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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.

- Taxonomy Laboratory

July 6, 1966

Miss Beryl Robichaud
Vice President
McGraw-Hill, Inc.
Hightstown, N.J. 08520

Dear Miss Robichaud:

Dr. Rogers has left for Mexico. However, August 4 does not appear to conflict with anything, so we will expect you.

Sincerely,

Henry S. Fleming
Professor of Botany

HSF:ch

- Taxonomy Laboratory

July 6, 1966

Miss Anna M. Lee
Department of Biostatistics
School of Public Health
The University of Michigan
Ann Arbor, Michigan 48104

Re: Letter to Dr. D. J. Rogers
New York Botanical Garden
June 27, 1966

Dear Miss Lee:

The program you are referring to is available through IBM. The listing is available through the title "A taxonomy program for the IBM 704" produced by T. T. Tanimoto and Robert A. Loomis. The program deck is also available through the IBM Applications Library at 590 Madison Ave., New York 22, N.Y.

Our own laboratory has since abandoned this approach. Though the information provided by the concept was an improvement on what had been previously available, the biological premises were too restrictive and the mathematical definitions inadequate biologically. We have written a new program for the analysis of characters using the information theory base employed in the former program but with an entirely different base of definition. This program at present is being debugged for the IBM 7044 and 7094.

As a clustering program, we are using a computer program based on graph theory—a relatively new, 10 to 15 years or so, math discipline—and find it far more satisfactory for developing classifications than the original Rogers-Tanimoto program you referred to. Unfortunately, we do not have listings and program decks available yet, though it has been debugged and is running on the IBM 7044 and 7094. If you are interested in this program, write Dr. Rogers toward the end of July as he will be in Mexico until then (but see *Systematic Zoology* 15: 59-69).

You will have noticed from the above letterhead that we have moved from the New York Botanical Garden. Any future correspondence should be sent here to the Taxonomy Laboratory.

Sincerely,

Henry S. Fleming
Professor of Botany
(Assistant to Dr. D. J. Rogers)

HSF:ch

- Taxonomy Laboratory

July 1, 1966

Dr. Hugh Cutler
Missouri Botanical Garden
St. Louis, Mo.

Dear Hugh:

I am enclosing a key. I am unable to discover a lock in Colorado that will accept it. There is just a chance that it belongs to you, though the morning Mary and I left, I thought I had left it on the dresser.

Dave just left for a few weeks in Mexico. You guessed it--he is after more Manihot specimens.

He and I have said several times that we would try to make your annual systematic symposium this year. My recollection is that it occurs in October. If you can spare the time, would you drop me a line giving the details of the symposium?

Tell Marion instead of joy riding down a flooding Missouri River, why doesn't she get you to come out here with it and we'll give you a nice piece of dry foothill prairie to set it up in. Come out anyhow and we'll show you some mountains. Sometimes we should go down the river through Dinosaur National Park.

Best to Marion and the best from Mary.

Sincerely,

Henry S. Fleming
Professor of Botany

HSF:ch

Enc.

- Taxonomy Laboratory

July 6, 1966

Mr. George F. Freytag
Head, Agronomy Department
Escuela Agricola Panamericana
Tegucigalpa, Honduras

Dear Mr. Freytag:

Dr. Rogers left for Mexico July 1 in search of more Manihot.
He expects to return around the end of July and will answer your
letter of June 30, 1966 as soon as possible thereafter.

Sincerely,

(Mrs.) Cleo Hepworth
Secretary

- Taxonomy Laboratory

July 6, 1966

Mr. S. H. Schmer
Botany Department
The University of Tennessee
Knoxville, Tennessee 37916

Dear Sy:

Dave has left for Mexico to collect Manihot. We used to have a chap further south who had a very bright future and was working on a very small segregate of Manihot, a species M. esculenta, I believe. However, he has fallen by the wayside and will or has come to a very sticky end.

I do hope he does not confuse Juncus with Junco but it would be exciting if he did. Dave will be back near the end of the month.

Sincerely,

Henry S. Fleming
Professor of Botany

HSF:ch

July 8, 1966

Dr. Herman Goldstine
International Business Machines Corporation
Yorktown Heights Research Center
Yorktown Heights, New York

Dear Dr. Goldstine:

Enclosed herewith are flowcharts and documentation for our Similarity-Clustering Program, a principal part of the larger package required for classification.

We are sending you these documents as a sort of progress report for the grant made to us by IBM. These, with other necessary documentation, will be submitted to the SHARE library for their acceptance.

Without too much self-admiration, I must say that the Similarity-Clustering Program sent here comes closest to meeting the needs of life scientists of any we have encountered. A number of applications in botany, made with our collaboration, have proved that this package comes closest to satisfaction of the biologists of any such methodology. The number of new insights provided by this program into complex biological data is rather remarkable, and we are still finding new interpretations made possible by this method.

As you might have anticipated, we have not progressed as far as we had hoped to in this year's operation. The usual problems faced us—a bigger problem than we anticipated; unfamiliarity with computer configurations; modifications made necessary by apparent errors and inefficiencies in the original program, etc. Our biggest delay occurred as a result of Western Data Processing Center's switch-over to a new direct coupling arrangement. The result of the confusion in this operation was that we moved our operations to the 7044 in the Graduate School of the University of Colorado, Boulder, where we received the best service that we have ever had. I must say that it was a pleasure to work with a whole operating staff, from manager down, that really knew their hardware and software.

Hopefully, the Western Data Processing Center is back in action, and we expect to continue with the remaining parts of our work through the tele-processing unit on the 7094 in Los Angeles. We will continue there until about this time next year when we hope to have installed a 360/44 on this campus. Again, because we have some of our work in assembly language, we will have conversion problems, but these may not be as serious as we presently anticipate.

July 8, 1966

The largest remaining tasks in converting to FORTRAN IV involve programs labelled as "character analysis" and satellite programs for the cluster analysis. The satellite programs are for printing a graph of the results, and for discovering the minimum similarities within any cluster. We also hope to discover some means to program the printing routines for drawing sub-graphs, but the complexities and uncertainties to be found in this process have made it impossible to see how to set up a flowchart.

Tied in with classification is a large number of problems in information retrieval. Since biological classifiers have been using certain information retrieval systems set up on an intuitive basis, we hope to extract from them models which will be compatible for computers. The copying of past methods in other classificatory processes for computer programs has paid off in our clustering methodologies. It may pay off for information retrieval, and we feel this is our next set of objectives.

I trust that the enclosures are informative and useful. Please feel free to ask any questions regarding the concepts or program.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

July 11, 1966

Dr. Jerry S. Kidd
Program Director for
Special Projects Program
Office of Science Information Service
National Science Foundation
Washington, D.C. 20550

Dear Dr. Kidd:

Dr. Rogers is at the present time on a collecting trip to Mexco. I expect he will be away till near the end of July.

However, the end of August, specifically the week of the 29th of August, will be reserved for you. When you know the details of your plans, E.T.A. Denver, etc., let us know and we can arrange to meet you at the airport.

We are looking forward to seeing you.

Sincerely,

Henry S. Fleming
Professor of Botany

HSF:ch

- Taxonomy Laboratory

July 21, 1966

Mr. Mac MacKeever
The New York Botanical Garden
Bronx Park
Bronx, New York

Dear Mac:

Some time ago I think I indicated to you that I had made a search of my files and have not been able to locate the blue slips needed by your filing system. As I think I must have indicated to you earlier since I do not have these slips, I would be very pleased if you would send me Xerox copies of these blue shipping notices, and we'll be glad to sign those in place of the others. I hope this is satisfactory. It represents the best I can do. I hope the trip to your favorite island was successful. I am just back from a very unsuccessful trip to northwestern Mexico. We got there before the rains did, and as a result, no Manihot showed anywhere.

Best to everybody,

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

July 21, 1966

Ing. Agr. Julian Camara-Hernandez
Botanical Museum
Harvard University
Oxford Street
Cambridge, Massachusetts 02138

Dear Mr. Camara-Hernandez:

I have been completely unsuccessful in obtaining travel funds for the International Congress of Americanists. I wonder if you have had any success at all in obtaining funds through the Organizing Committee of the Congress. I would appreciate your earliest reply to this letter as I must either accept or decline the invitation very shortly.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

July 21, 1966

Dr. Llewellya H. Colinvaux
Botany and Plant Pathology
College of Biological Sciences
The Ohio State University
Columbus, Ohio 43210

Dear Llewellya:

It was good to hear from you in your letter of the first. I should have answered sooner but I am just back from Mexico.

I would like to suggest the following as a procedure for us with regard to Halimeda. We have developed a completely new computer program for clustering of organisms which we find to be much more satisfactory than the one we had used earlier on your data. I am enclosing a reprint of an article which describes this new methodology, at least as far as the biological aspects of the program are concerned. This method gives much clearer pictures of the structure and hierarchical organization than we got with the other program, and you can now get a much better idea of the inner relations between your species and subspecific categories than we ever had before. With this in mind, would it not be a good idea to put all of the species data onto cards, run it through this program, and then you would have an overall interrelationship between each of the entities which you wish to recognize?

We have also become a bit more sophisticated on the method of use of characters and how to set up the characters. We can now come a little closer to reflecting the taxonomist's desires and thoughts about the characters that he uses, and I think that it would be interesting to go back and do the whole thing again. This is not to suggest that the work that has already been done in coding up the species that you had already wrapped up in the monograph need to be completely recoded. The characters as they were set up can still be used, but the way they are set up can be modified to fit the new conditions. It is probably the case that you have had an opportunity to discover that the characters as we use them need some sort of modification, however. We no longer use the Port-A-Punch coding device or recording device because it is too much difficulty. We just use a standard card format input that I will show you if you care to go ahead with this. The advantage is to this process is that you can go to the new species or new material that you have and incorporate

whatever data is available on them in the same manner and run it right through. I would suggest that the whole process should not take very long because you can probably just go to the new material rather quickly.

Unfortunately, we can no longer code the data for the specimens for you. This is something that we are asking all of our collaborators to do for themselves. What we will do is to provide you with aid in setting up the characteristics and punching the cards, and running the program. After the program is run, we can suggest a method of interpretation that should be put upon it. If you are interested in this process, we will be glad to go ahead on that basis. I certainly hope you are because we have a warm spot in our heart for Halimeda. We are looking forward to having your affirmative reply.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

July 25, 1966

Dr. Perry R. Stout, Chairman
Dept. of Soils & Plant Nutrition
University of California
Davis, California

Dear Dr. Stout:

I am prompted to write after having read your paper in BioScience, "Plant science research strength in American universities, 1965-1975."

Inasmuch as the results of your work will probably have some rather fundamental effect on the thinking processes for the various granting agencies and policy within the National Academy of Sciences, it seemed to me that I should point out what I feel to be a fundamental omission with respect to plant taxonomy. Of course, I realize that you cannot be on top of the latest developments in all of the disciplines of botany, but there is one place where I feel that your sampling technique broke down, and that is that the newer endeavors in taxonomy were not at all reflected by those taxonomists who answered the inquiry.

Taxonomy, much as plant physiology and biochemistry could not begin to be a useful or fundamental contributor to modern biology until certain methodologies and techniques from chemistry came forward, could not contribute greatly until the development of certain pieces of equipment, particularly the computer. Although a survey at this date would not indicate more than a half dozen people who are using a computer in taxonomy, particularly plant taxonomy, I think you will discover that in the next decade the growth of the use of the computer for this field will be phenomenal. Although I am one of the few taxonomists who specifically devote their attention to the applications of computers to the complexities of plant classification at this stage of the game, I know that any number of young Ph.D.s and graduate students around the country are vitally interested in methodologies dealing with the computers.

Since this is the case, there should have been some reflection in your survey of a greatly increased need for computers, and therefore, a vast expenditure of funds to put computers in several taxonomic centers in the country. The types of computer hardware needed for plant classification is not the small core, small memory computer but the very largest computer with the greatest speed and storage capacity. These pieces of equipment must be primarily under the control of the taxonomist

July 25, 1966

rather than to be a university-centered computer, that is, the primary responsibility and control and use of these computers will be for taxonomy alone with only secondary utilization by such people as mathematicians, etc. The cost of the computer centers is astronomical as you know-- (that is, astronomical in terms of biological expenditure). But their application is such that the quantum jumps to be made in taxonomy as a result of their use will certainly justify their cost.

It seems to me that it is critical to add an addendum to your paper, perhaps in a subsequent issue of BioScience which helps to show this need. I would be glad to work with you to help flesh out the information about the needs for computers and classification, and also to point out in such a paper the new direction that taxonomy inevitably has to take.

I am looking forward to having your comments on this letter.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:chh

- Taxonomy Laboratory

July 25, 1966

Dr. Robert Thacker
ONR Resident Representative
University of Denver
Columbine Hall
2030 E. Evans
Denver, Colorado 80210

Dear Dr. Thacker:

I should like to determine if ONR supports summer institutes or intensive short courses. We would like to offer about a 3-week intensive program here at Colorado State University on the use of computers in biological classifications. We think there are probably a number of interested workers around the country who could profit by such.

If ONR has a program for sponsoring such activities, would you please send me the necessary literature? I will be looking forward to hearing from you.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

July 26, 1966

P - S - F Inc.
Box 392
Pottstown, Pennsylvania 19464

Gentlemen:

Can you supply materials for map backing similar to the enclosed sample in pieces sized 46" wide by approximately 110" long? We are specifically interested in pieces large enough to mount maps whose dimensions are 46" x 35". Please quote prices if available.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

July 26, 1966

Dr. Julian A. Steyermark
Instituto Botanico
Apartado 2156
Caracas, Venezuela

Dear Julian:

Thanks for your letter of the 6th indicating your willingness to serve as a consultant on the Cinchona work. If I may, I would like to recommend consultant's fee at the rate of \$100 per day plus per diem and travel expenses where required. I anticipate that the need for your advice will come at a time when you will be in New York, and you can either fly out here or we can come there, whichever is the most convenient. For the first year I have listed a \$500 total for consulting with you but anticipate yearly additions.

I am basing the rate on that given to me by our own administrative official who suggested a daily rate rather than a flat total for the year. I trust that this will be satisfactory.

Best wishes,

David J. Rogers
Professor of Botany

DJR:ch

July 27, 1966

Dr. P. F. Knowles
Agronomy Department
University of California
Davis, California 95616

Dear Paul:

When I returned I found a letter that you had written suggesting places to stay at Pullman, etc. I had left the Friday before the Tuesday meeting at Pullman, as I had wanted to stop off at Montana State University which was on the way, but thanks for your thoughts.

Enclosed is a copy of our M. esculenta coding. You will notice a total of 15 characters, K^1 , K^2 , K^3 , etc. The majority of the characters have states which are mutually exclusive. In other words, we can record a simple "yes" or "no", "present" or "absent" for at least one state of a particular character for each specimen. All characters in the M. esculenta list that have no value given for N and k or are not accompanied by a matrix such as character K^5 are of this type. The character "leaf color" in your C. t., which just off hand I would divide into (1) grey-green and (2) dark green, or the character "early inflorescence color" (1) yellow or (2) yellow orange, I should consider as of this type.

Those characters that have a value to the right of the states given to k and N are characters in which the states are not considered as mutually exclusive. In character K^2 , "color of stem", the value, $K = 1$, signifies that specimens possessing states that are adjacent in the coding will not be considered as completely dissimilar. In the instance of K^2 , a plant that has a silver stem will be considered slightly more than half similar to a plant with a silver-brown stem but will be completely dissimilar to a plant that has a brown or yellow stem. You will notice that states 3 and 4 have no assigned state. One of these states is redundant at the moment and was included for private reasons which do not concern us at the moment. One null state, state 3, is sufficient so that a specimen which has silver-brown stems will not be considered at all similar to a specimen with brown stems. Your character "spinyess of leaves" could qualify for this type of coding. My feeling is that plants with only an apical spine should be separated from those with few spines or moderately spined. Thus:

1. apical spine
 2. 0
 3. few spines
 4. moderately spined
 - etc.
- K = 1

In other words, I suppose I hypothesize that the apical spine is under different genetic control than the other spines.

The symbol, N, refers to the number of states that are to be considered as ordered. Notice character K⁶. The symbol k = 1 means that neighboring states are to reflect some similarity and N = 2 will restrict the states that can exhibit this similarity to the first two states. Namely, those plants that have slightly or moderately raised scars will be considered as somewhat similar, but plants with smooth or very large scars will be completely different from these slightly or moderately raised scars plants and also completely different from each other.

The third type of modification possible is for characters that are not composed of states that are continuous or orderable. They can be called reticulate characters. Character K⁵ of M. esculenta is of this type. The matrix gives the computer (as a look-up table) the degree of similarity to be assigned to plants with particular states. A plant that is unbranched (state 16) is half similar (.500) to a plant that is branched at the top (state 1) but completely unsimilar to a plant that is branched at top, 3/4, 1/2, 1/4 (state 15), and so forth. I am not suggesting that your character in C. t. be set up in this fashion. That is a decision that you will have to make. As a matter of fact, I did not get an intuitive feeling for the justification for setting your plants up in 1/5s but again it must be considered that I do not know your material.

Note characters in M. esculenta, K⁹ and K¹⁰. State 4 in both of these characters is titled "logical." The logical state is used in those characters in which the character is applicable to some specimens in the collection and not to other specimens. The latter specimen would be coded as not logical. A simple example: Some plants have sepals and some plants do not. Those plants that have sepals have an additional character that describes the shape of the sepals. This character must contain a logical state for the coding of plants that do not have sepals. It is meaningful information that we cannot assign a state of shape to those plants lacking sepals and it is consequently, important to assign a state for the containment of this information. I consider that the coloring of the matured flowers of your plants might qualify for this type of treatment. In other words, in a character concerned with faded flowers, the colors of those plants coded for in a previous character "color of fresh inflorescence", yellow flowers, should have a logical state for coding those plants that have yellow-orange flowers when fresh.

At all events, if any of the above seems confusing, we will go over it when you visit us in August. We can also inform you about the theoretical basis for what we are doing and the nature of the computer output.

Dr. P. F. Knowles

- 3 -

July 27, 1966

The important consideration at the moment is to have a list of the characters and probable states to talk over. We will do the card punching for you from data sheets which we will supply and inform you how to fill out.

If you write us when you expect to arrive, we can make a reservation at a number of local motels for you. At all events we will see that you have a place to lay your head. As I told you in Pullman, the Monday (Aug. 29) following the weekend you expect to arrive, we have a visitor so you may be a bit neglected.

Sincerely,

Henry S. Fleming
Assoc. Prof. of Botany

HSF:ch

Enc.

Please note: After surveying this list, I find it meaningless for me to attach a ranking to these words which has any significance.

If for the sake of the project it is essential that a ranking be given, please let me know and I will force a rank order on the enclosed list. But if it is possible to accomplish the project without this ranking, I will be much happier.

The terms placed to the right as synonyms under one general term may indeed fit more comfortably under other of the general terms and the combination in a title for example may throw any one of the synonyms into a general term rather than as a synonym for one of the general terms to which I have assigned it.

(Continued on attached page)

GENERAL TERMS

SYNONYMS

quantitative taxonomy

Numerical taxonomy (German = numerische taxonomie), taxometrics, computer classification, automatic classification.

Quantitative classification, quantitative systematics, biometric classification, statistical taxonomy.

Any mathematical designation coupled with classification, systematics, or taxonomy, i.e., graph theory, information theory, factor analysis, principal component analysis, iterative techniques, partitioning, etc.

Classification models.

Pattern analysis and/or recognition.

Phenetic classification.

Non-Linnean classification.

Adansonian methods, (also include search for Adanson).

Medical classification and/or diagnosis.

Hierarchical classification (non-hierarchical classification).

Clustering techniques for classification

Iterative techniques for cluster analysis; several statistical terms apply, i.e., multivariate analysis, principal component linkage analysis, factor analysis, multidimensional analysis, etc.

Plus other mathematical disciplines.

(Continued on attached page)

GENERAL TERMS

SYNONYMS

Similarity measures

Distance functions, correlation coefficients, Pearson-Lee regression coefficients, simple matching coefficients.

Character analysis

Differential operators, character coding, bionumeric codes, weighted and/or unweighted characters.

Evolution models and computer programs

1. cladistics
2. phylogenetic
3. branching sequences in phylogeny
4. ground-plans

Key programs with computers

Identification routines.

Numerical representation.

Applications to specific groups of plants or animals of any of the above categories.

Books or articles entitled "Use of computers in"

- a. biology
- b. anthropology
- c. sociology
- d. psychology

- Taxonomy Laboratory

July 28, 1966

Dr. Theodore J. Crovello
Department of Entomology
The University of Kansas
Lawrence, Kansas 66045

Dear Ted:

Under separate cover I am returning your thesis. I have made some comments both in the margin and on pieces of paper along with it. You can take these for what they are worth. They are my opinion based on our experiences in this field.

Most of these comments are intended to try to sharpen up our language and what must be done in order to bring the whole bit of mathematical models and the science of taxonomy up to a more scientific level. When one embarks upon the process of employing mathematics and computers in any field, one is obligated to express one's self in such a way that mathematicians as well as biologists can understand the meaning. Under these circumstances, unless you follow procedures given in mathematics, that is, the statement of premise, the establishment of rules, the discussion and certainty and the certainty that the rules used do not contain any illogical process, you will not succeed in the discussion. I know, I have had this difficulty myself. Our training as taxonomists does not give us any of the precision required for this field, nor, unfortunately, do courses labelled as biostatistics do it either. It apparently takes more training and more disciplining in the mathematical field itself than we can expect to have. It is for reasons such as this that I personally have employed mathematicians trained broadly in that discipline rather than to try to wrap up the needed mathematics myself. I find that being a taxonomic botanist is a full-time occupation and requires the best efforts of my part to understand what is going on mathematically but to insist that the mathematician do the mathematics only after he and I thoroughly understand what is wanted.

It is clear, I think, from my little comments that I am trying to get across an attitude that I think we must assume if we are to get any kind of models to work for us and any kind of computer programs. Really when it comes down to it, many of the problems deal with the identifying pieces of information which we frequently refer to as characters and character states. These problems of characters and character states are not new. They have been with us for years and years and years. I think

July 28, 1966

it is time that we recognized that a character is strictly a construct in the mind of the biologist and has very little significance from the standpoint of the biology of the plant itself. This refers to any classification, not only those in which we try to get a computer to make the necessary comparisons for us, or whether we are doing a strictly 19th-century, straight forward classification as perhaps Asa Gray may have done it.

Although I still feel that we are doing pioneering work in helping the science to grow, I have lost, as you can see, some of the missionary fervor which usually accompanies the first shifts out an old and into a new way of doing things. Although we may eventually end up with some good useful computer programs—I think there are some running around now—we still have a very long way to go before we can claim to have a satisfactory procedure, and I still think that all we are doing is developing procedures, we are really not changing our attitudes, goals, or desires in the field of taxonomy.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 31, 1966

Miss Margaret N. Eccles
Production Editor
Scientific Book Department
APPLETON-CENTURY-CROFTS
Division of Meredith Publishing company
440 Park Avenue South
New York, N.Y. 10016

Dear Miss Eccles:

Enclosed herewith is the corrected galley for our chapter "Use of Computers in the Study of Taxonomy and Evolution." It is a nice clean galley which we appreciate. Only one or two modifications were required in the body of the galley.

Unfortunately, we goofed in this office on the reference list submitted with the original manuscript. Apparently we sent in one of the earliest manuscript reference lists rather than the final one which included all of the references, because we had to insert seven new references to make the reference list comply with the citations in the text. I judged it better to type an entirely new set of references rather than to try to insert them. These, I believe, conform to your style and are complete. I apologize for this error on my part and I trust it will not cause too much difficulty for you.

The figure which you requested that we modify has been modified, and I believe that the new copy of that figure will fit page width.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

August 31, 1966

Mr. Harold K. Voris
Division of Reptiles
Chicago Natural History Museum
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

Dear Harold:

You are no doubt wondering what is happening to your data. SO far nothing. This can be explained easily. If you will look at the mimeo sheets that I sent you earlier entitled "Input Deck Setup for Similarity-Clustering Program" on page 3 the last statements entitled "Maximum Values," you will notice that there is a maximum of 300 matrix elements. Your deck contains 356. We are adjusting our programs to accommodate a larger number of matrix elements and should run your data shortly.

I might also comment that there are a number of objects in the data you sent me with a great deal of information missing (20 or more, and as many as 54, characters with zeros). I would suggest that these objects not be included in the machine processing as their placement will be dubious and their presence could lead to other objects being misplaced as well. I would suggest that such poor specimens as these actually contribute little to the formation of a classification, and thus should not be brought into consideration until after some classificatory hypotheses has been worked out, at which time these poor specimens can be placed "by inspection."

I would be very interested to see a copy of your character descriptions, and the descriptive states you have established for each together with ordering parameters and matrices, if you are willing to send me a copy.

I hope to be sending you a big package soon.

Very truly yours,

George F. Estabrook

GFE:ch

- Taxonomy Laboratory

August 30, 1966

Mr. J. B. Phipps
Department of Botany
College of Science
Faculty of Arts and Science
The University of Western Ontario
London, Canada

Dear Mr. Phipps:

I am sending you a flow chart for a program for our graph theory clustering program. The flow chart will be of more general value to you than would be a listing of the FORTRAN statements. This would be the case under any circumstances since our experience has been that no two computer installations have the same instruction set. I am also sending a mimeographed paper "A General Method of Taxonomic Description, etc."

The last mentioned paper is sent because we feel that a thorough understanding of the preparation of taxonomic data is a critical element to be understood before attempting to use the clustering method. I might say this applies no matter what computer program is employed. We have written the computer program in FORTRAN IV, but you will see places in which machine language is employed. Machine language is required in order to get sufficient room in the internal memory units of any computer that we know. This will require that program be done by a relatively experienced and competent programmer.

These items, though in mimeograph form, have been submitted for publication and are, therefore, not for general distribution.

I will be interested to know of your proposed use of this program and would like to hear from you when you have had an opportunity to digest the contents of the papers sent. Please do not hesitate to write for assistance.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

August 24, 1966

Mr. Carl W. Bollwinkel
Department of Botany
Southern Illinois University
Carbondale, Illinois 62903

Dear Mr. Bollwinkel:

I am sending you a flow chart for a program developed since the one that appeared in BioScience. This program is far superior to the one described in BioScience, and should be more satisfactory for clustering purposes. Discussion of the biological significance is given in the enclosed reprint from Systematic Zoology. I am also sending along a mimeographed paper "A General Method of Taxonomic Description, etc."

The last mentioned paper is sent because we feel that a thorough understanding of the preparation of taxonomic data is a critical element to be understood before attempting to use the clustering method. I might say this applies no matter what computer program is employed. We have written the computer program in FORTRAN IV, but you will see places in which machine language is employed. Machine language is required in order to get sufficient room in the internal memory units of any computer that we know. This will require that program be done by a relatively experienced and competent programmer.

These items, though in mimeograph form, have been submitted for publication and are, therefore, not for general distribution.

I will be interested to know of your proposed use of this program and would like to hear from you when you have had an opportunity to digest the contents of the papers sent. Please do not hesitate to write for assistance.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

Taxonomy Laboratory

August 25, 1966

Dr. Howard Irwin
The New York Botanical Garden
Bronx Park
Bronx, New York 10458

Dear Howard:

Business first, yak later.

Footnotes to be added to our joint paper:

- 1/ Computing methodologies research has been supported by Contract No. Nonr 3640(00), the Office of Naval Research, and by Grant GM 11208, the National Institutes of Health, to the junior author.
- 2/ Formerly Curator of Quantitative Taxonomy, The New York Botanical Garden; presently Professor of Botany, Colorado State University, Ft. Collins, Colo. 80521.

Perhaps it would be wise to add a third footnote with something of the following ideas included:

- 3/ Anyone interested in the computer methodologies employed in this work should address his inquiries to the junior author.

You can use whatever format for these that is required by the Memoirs.

I didn't have too much luck with the seeds you sent me from Brazil. The only ones that germinated were numbers 10937, 11051, and 11701. Of these, the first one bit the dust about two weeks after it began. The other two are (seemingly) happy. I'm sorry about losing the first one because it seemed to be one of those species with simple leaves (at least in the seedling stage). Though we tried many different treatments--different germination techniques, soil and water regimes, etc., we just didn't know enough about the requirements to make them go. Perhaps some microrhizal activities should have been at work. But anyway, did you collect specimens for each of the seeds you sent? I feel that that is almost an insulting question, but am really eager to get the specimens since there seemed to be much good character information in the seeds, which I need desperately.

Our work here sounds almost like a broken record--difficulty getting a satisfactory arrangement with the computers, programming problems, lack

August 25, 1966

of time and funds, etc. Our planned use of an IBM 7094 via a tele-processing line from here to the Los Angeles location of the hardware never worked out because of the confusion in the center in LA. Any programs we sent through the line seemed just to go down the drain—we never got any response. The hardware on this campus is too small (at the moment) to handle our work. So, we have been renting time on an IBM 7044 in the Graduate School of the University of Colorado, Boulder. We hope to have a monster RCA computer installed on this campus this coming fall, but we'll be stuck with rewriting again for another manufacturer's hardware. And so it goes—trying to carry on a million dollar program with a peanuts budget.

In spite of all this, we love it here in Colorado. I wouldn't go back to the mess in NY for all of IBM's hardware, nor even yet to NYBG, though sometimes we miss the library facilities. Your nutshell summary of events there gave Henry and me a real belly laugh. Hope you found your house in good shape after the year's absence. Regards to the family.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 25, 1966

Prof. A. Chaves Batista
Coordenador de I SIMPOSIO LATINO AMERICANO DE
MICROBIOLOGIA DOS SOLOS
Instituto de Micologia da Universidade
Federal de Pernambuco-Avenida Rosa e Silva nº 347
Recife-Pernambuco-Brasil

Dear Professor Chaves:

I very much appreciate your invitation to attend "I SIMPOSIO LATINO AMERICANO DE MICROBIOLOGIA DOS SOLOS". I am sorry that I will not be able to participate. I wish you the best of luck in the symposium which I think is of fundamental significance.

Very sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

August 22, 1966

Dr. Daniel B. Ward
Herbarium
Institute of Food and Agricultural Sciences
University of Florida
312 Rolfs Hall
Gainesville, Florida

Dear Dan:

I am sending under separate cover three mimeographed or copied papers: 1) the orchid characters, 2) flow chart, and 3) a paper on characters. Items two and three are privy communications not for general distribution as they are both in press. Item two is the actual programmer's flow chart for the clustering process. This is a program that has been written for the IBM 7044. It is a later edition and we think a cleaner program than the one that we had running in New York on the CDC machine. The only part we do not like is the sort routine. You should probably insert a standard package sort routine.

Anyone wishing to use the CDC program would have been in very great difficulty because the thing was under the control of the programmer to such an extent that unless you were the programmer who did the work originally, you would have a difficult time knowing what the directions for the operation of the program were. The flow chart sent to you allows anyone with good programming skill the ability to write the program for the individual machine that you wish to use. This would almost be the case under any circumstances.

As you may know, no two computer installations, even though they have the same manufacturer and number designation, are identical in their configurations. And for each installation, one has to have a few special instructions. Therefore, the best thing to do is to start with the flow chart and follow it through. The flow chart is, incidentally, to be published in the SHARE Library soon.

The second mimeograph paper is a preprint that we have submitted to BioScience for publication. This is an essential before you can use the computer program. We have discovered that the most critical element in the whole process of the use of computers for classification of plant materials is the structuring of the input data. We, ourselves, have had a long learning period in order to be able to put out the kind of paper that we are sending to you. Unless one is willing to be very diligent in the preparation of one's data for a computer, no matter how good a

August 22, 1966

program be, you will have no results unless your data be prepared adequately for it.

We have had a number of people to collaborate with us in the use of our clustering methods, and it has been our experience that these individuals do their best job after they have had some personal instruction from us about their own data. This is in respect to how to set up the data if one is to appropriately use the machinery. It does not refer to the scientist's own ability to recognize pieces of information which will make good characters. One of the things that we have discovered is that the most critical element in any kind of work, whether he be using a computer or not, is a specialist's own skill in taxonomy. We are trying to discover how one may achieve this skill on a better than trial-and-error basis, but so far the modus operandi has not been completely worked out. If it had been worked out, you may be sure that you would have seen, for example, a monograph of the genus Manihot by now.

I will be very interested in your comments after you have had a chance to read through both of the documents that I am sending to you. I would like to know in what manner you would like to utilize these programs, and I would further be very pleased if you would let us know of any problems that you have. We will try our best to answer specific questions.

Good luck and keep it up.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

August 23, 1966

Dr. Frederick L. Wellman
Department of Plant Pathology
School of Agriculture and Life Sciences
North Carolina State University
Raleigh, North Carolina 27607

Dear Fred:

I have your letter and interesting Proposal for an International Center of Tropical Phytopathology. Incidentally, I think your secretary must have mistakenly sent me all your carbons, so I'm returning them with this letter.

This came at an opportune time, for we are in the process of developing a big request for funds to determine the best techniques of computer use in biological information retrieval. Yours is a demonstrated need for such techniques, and if we may, we would like to cite your proposal as an indication of the fundamental need for investigations in proper machine methods of handling the fantastic loads of scientific information in the biological sciences.

With this introduction, let me make a few (hopefully) useful comments on your proposal. First, as I see it, the problem of information retrieval itself is not sufficiently well worked out to make it possible to go right into a program for phytopathology, or for any of the other biological disciplines. We cannot take up traditional library techniques, for they are not designed with computers in mind. They (library techniques) are developments of hundreds of years of manual methods, and are mostly for the orderly storing of books and serials. In more unhurried days, with far fewer pieces of literature, a worker could take the indexing systems, the bibliographies, etc., available, put them together with his own knowledge, and in a few days or weeks, ferret out the information required by him. Note that the library did not "retrieve" the information—it merely stored it. The individual had to do the retrieving. How he retrieved what he was looking for is known only to him, and probably involved a trial and error, hit or miss procedure. This we cannot tolerate in a system which employs electronic data processing devices.

In the last few years, "computerniks" have attempted to convert the manual library system to a computerized practice. That this hasn't worked satisfactorily is indicated by the many different pragmatic approaches to information retrieval that have been cooked up, and by

the fact that none of the methods so far concocted have lived up to their advanced billing. Now I think that those agencies charged with the funding of proposals for information retrieval are beginning to be more wary of proposals which are not scientifically based investigations of the problems. Here is an area which needs as much scientific study as the primary problems in biology itself.

My intent in these comments to you is that you should be wary of any librarians's or computer programmer's claims to the effect that he (or they) can handle the information retrieval aspect of your primary goal for phytopathology. And for God's sake, Fred, do not be misled by the size of any computer installation, or the speed of operation of a particular computer. The most critical element in computer use is the program which instructs the computer on the procedures to be followed. And the design of the stored program is one of the biggest problems facing any of us—biologists, chemists, physicists, librarians. There are several facets to this design: first, what do you want as a biologist; second, how do you get what you want; third, can you design a logical system to meet your needs; fourth, is the physical size of the computer capable of handling what you want; fifth, are you duplicating someone else's procedures which you might adopt. There are others, but these serve to indicate the nature of the problem.

From your statement of the kinds and numbers of staff for your proposal, I feel that you have underestimated these requirements, and that you will need other types of disciplines to make it work. The most glaring omission I can see is that of a competent mathematician in the project. Our experience should serve to indicate that a well-trained mathematician (as differentiated from a half-baked biostatistician) is a central element to give you the kind of thinking needed to efficiently carry forward the development of satisfactory programs.

You mention as the last goal in the proposal, computer diagnosis of plant diseases, etc. This, in itself, is an extremely ambitious goal. May I ask your definition of diagnosis? I know that a number of medical investigators are attempting diagnosis by computers, but to my knowledge, none of these have produced reliable systems. One of the reasons (and there are many for failure is that they do not recognize that you cannot diagnose without having first some sort of classification. I suspect the same problem will arise in plant pathology. If you can equate disease diagnosis with disease identification, then indeed the same problem arises. You can't write a key to identify an organism unless that organism has already been placed in a classification. The classification must be in the computer memory, so that when a set of characters which may identify the organism are presented for identification, somewhere there will be a match between the classification and the organism.

From the foregoing, you can see that I have spent some time working on the general system which must underlie the type of work you and your group wish to accomplish. This being the case, it would seem wise to me to let us keep on with the project (we hope in an expanded way) and collaborate with your group in the most profitable manner. I say that we

August 23, 1966

can avoid much duplication of effort if we are aware that we are indeed involved in much the same sort of project, but at a more generalized level, as you are. I think your efforts would be enhanced, and I am certain that we would benefit by a regular exchange of expertise—you and your group from the phytopathological aspects, we from the computer aspect. This is not to say that I wish to undermine your project at all. On the contrary, I would hope to enhance your chance of success with such a project. Your ideas for an international center is a fundamental requirement for phytopathology, and I cheer them.

I would merely caution that there are many pitfalls in this information retrieval area, and I cannot advise anyone to enter this arena unless he be willing to give up his primary intent—the study of phytopathology. We have gone a considerable distance in this direction, indeed to the point where we cannot back out. We are too committed. Not that I would have it otherwise—we didn't drift in, but went after it with the certain knowledge that someday it would be a requirement.

May I ask how far along you are with the submission of your proposal? Where do you expect to get your funds? Is this from FAO, UN, NSF, USDA, AID, or where? Or am I being too nosy?

Sincerely,

David J. Rogers
Professor of Botany

DJR:ich

Enc.

- Taxonomy Laboratory

August 22, 1966

Dr. Hugh Cutler
The Missouri Botanical Garden
2315 Tower Grove Avenue
St. Louis, Missouri

Dear Hugh:

Could you please send me whatever announcements have been made about the annual symposium there? Somehow or other I have mislaid the preliminary announcement which was sent earlier. If there are registration forms and so forth available at this time, please send those too. I hope to attend.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 22, 1966

Dr. Charles T. Mason, Jr.
Herbarium
College of Agriculture
The University of Arizona
Tucson, Arizona 85721

Dear Dr. Mason:

I am pleased to acknowledge receipt of the 40 specimens of Manihot which arrived in good shape last week. These are excellent materials and will aid me considerably in the classification of the species in that area. Thank you for your prompt attention to my request.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 22, 1966

Dr. Pierre Dansereau
The New York Botanical Garden
Bronx Park
Bronx, New York 10458

Dear Pierre:

I must acknowledge receipt of two things from you, one, your recommendations for maps for Latin America. I am sorry to see that we are so short on really good vegetation maps. The Manihot illustrations that you had had came through in a separate envelope.

I am looking forward to seeing you at the meetings at the Peabody Museum in New Haven this October.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 22, 1966

Mr. A. Stern
Control Data Corporation
Corporate Headquarters
8100 34th Avenue South
Minneapolis, Minnesota 55440

Dear Mr. Stern:

Ref.: Your letter August 16

Your records are incorrect and incomplete. I enclose a copy of my letter to your Chicago office, dated April 20, 1966. Inasmuch as I received no reply to my courteous effort to correct the incorrect billing, I assumed that that was your curt method of recognizing your error.

I have no liability to CDC. All just and due bills have been paid. Your letter is, therefore, inappropriate.

My efforts to keep my account with the Great Neck service center straight go back considerably farther than the above mentioned letter. You will find somewhere in the files of CDC a letter dated November 1, 1965, to a salesman then working for the New York office, a Mr. Jack Canifrey. If you find that letter, you will discover that there was already confusion about your billing for work done on our agreement number 324-1341. Again I made an effort to straighten that problem out, but again did not receive the courtesy of a reply.

Furthermore, I spent considerable time and money in personal phone calls in May of this year to a Mr. Donald Geschlecht of your own office attempting to get our accounts straight. I thought that we finally had settled all the various bills, and had hoped that by that time you would have been satisfied. Since this is not the case, I am at a loss to know how to free myself from your continuing errors. Your letter is an insult, and I trust that I have made this clear.

David J. Rogers
Professor of Botany

DJR:ch

Enc.

cc: President, Control Data Corporation

- Tammoney Laboratory

April 20, 1966

C O P Y

Control Data Corporation
Data Centers Division
P.O. Box 9817
Chicago, Ill. 60690

Gentlemen:

Enclosed is a copy of invoice No. 500687, for \$452.30. We have not paid this in hopes that some clarification would be made by this time. Since it has not been straightened out, let me review the situation.

We have had no computing done, no programming, or other charges to us since December, 1965. At that time, we received, and paid invoice No. B8935D, month of December. The following data from that invoice is as follows: Project DL2413, Area 3004, Customer No. 4675, Tax 300. The total bill was \$516.00.

I hope you will be able to review and correct this situation.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

Info retrieval

- Taxonomy Laboratory
Telephone: 303-491-5201

August 16, 1966

Dr. C. F. Konzak
c/o Dr. F. T. Gardner
Local Arrangements Committee
American Society of Agronomy
Student Union Building
Oklahoma State University
Stillwater, Oklahoma 74075

Dear Dr. Konzak:

I trust that you received my cable, dated August 15. In the cable I suggested that it was highly important that we meet in Denver, or here in Ft. Collins if you prefer. Incidentally, we expect Dr. Knowles on August 26 or 27, as he intends to make a short visit at that time. Perhaps you and he will be attending the same meeting, and you could arrange to travel together. Please call me from Stillwater. I can meet you at the airport in Denver, if that is convenient.

I have previously suggested that a data retrieval system be established to underlie the IBP, but did not receive any encouragement from my contact, Dr. Ledyard Stebbins. However, I am pleased to see that such an activity is under way, and will be pleased to participate in it. The task is a large one, and will require the best efforts of a number of people, in a number of disciplines.

I have a small group interested in various aspects of information retrieval for the biological sciences, and we have particular interest in data retrieval in the same areas which you have outlined in your letter. Our interests, while not identical to those of Dr. Dietz's, are intended to complement his. While Dr. Dietz's system is intended to operate largely with a punched card system, and only use the computer as a method of placing data on tapes which can then be searched or sorted, our system makes conscientious and consistent use of the main computer memory units under direct control of a stored program. There are several differences between the two operational philosophies. In Dr. Dietz's system, the operator must make the assignment of storage space for an item of information, and subsequently, if he wishes to retrieve this item, he must make up a new set of instructions which precisely designates the place of storage of that item. This is known by Dr. Dietz, and he has made an excellent design for this operation.

August 16, 1966

The stored program system we envisage, however, gives more overall flexibility to the storage and retrieval problem, allowing the investigator his own procedures, but which in turn are made into a universal system by the directions of the stored program in the computer's main frame. With this stored program, we can make correlations not initially made by the investigator, for a large number of parameters. While this goes farther than a simple retrieval system, we have found that the simple retrieval systems so far developed inevitably lead to further demands which they are not designed to serve.

I should like to outline to you some of the methodologies we hope to develop, but feel that we must have a conference with you to accomplish this. There are many facets to the problem, some of which we have worked out, others which still need to be solved. If an over-all program for IBP is to be established, we know that some such system as ours must be developed, and this should be started almost immediately.

Looking forward to seeing you.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:chh

- Taxonomy Laboratory

August 15, 1966

Dr. Geoffrey H. Ball
Radio Systems Laboratory
Stanford Research Institute
Menlo Park, California 94025

Dear Dr. Ball:

Your letter of 3 August was forwarded to me from New York. Our present address is given above.

Since the program we devised was supported by NIH funds, you are welcome to use them. Our only request is that any use of the programs acknowledge the source.

When we left New York, the program was still "in flux." While it did indeed do the job described to you by Mr. Mabie, we had not settled on any particular flow chart, and many of the routines were called at option, and were controlled by the programmer. We never received any documentation, and would be happy to have that program, as it stood, described from the programmer's point of view. If you can get this from Mr. Mabie, we would like to have a copy of it.

There are several other facets of the output that Mr. Mabie did not include, i.e., each cluster was listed with the minimum similarities to be found amongst the objects of the cluster; the amount of "connectedness" amongst the objects in each cluster at each partition (the number of connections existing versus the number possible), and a measure (the most) indicating the separateness of a cluster from its neighbor. Several other items are included, all of which give information concerning the objects and their clusters.

Mr. Mabie indicated in his letter to you that further work with the output is done by hand. We still continue to follow a manual routine to "graph" the output, although we hope that someday this activity will be programmed. I am sure that Mr. Mabie could have developed a program for this purpose, had he been given the opportunity. Unfortunately, our funds, which have never been plentiful, petered out before we could contract with CDC to have this job done.

We have reprogrammed the CDC program for the IBM 7044 and 7094 available to us here. This has been fully documented, and will soon be submitted to SHARE, for the two machines. In this job, a considerable

August 15, 1966

amount of former manual control of the program has been eliminated, and considerable increase in the options for varying the program have been included. If you are interested in these, please let us know.

One word of caution should be given. The program is extremely sensitive to the format of the input data, and it is no small chore to select and prepare your data. Our whole effort in designing this program was directed towards classification of biological objects, and most of the objects we wish to classify are described by qualitative information. These pieces of information (called characters in the biological milieu) are generally considered as discrete, though some types of data are continuous.

We have found that workers interested in use of this program are generally benefitted by spending a few hours with us, getting the feel for the program's operation, objectives and philosophy, as well as instructions for data preparation. You can probably save a considerable amount of time if you are aware of this problem. If you wish to do so, we can arrange for a visit here, where you can get definite instructions from our programmer, mathematician, and from the biological standpoint.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

cc: Henry C. Mabie

- Taxonomy Laboratory

August 15, 1966

Dr. T. Wood
Faculty of Pharm.
Kwame Nkrumah Univ. Sci. and Technol.
Kumasi, Ghana

Dear Dr. Wood:

I would appreciate receiving a reprint of your paper entitled:
"The toxic and nutritional qualities of cassava (Manihot utilissima).
West African Pharm. 7(1): 2-4. 1965.

Thank you.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 15, 1966

Dr. E. Pechnik
Instituto Nutr.
University of Brasil
Rio de Janeiro, Brazil

Dear Dr. Pechnik:

I would appreciate receiving reprints of your papers entitled:
"Sobre o aproveitamento da folha de mandioca (Manihot sp.) na alimentacao humana" ARQ BRASIL NUTR 19(2): 11-20. Illus. 1963 (recd. 1965); "Sobre o aproveitamento da folha de mandioca (Manihot sp.) na alimentacao humana. II. Contribuicao ao estudo de valor alimenticio" ARQ BRASIL NUTR 18(1/2): 11-23. 1962 (recd. 1965); and "Sobre o aproveitamento da folha de mandioca (Manihot sp.) na alimentacao humana. III. Mandioca mansa." ARQ BRASIL NUTR 18(1/2): 25-36. 1962 (recd. 1965).

Thank you.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 11, 1966

Mr. Homer N. Metcalf
Plant and Soil Science Department
Montana State University
Bozeman, Montana 59715

Dear Homer:

We're glad your cherry crop came through with flying colors. You had better be careful or everyone will be going to Polson instead of Washington, D.C. to see the cherry blossoms.

We're returning the motel check. It is carrying graciousness too far--having gourmet meals and lodging too--it is not only immoral but indecent.

We did not return by Glacier but to the south. We figured we could do Glacier from North Dakota. Went down by 95 and 15 to Boise and then on to Logan where we cut west through Logan Canyon to Bear Lake and stayed the night at Little America. In transit we saw the Craters of the Moon. I don't recommend 95 for making time on, but we were surprised that such country was there. Knowles comes up on 95. Turned south shortly after Little America through Flaming Gorge to Vernal--saw the Dinosaur diggings and then on home. Figured we could conveniently come from Fort Collins back to see the Yampa and Green River Canyons when we had more time.

Sam Dietz sends you his best and the business with Knowles went off well. We all had dinner together the last night. I did not notice the heat if it was warm. Maybe Sam was too entertaining showing us the country, etc. Curious--all that wheat on top of the lava. The trip was worth it all just to see the red cedars on that Missoula to Lewiston run. The road from Lewiston up to the top to get to Pullman reminded me of the old road from La Guiva to Caracas, Venezuela.

We expect Knowles the last weekend of this month, and the following Monday and Tuesday a chap from NSF (Washington) is coming out to see us; otherwise, Dave and I are free. So come at your pleasure if you wish. The boys are off but expected back momentarily which will take some of the computer push off me. I can't promise gourmet meals but the house is yours.

Sincerely,

Henry S. Fleming

Computer Course

- Taxonomy Laboratory

August 11, 1966

Dr. Perry R. Stout, Director
Kearney Foundation of Soil Science
University of California
265 Hoagland Hall
Davis, California 95616

Dear Dr. Stout:

I am pleased to have your two letters of July 29 and August 1 and your copy of "Plant Sciences." I am returning your copy under separate cover and have ordered one for myself. We already have a copy of the report "Digital Computer Needs in Universities and Colleges." These are all instructive pieces of information. As you suggest, I think it will be useful to discover over the next few years the various applications of computers in botany. I am not certain how this should proceed, but we will give it some thought. I should think that the National Academy might be interested. Can you suggest the most appropriate person in the Academy to whom I might address inquires for aid or suggestions?

The report on the plant sciences is certainly a comprehensive document. I am particularly impressed with the section on applied and economic botany, and I trust the recommendations included therein can be put into action.

Again, thank you for your considerations and letters.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 10, 1966

Miss Beryl Robichaud
Vice President
McGraw-Hill, Inc.
Hightstown, New Jersey

Dear Miss Robichaud:

I am sorry that various things have interfered with our getting together on the violets. I will be free the rest of the month with the exception of the 28, 29, and 30, so that if you can make a trip in August these are the only dates I will be unavailable.

I expect to be coming to New Haven and vicinity for a symposium from October 26 through the 28th celebrating the Peabody Museum's 100th anniversary (Pierre will be there). Perhaps we could get together in New York after this symposium.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 8, 1966

Dr. Ascell Löve, Chairman
Department of Biology
University of Colorado
Boulder, Colorado

Dear Ascell:

I am sending under separate cover several reprints you might be interested in. We have just completed the enclosed mimeographed "General write-up for similarity-clustering program." When you have had an opportunity to look through it, I would like to have this copy back inasmuch as it has a heavy run for requests and we are very short of them. Perhaps it would be well to read the paper by Wirth, Estabrook, and Rogers entitled "A graph theory model for systematic biology, with an example for the Oncidiinae (Orchidaceae)" before perusal of the program. My major reason in sending the flowchart (mimeographed paper) is to illustrate the nontrivial nature of taxonomic methodology. In a sense this flowchart is a good expression of what a taxonomist does as he processes his data for classification, whether or not he uses a computer. I suspect that if we wrote a program for a specific methodology in, say, physiology, we would discover a much less complex process.

The other reprints are for your files.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

August 10, 1966

Miss Anna M. Lee
Department of Biostatistics
School of Public Health
The University of Michigan
Ann Arbor, Michigan 48104

Dear Miss Lee:

I have your letter of July 28. We would have sent the listing requested sooner but have delayed pending a few minor changes in it which will improve the running efficiency. This would have been done but my programmer has been tied up because of the airline strike. I am hoping he will be back next week. At that time we will have a listing made for you.

In the meantime, I am sending a mimeographed copy of a paper which I think is necessary and essential to anyone who wishes to utilize the clustering methods employed. We have discovered that the most critical element in the clustering analysis is in the understanding and preparation of the input data. Please note that the enclosed mimeographed paper is not for distribution. I send it to you because I expect that you would like to follow this format (or the ideas herein in setting up your information). If there are any questions after reading this paper, please do not hesitate to inquire. We have discovered that the input methods require more than average knowledge of the classification procedure throughout than is generally available to most workers. The listing of the program should be forthcoming soon.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

August 8, 1966

Dr. Charles T. Mason
Department of Botany
University of Arizona
Tucson, Arizona 85721

Dear Dr. Mason:

May I please have on loan all the specimens representing the genus Manihot in your herbarium. I am particularly concerned to see those from Arizona, found in various mountainous regions of the southern part of the state. There are several collections from the Santa Catalina, Santa Rita, Rincon, and Baboquivari Mts., but most of the specimens I have seen are fragments, and I want to know more of these before working up Manihot in a monograph.

Perhaps some of the specimens of interest are filed under Janipha manihot. The specific epithets most likely to be encountered are M. angustiloba, M. carthaginensis, M. isoloba, M. mexicana, M. davisiae, and M. chlorosticta. I will be happy to see any other Manihot material you may have as well.

Would you also be kind enough, if you have acquaintance with the areas mentioned above, to fill me in on the general ecology of the regions where these plants have been collected. What about rainfall patterns? When are these plants liable to be in flower and/or fruit?

If you have any graduate students working on the floras of these areas, perhaps you might ask them to be on the lookout for more material of these apparently rather local plants. I would be happy to assist financially in any way if students could make collections of Manihot for me.

I trust this is not too much of a burden. At any rate, I will be happy to see the specimens in your collection.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 5, 1966

Dr. William T. Stearn
Department of Botany
British Museum (Natural History)
Cromwell Road
London, S.W. 7, England

Dear Dr. Stearn:

I have just now had an opportunity to spend some time with "Botanical Lantín." I feel required to thank you for writing it—the title does not do justice to the comprehensiveness and value it has for me and for most other taxonomic (even physiologic) botanists. Having been exposed to the precision (and vagaries), joys, and exasperations of Latin descriptions by the late Robert Woodson, himself a classicist, I can appreciate the great usefulness of this one volume.

But I must ask: Aren't you swimming against the tide? Note the length of Latin diagnoses found in the latest botanical works. Most of them barely fill the bill of the International Rules. There is a growing recognition that, unless one spend an inordinate amount of time becoming really well-founded in a language, it is not possible to carry one's precise meaning across in another tongue. Is not your argument for botanical Latin one of personal experience, past inclinations, and education in the public schools? That must be a unique experience, not common to the rest of the world, no matter how we try to emulate it.

No matter how I argue, however, I will attempt to make any Latin statements in keeping with your fine publication. I shudder, though, when I think of submitting my work to any publication of which you must be the arbiter of the included Latin!

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

August 4, 1966

Dr. T. P. Burnaby
Department of Geology
The University of Keele
Staffordshire, England

Dear Dr. Burnaby:

Enclosed is the reprint you requested (*Systematic Zoology* 15 (1966) 59-69). Dr. Wirth is no longer with us and any future requests might be sent to the address above. Thank you for the reprint "Growth-invariant discriminant functions and generalized distances."

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

MEMORANDUM

August 1, 1966

TO: Dr. Richard T. Ward
FROM: David J. Rogers
SUBJECT: Budget Reorganization and changes in Schedules

1. Mr. George Estabrook who is now on full-time on a NIH grant will be changed to a part-time basis beginning September 1. Mr. Estabrook will be attending graduate school at the University of Colorado, Boulder, where he will pursue a mathematical program which has direct bearing on our program. His thesis study, which he has already outlined to me, will be directed towards some of the more theoretical aspects of mathematics involved in a program already commenced as part of his full-time occupation here. Therefore, Mr. Estabrook's program in advanced study directly contributes to the operation of this group. Since this is the case, I will consider that Mr. Estabrook's activities will not drop from full-time to half-time but will be about two-thirds of his full-time work with me. I would like to pay Mr. Estabrook at the rate of \$5,000 for a 12-month's year.

2. Regarding Mrs. Cleo Hepworth, I would like to have her revert to her original status in pay and grade for full-time secretarial assistance. The needed funds may be derived from the funds left available as a result of Mr. Estabrook's change in salary.

There are several good and pertinent reasons for the maintenance of a full-time secretary. First of these is the work load required in our operation. In addition to secretarial work, Mrs. Hepworth has learned the operations of a keypunch and a considerable amount of her time is occupied with punching data to be computed. For example, during the spring quarter all of the data prepared by the students in Course B-170 was punched by Mrs. Hepworth. Our own research data is also punched by Mrs. Hepworth.

Perhaps one prime reason for needing a full-time secretary is our physical isolation from the Department of Botany. Since we are isolated by some distance from the department, it is essential that we have someone available at all times to take care of the many routine administrative details which could potentially be handled by others (the departmental secretary) if we were in closer proximity to the remaining staff of the department.

3. I hope that it will be understood that I am making conscientious efforts towards meeting my own salary. But in the meantime, it is hoped that our operations will not be curtailed by loss of a secretary, by failure to be able to derive from grant funds money for mail, telephone, and other essentially overhead expenses.

It has been my feeling that the administration of CSURF is willing to continue this sort of support, but there may be some lack of communication which

Dr. Richard T. Ward

- 2 -

August 1, 1966

makes it difficult for you to get a budget commitment from them. If this is the case, perhaps a general review, with all interested parties, would be useful.

September 28, 1966

Dr. Robert E. Perdue, Jr.
New Crops Research Branch
USDA
Beltsville, Maryland

Dear Bob:

Are you interested in returning to the fields of Academe? We are looking for a chairman of the Botany and Plant Pathology Department here at Colorado State University, and need outstanding candidates. If you wish to toss your hat into the ring, please let me know, and I'll provide details necessary for the application.

I hope you can, or want to, consider this post. It needs a strong administrator, and one with some stature. There are many challenging problems to pull the department together, to build its stature in the University and in the country. The University has as its goal the achievement of excellence in biology, rather than in the physical sciences. To this end, a reorganization of all now separate departments is being proposed. The University's background is a land-grant state-supported institution, governed by a board chosen from the agricultural community of the state, though some of the members are from the business and professional community. This indicates its former status as the agricultural and mechanical college, from which it moved to university status only ten years ago. There are now some 12,700 students, and the prospects are for a rapid rise in enrollment in the next few years.

In the department are some 20 professional staff of assistant professors or higher, with a number of other teaching assistants, and people on special research status (non-tenure bearing). There will be several retirements shortly, and new positions to be filled. The strongest single push in the department at the moment is in plant pathology, with about five full-time staff. This needs to be balanced with the other subdivisions, and will require some doing.

The chairman is appointed for a five-year term, and may be reappointed if all agree. The department has adapted a code covering the duties, lines of command, and responsibilities for the chairman and all other staff. I helped in the formulation of this code last year, and feel that it is a very sound set of procedures. The chairman may have one course, or the direction of graduate students, but his administrative duties will preclude any more than this.

September 28, 1966

One of the certain chores to be faced is the development of new building and facilities. We are much over-crowded now, but the plans, though not definite, place us in a new building in about five years. I and my crew are housed in the third oldest building on campus, some distance separating us from the main botany building. While we are happy in our place and will be for some time, we will undoubtedly out-grow this building in that time.

The department is a member of the college of Science and Arts, to which a new dean has just been appointed. The upper echelons of administration are in the hands of young, vigorous men, and I am quite pleased with them.

Decision on making this application should be soon. We expect a deadline of November 1 for applications, complete with vitae and recommendations. If you are not personally interested, can you suggest other good candidates? I will be glad to hear from you. Please note that my mailing address should include "Old Music Building."

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

September 28, 1966

Dr. Ernest R. Sohns
CSIS
National Science Foundation
Washington, D.C. 20025

Dear Ernie:

Are you interested in returning to the fields of Academe? We are looking for a chairman of the Botany and Plant Pathology Department here at Colorado State University, and need outstanding candidates. If you wish to toss your hat into the ring, please let me know, and I'll provide details necessary for the application.

I hope you can, or want to, consider this post. It needs a strong administrator, and one with some stature. There are many challenging problems to pull the department together, to build its stature in the University and in the country. The University has as its goal the achievement of excellence in biology, rather than in the physical sciences. To this end, a reorganization of all now separate departments is being proposed. The University's background is a land-grant state-supported institution, governed by a board chosen from the agricultural community of the state, though some of the members are from the business and professional community. This indicates its former status as the agricultural and mechanical college, from which it moved to university status only ten years ago. There are now some 12,700 students, and the prospects are for a rapid rise in enrollment in the next few years.

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The chairman is appointed for a five-year term, and may be re-appointed if all agree. The department has adapted a code covering the duties, lines of command, and responsibilities for the chairman and all other staff. I helped in the formulation of this code last year, and feel that it is a very sound set of procedures. The chairman may have one course, or the direction of graduate students, but his administrative duties will preclude any more than this.

September 28, 1966

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Decision on making this application should be soon. We expect a deadline of November 1 for applications, complete with vitas and recommendations. If you are not personally interested, can you suggest other good candidates? I will be glad to hear from you. Please note that my mailing address should include "Old Music Building."

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 28, 1966

Mr. Harold K. Voris
Division of Reptiles
Chicago Natural History Museum
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

Dear Harold:

Please find enclosed (1) the print-out for the two runs of your Hydrophiidae and (2) a mimeo entitled "Reading the Print-Out." I will return your deck under separate cover. It is difficult for me to interpret your results as I am not familiar with your study. However, it would seem that you have some structure present. L 42 indicates that you have two main groups with some aberrant "out lyers." If pairs join which surprise or displeas you, you might consult the similarity matrix to see on how many characters the comparison was based. We are ready to run a larger study whenever you have it ready.

As I am sure you realize, it is not without considerable expense that we administer and run our programs. The strictures of our own research budget make it impossible to operate like a free service organization. For this reason, if you have funds available to you to conduct your own research, we would appreciate at least a token contribution of \$50. If your funds allow, we would expect more realistic support. Please communicate with Dr. David J. Rogers, (same address as mine) on this point.

We would be extremely interested in your comments concerning the procedure, your results, and any suggestions you might have. I hope this analysis proves useful to you. The hundred some odd pages of print-out warrant considerable perusal, and it has been our experience that passing your attention back and forth from your specimens to the print-out is a process which continues to extract "goodies" from the analysis for some time.

I am sorry that we (you and us) have taken so much time getting this analysis run. However, we are ready to run your whole study as soon as you are.

Very truly yours,

George F. Estabrook

- Taxonomy Laboratory

September 28, 1966

Professor L. Wolpert
Department of Biology
Middlesex Hospital Medical School
London, W. 1
England

Dear Dr. Wolpert:

Enclosed is the corrected page proof for Estabrook "A Mathematical Model in Graph Theory for Biological Classification." We wish to recognize the superior type-setting job done on the flow chart of the algorithm.

If at all possible at this late stage, I wonder if a note could be added just after the references? If possible, the note is as follows (and submitted on a separate page):

A paper relevant to the discussion of descriptions on p. 002 appeared as follows: Estabrook, G. F. and D. J. Rogers. 1966. BioScience, 16(11).

Other than those items noted, the page proof is in order.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

September 22, 1966

Mr. Harold K. Voris
Division of Reptiles
Chicago Natural History Museum
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

Dear Harold:

Thanks for the coding sheets. I have copied them off. I should have output for you early next week. We are recompiling our source decks tomorrow to make other changes as well as increasing the number of matrix elements. If all goes well, you should have output for 41 snakes (those with 20 or fewer missing characters) as well as for 50 snakes, sometime next week. I appreciate your patience.

Very truly yours,

George F. Estabrook

GFE:ch

- Taxonomy Laboratory

September 28, 1966

Dr. Lincoln Constance
Department of Botany
University of California
Berkeley, California

Dear Lincoln:

Do you have any potential candidates for departmental chairman here at Colorado State University? The usual statements about the position can be made: Ph.D., ages 35-45, high professional standing, salary commensurate, or competitive with other land-grant schools, etc.

If you care to contact any candidates directly, I suggest that they send their curriculum vitae, along with letters of recommendation, to:

Dr. Tyler Woolley
Zoology Dept.
Colorado State University
Fort Collins, Colorado 80521

Deadline for receipt is November 1. This seems rather short notice, but we've been looking already, and have a number of candidates already in.

I will appreciate your assistance.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

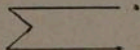
- Taxonomy Laboratory

September 28, 1966

Miss Diana C. Kloch
Assistant to the Editor
AIBS
3900 Wisconsin Avenue, N.W.
Washington, D.C.

Dear Miss Kloch:

Herewith are the corrected galleys of our paper. You will note a number of corrections to be made in the setting of the equations, particularly. I do not know whether there will be an opportunity to check page proof, but it would be very helpful for us to do so. You will note the use in the equation of the sigma sign (sum) with extended arms, thus:



If the type for such sigma is not available, then I am sure a more standard sigma may be used. We prefer this form, however, which is frequently used in mathematical papers.

Proof of the tables and figure are not included. I trust these will be carefully checked by you for their accuracy. The tabular material was cut out of our manuscript and not returned to us with the proof.

We are pleased with the speed with which this paper has been processed. Thank you for your efforts.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

= Taxonomy Laboratory

September 23, 1966

Dr. Brian D. Ainscough
Zoology Department
University of the West Indies
St. Augustines, Trinidad, W.I.

Dear Dr. Ainscough:

I have to reply to your letter addressed to Dr. Michael Wirth at this address. Since Dr. Wirth is no longer with us, we will fill your request for a program listing. The program is now written in FORTRAN IV for the IBM 7044. When I have conferred with my programmer, I will determine the scope of the problem for the conversion to the 1620. I have no doubt that a clever programmer can transfer from the larger to the smaller machine, if you are willing to live with the time expenditure which the 1620 will require with this rather complex program.

The CDC 1604 mentioned in our paper used a language (FORTRAN 63) not compatible with the IBM's compiler system.

Since the program is extremely sensitive to the structure of the input data, I am taking the liberty of sending to you a pre-print which should be well digested by you before consideration of the program itself. This paper addresses itself to the problems of characters used in the taxonomic methodologies for computers and will, I am sure, be of value to you as you go into the taxonomy of soil mites.

Upon its completion, we will forward to you a program flow chart and listing. Thank you for your inquiry.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 23, 1966

Dr. J. F. Danielli, F.R.S.
Chief Editor, Journal of Theoretical Biology
The University Health Center
414 Michael Hall
Buffalo, New York 14214

Dear Dr. Danielli:

I am wondering about the fate of the paper (B420, Estabrook, A mathematical model in graph theory for biological classifications) in the Journal of Theoretical Biology. On August 8 we sent a second copy of the manuscript to Miss Joan Fujimoto, Academic Press Inc., Berkeley Square House, Berkeley Square, London W. 1, England. Since we have had no acknowledgement of the receipt of that copy, we wonder if it has gone astray. Perhaps you will recollect that we received partial galleys of this paper, omitting the latter portion of it. I will appreciate your reply to this letter.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 23, 1966

Officer in Charge
International Symposium on Tropical
Root Crops
Department of Agriculture
University of the West Indies
St. Augustine, Trinidad

Dear Sir:

May I inquire as to the fate of the International Symposium on Tropical Root Crops. The first circular indicated that a second information circular was to be issued in September. To date I have not received one. Is the deadline for the submission of papers still October 31?

I should like to know in order to support my travel whether there has been an effort to have this symposium recognized by the National Science Foundation in Washington. Your early reply will be appreciated.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 22, 1966

Dr. Richard M. Klein
New York Botanical Garden
Bronx Park
Bronx, N.Y. 10458

Dear Dick:

First, I returned Gentile's MS ages ago. We had better start checking back on it. My MS is about nine-tenths done. Two more chapters will finish it off.

Wellman's MS has been in my hands since August. I have finished going over it. It is about one-third the former length. It is good, and I have no changes to make in it. One point is bothering me, he says that I have the originals of the drawings. I do not. My recollection is that they were left at the press from the original version and they should be in the press's hands. Please check this now. If not, I may find myself doing some black and white drawings.

Wellman wrote in his cover letter to me that this is the last time he is going to revise. I don't blame him. I think he has done a beautiful job and has had considerable amount of forbearance with us. My opinion is that damned little needs to be done. I would suggest that he has completed his contract and is now ready to be paid the second half of his royalty advance. I hope that this concurs with your opinion.

You are still on the list, and I am on the committee this year, hang on.

Regards,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 21, 1966

Dr. G. T. France
New York Botanical Garden
Bronx Park
Bronx, New York 10458

Dear Ian:

I need Pennington's address to send him his print-out. Where
can I reach him?

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 21, 1966

Dr. Alick Elithorn
The Royal Free Hospital
Lawn Road
London, N.W. 3
ENGLAND

Dear Dr. Elithorn:

I am sorry to have delayed such an inordinately long time in sending reprints of papers you requested. I trust that it is not too late to be beneficial. I am sending under separate cover several papers which I feel are useful. Two of these papers are pre-prints of papers accepted for publication and should appear shortly. I shall keep you on my mailing list for papers now in the works.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 21, 1966

Dr. A. W. Crompton, Director
Peabody Museum of Natural History
Yale University
New Haven, Connecticut 06520

Dear Dr. Crompton:

I have listed below an itemized statement of my round trip
fare to New Haven for the Centennial Celebration in October.

Round Trip - Denver to N.Y.	\$190.20
Round Trip - N.Y. to New Haven (air taxi)	30.00
Round Trip - Ft. Collins to Denver	<u>20.00</u>
TOTAL	\$240.20

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

— Taxonomy Laboratory

September 20, 1966

Dr. Askel Love, Chairman
Department of Biology
University of Colorado
Boulder, Colorado

Dear Askel:

Here is the paper I mentioned over the phone. If this work is funded, it should provide taxonomists with a very practical system when working on large floras. This work does not overlap with our previous programs, but is intended to be used at another point in the taxonomist's work.

While we feel that the previous programs are of more real significance in taxonomy, we also recognize that it will take much more time before taxonomists appreciate their value, and learn how to use the programs for clustering. On the other hand, the information retrieval programs should be more readily acceptable because they do not get into those areas of taxonomy dealing with the theoretical aspects.

The enclosed paper represents a considerable amount of work already done, even before we have the funds to do it. It therefore represents quite an expenditure of funds and would, if placed in the hands of some computer-oriented types, be quite a loss to us. I'm sure you understand this, and that I need not add any admonitions.

I will appreciate any comments you care to make on the paper, and if any questions arise, give me a call.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ich

Enc.

- Taxonomy Laboratory

September 20, 1966

WDPC Technical Editor
WESTERN DATA PROCESSING CENTER
Graduate School of Business Administration
University of California
Los Angeles 24, California

Dear Sir:

We have completed the project that we undertook using WDPC
job number 2633, and we wish at this time to cancel the number.

We will no longer be using the services of WDPC.

Thank you for your cooperation in the past.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

cc: Ken Meaderis

- Taxonomy Laboratory

September 20, 1966

Mr. Mark Halpern
Dept. 52-40, Bldg. 201
Lockheed Missiles and Space Co.
Palo Alto, California 94304

Dear Mark:

I hope you will be interested in the enclosed paper. Perhaps from it you can develop a little clearer picture of our aspirations, as well as the fundamental role XPOP plays in them.

Obviously, many details were omitted, but we hope that the structure and values show sufficiently. Our problem is to know just how much to say in applying to granting agencies for funds. Either too much or too little will have damaging effects; but when is it just right? Fortunately, the agencies seem willing to work with us in the development of the right grant vehicle.

I think that we will be successful in our search for funds, but just when, or with which agency, is beyond me to tell at this moment. Much more has to go into the grant request, but these are details which require more administrative work than anything else.

We were certainly pleased to have you visit us, and hope that we will be seeing you again soon.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

P.S. Any comments you care to make about the paper will be appreciated.

- Taxonomy Laboratory

September 20, 1966

Dr. Arthur B. Callahan
Biology Branch
Office of Naval Research
17th and Constitution Ave., NW
Washington, D.C.

Dear Dr. Callahan:

Enclosed is a statement of our research aspirations in biological information retrieval. This paper only includes the research aspects, and is not yet a completed grant application. I am sending it to determine whether ONR is interested in supporting this type of research work. In spite of its obvious biological slant, I feel that the results of this type of work will have useful effects in other branches of science.

I will be pleased if you and others in ONR will comment on the enclosure. If this be a suitable project, we will continue with the development of appropriate schedules of personnel and budgeting.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

September 20, 1966

Dr. G. B. Lucas
Dept. Plant Pathology
Box 5397
North Carolina State
Raleigh, North Carolina 27607

Dear Dr. Lucas:

Thanks for your letter of September 13. I will respond to you, hoping that Fred will see the letter as well. First, let me say that I cheer your ideas for a tropical pathology center, and second, present some of my ideas on how we might cooperate in the development of that center.

The enclosure is a statement of the scientific aspects of our intended information retrieval work. It is prepared for granting agencies, which will explain the first paragraph. Since the methodologies explained in it represent our thinking about the needed work, I trust that you will not circulate it.

From this paper, you can see not only the procedures, but also our plan to collaborate with other biologists in the development of an adequate IR system. We hope that you and your group might be interested in becoming one of these collaborators. We have several other groups interested in such collaboration, and yours would add an area not covered by these groups. You can also see that our approach to the IR problems is at a rather basic level. We have found this approach essential when dealing with biological classification using computers, and have no reason to believe that it will not work in IR areas. Let me emphasize that we do not expect to become the IR center for biology in the country. Such an aspiration would be absurd. But, if a good, standardized set of procedures could be used across the country, by special groups, then there is the possibility of later tying them together more expeditiously. This procedural development is our goal.

I hope you will be interested in this work, and that we can find suitable areas of collaboration. Any words that you care to say about the enclosed document will be appreciated.

Sincerely,

David J. Rogers
Professor of Botany

Enc.

September 20, 1966

Dr. Rowena Swanson
Information Sciences
Department of the Air Force
Air Force Office of Scientific Research (OAR)
Washington, D.C. 20333

Dear Dr. Swanson:

On 16 May, you were good enough to answer my general letter and statement about some similarities between biological classification and information retrieval with some very pertinent queries. I recognized the need for more work and more precise statement of our aspirations, and indicated in a letter on May 25 that I probably would not respond for a "couple of months."

An ample "couple of months" has passed, but the project has been developing, and herewith we submit a statement of our intentions and aspirations. The scientific aspect only is included; it has not yet seemed appropriate to add the other aspects—money.

The enclosed document has been prepared as the scientific justification for a grant proposal. There are many more generalities than specifics in it, but from it, I think you can see the direction of our work. Throughout, we* have kept our proposal pointed at biological information retrieval, but I think that the software developments could apply generally. I hope we aren't being too optimistic about this, but we don't want to make claims in the proposal until we've tried the system out.

Our work, hopefully, carries us from the primary investigations and developments through various stages to the actual testing of selected types of IR problems. This way, we get feed-back from the real world, rather than just tossing it out to the common man. In fact, tossing out such procedures (at least to most of the biologists we know) without following up would be rather worthless. So in addition to collaborating with certain people during the development, we want to provide the necessary structure to help working biologists

* "We" refers to David J. Rogers, Henry Fleming, (taxonomists), George Estabrook (mathematician) and Robert Brill (programmer).

September 20, 1966

get their own system going, taking away the need for the biologist to get wrapped up in the maze of computer problems he would have if he had to go it alone.

Now, to give you some dimensions, I will make a few guesses about needs. First, in the way of hardware, we expect to soon have an RCA Spectra 70 (55?) (65K memory, 32-bit word) installed on this campus. Supposedly there will be 6 tape drives and drum (or disc-packs or data cell) or at least some random-access device. I do not know whether the random-access device will be available to us or not, but assume that it will not. Then, we'll have to rent our own. Cost? unknown at this time. Second, for software, we may have to pay some token amount to Lockheed for the use of the XPOP, developed in their computer center. Again, I haven't investigated how much the "token" will be, but I guess in the neighborhood of \$10,000. Third, the time investment: no less than five years. Personnel line up about as follows: full-time programmer, one half-time assistant programmer; one full, one half-time mathematician, one biomathematician (more biologist than mathematician); one clerk-key puncher, stenographer; director (principal investigator) about 40% time. These, added up, come to about \$50 or \$60,000 per year. Travel will be a pretty big item because of the collaborative angle, and roughly amounts to \$5,000 per year. Add the overhead, and you have about what is needed.

Again, let me say that we have not really given the budgetting aspects any attention. If the scientific aspects are of sufficient value, then the money needed for it will be forthcoming. I will be very pleased to have your comments on the IR system itself, and any guides on the budgetting aspects.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

P.S. Please send us the latest brochures on grant (contract) submission.

September 19, 1966

Dr. Sam Dietz
Regional Plant Introduction Station
Johnson Hall 59
Washington State University
Pullman, Washington 99163

Dear Dr. Dietz:

On the recommendation of Dr. Konzak, I am sending you a copy of a paper describing our anticipated directions in information retrieval in the biological sciences. This paper was prepared for the Office of Science Information Services, NSF, and therefore the first paragraph may sound a little strange. We are slowly working towards a grant, either from NSF, or from any other agency that we can get to fund us. While I am glad to share this information with you, I hope that you will understand its confidential nature and not distribute it.

Essentially, the paper describes some basic research that we want to do in the information retrieval area. In the past, we have found that our approach "paid off" in practical programs for classification, and we feel confident that the same approach will pay off in information retrieval. In our own mind, there is much in common between taxonomy and information retrieval, and a good classification is, or has, many elements of a good retrieval system. What we have done is to separate out the various parts of taxonomy, and try to work on each part as a building block in the house of taxonomy.

We have, as a team, two taxonomists, (myself and Henry Fleming whom you've met), a mathematician (George Estabrook) and a programmer (Bob Brill). We've been together long enough to recognize the nature of the problems—I know the biologist's desires, some of the mathematical terminology, and enough about the computer to understand the specific problems there. Henry is even more at home in these three areas than I am. The mathematician has had enough contact with us to understand some of the biological problems, and what he has to do to make a decent logic of the math to solve these problems. The programmer, too, is in on the other disciplines.

The purpose of this explanation in this letter is to indicate to you that we are by no means making claims to be (or to become) the biological information retrieval center in the country. Far from it—

September 19, 1966

our goals are more in the direction of doing some of the work which can take away the difficulties which other biologists would have if they want to get a computer to do some specific information retrieval job. As with our classification programs, we hope to cooperate with workers interested in having a particular IR problem solved, giving aid and advice as needed so that the biologist can stay with his job and not be side-tracked by the maze of special knowledge required to make a computer work for him.

As I understand it, you are providing the same type of service for plant introduction in USDA. This being the case, I am not certain how we could help much with your project, but I would rather not close the door on some possible collaboration until we are certain that there is no area where some mutually beneficial work can be done. I definitely am interested in such collaboration, provided we can make it. We probably should have an exchange of ideas, once you've seen what we're up to, for I feel certain that we (in this group) could benefit from your knowledge, even though you might feel that it is a one-way street.

At any rate, we won't be in operation on this project for some months. The granting agency mills grind slowly, and as you can see, we haven't even made a formal request yet. This time, we're attempting to fix it so that there won't be a "no" to our request by asking for the advice and consent from NSF in advance. The critical element--money--is yet to be considered. There might, indeed, very likely will be, a hang-up on this unpleasant aspect. But, this project will not be ditched by one agency's refusal.

I shall be interested to have your reactions to the paper and to the possibilities of collaboration. While there is obviously no immediate press, I would like to know whether we have struck a resonant chord.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

September 19, 1966

Dr. C. F. Konzak
Plant Breeding and Genetics Section
IAEA
Kärntner Ring 11, A-1010
Vienna, I, Austria

Dear Cal:

I hope you've successfully completed your rounds of visits, and that this finds you "at home." Enclosed is our write-up for the NSF proposal. It will, I trust, straighten out some of the things we were making claims for when you were here.

I really appreciate your visit, for amongst other things, you gave us some much-needed confidence that the work we're doing is indeed useful. And confidentially, you were the first to receive a full-scale exposition of our ideas. Since this was the case, we tried out several approaches, and indeed, learned something about the whole thing ourselves. The exposition of the work wasn't as easy as we had hoped it to be. I only hope that you didn't get too confused by our gropings. Perhaps the enclosed paper will help to straighten out some of the crooked spots and routes we took in our explanation.

One thing that I tried to point out in the paper is the difference, as I see it, between an information retrieval system to be employed by a librarian and that for a working biologist. Much of the information wanted in a retrieval system wanted by the biologist has never been published, and in some cases will never be published, per se. On the other hand, a librarian wants to turn over all he can find already published for you to read along a particular line. We also tried to point out that there is a great need for both basic and applied research in information retrieval. Much of the latter has been tried, and a smaller amount of the former, but seldom, it seems, has one group carried through the whole process. This we want to do, and we want to help out in IBP. I hope we can.

I hope you will give us the benefit of your thinking about this paper, and how we can best fit into the IBP program. I trust that you will be able to pass these ideas along to others there, though I specifically do not want this to get to a strictly computer-oriented type. We could have our whole operation "scooped," and then we would be out of luck.

September 19, 1966

A copy of this paper is being sent to Sam Dietz for his information. We will offer our help to him, in case he wants to do something with it in his work. I hope we can be of service to him, for one of our goals is to provide that service.

We have today forwarded this document to NSF, and hope that you can write in to NSF* to advise them of your interest in it. That letter will do us more good, (and hopefully, you too) than almost any other letter that I could imagine.

Looking forward to hearing from you,

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

*In case you've misplaced the NSF address, write to:

Dr. Burton Adkinson, Head
Office of Science Information Service
NSF
Washington, D.C. 20550

- Taxonomy Laboratory

September 19, 1966

Dr. Larry Oliver
Office of Science Information Service
National Science Foundation
Washington, D.C. 20550

Dear Dr. Oliver:

As usual, I meet deadlines a week or two later. Enclosed is the write-up which I promised to have in your hands two weeks after you were here. Here's hoping that there is some (it had better be a lot) of correlation between what we said to you and what we've said here. I must say that our conversations with you helped us tremendously in preparing this paper, and we are all grateful to you.

Additional copies have been sent—ten to Dr. Adkinson, one to Dr. Kidd. One item has to be mentioned, and that is that only one set of the first three references cited in our paper have been forwarded with the document, and these went to Dr. Kidd. I trust that this procedure works. The three references go into much more detail about XPOP than we included in the write-up. You know these details, but if you wish to refresh a bit on the XPOP system, would you please ask Dr. Kidd for them.

We are still refraining from mention of staffing patterns, or hardware needs, or funding because we want to be sure we are in the right ball park. When this is established, then we feel that the next step is the organization to carry out the proposal. You and others at OSIS will, I hope, take a good sharp look at this paper and let us have the benefits of your thinking on it.

Let me thank you for your assistance, and for taking time out to come out to see us. I hope we'll have the chance to see you here again. In the meantime, I expect I'll be in Washington towards the end of next month, when I will certainly stop by.

Best regards,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

September 19, 1966

Dr. Burton W. Adkinson, Head
Office of Science Information Service
National Science Foundation
Washington, D.C. 20550

Dear Dr. Adkinson:

Enclosed are ten copies describing the scientific aspects of our intended work in information retrieval. These are sent in the hope that a clearer picture of our procedures will emerge. I appreciate very much the opportunity to present our ideas in this manner, for it permits us to develop our work in an orderly way, and at the same time prevents later disappointments. I am also sending copies to Drs. Kidd and Oliver.

You will note in the procedures section that we do not have aspirations of becoming the center for biological information retrieval in this country. Rather, it is our hope to provide procedures which will make it possible for some uniformity to develop in many centers, such that all interested workers can proceed in the development of their own IR systems that can, if desired, be tied into a larger system. We know from past experience in biological computer classification that we will have to serve as advisers to those who wish to develop their own IR system. In this sense, we hope to provide service to such workers, thereby reducing their load of work at a level of how to do it, rather than what to put in.

Before we proceed to the task of developing further collaborators in this work, we will be pleased to have your and your staff's reactions to this paper. If we are wide of the mark, we would be embarrassed to have to say to our collaborators that we are not in a position to provide the work we promised. Those collaborators so far contacted (I mentioned these in a previous letter) have immediate problems in biological IR, and are willing to stick their neck out for a system that will be useful to them. They seem genuinely interested in our methodologies.

Looking forward to your comments, I am,

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch
Enc.

- Taxonomy Laboratory

September 19, 1966

Dr. Jerry S. Kidd
Program Director for
Special Projects Program
Office of Science Information Service
National Science Foundation
Washington, D.C. 20550

Dear Dr. Kidd:

Enclosed is the write-up of our intended procedures, developed as promised after Dr. Oliver's visit. I have sent 10 copies to Dr. Adkinson, and am sending a separate copy to Dr. Oliver. This may not be the correct protocol, but I hope that it will serve to communicate our aspirations and intentions to you and others in OSIS.

Enclosed with your copy are three of the references cited. These are the only copies available, and none of the other papers sent to Dr. Adkinson have these attached. I will appreciate it if you could circulate them to those who want to learn more precisely about the software aspects.

While the enclosed document is not exhaustingly detailed in procedures, I do believe it to be sufficiently explanatory to give you an adequate picture of our work. Let me emphasize that we are attempting to do some rather basic research in information retrieval, rather than trying to forge some pragmatic IR system for our own specific needs. (Though the proposal grew from these needs.)

As I indicated in the cover letter to Dr. Adkinson, I am a little wary of attempting to get other collaborators than those mentioned in an earlier letter to Dr. Adkinson, until you and others in OSIS have had a chance to evaluate the enclosed document. I am confident that we will have no trouble getting additional workers interested in our work. I know there to be a number of people who have come to us asking precisely for the sort of things we are developing, but until we have some indication as to whether we are on the right track or not, I do not wish to commit collaborators to the project and then have it fail.

I look forward to your comments and evaluation. I also wish to express my gratitude for this procedure of developing a proposal.

Dr. Jerry S. Kidd
September 19, 1966
Page 2

Certainly it is meritorious, and by this procedure we move more positively to our mutual goals.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

September 13, 1966

Mr. George S. Bass
Calle 31 #6-42
Bogota, Colombia

Dear George:

Thanks for your post card with your interests in my coming to see you. I could not get additional funds to carry me down to the meeting in Argentina, and that is why I dropped, for the moment, plans to visit you in Colombia.

What is the best season for you and for finding Yuca growing at its maximum? For example, are your rains distributed through the year, or is there a specific dry period where your hoped-for or existing plantation is. I know that along a considerable amount of coast there is a dry period in which everything is leafless or nearly so. It would not be profitable to visit during one of these dry periods.

Let us try to get the time where all of these variables are considered and let us consider that my trip will not be combined with some other hejira.

If you wish to plan it this way, fine. I personally would prefer to visit you when the snows are on the ground here, but that is not the most critical element. Looking forward to your reply.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

September 9, 1966

Dr. Howard Irwin
The New York Botanical Garden
Bronx Park
Bronx, New York 10458

Dear Howard:

Good news on the publication of our paper. Should I ask about the numbers of copies of the Memoirs that are distributed? Or is this an explosive topic with BM? I guess that reprints will be available.

I am sending under separate cover a preprint of an article which is scheduled to appear in the November issue of BioScience, and another mimeographed set of instructions needed in the preparation of the final data for running. You will see from the preprint that we have added a number of refinements in methodology about characters which you should welcome. Some of these ideas were generating while in New York, but have now become "operational." That is, we can handle these modifications in our new program.

You need no longer use the Port-A-Punch. Instead, a form similar to the one enclosed may be used. This will please you, I hope.

We welcome the opportunity to run more Cassia. There are some considerations which you will want to know about, however. You should begin considering that the use of the computer is an item of expense in your research, and that funds for this are as justifiable as any other expendable money. The need for this type of funds is probably evident to you. We could consider the first runs that we made for you as a valid part of our research in the development of the programs, and therefore chargeable to our own grant. But we must now consider that there are no more "bugs" in the program, and that any use of it afterwards is considered as "production." Our own funds are used up, as far as graph is concerned, and any money that we have for programming will go into development of other, equally vital, programs.

An estimate of the costs to you can be made, provided we know the number of objects you wish to run. We pay \$100/hr. for the present computer. I can only guess that this figure will remain stable. That does not include our time involvement, but for a while, we won't consider time expenses as an expense to you. If others begin to

September 9, 1966

request our assistance (which they already have), we will have to charge them for the work, and if they have no computer of their own, then charges for running on ours.

I mentioned earlier that we are developing other programs. One of these is, or should be within the next couple of months, running here. This is "character analysis" and I'll not give any details other than to say that it should be useful before the similarity-clustering program, to determine which characters (and attributes) are doing the job, and how well. We might consider that your data could be experimental for this program, if you're interested. I should think you would be, but can't be sure. The biggest effort now is going into methods for information retrieval systems, and we are in the throes (or throws?) of writing a proposal to tackle the fancy of NSF. That ain't easy, as you know.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

September 8, 1966

Dr. Sidney R. Galler
Smithsonian Institute *Asst. Secretary (Science)*
Washington, D.C. *20560*

Dear Sid:

We have been concentrating our attention for the past several months on the procedures for an information system in biology. It has been our method of operation, as you know, to combine the efforts of biologists, mathematicians, and programmers in the attack on the classification problems. Because this is the case, it is my firm belief that methodologies which we have either developed or will have developed shortly for information retrieval, should be of immense value to you. I would like to invite you to hear about these methods and would suggest that if it is at all possible that you visit us here along with your programmer and anyone else with primary concern for the IR system. I suggest that you come to see us because we can give you the benefit of the biological, mathematical, and programming techniques more completely than could be done if I alone came to visit you. If I visit with you, I would not be able to give you the intimate details of the computer system which we have hopes of adopting.

Let us know if such a meeting is of interest to you, and if you can possibly spare the time to visit us here. If this is not possible, then I will certainly want to say as much as I can say knowledgeably to you and your group there.

The method that we hope to put to work is still in need of research to flesh out the bones of the idea. We will shortly prepare an application to Burt Adkinson's group at NSF for support of this research. Let it be said that we as a group do not intend to build any mammoth information center here in our shop. Our goal rather is to do the groundwork for a general system which other interested people may use without the necessity of developing whole procedures for themselves. First, we are adopting a compiler which is best described as a "program builder" (it has already been designed and tested for another purpose by another group). With this compiler as the skeleton, we will develop a program precisely defined for biological information retrieval. Much of the work on this aspect has already been done. I will develop for my own interests a retrieval system for Manihot which illustrates the applicability of the general

Dr. S. R. Galler

- 2 -

September 8, 1966

system for biologists. We will have an essentially natural language method of query to the system.

There are several claims made in the above paragraph for the generalities of our approach, and to show that our claims for these generalities are not completely "blue sky", is the reason why I invite you and your colleagues to visit us. I hope you can make it. If not, let me know and I will plan to stop by to see you.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 8, 1966

Editor
IBM Journal of Research and Development
590 Madison Avenue
New York 22, N.Y.

Dear Sir:

Will you please tell me where I may obtain reprints of the paper "Addressing for Random-Access Storage" by W. W. Peterson which appeared in your journal, Vol. 1 No. 2, April 1957, page 30? If the author is a staff member of IBM, I will be pleased to have you forward this letter to him, if that be the route to obtain the reprint. Thank you.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

MEMORANDUM

September 7, 1966

TO: Dr. Richard T. Ward
FROM: David J. Rogers
SUBJECT: Staff Parking Permit for Mr. Robert Brill

1. Request that Mr. Robert Brill, programmer on my staff, be issued a staff parking permit in Zone 4.
2. Reasons for permit: Mr. Brill is on my staff and ranks thus in the same category as other professional staff members. Mr. Brill frequently has to use his vehicle in matters relating to our program and projects with computers.
3. The new zoning positions eliminates any opportunity for him to park in a convenient location near our building. The parking lot next to the Old Music Building is seldom fully occupied, there being a low density of faculty and students in this area.

- Taxonomy Laboratory

September 7, 1966

Dr. Hugh Cutler
Missouri Botanical Garden
2315 Tower Grove Avenue
St. Louis, Missouri 63110

Dear Hugh:

Enclosed is my \$4.00 registration fee. I suppose you have forms for room reservations and so forth; if not tell me where I should hope to find a satisfactory hotel space. Looking forward to seeing you.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

- Taxonomy Laboratory

September 7, 1966

Miss Beryl Robichaud
Vice President
McGraw-Hill, Inc.
330 West 42nd Street
New York, N.Y. 10036

Dear Miss Robichaud:

I hope that October can find us in the office sufficiently long so that you may fit us in your schedule. The dates of my absence will be October 14 through 16 (in St. Louis) and October 25 through 30 (at Yale and environs). This leaves, then, in the middle of October, the 10th through the 13th and the 17th through the 21st. I hope this fits your schedule.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 7, 1966

Dr. Perry R. Stout
Director
Kearney Foundation of Soil Science
University of California
265 Hoagland Hall
Davis, California 95616

Dear Dr. Stout:

I am remiss in not acknowledging your letter of August 22.

It seems that in the search for applications for computers in medicine in biology that the more "classical" areas of biology get overlooked. I note, for instance, in the citations of the book "Digital Computer Needs in Universities and Colleges" that the biological applications of those more specifically oriented to medicine.

I think that I will soon be in a position to make something of a bibliography of the more strictly biological applications inasmuch as I have just finished writing a paper reviewing these applications. Perhaps I will submit these notes and bibliography to the National Academy to have added to their information store.

Once again, thanks for your several letters and references.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

September 6, 1966

Dr. Herman Goldstine
International Business Machines Corporation
Yorktown Heights Research Center
Yorktown Heights, New York

Dear Dr. Goldstine:

In July we sent a "progress report" on the grant which you so kindly sponsored. As I indicated in the cover letter that accompanied the report, we have completed part of the work we hoped to do, but for a number of reasons, did not accomplish the total task. The complexity of the task is somewhat indicated by the nontrivial flow diagrams included as the "meat" of the progress report. I trust that we may have your support for a continuation grant to help us on to the conversion of the CDC programs. A formalized grant request is included herewith.

The nature of our remaining task is indicated in the enclosed grant request. I have included a rough, "in house," resume of the major remaining task, that of "character analysis" or CHARANAL. This resume is included to give you some idea of the type of work we are attempting, rather than to ask you to guess at the importance of our remaining work. Since this work has not yet been formerly published, we hope you will consider it to be confidential. The input to the CHARANAL program is identical to that for the Similarity-Clustering program, which was described in our progress report.

You may be interested to learn that we have used the Similarity-Clustering program as the core of a new course given here at CSU whereby students become familiar with the problems and procedures for use of computers in biological areas. Furthermore, we have put the Similarity-Clustering program to work in a number of interesting applications, and hope to soon collaborate with Dr. P.H.A. Sneath of the British Medical Research Council.

One of our difficulties in completing our task is that we have the services of our programmer only half-time. While the programmer is very good (he worked for IBM on converting FORTRAN from the IBM 704 to the 709), he does not have full time to devote to our project. As a matter of fact, the only reason he is willing to work for us at the price he does is that he is now a graduate student in botany, under my direction

September 6, 1966

for his advanced degrees. To help speed the process of conversion, you will note that we have requested some additional funds for a part-time, student programmer to work under the direction of our regular programmer.

I might point out that we are faced with still another conversion problem, though perhaps of less difficulty than the original one. We will (hopefully) have installed on this campus this coming fall an IBM 360/44. If all our programs were in FORTRAN IV, there would be practically no problem, but because we have to use machine language to pack the words, the differences between the 7044 and 7094 word length and that of the new system will require that we do more reprogramming.

Let me express my appreciation for your support this past year and hope that we may have your support for the coming year.

Very sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 6th, 1966

Dr. Burton W. Adkinson, Head
Office of Science Information Service
National Science Foundation
Washington, D.C. 20550

Dear Dr. Adkinson:

We were very pleased to have had Dr. Larry Oliver visit us last week. I am sure that he was able to discover more precisely what we had in mind, and what we really intended to do in information retrieval during his visit.

We are in the process of writing a more precise statement of our aspirations, giving documentation for our various claims to produce a generalized tool with which information retrieval systems for specific applications can be built, and with which we intend to build an IR system for taxonomic biology. In this statement, which still will not be the final grant request, you and your staff will have available the necessary materials to evaluate our procedures.

Dr. Oliver suggested that one valuable adjunct to any proposal would be statements from several important user groups which indicated that our proposed system would be useful to them. To this end, I am asking several users (and producers) of biological information retrieval systems to examine our proposals and then, if they find them useful, to write to you of their interest. The groups so far contacted are quite diverse in their objectives. One group, forming a subcommittee from the International Biological Program (IBP), is charged with the development of uniform information retrieval system to be used in the IBP. Dr. C. F. Konzak, a geneticist and plant breeder on leave from Washington State University, Pullman, whose address at present is Joint FAO/IAEA (International Atomic Energy Agency), Vienna, Austria, is the leader of the IBP subcommittee. I trust that a letter from him will soon be addressed to you. A second group of users is The National Seed Storage Laboratory, USDA, whose main laboratories and facilities are here on our campus, will soon convert their present IR system (on edge-punched cards) to a computerized system. Dr. Edwin James, head of this laboratory has been given a thorough briefing on our IR proposal, and wishes to support (and use) our system. He will probably be addressing a letter to you indicating his support for our work.

There are several other biological groups whom I hope to contact in the near future. We want, for example, to work with Biological Abstracts, and I will soon be in contact with Dr. Phyllis Parkins to determine their interest, and possible utilization of our developed procedures. I hope

to work with Dr. Sidney Galler, whose interest in an IR system for the Smithsonian comes closest to my own individual needs for a system of any of the above listed. Again here on our own campus, the School of Veterinary Medicine has a number of IR problems which we hope to work on.

These various groups indicate the breadth of our intended operation. They are by no means the only ones with whom we will eventually make arrangements, but it seems to me that what is needed more than anything else is the scientific investigation which we hope to accomplish. We obviously cannot guarantee that our system will "work," no more than anyone can guarantee the results of a scientific investigation. My own background and experience in the use of the computer for biology makes me know that claims of the workability of this or that method, in advance of the research, leads to many disappointments. However; we feel confident that by our procedures, where we clearly separate the IR problems from the data, we can advance the science which underlies information retrieval.

Our experience over the past few years indicates another need amongst biologists. Many workers recognize that something drastic has to be done, that some new breakthrough is required if they are to keep their heads above water. With this in mind, they begin to search for some way out of their dilemma. In most cases, they have not had any experience with computers, and are quite naive about the difficulties involved in computer use for this or that problem. Give them credit, however, for trying to discover someone who has done something about the use of computers in biology. I have been on the receiving end of many requests for assistance, simply because I have made some public statements about our research using computers in biology. We have become, as a result, an informal information center or service bureau for many scientists—including psychologists, sociologists, and biologists. None of our present grants indicates this as one of our primary goals, but we feel obligated to help out where we can, and have indeed spent much time in advising and assisting those whose needs we could adequately meet. The need, therefore, is to provide a place (and a group) from which such knowledge can be disseminated, while at the same time we are carrying on to fulfill the objectives of our research.

Again, let me assure you that we are working on the necessary explanations of our research project, and hope to have these in your hands shortly.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

- Taxonomy Laboratory

September 1, 1966

Dr. Richard W. Holm, Editor
EVOLUTION
Division of Systematic Biology
Stanford University
Stanford, California 94305

Dear Dick:

On May 24 I wrote requesting your opinion on the submission of a paper to EVOLUTION. Since I have not heard from you, I wonder if that letter has gone astray. If it has, let me know--if not, I would appreciate your reactions to the proposed paper.

Yours truly,

David J. Rogers
Professor of Botany

DJR:ch