIMENTARY LOBES PRESENT
3. NARROWLY PELTATE: 0.2 - 0.5 CM
4. WIDELY PELTATE: > 0.5 CM
5. VERY NARROWLY PELTATE: < 0.2 CM

10. LAMINA AT BASE OF MEDIAN LOBE SINUS
OPTION=CODE NO. OF STATES= 4
1. LAMINA DISJUNCT: LEAF APPEARS COMPOUND
2. LAMINA CONNECTED: NARROW < 0.5 CM
3. LAMINA CONNECTED: VARIABLE NARROW - WIDE
4. LAMINA CONNECTED: WIDE > 0.5 CM

11. WIDTH OF MEDIAN LOBE BASE
OPTION=CODE NO. OF STATES= 4
1. ONLY MIDRIB WITH PRACTICALLY NO LAMINA
2. < 0.25 CM
3. VARIABLE: NARROW - WIDE
4. > 0.25 CM

12. SHAPE OF SINUS
OPTION=CODE NO. OF STATES= 8
1. FIG. 1
2. FIG. 2
3. FIG. 3
4. FIG. 4
5. FIG. 5
6. FIG. 6
7. FIG. 7
8. FIG. 8

13. SHAPE OF PRIMARY CONSTRICTION OF MEDIAN LOBE
OPTION=CODE NO. OF STATES= 7
1. MOSTLY LONG: INCISED
2. MOSTLY LONG: CLEFT
3. MOSTLY SHORT: OCCASIONALLY LONG/SINUATE
4. MOSTLY SHORT: OCCASIONALLY LONG/ENTIRE
5. SHORT
6. NO CONSTRICTION: OVATE - OBLONG/LINEAR/TRUNCATE
7. NO CONSTRICTION: HASTATE - GLADIATE

14. POSITION/SHAPE OF SECONDARY CONSTRICTIONS OF MEDIAN LOBE
OPTION=CODE NO. OF STATES= 10
1. WITHIN/BELOW THE PRIMARY CONSTRICTION USUALLY DEEP
2. WITHIN THE PRIMARY CONSTRICTION RARELY BELOW
3. RARELY PRESENT BUT WITHIN THE PRIMARY CONSTRICTION
4. NO SECONDARY CONSTRICTION: PANDURATE
5. NO SECONDARY CONSTRICTION: OVATE - OBLONG/LINEAR/TRUNCATE

CONTINUED ON NEXT PAGE

6. ONE CONSTRICTION ONLY BELOW THE BASAL LOBULE
7. SEVERAL SHALLOW CONSTRICTIONS ABOVE THE BASAL LOBULE
8. NO CONSTRICTION: GLADIATE
9. NO SECONDARY CONSTRICTION: HASTATE
10. A VERY SHALLOW CONSTRICTION NEAR APEX

15. SHAPE OF MEDIAN LOBE APEX
OPTION=CODE NO. OF STATES= 15
1. FIG. 1
2. FIG. 2
3. FIG. 3
4. FIG. 4
5. FIG. 5
6. FIG. 6
7. FIG. 7
8. FIG. 8
9. FIG. 9
10. FIG. 10
11. FIG. 11
12. FIG. 12
13. FIG. 13
14. FIG. 14
15. FIG. 15

16. ABAXIAL SURFACE WAX PATTERN OF LEAF
OPTION=CODE NO. OF STATES= 3
1. SMOOTH
2. STUBBY
3. FARINOSE

17. PETIOLE LENGTH
OPTION=CODE NO. OF STATES= 3
1. SHORT < 5 CM
2. MEDIUM 5 - 15 CM
3. LONG > 15 CM

18. ARRANGEMENT OF LEAVES
OPTION=CODE NO. OF STATES= 2
1. VERY CLOSE ROSETTE-LIKE
2. WIDER SPACED

19. PLANT GROWTH HABIT
OPTION=CODE NO. OF STATES= 11
1. VINE
2. DECUMBENT SHRUB
3. SPINDLING SHRUB
4. ERECT SMALL SHRUB
5. ERECT TALL SHRUB - ERECT LOW TREE
6. LOW SPREADING TREE - SPREADING SHRUB
7. CROOKEDLY BRANCHING LOW TREE
8. TALL WOODY TREE
9. ERECT SHRUB OF VARIABLE HEIGHT
10. WEAK STEMMED TRAILING SHRUB
11. ERECT WOODY SHRUB

20. INFLORESCENCE
OPTION=CODE NO. OF STATES= 7

CONTINUED ON NEXT PAGE

6. ONE CONSTRICTION ONLY BELOW THE BASAL LOBULE
7. SEVERAL SHALLOW CONSTRICTIONS ABOVE THE BASAL LOBULE
8. NO CONSTRICTION: GLADIATE
9. NO SECONDARY CONSTRICTION: HASTATE
10. A VERY SHALLOW CONSTRICTION NEAR APEX

15. SHAPE OF MEDIAN LOBE APEX
OPTION=CODE NO. OF STATES= 15
1. FIG. 1
2. FIG. 2
3. FIG. 3
4. FIG. 4
5. FIG. 5
6. FIG. 6
7. FIG. 7
8. FIG. 8
9. FIG. 9
10. FIG. 10
11. FIG. 11
12. FIG. 12
13. FIG. 13
14. FIG. 14
15. FIG. 15

16. ABAXIAL SURFACE WAX PATTERN OF LEAF
OPTION=CODE NO. OF STATES= 3
1. SMOOTH
2. STUBBY
3. FARINOSE

17. PETIOLE LENGTH
OPTION=CODE NO. OF STATES= 3
1. SHORT < 5 CM
2. MEDIUM 5 - 15 CM
3. LONG > 15 CM

18. ARRANGEMENT OF LEAVES
OPTION=CODE NO. OF STATES= 2
1. VERY CLOSE ROSETTE-LIKE
2. WIDER SPACED

19. PLANT GROWTH HABIT
OPTION=CODE NO. OF STATES= 11
1. VINE
2. DECUMBENT SHRUB
3. SPINDLING SHRUB
4. ERECT SMALL SHRUB
5. ERECT TALL SHRUB - ERECT LOW TREE
6. LOW SPREADING TREE - SPREADING SHRUB
7. CROOKEDLY BRANCHING LOW TREE
8. TALL WOODY TREE
9. ERECT SHRUB OF VARIABLE HEIGHT
10. WEAK STEMMED TRAILING SHRUB
11. ERECT WOODY SHRUB

20. INFLORESCENCE
OPTION=CODE NO. OF STATES= 7

CONTINUED ON NEXT PAGE

1. SOLITARY FLOWER: RARELY 2
2. RACEME: SUBSPICATE/CORYMBOSE
3. RACEME: SUBSPICATE
4. RACEME: VARIABLE OF LESS THAN MEDIUM LENGTH
5. PANICLE: MEDIUM SIZE
6. PANICLE: LONG WITH MUCH BRANCHING
7. RACEME: LONG

21. POSITION OF FEMALE FLOWERS IN THE INFLORESCENCE
OPTION=CODE NO. OF STATES= 4
1. DIVERSE
2. ONLY ABOVE THE LOWER HALF OF RACHIS ON LONG PEDICELS
3. ONLY AT THE BASE OF INFLORESCENCE
4. FLOWER SOLITARY

22. OPEN FLOWER REFLEXION
OPTION=CODE NO. OF STATES= 2
1. REFLEXED
2. STRAIGHT

23. NATURE OF BRACTEOLES
OPTION=CODE NO. OF STATES= 4
1. FOLIACEOUS
2. NON-FOLIACEOUS
3. NO BRACTEOLE: FLOWER SOLITARY
4. SEMI-FOLIACEOUS

24. COLOR OF BRACTEOLE IN HERBARIUM MATERIAL
OPTION=CODE NO. OF STATES= 3
1. PURPLISH
2. GREENISH WHITE
3. NO BRACTEOLE

25. NATURE OF BRACTLETS
OPTION=CODE NO. OF STATES= 3
1. FOLIACEOUS
2. NON-FOLIACEOUS
3. ABSENT

26. COLOR OF MATURE FLOWER TEPAL
OPTION=CODE NO. OF STATES= 2
1. GREENISH YELLOW
2. PURPLISH STREAKED

27. SHAPE OF MATURE MALE BUD
OPTION=CODE NO. OF STATES= 6
1. LONG ALMOST TUBULAR
2. ALMOST TUBULAR WITH A TENDENCY TOWARD INFLATION AT THE BOTTOM
3. DISTINCTLY CONSTRICTED IN THE MIDDLE/INFLATED AT THE BOTTOM
4. CONE SHAPED
5. CAMPANULATE
6. AURICULATE

28. LENGTH OF MALE TEPAL
OPTION=CODE NO. OF STATES= 2
1. > 2 CM
2. < 2 CM

CONTINUED ON NEXT PAGE

29. POSITION OF FRUITS IN THE FRUIT CLUSTER
OPTION=CODE NO. OF STATES= 4
1. BASAL
2. ABOVE THE LOWER HALF OF THE RACHIS
3. BASE UPTO APEX OF INFLORESCENCE
4. SINGLE FRUIT CONNECTED WITH THE STEM DIRECTLY

30. COLOR OF FLOWER BUDS
OPTION=CODE NO. OF STATES= 2
1. GREENISH YELLOW
2. PURPLISH

31. SIZE OF MATURE FRUIT
OPTION=CODE NO. OF STATES= 5
1. SMALL: HEIGHT < 1.25 CM
2. MEDIUM: HEIGHT 1.25 - 1.75 CM
3. LARGE: HEIGHT 1.75 - 2.5 CM
4. VERY LARGE: HEIGHT > 2.5 CM
5. VARIABLE: 1.25 - 2.5 CM

32. FRUIT SURFACE
OPTION=CODE NO. OF STATES= 3
1. WITHOUT RIBS
2. PERCEPTIBLY RIBBED
3. PROMINENTLY RIBBED

33. FRUIT APEX
OPTION=CODE NO. OF STATES= 3
1. WITHOUT POINT
2. SLIGHTLY POINTED
3. PROMINETLY POINTED

34. SEED SIZE/SHAPE
OPTION=CODE NO. OF STATES= 7
1. SMALL ROUND: < 1 CM
2. SMALL OBLONG: < 1 CM
3. MEDIUM ROUND: 1 - 1.5 CM
4. MEDIUM OBLONG: 1 - 1.5 CM
5. LARGE ROUND: 1.5 - 2 CM
6. LARGE OBLONG: 1.5 - 2 CM
7. VERY LARGE: > 2 CM

35. PUBESCENCE OF YOUNG STEM
OPTION=CODE NO. OF STATES= 3
1. PUBESCENT
2. SPARSELY PUBESCENT
3. GLABROUS

36. PUBESCENCE OF MATURE STEM
OPTION=CODE NO. OF STATES= 3
1. PUBESCENT
2. SPARSELY PUBESCENT
3. GLABROUS

37. TEPAL PUBESCENCE
OPTION=CODE NO. OF STATES= 3

CONTINUED ON NEXT PAGE

1. PUBESCENT
2. GLABROUS
3. SPARSELY PUBESCENT

38. PUBESCENCE OF BRACTLETS
OPTION=CODE NO. OF STATES= 3
1. PUBESCENT
2. GLABROUS
3. SPARSELY PUBESCENT

39. ROOT
OPTION=CODE NO. OF STATES= 2
1. TUBEROUS
2. NON-TUBEROUS

40. COLOR OF MATURE STEM
OPTION=CODE NO. OF STATES= 5
1. REDDISH BROWN
2. DARK REDDISH BROWN
3. BROWNISH GREY
4. GREENISH BROWN
5. SILVERY GREY

41. POSITION OF BRACTLETS IN THE PEDICEL
OPTION=CODE NO. OF STATES= 5
1. AT HALFWAY
2. NEAR THE BASE
3. ONE NEAR BASE: ONE AT HALFWAY
4. NEAR TOP
5. NO CONSISTENT PATTERN

42. BRACTEOLE MARGIN
OPTION=CODE NO. OF STATES= 3
1. SMOOTH
2. SERRATE
3. NO BRACTEOLE

43. PUBESCENCE OF OVARY
OPTION=CODE NO. OF STATES= 2
1. PUBESCENT
2. GLABROUS

44. PUBESCENCE OF PEDICEL
OPTION=CODE NO. OF STATES= 2
1. PUBESCENT
2. GLABROUS

48. ROGERS ET APPAN IDENTIFICATION
OPTION=CODE NO. OF STATES= 21
1. M.PAUCIFLORA T.S.BRANDEGEE
2. M.WALKERAE CROIZAT
3. M.MICROCARPA MUELL.ARG.
4. M.MICROCARPA SSP. PARVICOCCA STAT.NOV.
5. M.MEXICANA I.M.JOHNSTON
6. M.ANGUSTILOBA [TORR.] MUELL.ARG.
7. NEW TAMAULIPAS SPECIES
8. M.CHLOROSTICTA STANDLEY ET GOLDMAN

CONTINUED ON NEXT PAGE

ID: MANIHOT MORPHOLOGICAL DATA BANK - 3 OCT. 68

9. NEW OAXACA SPECIES
10. M.LUDIBUNDA CROIZAT
11. M.DAVISIAE CROIZAT
12. M.AESCULIFOLIA [H.B.K.] POHL
13. M.AESCULIFOLIA SSP. INTERMEDIA STAT.NOV.
14. M.ESCULENTA CRANTZ
15. M.AURICULATA MCVAUGH
16. M.ISOLOBA STANDLEY
17. M.CAUDATA GREENMAN
18. M.MICHAELIS MCVAUGH
19. M.FOETIDA [H.B.K.] POHL
20. M.PRINGLEI WATSON
21. M.TOMATOPHYLLA STANDLEY

PRINTED: 10/01/68

A SAMPLE BOOK OF A FEW MANIHOT SPECIMENS

BELOW IS A LIST OF THE DESCRIPTORS FOR THIS BOOK IN THEIR HIERARCHICAL ORDER.

COUNTRY OF COLLECTION
PROVINCE/STATE OF COLLECTION
HERBARIUM
MOST RECENT IDENTIFICATION
COLLECTOR
COLLECTOR NUMBER
HERBARIUM ACCESSION NUMBER
ITEM NO.

NUMBER OF ITEMS IN THIS BOOK = 47

MEXICO

COAHUILA

F

M.ANGUSTILOBA [TORR.] MUELL.ARG.
MARSH E.G.
1163
1224398
47

TEX

M.ANGUSTILOBA [TORR.] MUELL.ARG.
MARSH E.G.
1163
ILLEG.
48

HIDALGO

GH

M.CARTHAGINENSIS [JACQ.] MUELL.ARG.
WALKER E.J.
1003
NO
21

JALISCO

GH

M.MEXICANA
PALMER E.
156
NO
49

NY

M.MEXICANA
PALMER E.
156
NO
50

NUEVO LEON

F

M.ANGUSTILOBA [TORR.] MUELL.ARG.
EDWARDS M.T.
411
902956
45

PERKINS A.E. ET HALL J.M.
3565
1511454
39

MO

M.MEXICANA JOHNST.
GREGG J.
198
1771295
32

TEX

M.ANGUSTILOBA [TORR.] MUELL.ARG.
EDWARDS M.T.
411
1181948
46
88369
44

NUEVO LEON
TEX
M.WALKERAE CRUTTAT
CRUTCHFIELD J. ET JOHNSTON M.C.
5460 A
180147
41

OAXACA
UC
M.PAUCIFLORA BRANDEGEE
KIMNACH M. ET MORAN R.
161
M 184202
7

US
M.PAUCIFLORA BRANDG.
CONZATTI C.
4130
1081208
9

PUEBLA
F
M.PAUCIFLORA BRANDEGEE
PURPUS C.A.
3418
276352
6

M.PAUCIFLORA BRANDG.
SMITH C.F. ET PETERSON F.A. ET TEJEDA N.
3563
1556223
10

MO
M.PAUCIFLORA BRANDEGEE
PURPUS C.A.
3418
1771294
5

NO
M.PAUCIFLORA BRANDG.
SMITH C.F.
S.N.
NO
8

NY
M.PAUCIFLORA BRANDEGEE
PURPUS C.A.
3418
NO
3

TEX
M.PAUCIFLORA BRANDG.
SMITH C.F. ET PETERSON F.A. ET TEJEDA N.
3563
209011
13

MEXICO

PUEBLA

UC

M.PAUCIFLORA BRANDEGEE
PURPUS C.A.
3418
131175
1

178785
2

M.PAUCIFLORA BRANDG.
PURPUS C.A.
5841
187528
11

US

M.PAUCIFLORA BRANDEGEE
PURPUS C.A.
3418
841146
4

M.PAUCIFLORA BRANDG.
ROSE J.N. ET PAINTER J.H. ET ROSE J.H.
10114
453614
12

TAMAULIPAS

ARIZ

M.ANGUSTILOBA (TORR.) MUELL.ARG.
LESUEUR H.
246
70283
37

F

M.ANGUSTILOBA (TORR.) MUELL.ARG.
LESUEUR H.
246
1003350
36

GH

M.ANGUSTILOBA (TORR.) MUELL.ARG.
KENOYER L.A.
C 142
NO
31

M.SP.
PRINGLE C.G.
2243
NO
24

MICH

M.ANGUSTILOBA
HERMANN F.J.
13695
NO
34

MEXICO
TAMAULIPAS
MICH
M.ANGUSTILOBA (TORR.) MUELL.ARG.
BARTLETT H.H.
10413
NO
35
13695
NO
33
TEX
M.ANGUSTILOBA (TORR.) MUELL.ARG.
LESUEUR H.
246
88370
38
M.WALKERAE CROTZAT
CRUTCHFIELD J. ET JOHNSTON M.C.
5523
186634
40
5572 B
186345
29
5784 F
ILLEG.
42
GRAHAM J. ET JOHNSTON M.C.
4721 B
174836
43
JOHNSTON M.C.
5363 B
179951
30
UNKNOWN
UNKNOWN
F
JATROPHA
SCHOTT A.
52
280989
16
42502
17
NY
M.WALKERAE CROTZAT
SCHOTT A.
S.N.
NO
14
15

TEXAS

A
M.WALKERAE CROIZAT
PARKS H.B.
S.N.
NO
22
23

MO
M.CARTHAGINENSIS (JACQ.) MUELL.
WORNOCK R.H. ET BARKLEY F.A.
147
1272285
18

NO
M.WALKERAE CROIZAT
ROGERS D.J.
522
NO
25

UC
M.CARTHAGINENSIS (JACQ.) MUELL.ARG.
WORNOCK R.H. ET BARKLEY F.A.
147
869189
19

US
M.WALKERAE CROIZAT
WORNOCK R.H. ET BARKLEY F.A.
147
1887761
20