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5th Floor, Hunt Library
Carnegie Mellon University
4909 Frew Street
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Telephone: 412-268-2434
Email: huntinst@andrew.cmu.edu
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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

September 21, 1966

Dr. G. T. Prance
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

MICHIGAN STATE UNIVERSITY EAST LANSING

DEPARTMENT OF FORESTRY

January 28, 1964

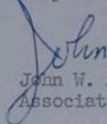
Dr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

Thanks for the kind remarks in your letter of 9 January 1964. You will have to wait a little longer to get the answers to your third paragraph for I want to be sure what I am writing about before I inform you of our storage facilities in the 3600 computer. Our chief programmer has been out of town for the last several weeks, and I also have been extremely busy but promise to get you some pertinent information as soon as possible.

Enclosed please find a U. S. Forest Service reprint that might be of interest to you in your computer work.

Very sincerely yours,



John W. Andresen
Associate Professor

JWA/cs
Enclosure

January 9, 1964

Dr. John W. Andresen
Department of Forestry
Michigan State University
East Lansing, Michigan

Dear John:

I don't know why I waited so long to answer your letter. I should definitely have said that I will be happy to see your paper on *Pinus strobus* var *chiapensis*. Definitely we ought to have papers like this for *BRITTONIA*, and I hope you will have a go with it.

As far as sending any material for the program is concerned, may I suggest that you hold that for just a bit. We are, as you probably know, having to depend on a computer at New York University, and we have so little time on that computer that we have barely enough time to run our own stuff.

We have been checking on the 3600 and have found out that in terms of storage it does not have a tremendous amount more than the 1604. Does your computer have any disc pack storage to go with it as satellites? This would be the answer as far as any biologist is concerned because we can, with our present program, exhaust the memory of the computer very rapidly, and the only answer we can see that would be appropriate to running the whole thing with some degree of efficiency would be with disc pack storage. If you have disc pack on your facility, you are indeed fortunate. Very obviously, if you have to call from tape for processes of computation, you slow down the computer terrifically, and we think that this can be overcome if one uses the random access type storage available in disc packs. It would be interesting to see whether this has been brought into your center or not.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

ask if 3600 has a
disc pack?

MICHIGAN STATE UNIVERSITY EAST LANSING

DEPARTMENT OF FORESTRY

December 17, 1963

Dr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

I was pleased to read in your letter of 10 December 1963 that the mimeographed material of our computer work here at Michigan State University was of use to you.

In relation to the CDC 3600, I will be very happy to send you a copy of the problem I have just completed in relation to a redescription of Pinus strobus var. chiapensis. Dr. N. T. Mirov and I believe we have more than enough evidence to elevate the variety to specific rank. Our conclusions will be based on results obtained by using the coefficient of divergence technique plus several applications of the analysis of variance technique, which in turn is based on results supplied by the 3600. In relation to this, I wonder if such a redescription plus the use of several statistical analyses and their derivation would be of interest to the readers of Brittonia. I should have the manuscript finished in about a month or so and would like to have you look at it to give me your opinion.

Now back to the material I would like to send you--I can supply you with duplicates of the call and data cards, a print-out of all the cards, plus the results when I called for a program of a one-way analysis of variance, unequal sub-classes.

Before I forget, I want to thank you very much for your "taximetrics" paper and also the one on using the "porta-punch." The latter has been in use by foresters for quite a while in tallying field data in their timber cruising activities. One other application of this is the "mark-sensing" technique which might be better in the field because a stylus is not required and neither is the "porta-punch" holder necessary. A pencil and the cards are all that are required, but this is something you probably thought over several years ago.

Always with my kindest regards and best wishes for a happy holiday season,
I remain

Very sincerely yours,

John

John W. Andresen
Associate Professor of Forestry

JWA:cs

December 10, 1963

Dr. John W. Andresen
Department of Forestry
Michigan State University
East Lansing, Michigan

Dear Dr. Andresen:

Forgive me for having delayed so long in answering your letter of November 11 and acknowledging the printed material you sent from your laboratories. What a wonderful set up you have there!

We have just completed a program with the CDC 1604. It is a very complicated and sensitive program and would certainly be much advanced were we able to use the 3600 on it. One of our immediate problems is that we run out of storage capacity very quickly with the 32000 K memory.

We have certainly got a number of things to do to the program, but as it stands at the moment it is a workable program and has numbers of intriguing possibilities that we have only begun to explore. We are very shortly beginning the write-up on this and will circulate as fast as we can the information about this program. I am sure that it could run as well as on the 3600 as it can on the 1604 with little modification. We will be pleased to keep in touch with you.

I don't believe that I sent you a little paper that we wrote up last spring. Perhaps you have not received BRITTONIA and so I include a reprint from there as well. The punch card paper (AIBS) is something we think will probably be very useful to taxonomists, and we have a number of taxonomists who have punched data for us using these cards. We will be testing our procedures with these different taxonomists' data to determine the validity and strength of our program.

Thanks again for your thoughtfulness in sending us your material.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF
Enclosures-2

DEPARTMENT OF FORESTRY

November 11, 1963

Dr. David Rogers
New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dr. Rogers:

Under separate cover, I am forwarding you a set of mimeographed instructions and explanatory brochures pertinent to our new 3600 computer. As an educational institution, we obtained the computer and its other components for \$1,400,000. The commercial price is about \$2,500,000. It was manufactured by the Controlled Data Corporation of Minneapolis.

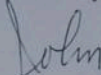
I am sending you the materials because of your interest in numerical plant taxonomy. As you may or may not recall, we spent a few moments together at the Ninth Annual Symposium on Systematics in Missouri in October of 1962. At that time, I mentioned we were getting a new computer but knew little of the device. I still do not understand all the complexities of the computer, but I am gradually learning how to prepare various programs using data from my taxonomic studies. One of the more pertinent explanations to taxonomic work is located near the end of the set and is titled "Pattern Analytic Methods (PAM) for the CDC 3600." In particular, the rank order typal analysis is pertinent to studies in variation.

As I learn more of the techniques involved and work some problems, I will be better able to write you of our programs. In the meantime, I will continue to send you copies of any materials that are released by our Computer Center.

I missed you at the recent October 18-19, 1963, meeting in Missouri but perhaps will get to see you again in 1964, at which time we can discuss in greater detail the use of a computer as a tool in taxonomic research.

Always with my kindest regards, I remain

Sincerely yours,



John W. Andresen
Associate Professor of Forestry

JWA:cs

University of Toronto

TORONTO 5, CANADA

DEPARTMENT OF BOTANY

December 29, 1964.

Dr. David J. Rogers,
New York Botanical Garden,
Bronx Park,
New York 58, N. Y.,
U. S. A.

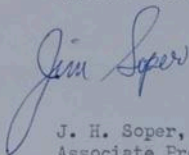
Dear Dr. Rogers:

Thank you very much for your letter of December 22nd with comments about Dr. Michael Levin. This is exactly the kind of information we need in assessing applications from persons not known to us.

In regard to your 7090 program - I understand fully your situation and hope you will have it soon. I am in a similar situation regarding assistance with a FORTRAN program to convert latitude and longitude readings to artificial X and Y readings for my mapping project. It has been promised by a friend who is doing it free of charge and therefore I cannot push him.

I expect to be in Washington on January 15th to attend a discussion at the N.S.F. on the use of machines in botanical research. Perhaps I will meet one of your group or someone from the I. P. I. project there.

Yours sincerely,



J. H. Soper,
Associate Professor
and Curator.

JHS/jk

December 22, 1964

Dr. James H. Soper
Department of Botany
University of Toronto
Toronto 5, Canada

Dear Dr. Soper:

I am sorry that I can not recommend Dr. Michael Levin. He was in the employ of this department on a grant from the first of February, 1964, to the first of July, 1964. We did not find him satisfactory. I am not certain that he ever quite understood what was intended in taximetrics. It is fairly certain that he does not have a grasp of the fundamental activities of theoretical taxonomy. I can not speak for his ability as an ecologist.

On a different subject--we still are waiting for the conversion from the 1604 to the 7090 write-up. I am sorry that it has not appeared as fast as we would like. We hope it will not be too much longer. The way this is being done is that a friend of ours at Columbia University who has an interest in the same problem is having the program converted, and inasmuch as it is being done free of charge, we cannot push him too much. However, I hope to have a report before too much longer for you.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

University of Toronto

TORONTO 5, CANADA

DEPARTMENT OF BOTANY

December 18, 1964.

Dr. David J. Rogers,
New York Botanical Garden,
Bronx Park,
New York 58, N. Y.,
U. S. A.

Dear Dr. Rogers:

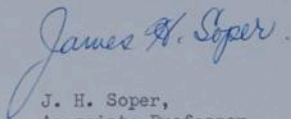
In reply to a recent advertisement for a taxonomist with ecological and phytogeographical interests, we have just had an application from Dr. Michael H. Levin.

Would you be willing to send us a brief statement of your opinion of this man as a prospective teacher and research botanist? We are in need of assistance with courses in taxonomy and ecological plant geography. Also I would welcome someone with interest and experience in taximetrics.

On another matter, have you yet had an opportunity to perfect your taxonomy program for the I.B.M. 7090? I mention this simply because I hope you won't forget that we would like to try your program at Toronto.

With best wishes for the holiday season,

Sincerely yours,



J. H. Soper,
Associate Professor
and Curator.

JHS/jk

University of Toronto

TORONTO 5, CANADA

DEPARTMENT OF BOTANY

November 20, 1964.

Dr. D.J. Rogers,
Curator of Quantitative Taxonomy,
The New York Botanical Garden,
Bronx Park,
New York 58, N.Y. U.S.A

Dear Dr. Rogers:

The two reprints which you sent recently have arrived and I want to thank you both on my behalf and on that of my student, Mr. Barr. Also this reminds me that I did not answer your letter of October 29th where you indicated the present status of your taxonomy programmes. Certainly we would appreciate a 7090 programme more than the one for your CDC 1604 and we will be willing to wait until you have had a chance to perfect and test this programme at Columbia. In the meantime we are working on the coding of characters for the particular problem on which Mr. Barr is working and we will perhaps test a program from Dr. Rohlf which he sent earlier in the year.

Thank you for saying you will keep us advised of your situation and we look forward to receiving a 7090 programme when it becomes available.

We had an enjoyable visit recently with Dr. and Mrs. W.C. Steere on the occasion of his lecture before our Royal Canadian Institute. I had a chance briefly to show Dr. Steere the technique that I am using for the simple production of distribution maps by a modified 407.

Yours sincerely,

James H. Soper
J.H. Soper
Associate Professor & Curator.

JHS/md

October 29, 1964

Dr. James H. Soper
Department of Botany
University of Toronto
Toronto 5, Canada

Dear Dr. Soper:

Thank you for your letter of October 22. I have delayed answering in hopes that I would have some later news about re-programming that would be of interest to you.

I note that you are using the 7090. Inasmuch as some of the program is written in machine language specifically for the 1604, it would be difficult to refer that to the machine language of the 7090. The machine language is mostly dealing with the input and the packing of the words, and because the word length and addressing procedures for the 90 are different from the CDC, there will be considerable trouble there unless the full explanation and flow charts be given.

Although we stated in our paper that we would make the program and flow charts available, our research which has developed since this paper was published (it was sent to the printer in May) indicates that we should probably have a much more efficient program shortly than the one described in that paper. We are at work at the moment on rewriting the program for a 7090 at Columbia University. It would seem to me valuable, therefore, if you can wait to allow us to do the full program with the new methodology which we feel gives a much better taxonomic clustering procedure.

I hope that this arrangement is satisfactory to you, and we will keep you advised of the situation as it develops. As soon as the reprints arrive, we will send you a copy.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

Oct. 22 1964

Dr. D. J. Rogers

I would greatly appreciate
receiving a copy of your paper
"A Computer Program for Classifying
Plants, II" which appeared in
BioScience, Sept. 1964.

David Barr
(cc Prof. J. H. SOPER)

University of Toronto

TORONTO 5, CANADA

DEPARTMENT OF BOTANY

October 22, 1964.

Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
New York Botanical Garden,
Bronx Park,
New York 58, N. Y.,
U. S. A.

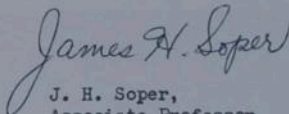
Dear Dr. Rogers:

I have read with great interest your recent paper with Henry Fleming in the September issue of BIOSCIENCE and would appreciate receiving a reprint if available.

I now have a student who is collecting data for a computer-analysis of our local collections of Amelanchier. We will be working with an I.B.M. 7090 so I suppose the program which you used on your C.D.C. 1604 would not be compatible on I.B.M. equipment. Perhaps we could prepare a FORTRAN program if we had the detailed flow charts which you mention on page 16 of your article. Have these been completed? If so, I would appreciate receiving a copy.

Under separate cover I have sent you a copy of my first progress report on computer mapping. I enclose a separate request for a reprint of your paper.

Yours sincerely,



J. H. Soper,
Associate Professor
and Curator.

JHS/jk

University of Toronto

TORONTO 5, CANADA

DEPARTMENT OF BOTANY

April 23, 1964.

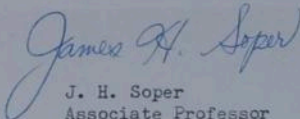
Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
New York Botanical Garden,
Bronx Park,
New York 58,
N. Y., U.S.A.

Dear Dr. Rogers:

Thank you for the reprints on taximetrics which arrived last week. They will be useful in connection with assigned reading for students in my course in Systematic Botany. I will look forward also to the appearance of your current paper in this field.

Since writing to you I have uncovered more information on machine mapping which necessitates some revision of my report on this subject. However, I hope to complete the manuscript in the next week or so. I'm afraid my question about printing out the dendrogram sounded facetious, but that was not by intent. I simply felt that this task could be easily added to a taxonomy program as part of the print-out of results.

Yours sincerely,



J. H. Soper
Associate Professor
and Curator

JHS/jk

April 14, 1964

Dr. James H. Soper
Department of Botany
University of Toronto
Toronto 5, Canada

Dear Dr. Soper:

In answer to your letter of the 8th, I am enclosing reprints of the papers that we have so far available in the field of taximetrics. We do not have a completed program for cluster analysis, but we are in the process of preparing the flow charts and diagrams that would be necessary to run on any computer different from the one we used.

Referring to your request for information concerning "dot maps", I know of no work done on this continent on this aspect. Also, I do not have much information on your question concerning dendrograms. I do know that Dr. F. James Rohlf, Department of Biological Sciences, University of California, Santa Barbara, California, does have a dendrogram program written for the 7094. Whether this actually prints the dendrogram or not, I am not sure. We have not investigated it because we have not felt it adequate for our needs.

We are in the process of final preparation of the manuscript which gives full details of our methods, theoretically as well as the actual details. This paper should appear, I hope, in Bioscience, a new publication of AIBS.

I hope that this information is useful to you. We appreciated receiving the reprints that you recently sent.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

University of Toronto

TORONTO 5, CANADA

DEPARTMENT OF BOTANY

April 8, 1964.

Dr. D.J. Rogers,
New York Botanical Garden,
Bronx Park,
New York 58, N.Y. U.S.A

Dear Dr. Rogers:

I am interested in the application of data processing-methods to botanical problems and would appreciate receiving reprints of your papers in the field of Taximetrics. Also, if copies of I.B.M. Taxonomy programs are available, I would like to try computer analysis on some problem in Ontario vascular plants.

My research deals chiefly with plant geography and during the past year I have been investigating the use of machines for the preparation of distribution maps. I have carried out tests on three different types of equipment and have succeeded in repeating (and possibly improving) the technique used by Walters & Perring in the "Atlas of the British Flora". Before publishing a report on this investigation I am trying to find out whether other biologists on this continent are investigating or using machine methods for plotting "dot maps" of the type shown in the enclosed reprint. I have not been able to find any pertinent references in the literature.

Incidentally, I wondered whether, in the Taxonomy programs, the Computer prints the dendrogram and if not, why not?

I shall be grateful for any information or assistance you can give me in these matters.

Yours sincerely,

James H. Soper
J.H. Soper

Associate Professor & Curator.

JHS/md
encl.

NOV 18 1965

MISSOURI BOTANICAL GARDEN

"SHAW'S GARDEN"

2315 TOWER GROVE AVENUE
ST. LOUIS 10, MISSOURI

November 15, 1965

Dr. David R. Rogers
Professor of Botany
Department of Botany & Plant Pathology
Taxonomy Laboratory
Colorado State University
Fort Collins, Colorado 80521

Dear Dave:

I was much interested in your letter, and I wish you'd come by sometime. I have had long conversations with a couple of the men at Berkeley who are working with computer problems, and I have been reading Ornstein's paper which he was kind enough to send me.

I have also done quite a little talking with taxonomists and statisticians about the iterative way in which my metroglyph analyses were done in practice. I don't believe I ever described it fully in print, though I know that Hatheway was fully aware of it eventually, perhaps from conversation with me. I'd eventually (after I had used it on several different things) try and get three unrelated kinds of characters, not just three reflections of flower size; a good set would be pedicel length minus petiole length; hair position (appressed versus retrorse) intensity of color in the eye of the flower. I'd score each in three grades and turn it into an index going from 0 to 6. With this index I would make a frequency distribution of a population which had two different things in it. Then I'd take my next best character and see how it fell along this index. If it looked at all possible, I'd score it in three grades and add to the index. Then I'd make a new index including this character and running from 0 to 8. Then I would see what kind of a frequency distribution this made. If it was no better I'd lay it aside for the moment; if it was worse I'd pitch it out; if it was better I'd know I had a pretty good start at building up a really good discriminator for the two-ended population I thought was made up of two different elements. (If someone like Ledyard Stebbins wanted me to get excited about complexes of three to five things all interacting, I would ignore them until I had found out something about the populations where the story was a simple one).

My data on the forest-encouraged coffee at Jimma, Ethiopia have a clearly uniformish element at one end, the other pole is made up of at least two elements. I'm getting ready to write this up in detail as an example of method as well as an example of what hellish variation within populations one finds when he investigates really primitive agriculture.

Dr. David R. Rogers
Colorado State University

November 15, 1965
Page Two

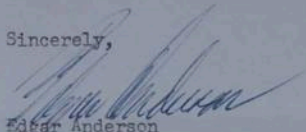
As soon as your letter came I want to see if collection of *Uvularias* is still in good condition. They are somewhat chippy from having been worked on by a good many classes, but I think they will serve your purpose. You ought, right away, however, to write around and get collections from such people as Dunn at Columbia, Missouri, and someone in southern Michigan where the ~~same~~ *grandiflora* has nothing else to cross with.

Things are going well with us personally. Dorothy is distinctly improved again within the last six months. I am practically back to what I was before I was ill except for gradual aging. I have not only done a lot of writing for our Bulletin, but I am getting back to scientific writing, and I have given one Seminar at the University this Fall which was in the same class with the ones I used to give occasionally here and elsewhere. Phoebe is now a real social worker and carrying as large a case load as she is supposed to. She's still in Cincinnati and is engaged to a man her own age who is a semi-invalid but is able to support himself.

Gates is taking hold of our problems, and things are going forward more encouragingly than anyone could have hoped.

The horticultural operations of the Garden were greatly improved during the last two years, and the place has never looked better than it looked this Fall. I won't have to keep my eyes closed when I walk down through it the way I used to.

Sincerely,



Edgar Anderson
Curator of Useful Plants

EA/ph

I've talked to Lewis since I dictated the above. We'll check out all I have including MBO duplicates so that it will be regularized and there'll be a record. If your grant can pay for the shipping it would help our Herbarium budget.

I'll let you know about when the stuff is going forward. Lewis is heroically trying to get records of REW's destroyed duplicates whenever possible.

A. W. R.

December 7, 1965

Dr. Leonard Ornstein
Division of Cell Biology
Cell Research Laboratory
Mount Sinai Hospital
New York City, New York

Dear Dr. Ornstein:

I received your interesting separate on COMPUTER LEARNING AND SCIENTIFIC METHOD a month or so ago and have worked at it intensively from time to time. Though much of it is beyond my technical competence I have long been interested in the efficient manipulation of pattern data and in the recognition and analysis of significant patterns. I was delighted with the density-wave length analyses of your electrophoresis runs.

I would raise my eyebrows a little at your comparison of herpetologists on Page 441, though you have qualified your statement by saying "about as well". As one of a very few people who have studied the species problem in the minds of taxonomists as well as in the organisms they were classifying, I have learned that "taxonomic intuition" varies greatly among first-class taxonomists. Most of my experimental work was done with the ideographs of two species of *Uvularia* presented on Page 95 of Kempthorne's *Statistics and Mathematics in Biology*, Ames 1954. I used them in individual experiments on cards the size and shape of playing cards and with whole audiences on boards or projections up to five feet high.

I learned that good taxonomists have very different kinds of minds. Of the several hundred who tried sorting the cards, one of Viktor Hambruger's graduate students in Embryology sorted them quickly and correctly faster than any taxonomist I tested. Richard Holm of Stanford, who began as an enthusiastic herpetologist before we had any herpetologists among our zoologists, was never able to sort them to his satisfaction even after I had told him that there were two "key differences" not on the diagram, which would allow for a sharp separation.

Though I have discussed these results somewhat in public, I have published in this field only a few of the data. I soon learned that it merited full scale investigation by a sensitive naturalist and a competent psychologist working together. I also felt that some of my major discoveries were to embarrassing to greatly appreciated colleagues and students, for public discussion.

Dr. Leonard Ornstein
Division of Cell Biology
Mount Sinai Hospital
New York City, New York

December 7, 1965

Page Two

I might add that I was very much taken by the presentation of Figure 1 and your discussion of it. Several years ago I discussed Weyl at some length with my statistician friend, John Tukey.

Sincerely,

Edgar Anderson
Curator of Useful Plants
Missouri Botanical Garden

EA/ph

November 24, 1964

Dr. Edgar Anderson
Missouri Botanical Garden
2315 Tower Grove Avenue
St. Louis 10, Missouri

Dear Andy:

Thanks a lot for the thoughtful comments on our papers. Would that we could get the same sort of response from others to whom we have sent them rather than just a "no information" thank you!

We recognize that there is a heck of a lot more in the taxonomic thought process than we have anywhere near gotten under our belt, but I do think that we are on track.

Sincerely

DJR:MDF

MISSOURI BOTANICAL GARDEN

"SHAW'S GARDEN"

2315 TOWER GROVE AVENUE
ST. LOUIS 10, MISSOURI

November 20, 1964

Dr. David Rogers
New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

Your separates arrived in the morning mail and I have spent most of the afternoon with them. For Rogers and Fleming I was on solid ground through Table II. By figure 3, I understood your aims but my grasp of the dirty details was too imperfect to be helped by the figure. I'll not bother you with questions until I've done more homework. I know from Mike Worth's difficulties how anxiously this paper has been awaited.

Your taximetrics paper I skimmed some months ago. I've read it through carefully and have some comments and corrections which I will send off now while it's all fresh in my mind.

(1) A. negundo p. 287. "simple leaves in all other species of the genus." I suppose you are now tired of hearing that there are several oriental species of the section NEGUNDO as well as a whole section of trifoliate species, including the charming Acer griseum. Rehder laid out the information about the ones of horticultural consequence in his Manual.

(2) Purposes of classification. For the particular audiences this paper will get, it might have been worth while to point out the greatest general scientific usefulness of the taxonomic work which has been done on the flowering plants: It allows their scientific names to be used as pegs on which all kinds of scientific information can be hung. It is basically the world's most far-reaching and successful information retrieval system, as you well know, though only worked at piecemeal and very incomplete. It is none the less incredible how, (given nothing to start on but the scientific name of a particular higher plant) one can get a vast amount of information about that kind of plant out of a good botanical library and herbarium in a very short time. This basic use has had a healthy, steady growth.

An example of the kind of important information that can be had from a monograph is closeness of relationship. A well trained plant breeder, starting in on a new problem immediately gets hold of the best information he can find about the species or genus he is starting work with,

Dr. David Rogers #2

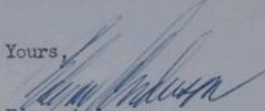
to lay down the framework in his mind for what probably can be crossed with what. We once had a taxonomically innocent horticulturist here who wasted years and space and money, breeding new pentstemons. He got in all the pentstemons he could find in the seed lists and crossed the ones which he thought might produce better flowers. In several years he didn't happen to hit upon any crosses which were in the same section or sub-section. The few crosses which set seed produced plants too sterile to breed from. Taxonomy got its present respect in certain land-grant universities because Ledyard Stebbins and a few others like him, demonstrated through their students how much more efficient results were produced by plant breeders who were not completely innocent, taxonomically.

(3) p. 286, third paragraph. Comparative chemistry in the service of taxonomy. I suppose you are aware of the rapidly accumulating data on relationships coming out of precise studies of cell wall composition in the Algae, Protista and Fungi. Very exciting stuff.

(4) The "Characteristic" problem p. 289. Don't forget that basic differences in the phylogeny of the germplasm are well established between families and larger groups. Degree of dominance of the haploid phase frequency of polyploidy, etc. It is inconceivable to me that we should have found the major basic variables with our relatively crude methods. Keen taxonomists like Mr. Weatherby knew this from experience. Remember how he said that the attraction of taxonomic work was that whenever one turned to a problem in a family new to him he had to work out for himself an understanding of the variation pattern in that family. I note by the way that Jonathan Sauer's understanding of the evolutionary role of sea beach species is utterly different now that he has critical monographic understanding of *Canavalia* as well as *Amaranthus*. Don't misunderstand me; I think that one of the great hopes from the field you're starting in on, is progress in this direction. Don't let your conclusions about CHARACTERISTICS harden until you've worked cooperatively with phylogenetically able taxonomists on several genera. It's one thing to make good keys; it's quite another to establish phylogenies which are scientifically respectable. Both of these problems relate to the detection and analysis of Characteristics.

Congratulations on the way you are sticking by this fundamental problem and making a path into it which others can follow.

Yours,



Edgar Anderson
Curator of Useful Plants

EA:fg

January 4, 1965

Documentation Center
Library of Congress
Washington, D. C.

Gentlemen:

We have heard that the Documentation Center is interested in maintaining a file of computer programs.

Inasmuch as we have computer programs for the process of classification of plants, we wonder what should be sent to you and whether there are any specific instructions to those who wish to submit such material to you.

Any information that you may have on this will be appreciated.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

- Taxonomy Laboratory

October 25, 1965

Mr. Ion Carausu
Statiunea Biologica "Stejarul"
P. Neamt, Bacau, ROMANIA

Dear Mr. Carausu,

We are no longer involved in the studies of algal taxonomy and have passed on to other interests. Furthermore, you will note that we have left the New York Botanical Garden and are now situated at Colorado State University. We have no particular interest in the algae at this time. All of our work concerns the application of computers in taxonomy in general, and it was only for a very short time that we collaborated with an algal taxonomist on some marine algae, particularly on the genus Halimeda.

Sincerely yours,

David J. Rogers
Professor of Botany

DJR/ec

Stațiunea Biologica "Stejarul"
P. Neamț, Bacau, Romania

13th September, 1965

Dr. David J. Rogers
New York Botanical Garden,
New York,
U S A

Dear Dr. Rogers,

I am an young research worker at the Stejarul Biological Station - Roumania (founded in 1957).

Part of our research plan consists in studies on the Bicaz water power reservoir. In my laboratory there are studied the algal populations of this great reservoir (1.23 milliard m³), especially the planktonic ones. Diatoms are the main group, with *Asterionella formosa*, *Cyclotella* spp., *Fragilaria crotonensis* as dominant forms.

I have learned about your studies in the algal taxonomy, the use of computers for it and am extremely interested in them. In the case this is possible, send me, please, some reprints of your works and papers; all they would be helpful in my further activity and very desired.

Write me, please, whether is in the N.Y. Botanical Garden a section concerning with freshwater algae. What studies are made there? How is this section organized? Could you send me a booklet (guide) containing some details on it?

I would be very grateful to you,

Ion Cărașu

Ion Cărașu.
(Algological Laboratory)

PRINCETON UNIVERSITY
PRINCETON, NEW JERSEY 08540

August 23, 1965

Department of Biology

Reply To
P.O. Box 704

Dr. David J. Rogers
The New York Botanical Gardens
New York
New York

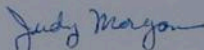
Dear Dr. Rogers:

Earlier in the summer I wrote you concerning the use of the computer in classification problems for Boltonia and you suggested that I come to New York and consult with you. I later wrote in July suggesting a day that I could come to New York. Since I have not received a reply, I assume the letter was lost in the mail (we have had some trouble with the mail service herein Princeton).

I am still interested in the problem and would like to come to New York to discuss it with you. Would you be available at any time this week? If you are able to talk with me this week, please call me collect at 924-9617.

Thank you.

Sincerely,



Judy Tate Morgan

ans 9/1/65

MUSEUM OF COMPARATIVE ZOOLOGY
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

"THE AGASSIZ MUSEUM"

August 10, 1965

Dr. David J. Rogers
New York Botanical Garden
Bronx, New York 10458

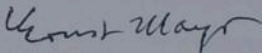
Dear Dr. Rogers:

Thank you very much for your reprints on computer taxonomy. I entirely agree with you that the computer is here to stay and that we must develop methods that are most helpful to the taxonomist. I hope I have been careful enough in my criticism of the Kansas group to make this point clear. Frankly speaking, I had to make quite an effort not to express my real feelings about the arrogance and superficiality of the Sokal group as bluntly as I was tempted to do. When Sokal still worked closely with Mitchenor his work was much better than it has recently been.

Your own approach to make the computer programs aid the working taxonomist is far more sensible and helpful.

Numerical Phenetics has had one good effect. It has forced the classical taxonomist to articulate his procedures. He can now verbalize much of what he used to do routinely but never put in words. The bad aspect of Phenetics is that one is now forced to refute all sorts of nonsense until one is able to get on with progressive work. I feel very strongly that a clear understanding of underlying concepts is an indispensable prerequisite for sound taxonomic operations.

Sincerely yours,



Ernst Mayr

EM:cmd

November 24, 1964

Dr. Chris Quadling
National Research Council
Ottawa 2, Ontario
Canada

Dear Chris:

Why don't we leave the spring date until we get closer to that time? You may be quite right that we don't need to give a seminar here.

The computer talk that I am to give at the AAAS meetings is on December 29. Hope I see you then.

Sincerely

DJR:MDF



NATIONAL RESEARCH COUNCIL
CONSEIL NATIONAL DE RECHERCHES
CANADA

16 November, 1964

OTTAWA 2.

Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
The New York Botanical Garden,
Bronx Park,
NEW YORK 58, N.Y.,
U. S. A.

Dear Dave:

Thank you very much for your understanding letter of October 22nd. I have been looking into the planning of the ASM Meeting next April and I find it is most unlikely that I shall be free on April 29th. It looks as if it will have to be April 30th or nothing. I shall be very happy to come and visit you on April 30th and it will not be necessary for me to give a Seminar in order to justify the visit. However, if you wish to schedule a Seminar for April 30th, that will be quite all right. Please let me know how you feel about this.

I would certainly like to see you in Montreal next December but I shall not be able to attend the Meetings in their entirety. Perhaps you could let me know on what day your talk is scheduled and I will try to be there.

Yours sincerely,

Chas

C. Quadling.

CQ/mb.

P.S. Thanks for the reprint! I'm sorry my affairs seem to be so complicated. I hope to be able to see you in Montreal. Best wishes to Bonnie and to Henry.

Chas

October 22, 1964

Dr. Chris Quadling
National Research Council
Ottawa 2, Canada

Dear Chris:

I am sorry you won't be able to make it down at the time we planned. I understand your predicament because I suppose this happens to each of us, although I have not yet been so called.

We will indeed want you to come later. Inasmuch as our seminars come on Thursdays, do you suppose that it would be possible for you to be here on April 29 rather than April 30? If that is convenient to you, I will go ahead and schedule it for that time.

I expect to be at the AAAS meetings in Montreal where I am supposed to make a summary of the computer methodology in the botanical section. I hope to see you there.

Sincerely

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF



NATIONAL RESEARCH COUNCIL
CONSEIL NATIONAL DE RECHERCHES
CANADA

OTTAWA 2.

October 14, 1964.

Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
The New York Botanical Garden,
Bronx Park,
New York 58, N. Y.,
U. S. A.

Dear Dave:

I am very sorry to say that I shall not now be able to visit the Botanical Garden, as arranged. I have been summoned to report for jury duty (of all things) at the time in question. Regretably one cannot evade one's civic duty when the call comes, neither can one forecast the timing of one's precise obligations.

Marg. and I greatly appreciated the kind offer in your last letter, and are sorry that we cannot now make the trip.

If you should later be able to renew your invitation to me to give a talk at the Garden, either April 30th or May 3rd, 1965 could conveniently coincide with the return trip from the American Society for Microbiology Meeting in Atlantic City. I appreciate the difficulties involved in arranging Seminars and shall understand if this suggestion is unsuitable.

With best wishes,

Yours sincerely,

C. Quadling.

CQ/LM

October 1, 1964

Dr. C. Quadling
National Research Council
Division of Biosciences
Ottawa 2, Ontario, Canada

Dear Chris:

We are very pleased to have your acceptance of our invitation for the 5th of November.

Concerning the topic for the seminar, I would suggest that the second topic that you mentioned would be of more general interest in this institution than would the aspects of the numerical methods as applied to the investigation of bacterial taxonomic problems. I hope that we will have a chance in our department to hear about your methodology in numerical methods anyway.

Connie and I hope that you will stay with us if it is convenient for you to stay in the suburbs, and we hope that Marg will come along as well. We will be pleased to have you stay with us, but if you find other arrangements in the city more convenient, we can understand.

If you will let me know the time of your arrival, I will be happy to meet you at the airport.

Looking forward to seeing you,

Sincerely

DJR:MDF

David J. Rogers
Curator of Quantitative Taxonomy



NATIONAL RESEARCH COUNCIL
CONSEIL NATIONAL DE RECHERCHES
CANADA

OTTAWA 2.

September 25, 1964.

Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
The New York Botanical Garden,
Bronx Park,
New York 58, New York,
U. S. A.

Dear Dave:

Thank you for your letter of September 9th, and for your kind remarks about the Conference. Your letter was awaiting our return from a short vacation.

I am happy to be able to accept your invitation to speak at your Staff Seminar on November 5th. I hope to make good use of this opportunity to see something of the work of your group, and I am sure that we shall have a number of problems of mutual interest to discuss. The expenses of the trip can be borne from funds available here.

I would appreciate some guidance as to the kind of talk preferred at the Botanical Garden. How large is the Seminar Group - and how formal? Do you have a specific subject in mind? I could give (1) a general talk about our experiences here in applying numerical methods to the investigation of bacterial taxonomic problems, and work up to the clustering program which we have been trying to get into operation this summer. Alternatively, (2) I think I can work up a general talk about the kinds of data-handling problems which culture collection curators (and taxonomically oriented microbiologists) face and the kinds of solutions we are considering for our own uses. The emphasis would be on information handling, storage, and retrieval rather than on taxonomy.

.....2

Whilst (2) might strike a responsive chord amongst those who work in herbaria, it would not be a 'research' paper in the usual sense. I would appreciate any suggestions you may care to make and hope to hear from you soon.

Yours sincerely,

Johns

C. Quadling.

CQ/LM

September 9, 1964

Dr. C. Quadling
Division of Biosciences
National Research Council
Ottawa 2, Ontario, Canada

Dear Chris:

Let me express my appreciation and Henry's for the fine job that you did in putting together a very productive and profitable conference. We certainly enjoyed it all, and Connie was well entertained as well for which we certainly are appreciative to the distaff side of the Quadling family.

I would like to invite you to come down to speak at the New York Botanical Garden's staff seminar on 5 November. I must say, however, that the Botanical Garden is not able to pay an honorarium nor expenses for this type of visit, and as a result we usually restrict ourselves to people in the neighborhood. We would be very pleased, however, if you could find a way to visit us then. If this is at all convenient to you, I trust that you will look favorably upon our invitation.

If funds are not forthcoming from your own office for such a trip, we might be able to wangle some funds from some of the commercial organizations around and about to foot the bill. IBM might be interested, for example. Let me know the situation, and I will see what I can do.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF



GEORGETOWN UNIVERSITY
WASHINGTON, D.C. 20007

DEPARTMENT OF BIOLOGY

November 17, 1964

Dr. David J. Rogers
The New York Botanical Garden
Bronx 58, N.Y.

Dear Dr. Rogers:

Thank you for the reprints which arrived today. I find the material extremely interesting. Enclosed are reprints of work done with the bacteria. The latest work is in press and when reprints are available, I'll send them along.

We are now employing an on-line automatic plotter to give us clustering data. The method works fairly well in most cases, with the usual one or two exceptions.

I hope that we will be able to meet again soon at another excellent conference as that which took place in Quebec City.

With best regards,

Yours sincerely,

R. R. Colwell
Assistant Professor

Nov. 12, 1964

Mr. Tom W. Coward
BioScience
200 P Street, NW
Washington, D.C.

Dear Mr. Coward:

I have nothing significant to add to the comments made by Dr. Schultz. The rationale for the coding system is well explained, but the actual process of retrieving the cards is left out.

I suggest that you ask the author to put in an appendix which describes the hardware necessary to make the system work. It shouldn't be much more, if I follow the procedure. However, I am sure that readers will want to know about the physical aspects of the system, which is not included in the discussion.

Sincerely,

David J. Rogers
Curator of Quantitative Taxonomy

Hudson Laboratories of Columbia University

145 Palisade Street
Dobbs Ferry, N. Y.

Telephone Code 914, OWens 3-5800

November 9, 1964

Dr. Donald F. Squires
Curator-in-Charge
Division of Marine Invertebrates
Smithsonian Institution
United States National Museum
Washington 25, D.C.

Dear Dr. Squires:

The program entitled "Taxonomy Program for Classifying Data" to which you refer was programmed under the direction of Dr. Lloyd Rosenberg who is a member of our laboratory staff. This is not a specialized program for oceanographic data. It is based on a paper "A Computer Program for Classifying Plants," Science, October 21, 1960, Vol. 132, No. 3434, pages 1115-1118 by David J. Rogers and Taffee T. Tanimoto. Dr. Rogers, who is associated with the New York Botanical Gardens, is, I believe, continuing his research into the use of computers in taxonomy. I would suggest that you contact him for further information on taxonomic applications.

If we can be of any further assistance, please feel free to call upon us.

Very truly yours,

Melvin Klerer, Ph.D.
Supervisor, Computing

MK:mf
cc: D.J. Rogers
L. Rosenberg

November 6, 1964

Dr. James N. Liles
Department of Zoology and Entomology
The University of Tennessee
Knoxville, Tennessee 37916

Dear Dr. Liles:

Enclosed is check in the amount of \$8.00 to cover registration fee for George Estabrook and me for attendance at the meetings of the American Society of Zoologists.

I should like to point out that the paper to be given by me will actually be a joint one given together with Mr. Estabrook.

Sincerely yours

Michael Wirth
Research Associate

MW:MDF
Enclosure

COPY

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
WASHINGTON 25, D. C.

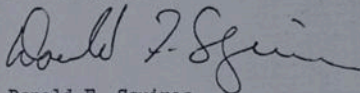
November 4, 1964

Dr. Melvin Klerer
Supervisor, Computing Section
Hudson Laboratories
145 Palisade Street
Dobbs Ferry, New York

Dear Dr. Klerer:

In a recent NODC publication I note that you list among the programs in your library one entitled "Taxonomy Program for Classification of Data." Is this a specialized program for oceanographic data, or is it more conceptual in application? I would be very interested in a little more detail if you can possibly help me. Here at the Smithsonian Institution, we are engaging in an expanding program of data retrieval and we are always interested in the work of others as well as their experience.

Sincerely yours,



Donald F. Squires
Curator-in-Charge
Division of Marine Invertebrates

COPY

THE UNIVERSITY OF KANSAS

LAWRENCE, KANSAS 66045

DEPARTMENT OF BOTANY

AREA CODE 913 UN 4-3410

November 3, 1964

Dr. David Rogers
New York Botanical Gardens
Bronx Park
New York 58, New York

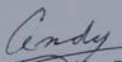
Dear Dave:

Thanks loads for the encouraging letter. I am currently translating the pertinent works and this is proving to be a slow and tedious job. When I get it about 25% completed, I will start thinking about possible approaches and will undoubtedly be contacting you with a cry for help.

I am much impressed by your Department of Quantitative Taxonomy. It may be that I will have to fly up there to get some basic information.

By now you have read our paper and I hope you did not find too much to criticize.

With all good wishes, I am sincerely yours,


Andrew M. Torres
Associate Professor of Botany

October 8, 1964

Dr. Andrew M. Torres
Department of Botany
The University of Kansas
Lawrence, Kansas 66045

Dear Andy:

I think you have an excellent idea in trying to sort out the genera of the Compositae. I also concur that it is a tremendous task, but it is time that somebody got scratching. It is the sort of thing that will never happen unless we do get going on it, and I think we now have the tools for starting it.

It would seem to me that one of the best things to do is to sort of get a broad over-all outline of your intentions so that you may lay out the work. I think that you will have to have collaboration with other Compositologists. These will have to be people convinced about our methods of analysis by quantitative means. This would indicate that by and large the folks would have to be young and not set in their ways. I doubt, for example, that Art Cronquist would ever be particularly interested in such an approach himself, although he would be one of the first people that you should talk to in going over your ideas.

We are hoping to get together here (and have made a good start) a group that can be of great value to all taxonomists as advisors when it comes to processing data as we are doing. There are now five of us in the Department of Quantitative Taxonomy, including a mathematician, a statistician, and three taxonomists. It is our intent to provide not only advice but actual collaboration with others interested in this work.

We do not know yet how financial arrangements will be made, but some sort of support is going to have to be given for advisory service. We would welcome any ideas that you might have as to how we might achieve the most satisfactory arrangements both for those seeking advice and for the establishment of such a group as this. We also hope that we can provide information concerning the best kinds of computer hardware for various problems.

In this connection we now have in our office a device which is a simple hole-punching machine called the Termatrix. This device allows the punching of up to 10,000 bits of information per punched card. Searching is done on a light box rather than to needle edged punched cards. I think that most genera and species can be incorporated on to a single card with the amount of space available on these cards. For identification purposes such a

device offers a great deal in terms of speed and low cost. If one wishes to make an analysis of the information from these cards, it is quickly transferable to ordinary IBM cards and can then go into the program.

As soon as our reprints of the Bioscience article arrive, we will be sure to send you one.

Incidentally, Peter Raven has asked if I would read your paper for Brittonia, and I have agreed to do so with pleasure. It arrived this morning.

I hope that the information here is useful and that you can begin to outline the project which will keep you out of mischief for the rest of your natural born days.

I am sorry I can't come to St. Louis this year--travel funds have run out.

Sincerely,

DJR:MDF

THE UNIVERSITY OF KANSAS

LAWRENCE, KANSAS 66045

DEPARTMENT OF BOTANY

AREA CODE 913 UN 4-3410

October 2, 1964

Dr. David J. Rogers
New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

I thoroughly enjoyed your paper in BIOSCIENCE. It appeared at a most opportune time because for some months I've been thinking about a problem I'd like to solicit your views on. In some respects it is like your problem in Halimeda. If you will indulge me I'll outline the problem to see what you think of it.

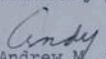
As you know, I've been interested in Zinnia and related genera in the subtribe Zinninae (COMPOSITAE-Heliantheae). There was one of the six genera placed there that simply did not belong. But what to do with it? I examined genera which I thought were close to it, visited herbaria, and talked to people. By chance I mentioned it to John Beaman and happily we were able to place it properly in Jaegeria in the Verbesinae. Now all that effort might have been systematized by using a numerical approach. I think there are many such misplaced genera that could be found out by an appropriate method. As it is now one has to search like crazy or wait for someone to discover it as he revises a genus, and even then it might be missed. If someone had revised Jaegeria (Robinson did in 1900) he may have missed the fact that the only species of Aganippea was an included one simply because he could not check all the composites.

My idea is to translate the treatments of the subtribes and genera (I'll ignore the species for now) of Heliantheae and list all the characters I can extract and use them to build a program much as you did with Halimeda. I'll probably get much fewer characters but since I'll be working on the generic and subtribal level, I may not need so many. I hope to effect a better alignment of genera in the subtribes. If this could be done it would be most helpful to a lot of us. The task will be long and hard but just now I think it can be done and would be worth while. There are hundreds of details to work out but I'd like to see such a project begun. What do you think?

Dave, be sure to send me a reprint of all your papers. We finally submitted our numerical study to BRITTONIA. It very well may be that you'll get to review it.

Will you be in St. Louis? If so, I hope we'll get a chance to talk.

Sincerely yours,


Andrew M. Torres
Associate Professor

MICHAEL REESE HOSPITAL AND MEDICAL CENTER

29th STREET AND ELLIS AVENUE • CHICAGO 16, ILLINOIS • DAnube 6-5700

INSTITUTE FOR PSYCHOSOMATIC AND
PSYCHIATRIC RESEARCH AND TRAINING

October 19, 1964

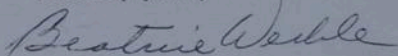
Dr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dr. Rogers:

In accordance with our telephone discussion of October 12th, Mrs. Jeanne Gardner, our programmer, and I plan to spend Monday and Tuesday, October 26 and 27 in New York. Will it be convenient for you to see us Monday morning around 9:30 or 10:00? We will try to find our way to the Botanical Garden without too many detours.

We look forward to the opportunity of discussing your computer classification program with you.

Sincerely yours,



Beatrice Werble, PhD

P.S. Should you find it necessary to get in touch with us prior to Monday, we expect to arrive in New York Sunday night and we have reservations at the Barbizon - Plaza.

BW/kb

October 15, 1964

Dr. Bernice Werble
Michael Reese Hospital and Medical Center
29th Street and Ellis Avenue
Chicago 16, Illinois

Dear Dr. Werble:

Following our telephone conversation, we are looking forward to seeing you on the 26th and 27th of October. I will not be in the office until 11 A.M. on Monday, but we will be pleased to have you come before that anyway. There are other members of the staff in my department with whom you can begin the discussions. For your information, the people you will be talking to are Mr. Henry Fleming, Dr. Michael Wirth, Mr. George Estabrook, and perhaps Dr. Robert Jancey.

If you are coming to the New York Botanical Garden directly from LaGuardia airport, I recommend strongly that you take a taxi. Although this will cost from \$5 to \$8, this is by far the best means in terms of time of getting to the Bronx from there. If your plane lands at Kennedy Airport, take a Carey bus to the east side terminal in Manhattan. From there you can get a free bus that takes you to Grand Central Station. There are trains leaving there (New York Central, Harlem Division) at 9:30 A.M. or at 11:30 A.M. When you get off at the Botanical Garden stop, you are right across the street from the entrance to the Garden. If your plane does not arrive in time to get either of these trains from Grand Central, again I recommend that you take a taxi, although the cost is high--\$10 to \$12. For your information and for the taxi driver, you can come up the Bronx River Parkway, getting off at the turn-off marked New York Botanical Garden, Allerton Avenue. The entrance to The Garden is on Southern Boulevard.

If you have come the night before, then you can come to The Garden best from downtown by taking the D train of the Independent Subway to Bedford Park Boulevard in the Bronx, and then it is a short walk down the hill to The Botanical Garden.

So you have three choices: (1) If you come on Monday morning landing at LaGuardia Airport, take a taxi. (2) If you land at Kennedy in time to get to Grand Central for the 9:30 or 11:30 train, take the Carey bus to the East Side Terminal, then to Grand Central, and thence by Harlem Division of the New York Central. (3) If you are in the city the night before, take the D train of the Independent subway. I hope this does not confuse the issue, but it does indicate the difficulty in getting somewhere in the City of New York by public transportation.

Sincerely yours

David J. Rogers

August 14, 1964

Dr. Benice Werble
Michael Reese Hospital and Medical Center
29th Street and Ellis Avenue
Chicago 16, Illinois

Dear Dr. Werble:

I am sorry for the delay in answer your letter of July 21, but I have just returned from three weeks' sojourn in Europe.

First of all, let me say that we will be very pleased to have a visit from you some time during the second half of October. I do not expect to be away from here at that time.

Also, I can tell you that our program is written in FOR-TRAN II.

With respect to your comments concerning the nature of the input data, I feel confident that we can find ways to suit your requirements even though they do not appear in our present method. However, these probably will be matters of discussion, and I will not say anything more except that I feel pretty confident that we can work out something to your satisfaction.

Looking forward to your visit in October, I am,

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

P.S. Give me a week's notice before coming and I will supply you with the necessary information as to how to reach The New York Botanical Garden. We find that most visitors when attempting to find out about the Garden from policemen in downtown New York are almost inevitably sent to the Zoological Park.

MICHAEL REESE HOSPITAL AND MEDICAL CENTER

29th STREET AND ELLIS AVENUE • CHICAGO 16, ILLINOIS • DAruB 6-5700

INSTITUTE FOR PSYCHOSOMATIC AND
PSYCHIATRIC RESEARCH AND TRAINING

July 21, 1964

Dr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Brook Park
New York 58, New York

Dear Dr. Rogers:

I am most appreciative of your very generous offer to work with me on our taxonomic problem. I am impressed with and highly respect the scholarly approach that you have taken to perfecting your program. I look forward to the privilege of working with you, but unfortunately it will be some time before we can get together. My vacation begins September 10 and extends to October 12. On my return, I will have to spend at least a week at my desk, but hope that we can tentatively plan for my visit to New York sometime during the second half of October, if convenient for you.

I should like to share with you some information about our data and our resources. Our data are measurement data. Our variables are qualitative questions answered in quantitative terms. The way you handle measurement data, as illustrated in the Science article, Table 4, p. 1116, would constitute too great a loss of information for our purposes. I am sure that in order for us to preserve vital information, your program would require modification to meet our needs. It was the professional rationale, the statement of underlying assumptions, and the simulation of the taxonomic process of your program that aroused my enthusiasm. I have referred the Science article to a programmer to discuss the possibilities of modifying a program written for "yes-no" data, to meet the requirements of our scales. In what language is your program written?

I should also like to share with you information about our resources. Chicago is rich in computer and programmer resources. Our institution, as a non-profit teaching and research center, as well as center for the provision of medical care, is in position to purchase computer time at non-profit rates. For example, we have available to us at the Illinois Institute of Technology, computer time on the 7040 which, I understand, is a machine comparable in speed and memory to the CDC 1604 32K, at the rate of \$100.00 an hour. We can also purchase time on the 7094 at the University of Chicago for \$450.00 an hour. It looks to me as though I will need my own programmer and there are a number of good ones in this city affiliated with the Computation Centers of the Universities, and also we can much more economically run data here. In addition, I am not a psychiatrist but am the research coordinator for our project. The principal investigator is Dr. Roy R. Grinker, Sr., Director of the Institute for Psychosomatic and Psychiatric Research and Training, who will apply the professional

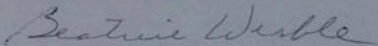
judgement in the taxonomic process. With Dr. Grinker involved in this most critical phase, the data would most expeditiously be run here in Chicago.

I want to conclude by saying that since I so thoroughly appreciate the care and scholarly approach that you have taken to your problem, I would want throughout the process of applying a taxonomic process of this kind to maintain close contact with you and to benefit as much as possible from your knowledge and experience. If, for example, you think it would be advisable to run a sample of our data in New York under your supervision, we would, of course, want to do this.

Finally, I think I have identified the Dr. Satterfield who has been applying your program. Last fall I had the opportunity to read an unpublished manuscript of his. His data and approach to the problem of psychistic classification are entirely different from ours, and I do not think that his experience would be helpful.

I am most anxious to hear your response to this communication and would find it very helpful to know in what language your program is written, and whether we can get together in October. Thank you again for your courtesy.

Sincerely yours,



Beatrice Werble, Ph. D.

kb

October 15, 1964

Dr. Leslie F. Marcus
Department of Statistics
Kansas State University
Manhattan, Kansas 66504

Dear Dr. Marcus:

Thank you for your letter of the 9th. I am sending a copy (under separate cover) of the issue of BIOSCIENCE in which our most recent paper appeared. The reprints have not yet been delivered.

I would be very excited to have a comparison made by you between your program and ours. In this respect I strongly suggest that we delay sending you the program deck until the most recent changes made since the appearance of the article have been incorporated into the program. There are many interesting changes that I won't bother to detail in this letter but which should be programmed and debugged within the next week or two. I hope this meets with your approval. I feel confident that the newer program is closer to doing what we want it to do than the one mentioned in the BIOSCIENCE article.

I hope that we will have a chance to get together some time soon. Any time that you are in New York, please drop in.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

Kansas State University

Manhattan, Kansas 66504

Department of Statistics
Statistical Laboratory
Calvin Hall

October 9, 1964

Dr. David Rogers
New York Botanical Gardens
Bronx Park, New York, N. Y.

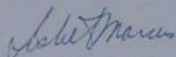
Dear Dr. Rogers:

I enjoyed discussing aspects of numerical taxonomy with you at the Microbial Conference in Quebec. I did get down to the New Jersey area and ended up spending all of my time with friends at Bell Laboratories at Holmdale. One worker there is using a similar coding scheme to yours, i.e. breaking a continuous scale into several (0, 1) variables; for discrimination and multiple regression in weather prediction. Since talking with the staff at Bell and rereading your original paper (Rogers and Tonimoto) I have become interested in this problem. Do you know of any references that deal with the theory of this type of data reduction?

I am looking forward to your forthcoming paper in the AIBS bulletin and would appreciate a copy when it is published. You also mentioned the possibility of sending a copy of the Computer-program used in your approach. I would like to compare this approach to the normalized or standardized scaled-variable approach that we use on correlation coefficients of Euclidean distances (following Sokal). Now that I feel I understand your procedure better I think it would be interesting to try it on our data. Contrary to the stated experience of others our results do seem somewhat sensitive to scaling technique (eg. whether on a 0-100 basis or mean=0, standard deviation=1 basis) and similarity index used.

I will be looking forward to hearing from you.

Sincerely,



Leslie F. Marcus
Assistant Professor of
Statistics

LFM:tw

September 15, 1964

Mr. Antony Santiago
c/o Department of Botany
University of Malaya
Pantai Valley
Kuala Lumpur, Malaya
Federation of Malaysia

Dear Mr. Santiago:

In reply to your last two letters, I am
afraid that our operations here and the strictures
that we have in terms of time and space are such
that we would not be able to support your request
for a Fulbright Research Scholarship.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

C/o Department of Botany,
University of Malaya,
Pantai Valley,
Kuala Lumpur, Malaya,
Federation of Malaysia.

Dr. D.J. Rogers,
Professor of Quantitative Taxonomy,
New York Botanical Garden,
New York,
U.S.A.

Dear Dr. Rogers,

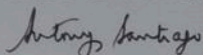
I have read with interest the abstract of your paper presented to the Tenth International Botanical Congress. My letter dated 14 July should have reached you when you were busy preparing for the Congress. You will also have received a copy of a letter from Dr. Harold Wooster of the Air Force Office of Scientific Research to me. I have applied for a Fulbright Research Fellowship for Research in your organisation. I have meanwhile, prepared 2 Tables which might interest you and which I have enclosed.

I should like you to compare and contrast these 2 Tables with those of the numbering system in the International Plant Index and with that of the clusters you mention in your abstract published. These 2 Tables together with the materials I have sent you earlier will, I hope, give you glimpses of the research program I have for "Reciprocal Adaptation of Coordinate System of Classification and Data Processing Machines for interpreting biological problems."

Some of my recent works suggest that coordinate methods of organising data for interpretation of biological variables will be useful in cases where biometric methods are unsatisfactory. I shall let you know of this when I have submitted my thesis for my Ph.D.

I hope you like me to work in your organisation and you will do every thing possible to get me into your organisation for furthering the researches I have outlined. I shall be very pleased to receive reprints of all your papers on the use of data processing machines in Botany and any other related papers.

Yours sincerely,



Antony Santiago.

Table 1. One method of subgrouping the taxon, the Plant Kingdom, within a matrix of (3x3) or 9 positions which are numbered 1 to 9.

TYPE OF	TYPE OF NUTRITION		
	Always photosynthetic	Other categories	Always nonphotosynthetic
Gametophyte always dependant on sporophyte	Most Angiosperms Gymnosperms Some groups of Algae 1	4	Few Angiosperms 7
Other categories	Some groups of Algae 2	Lichens 5	Actinomycetes Mycoscyetes Viruses Bacteria Fungi 8
Gametophyte always independent of sporophyte	Bryophytes Pteridophytes Some groups of Algae 3	6	9

Table 2. One method of subgrouping the Taxon 3 of Table 1 in the matrix of (3x3) or 9 positions which are numbered 31 to 39 within a matrix of (8x8) or 64 positions.

DOMINANT GENERATION	TYPE OF MATURING SPOROPHYTE		
	Maturing sporophyte independent of gametophyte	Other categories	Maturing sporophyte dependant on gametophyte
Sporophyte	Pteridophytes 31	 34	 37
Other categories	The groups of Algae of Taxon 3 of Table 1 32	 35	 38
Gametophyte	 33	 36	Bryophytes 39

C/o Department of Botany,
University of Malaya,
Pantai Valley,
Kuala Lumpur, Malaya,
Federation of Malaysia.

14 July 1964.

Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
The New York Botanical Garden,
Bronx Park, New York 58,
New York,
U.S.A.

Dear Dr. Rogers,

Thank you for your letter dated 16 June 1964.
It struck me recently that there is a possibility of my
applying for a Fulbright Research Fellowship here, if you
will give me a letter stating that my system of classification
is worthy of support and that you will provide me facilities
for my working on your material in The New York Botanical
Garden, on condition that I obtain some Research Fellowship
to enable me to work in your organisation for a year or more
before returning to Malaya to continue with the work.

On receiving such a letter I shall approach the Fulbright
Organisation here, for a Fellowship. The Fulbright Scheme
started only last year here and about 8 students are going over
to the U.S.A. on Fulbright Fellowships to do postgraduate and
post doctorate research this year.

I shall be very pleased to hear of your views and shall
certainly welcome a letter on the lines that I have suggested
or on something more tangible.

Yours sincerely,

Antony Santiago

Antony Santiago.

June 16, 1964

Mr. Antony Santiago
Department of Botany
University of Malaya
Pantai Valley
Kuala Lumpur, Malaya
Federation of Malaysia

Dear Mr. Santiago:

I have received the very interesting material which you recently sent. I am very sorry that there is nothing that we can do at the moment to help you with the continuation of your interesting studies.

We have tried and found no way to succeed in the kind of support you outlined as being needed.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

C/o Department of Botany,
University of Malaya,
Pantai Valley,
Kuala Lumpur,
Federation of Malaysia.

5 June 1964.

Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
The New York Botanical Garden,
Bronx Park, New York 58,
New York, U.S.A.

Dear Dr. Rogers,

I thank you for your kind notes in your letter dated 20 April 1964, which indeed encouraged me to pursue further my work in the coordinate system of classification. I am getting my methodology published and shall send you a reprint as soon as available.

As regards my qualifications I am a B.Sc. graduate in Botany, Zoology and Chemistry of the University of Malaya (1954), and an M.Sc. graduate in Cytogenetics of the University of Alberta, Edmonton, Canada, (1956). In 1956 I travelled extensively in Canada and the United States visiting research centres in particular, and getting to know breeding programs in temperate crops before I went to Trinidad, West Indies to do a course in cacao growing at the Imperial College of Tropical Agriculture. It was then that I had a hunch that something was basically wrong with growing of cacao by vegetative means and with breeding programs in many tropical crops. This prodded me to study and tabulate the breeding systems in cultivated plant species and their methods of propagation. My paper, "Controlled Evolution of Breeding Systems in Perennial Tropical Crops" was the outcome of these studies.

On my return to Malaya I worked on classifying the Malayan citrus species and varieties. Strangely enough, the coordinate system of classification is only a byproduct of these various studies. At present I am writing my doctorate thesis on "Studies in the Autecology of *Imperata cylindrica*." I shall be completing my Ph.D. studies in July 1964 after which I am keen to devote my energy to perfecting my coordinate system of classification.

You will, I hope, appreciate my anxiety to find an environment for developing my coordinate system of classification. Should you feel that it will be expensive to get me to do the work in New York it will be possible for me to do part of the work here under your auspices through the University of Malaya and partly with you in your establishment. It is cheap this way in terms of U.S. dollars.

The data processing machines I have in mind for the work such as the Punch, Verifier, Sorter, Collator, and Tabulator can be hired here for U.S.\$80.00 per month if brought to University premises but will be much cheaper if the company premises are used on bought time. If you are agreeable to these suggestions I can send you an estimate of the total cost of the project.

You will find further information of my personal self, works and publications in the following enclosures:

1. Controlled Evolution of Breeding Systems in Perennial Tropical Crops.
2. Comments on "Controlled Evolution" in Hindu Weekly Review.
3. Coordinate System of Classification of Biological Populations.
4. An Illustrated Guide to the Malayan Citrus Species and Varieties.
5. Proposed Botanical Nomenclature of Citrus in the Malay Language.
6. National Forests of Agricultural Crops for the Wet Humid Tropics.
7. Transcript of Record of the University of Alberta.
8. Open Letter of Reference from Dr. J. R. Hendrickson.
9. Semi-Confidential letter of reference from Professor J. B. S. Haldane.

I shall be very pleased to provide any further information which you will need to find me with facilities for working on the coordinate system of classification.

Yours sincerely,

Antony Santiago
Antony Santiago.

IN December 1938 I was President of a Scientific Congress held in Singapore to celebrate the centenary of Darwin and Wallace's publication of their theory of evolution, and the bicentenary of Linnaeus' publication of his system of classification. Papers were read on a variety of biological topics, and with one exception were up to the standard expected at English scientific meetings. The exception, which was very bad indeed, was read by a European resident in Singapore. Altogether five papers were read by workers from India, apart from my own, but as two were read by my colleague Mr. Subhosh Kumar Roy from the Indian Statistical Institute and two by my wife, I felt that the representation of Indian biology was a little over-sized. The fifth paper was read by Mr. Salim Ali, of Bombay, on the nesting habits of Indian weaver birds, and was illustrated by an excellent coloured film. It was undoubtedly one of the best contributions to the Congress. Although I am told that Mr. Ali has no university degree save honorary ones, he is rightly regarded in foreign countries as one of India's greatest scientists. I took the opportunity to mention the names of some young Indian biologists who I thought should be invited to Singapore or Malaya, and I hope that they will be asked over in the near future. Many Malaysians are of Indian origin, and cultural contacts between India and Malaya should benefit both countries.

Possibly the most valuable papers read were on the geographical distribution of various species of plants and animals in Malaya and Indonesia. Most of them were,

SCIENTIFIC CONGRESS IN SINGAPORE

The author narrates in brief several facts of biology observed by scientists, which they revealed in papers read at a Congress held recently in Singapore.

By J. B. S. Haldane

however, rather technical. An exception was an account of bird migration routes along the eastern coast of Asia and the neighbouring islands. There are great gaps in our knowledge which will only be filled when the people of Indonesia become literate, so that birds on whose legs rings have been put in Siberia or Japan can be reported if they are found in Java and other islands where they spend the northern winter. These geographical papers were, however, the raw material of science rather than science in its developed state.

Among the others I mention just three which were fairly general, and are of some interest to India. Dr. Santiago, of a South Indian Christian family, who have become Malaysians, introduced a new classification of crop plants, according as the main economic product is the seed, as in rice and coconut palms, other reproductive structures, as in fruit trees and cotton, or a part of the plant not connected with reproduction, for example jute fibre or palm sap. The plants are further classified according as they are propagated under human exploitation, entirely by seed, like rice and most palms, not at all by seed, like cultivated bananas and potatoes (for the so-called seed potatoes are underground tubers, not seeds) or by a mixed method.

He pointed out that improvement occurs automatically if the part used economically is also the

part propagated. For example, a rice plant which produces more seed than its neighbours will be better represented in the next generation. So will a root crop propagated by its roots. But if the economically valuable part is not used for propagation the crop will degenerate, from the human point of view, unless it is carefully selected. Thus in Indian villages one often finds mango or banana trees which have been propagated by seed, and are much inferior to those propagated by shoots or grafts. He drew the moral that the coconut tree, which is now being introduced in Malaya, should be propagated by seed, not by cuttings. I had stated the principle earlier, in much less detail, but this was in books containing a good deal of Marxian and, therefore, not obtainable in Malaya to-day, where scientific institutions are not permitted to buy Russian or Chinese scientific journals. Dr. Santiago's paper was a real contribution, not only to agricultural science, but to the study of the evolution of domestic plants, to which Darwin devoted a good deal of effort.

Dr. Hickling, of the Malacca fish culture station, presented some remarkable facts. An East African fish, *Tilapia mossambicus*, was introduced into Java in this century. The Japanese introduced it into Malaya, and its introduction into India is being considered. Dr. Hickling finds that when large numbers are put into a tank they

conceal growing when sexually mature, whereas in rivers they grow to a considerable size. He got over a new stock from East Africa, and found that they grew no better in tanks. However, when the two races were crossed, the hybrids grew about twice as quick as either "pure" race. When the father was Malayan and the mother African, the hybrids were of both sexes; but when the mother was Malayan, the broods usually consisted of males only. Not only did they grow quickly, but they went on growing after they were adult, as there were no females to distract them from eating. This work is of considerable biological interest. But the fact that hybrids between pheasants and poultry are all males is of no economic value. This is the first time that such an upset has been exploited for human use. If Indian fish breeders exploit Dr. Hickling's discovery it can be of great value. The two races can easily be bred in tanks, as for example the catla and rohu can. And if three for four Malayan females and as many African males are put in a tank, they should produce quickly growing broods of males only. Of course the technique must be tried out under Indian conditions. I hope in that it will be.

Dr. Polunin dealt with a very interesting question, the biology of the Muruts, a primitive people living in the forests of north-western Borneo, whose numbers are falling off. Certainly their mortality from

disease is high, but probably lower than that in India thirty years ago. The declining numbers are mainly due to sterility. Forty per cent of marriages were childless. Other anthropologists have attributed this to psychological causes. But it appears that these people desire children. A woman physician examined a number of childless mothers, and found physical abnormalities largely due to infection. It seems probable that an infection which is more or less harmless to most women in other communities has recently spread among these people. No doubt it could be controlled by antibiotics, but this is hardly practicable with people living in small communities scattered through dense forests. Once again, it will be of great interest to see whether the same thing is happening among any of the tribal peoples of India.

After the Congress, I saw something both of Malayan forests and Malayan agriculture. The forests are not unlike those of a small region of south-western India where rain falls during most of the year. The agriculture is very different, for the land is not fully exploited. However, India could learn a very great deal from Malaya. For example, the African oil palm produces about three times as much oil per acre as the coconut, and will certainly grow in many of the wetter areas of India. The questions of the Malayan Federation and of Singapore are, however, both increasing very quickly. About six times as many people are born in each year as die in Singapore. So Malaya will fairly soon require to use its cultivated areas fully, especially if it continues to grow rubber, which is inedible, as its main crop. Hence Malaya will soon have to learn from India.

I hope, therefore, that Malayan scientists will be invited to India, and more Indian scientists to Malaya. However, such invitations will be worse than useless if they are confined to heads of institutions. Research is mainly done by young men and women, and it is only their intellectual contacts with which are likely to be fruitful.

UNIVERSITY OF MALAYA

5373
5374
TELEPHONES: 82588
80705

CLUNY ROAD.
SINGAPORE.

DEPARTMENT OF ZOOLOGY

REF:

9th July, 1954.

TO WHOM IT MAY CONCERN:

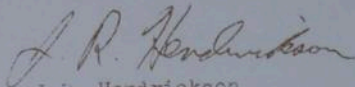
For a 30-day period during August-September, 1952, Mr. Anthony Santiago worked with me on the Talang Talang Islands, Serawek, carrying on field research on a population of Green Sea Turtles (*Chelonia mydas*). Mr. Santiago has asked me to write this letter giving my impressions of his suitability as a field worker and scientific assistant.

Mr. Santiago has the physical health, the enthusiasm, and the ingenuity to make him a good field worker in the tropics. Largely through his skilful approach and his knowledge of the Malay language, we established excellent rapport with the workers on the islands and were able to accomplish more than would otherwise have been possible.

The study necessitated very long hours and painstaking attention to detail; we worked almost all through the night and the day. I was impressed by Mr. Santiago's continued attention to the strict requirements of accuracy, even after the novelty of the experience had worn off and fatigue had become a major problem.

At one stage in the study I had to absent myself from the islands and spend a week in the hospital. Mr. Santiago carried on alone during my absence, under instructions to carry on a reduced program which was to be limited only by his physical endurance. Upon returning to the islands, I was well pleased to see how well he had carried on the work alone. I doubt that I would have been able to do more, had I been in his place.

Signed



J.R. Hendrickson
Lecturer in Zoology.

Now

Vice Chancellor,
Student Programs
East West Center
University of Hawaii
Honolulu
U.S.A.

INDIAN STATISTICAL INSTITUTE

Telegram STATISTICA, CALCUTTA-26
Telephone 55-4222 9 lines

33, RAJBAGHPORE TRUNK ROAD
CALCUTTA-26
22 October 1960

No. Bio/H/ 140

I heard Mr. Santiago read a paper at the Darwin-Wallace-Linnaeus centenary and bicentenary meeting at Singapore in 1958. Afterwards I visited the institute in which he was working at Kuala Lumpur, and was able to converse with him and discuss living plants with him for an hour or less. His paper on the economics of plant products in relation to the plants' reproduction struck me as the most original communication read to the meeting. As I was president I had to listen to a great many by "distinguished" authors. Mr. Santiago has a working knowledge of a great number of cultivated plants, with their methods of cultivation and harvesting. He has thought about them, and thought originally. I was inclined to disagree with some of his conclusions. However they may be true in tropical agriculture, but not in temperate agriculture; or I may be quite wrong.

Mr. Santiago struck me as rather lonely. I got the impression that none of his biological colleagues could discuss a new idea, and that he was pathetically pleased when I had something concrete to say about it. I am sure that he will benefit very greatly if he is given the chance of living for a year or two in an environment where research means anything more intellectual than discovering that x lbs. of $(\text{NH}_4)_2 \text{SO}_4$ per acre raise the yield of some crop by y%. I think that the benefit is likely to be mutual, that is to say that he will have special knowledge and a special point of view which will interest his Australian colleagues, and may be relevant to northern Australia.

I think it is a mistake to send stupid students from India or other tropical countries to agricultural or botanical departments in the temperate zone. If they come back with the belief that the problems of agriculture or botany in Bihar can be solved by the methods current in Ames, Iowa they may sterilise an institute for twenty years. On the other hand an intelligent man who has got a feeling for tropical plant life can be greatly stimulated by the contrast with the temperate zone. Mr. Santiago has started thinking for himself. I therefore think he will do better to go to Melbourne rather than (say) Townsville.

I understand that Mr. Santiago had great difficulty in obtaining permission to read his paper at Singapore. Having met his chief in Kuala Lumpur I am not surprised. If senior staff is chosen on political grounds they are not likely to appreciate originality. But, unless the chief has been changed, you may expect a very lukewarm report from him. I may add that my wife (Dr. H. Spurway, Ph.D.) states her impression that Santiago is a very able man who has had a raw deal.

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CALCUTTA-25

-2-

In conclusion I must state that I only saw Mr. Santiago for a few hours, and cannot be expected to have formed a detailed opinion of his ability. I might perhaps add that I believe him to be a Roman Catholic. I happen to be strongly opposed to the Catholic Church, and if his religious opinions have biased me in any way (as I hope they have not) they have biased me against him.

Yours sincerely,

(J.B.S. Haldane)

Copy to Mr. Santiago

No. 12674/3746/1

963



BY AIR MAIL
PAR AVION

Office of Postage

Mr. Antony Santiago,
C/o Department of Agriculture,
Kuala Lumpur,
Federation of Malaya,
Malaya.

INDIAN STATISTICAL INSTITUTE
Barrackpore Trunk Road
CALCUTTA-25.



TRANSCRIPT OF RECORD
OF
ANTONY SANTIAGO

Certificates accepted for entrance: Bachelor of Science degree from the University of Malaya.

Admission ruling: Admitted to the School of Graduate Studies for the M.Sc. degree.

Subject and Title	Grade	Subject and Title	Grade
<u>School of Graduate Studies for M.Sc. 1954-55</u>			
Biochem. 71 Plant Biochemistry	66		
Genetics 111 Cytology and Cytogenetics	74		
Genetics 102 Research Projects in Genetics and Plant Breeding	deferred credit		
Biometrics 53 Biometrics	74		
Pl. Sc. 200 Seminar in Plant Science	75		
<u>School of Graduate Studies for M.Sc. 1955-56</u>			
Genetics 102 Research Projects in Genetics and Plant Breeding	80		
Genetics 112 Advanced Genetics	76		
Pl. Sc. 200 Seminar in Plant Science	77		
Russian 1 Junior Course	65		
Soils 53 Advanced Fertility	audit		
Soils 56 Soil Classification and Conservation	audit		
Thesis "A Cytogenetic Study of Growth Habit, Speltoidy and Awning in a Mutant Induced by 2, 4-D Thatcher Wheat." - - - Complete - - -			

Academic honors: 1954-55: University of Alberta
Fellowship.

Degree: Master of Science.

Date conferred: May 17, 1956.

Other degrees and
date conferred:

Remarks: Granted honorable dismissal.

Extra-curricular activities
for which no credit is granted:

University of Alberta

INFORMATION TO ASSIST OTHER INSTITUTIONS
IN EVALUATING ALBERTA TRANSCRIPTS

Recognized Standard

The Committee on Special Projects of the American Association of Collegiate Registrars has rated the University of Alberta as an "a" university. That is, the Association has recommended that transcripts of record for this institution be given full value, degrees accepted for graduate standing, and graduate work accepted for advanced degrees.

Admission Requirements and Length of Courses

The general academic requirement for admission is Senior Matriculation (Alberta Grade XII). At universities where admission is at the Junior Matriculation level, students presenting Alberta Senior Matriculation are normally admitted to the second year of a four year pass course in Arts and Science. Hence, degree courses at the University of Alberta are correspondingly one year shorter than the equivalent courses offered at such institutions: e.g. for the degree of B.A., B.Com., B.Sc. in Arts, or B.Sc. in Household Economics—three years after senior matriculation.

System of Grading

Prior to December 1, 1941		After December 1, 1941	
Class I	85% to 100%	Class I	80% to 100%
Class II	85% to 84%	Class II	85% to 78%
Class III	80% to 84%	Class III	80% to 84%

Pass mark: 50% in undergraduate courses; 65% in graduate courses

Honor Awards

First Class General Standing: Prior to the 1947-48 session this award was made to all students who had secured an average of 80% (85% before 1941) or higher on their year's work. Beginning with the 1947-48 session First Class General Standing is granted only to graduating students.

First Class Standing is awarded any student who achieves an average of 80% or higher in his year's work.

Length of Sessions

During the Academic Year (July 1st to June 30th) the University of Alberta conducts a Summer Session of six weeks' duration and a Winter Session of twenty-eight weeks' duration. Where, as in Dentistry and Medicine, the Winter Session has been extended, the actual length of the session is indicated on the face of this document.

April 20, 1964

Mr. Antony Santiago
Department of Botany
University of Malaya
Pantai Valley
Kuala Lumpur, Malaya
Federation of Malaysia

Dear Mr. Santiago:

Dr. Maguire has given me your letter of 8 April to answer. At the moment we do not have any funds for post-doctoral fellows, even for nationals. It has become more difficult to get funds for post-doctoral work for young people in our own country and much more difficult for those from abroad.

The work that you have as your major interest, however, is of critical importance, and it may be that some time in the near future we will have an opportunity to find funds for a staff person who could work in this area. We can understand your difficulties in trying to proceed with such endeavors in Malaya; it is difficult enough here in New York.

I would like to know a bit more of your efforts and endeavors, your training, etc. and would like to have a copy of your paper "Coordinate system of classification of biological populations." If you have any comments that will throw some light on your training with respect to modern methodology in this area, I will be glad to hear from you on it.

When I have received the material, I will see then what can be done. At the moment, I do not hold out too much hope.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

CC: Dr. Maguire

C/o Department of Botany,
University of Malaya,
Pantai Valley
Kuala Lumpur, Malaya,
Federation of Malaysia.

8 April 1964.

Dr. Basset Maguire,
Head Curator,
The New York Botanical Garden,
Bronx Park, Bronx,
New York,
U.S.A.

Dear Dr. Maguire,

I understand from "Taxon" that you accomodate post doctorate fellows in your organisation and wish to know details. I also seek your advice on the availability of a fellowship and research grant for developing with the aid of data processing machines, my "Coordinate system of classification of Biological populations" Nature; London; 193; 154-155; 1962, in your organisation.

In Malaya, however, I am severely handicapped by lack of a suitable environment for developing my system in our young University where I can hardly find individuals with similar academic interests and a job for carrying out research in this field. My Ph.D. studies are nearing completion and I like to resume work on my favourite subject as early as possible.

I hope you will realise how much I will appreciate any help you can give me in finding me a place in your organisation.

Yours sincerely,

Antony Santiago
Antony Santiago.

RECEIVED

4-11-64

THE NEW YORK BOTANICAL GARDEN

September 14, 1964

Prof. E. D. Ford
Department of Botany
University College London
Gower Street WC1
London, England

Dear Professor Ford:

I am pleased to have your letter of 28 August inquiring about the use of computers in collecting productivity data. I am sure that the idea of the use of computers in this direction must have come from discussions with Dr. Ledyard Stebbins of the University of California at Davis with whom I have been discussing the possibility of data processing for the International Biological Program. It must have been that in this conversation he intimated that we had a program for productivity data. Unfortunately, we have not.

We do, however, have a computer program for plant classification, and we are sending herewith the only available reprints we have.

We have proposed that the data processing for the IBP be handled by some central unit where electronic devices could be immediately available to take care of the inflow of data and perhaps a more rapid correlation thereof. We have not pursued this beyond the proposal stage, however, and do not have any individual program so far written.

We will put you on our mailing list, and as soon as a new publication is in print (now in press), we will send you a copy of our latest work.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF
Enclosures

UNIVERSITY COLLEGE LONDON · GOWER STREET WCI
DEPARTMENT OF BOTANY

HEAD OF DEPARTMENT:
PROFESSOR D. LEWIS, F.R.S.

Telephone EUSTON 7030

28 August 1964.

Dear Dr Rodgers,

At the International Botanical Congress held in Edinburgh earlier this month I attended a meeting to discuss the International Biological Program. At this meeting one of the speakers mentioned that you were using computers in collecting productivity data.

I am at present engaged in research into the primary production of sweet chestnut coppice and the associated ground flora at a site in Kent, England. I shall be using the University of London's Atlas Computer for two purposes. Firstly in the processing of "raw data" to obtain production figures, weight/unit area. This will be mainly statistical programming. And secondly in treating the data so obtained at regular intervals during the current growing season to obtain equations of growth for a series of different ages of coppice.

I would be extremely interested to know at
what stage of obtaining information about production
you were using computers. Have you published
anything on this subject? If so I wonder if
you could send me a reprint, or further
information

Yours sincerely,
E. O. Ford.

August 21, 1964

Dr. E. J. DuPraw
Department of Zoology
University of California
Davis, California

Dear Dr. DuPraw:

We would be very pleased to have a visit from you as you suggested. Unfortunately, I will be away from my office, but Dr. Michael Wirth, who is very familiar with our whole program, will be here and would be pleased to talk over your methods and some of the later work that we have done.

Therefore, if you feel that you can stop in here, call us at 212 LU 4-8500 so that we can direct you to The Garden with the least difficulty.

Thanks again for your offer.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

Dr. Rogers,

I will be happy to provide you with a copy of the computer program, together with sample data and output, if it will be of use to you.

I will be through New York the first week in September, enroute to and from the Congress of Cell Biology in Providence.

E. J. Davis

August 17, 1964

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

Dear Dr. Stearn:

It was a pleasure to see you both in London and in Edinburgh. We are looking forward to the processing of your data when you have had an opportunity to prepare it.

We have made some modifications in our program techniques which give us much more confidence in the output than we have had in the past. This work was accomplished between the time of my presentation at Edinburgh and this moment. I think you will be quite excited about the results.

I should like to know if a formal request from the Head Curator of The New York Botanical Garden is required for the loan of the *Manihot* specimens that I selected while in London. As soon as I have your word, I shall proceed in the appropriate direction. Thank you for your assistance.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

BRITISH MUSEUM (NATURAL HISTORY),

Cromwell Road,

London, S.W.7.

Telegrams: NATHISMUS, LONDON, S.W.7.

Your ref. DJR:MDF
WTS/DEA

Department of Botany.

5th May 1964.

Dr. David J. Rogers,
Curator of Quantitative Taxonomy,
The New York Botanical Garden,
Bronx Park,
New York 58,
New York, U.S.A.

Dear Dr. Rogers,

Mr. Dandy has passed to me your letter of 30th April 1964 regarding your visit here in July-August. Needless to say, you will be very welcome. Most of the scientific staff are going to Edinburgh on July 29th but material will be available for you to study. Having given a little help to Sokal and Sneath in the preparation of the Principles of Numerical Taxonomy, I am interested to note that the New York Botanical Garden enterprisingly possesses a Curator of Quantitative Taxonomy!

Yours sincerely,

William T. Stearn

W.T. Stearn.

Bill:

Stearn's
last
statement

is
interesting -

Dane

Sounds tongue-in-cheek,
though -
Bill

July 14, 1964

Dr. Beatrice Werble
Michael Reese Hospital and Medical Center
29th Street and Ellis Avenue
Chicago 16, Illinois

Dear Dr. Werble:

Thank you for your letter of July 9 concerning the possible application of our program to your psychiatric data. While we have a debugged program running now, we are not satisfied that it has been maximized. We want to make a few more minor changes that will make the most efficient use of the computer memory before releasing it. We are very hopeful that we can work with you on your problem and suggest the following procedures.

Our program is all of one piece now, from input through the clustering analysis. It is therefore simpler to use our input format. Furthermore, quite a number of the procedures have been modified from our Science article, and there are a few points at which choices must be made by the individual worker. Since there are differences in sizes of desired clusters, we start out with several constants which may or may not derive the clusters you desire. The best procedure in a situation like this is to run through the program as far as the development of one or two clusters and then shut off the computer, take a look at the output and make a decision as to whether the constants are of the right magnitude or not. If they are, it is a simple matter to proceed. If not, these constants can be altered appropriately and the data rerun.

It would seem to me useful for you to spend a day or two with us to go over the procedure with its changes from the Science article, and then make a run on the computer that we rent from the Control Data Corporation Service Bureau on Long Island. The program is now workable on the CDC 1604 32k machine.

I do not know the number of objects that you have intended to analyze for clustering. Our experience so far indicates that for 31 objects, the running time is about 9 minutes, including compiling time (about two minutes). For larger numbers of objects, the time of running goes up rather rapidly. We haven't an exact figure that gives the time of runs for, say, 75 objects, but it would certainly be three to five hours.

July 14, 1964

I feel that, unless you have your own programmer and large computer, you would be able to process data more rapidly here. I do not know how far you have gone into our procedure, but I do know that it is a very sensitive, and apparently workable, method. For these reasons, if you wish, we will be glad to work through the program with you, and arrange time on the computer mentioned above. We are trying to get the rates down, but haven't yet succeeded in getting anything lower than \$225.00 per hour.

If this proposal has any interest to you, please let me know. At the moment there are a number of changes that we would like to try in our present procedure, and it might be profitable from both your standpoint and from ours to work together on the possible direction of these changes. Unfortunately, the remainder of the summer is fairly well occupied with travel away from New York, and we will not be here available for work until about the middle of September. If you can delay your activities until that time, we would be pleased to collaborate with you on this operation.

The person in Washington University known to be working on our program is Satterfield, but there are two or three of this name there and we'll check to get the other information.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

MICHAEL REESE HOSPITAL AND MEDICAL CENTER

29th STREET AND ELLIS AVENUE • CHICAGO 16, ILLINOIS • DAnebe 6-5700

INSTITUTE FOR PSYCHOSOMATIC AND
PSYCHIATRIC RESEARCH AND TRAINING

July 9, 1964

Dr. David J. Rogers
Curator of Economic Botany
New York Botanical Gardens
Bronx Park
New York City 58, N. Y.

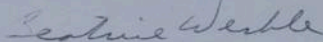
Dear Dr. Rogers:

Enclosed is a copy of a letter that I received from Dr. Herman Goldstine of the IBM Research Center. I had earlier written to him expressing interest in your work with Dr. Tanimoto published in Science, October, 1960, "A Computer Program for Classifying Plants". I found the rationale presented for your program to be highly compatible with a taxonomic problem on which I am working. Our's is a problem in psychiatric classification.

I am writing at this time to establish contact with you and am most enthusiastic about the opportunity that Dr. Goldstine mentioned, of gaining access to your program.

I would appreciate your letting me know in what manner and by what means you can most easily make your program available to us. I would also appreciate knowing the names of the psychiatrists who have already applied the program. Thank you very much.

Sincerely yours,



Beatrice Werble, Ph. D.

Encl:
BW/brh

H. H. Goldstein
Thomas J. Watson Research Center
Yorktown Heights, New York

June 30, 1964

Dr. Beatrice Werble
Michael Reese Hospital and
Medical Center
29th Street and Ellis Avenue
Chicago 16, Illinois

Dear Dr. Werble:

Thank you for your kind letter of June 18 regarding
psychiatric classification problems.

I have now talked with David Rogers and have
learned that he has a computer program available
and would be glad to make it available to you.
Furthermore, he knows some psychiatrists at
the Washington University Medical School who
have utilized this program or modified it for
psychiatric processes. I am sure that Rogers
can also put you together with these men.

We are very interested here in problems of the
sort that you have raised, and I would be delighted
to learn how your work progresses.

Very truly yours,

hng:mag

July 14, 1964

Dr. Harold Wooster, Director
Information Sciences Directorate
APOSR
Building T-D SRI
Washington, D. C. 20333

Dear Harold:

I have the copy of your letter to Antony Santiago. Santiago had already contacted me, and I had to turn him down because I could not find any way to support his activities either.

Incidentally, I would like to have a copy of your "Information Sciences 1963" for my own reference.

Sincerely

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

SRI

9 July 1964

Mr. Anthony Santiago
C/o Department of Botany,
University of Malaya,
Pantai Valley,
Kuala Lumpur, Malaya,
Federation of Malaysia,

Dear Mr. Santiago:

I strongly suggest that you write to:

Dr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Gardens
Bronx Park
New York 22, New York

I am sending him a copy of your Nature paper together with a copy of your letter and this one, so that your letter should not come as a complete surprise.

My reasons for suggesting Dr. Rogers are twofold. In the first place, he is a taxonomist and I am not, and he should know far more about the opportunities for fellowship and /or grant support in this field than I do.

Secondly, he has recently established a Department of Quantitative Taxonomy, with the objectives of investigating information retrieval methods, development of appropriate models for the correlative aspects of various biological disciplines, and a program of graduate education for interdisciplinary training in biology and mathematics. I suggest you look at the paper he and T.J. Tanimoto wrote in Science 132, 1115-1118, 1960, on a computer program for telling which of the (three hundred and fifty named species, but with much synonymy) species of Manihot esculenta (manioc, yuca, mandioca or cassava) various cultivated and wild plants belong to.

SRI

9 July 1964

This is not to say that your work is not interesting. There are obviously all sorts of intermediate positions between the classical Linnaean classifications of the herbaria and the sort of problems Dr. Rogers is concerned with, just as there are all sorts of intermediate positions between the Universal Decimal Classified libraries I found on a recent visit to India and the computerized information retrieval systems we are now experimenting with. The Indian librarians accused me, as an American, of claiming that the computer would solve all library problems. Of course it will not, but some of our computer approaches can be implemented with far simpler punched card and manual coordinate systems.

I am delighted to hear that my book on information storage and retrieval found its way to your country, and that you wrote to me. Our research program has grown since 1958. I am enclosing a copy of my last annual report to show you the sorts of things we are now supporting.

Best wishes in finding support for your continued research and studies.

Sincerely,

HAROLD WOOSTER
Director
Information Sciences Directorate

Enclosure
"Information Sciences 1963"

Copy to:
SRG/Dr Price
Dr. David J. Rogers
(address in body of letter)
& to receive a copy of
Mr. Santiago's Nature Paper

C/o Department of Botany,
University of Malaya,
Pantai Valley,
Kuala Lumpur, Malaya,
Federation of Malaysia,

8 April 1964.

Dr. Harold Wooster,
Air Force Office of Scientific
Research,
Washington 25, D.C.,
U.S.A.

Dear Dr Wooster,

I understand from your book entitled
"Information Storage and Retrieval" 1958 that you support
basic research in the field of information storage and
retrieval. I like to develop my "Coordinate system of
classification of biological populations" Nature, London,
193, 154-155; 1962, and popularise it.

In Malaya, however, I am severely handicapped by
lack of a suitable environment for developing the coordinate
system of classification in our young University where I
can hardly find individuals with similar academic interests
and a job for carrying out research in this field. My Ph.D.
studies in ecology are nearing completion and I like to
resume work on my favourite subject as early as possible.

I hope you will realise how much I will appreciate
any help you can give me in finding me a fellowship and
research grant for the proposed project in your organisation.

Yours sincerely,

Antony Santiago

Antony Santiago.

that the failure of these individuals to give a specific immune response to the viral antigens lies in the similarity of the antigenic structure of the virus to host antigens. Since antibodies to such cross-reacting pathogens will also be auto-antibodies, we need to know whether there is a level of such auto-cross-reacting antibody which will be beneficial to the host in promoting resistance to infection by that pathogen while yet being unable to cause the host tissue damage which at present we believe auto-antibodies may cause.

This work was supported by grant No. B3226 from the Institute of Allergy and Infectious Diseases of the U.S. Public Health Service.

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CO-ORDINATE SYSTEM OF CLASSIFICATION OF BIOLOGICAL POPULATIONS

By ANTONY SANTIAGO

Department of Botany, University of Malaya, Kuala Lumpur

A GOOD system of classification of biological populations is one which will permit the analysis and synthesis of views on the nature of variation in one or more characteristics which are common to a population. Such a system of classification can be designed by adopting ideas and techniques from mathematics.

The system of variation in any one characteristic which is common to a biological population may be represented on paper by a graduated straight line with each suitable portion of it representing a limited range of variation, and the whole graduated line representing the complete range of variation in the characteristic.

Table 1. THE NINE PRIMARY CLASSES OF *Citrus* SHOWING THE RELATIONSHIP OF THE BOTANICALLY IDENTIFIED *Citrus* SPECIES AND THE BOTANICALLY UNIDENTIFIED MALAYAN *Citrus* TYPES IN THE CO-ORDINATE SYSTEM OF CLASSIFICATION

	Proposed <i>Citrus</i> sub-genera which are based on the characteristics of germination of seedlings		
	Hypocitrus	Heterocitrus	Epicitrus
Characteristics of winged petiole of leaves from mature parent trees	True hypogical type of germination; hypocotyl-length varying between 0 mm. and 3 mm.	Intermediate between extreme types of germination; hypocotyl length varying between 5 mm. and 12 mm.; hypocotyl never forming a loop during germination	True epigical type of germination; hypocotyl length longer than 15 mm.; hypocotyl always forming a loop during germination
Bordered winged petiole; wing span below 5 mm.	<i>C. sinensis</i> Linn. <i>C. reticulata</i> Blanco. <i>C. limon</i> Linn. Two types unidentified 1	Two types unidentified 4	No representatives found in Malaya 7
Medium winged petiole; wing span ranging between 6 mm. and 20 mm.	No representatives found in Malaya 2	<i>C. aurantium</i> Linn. <i>C. auratifolia</i> Christm. <i>C. parviflora</i> Macf. Two types unidentified 5	Six types unidentified 8
Large winged petiole; wing span wider than 25 mm.	<i>C. grandis</i> Linn. 3	No representatives found in Malaya 6	<i>C. macroptera</i> Mout. <i>C. Ayeriz</i> D.C. 9

Table 1a. THE NINE SECONDARY CLASSES OF THE *CITRUS* SPECIES AND THE UNIDENTIFIED *CITRUS* TYPES CONTAINED IN CLASS 1 OF THE PRIMARY TABLE 1

Pooleability of fruit	Colour of cotyledons		
	Green	Greenish-white	White
Pooleable	<i>O. reticulata</i> Blanco. 11	No representatives found in Malaya 14	17
Strippable	No representatives found in Malaya 12	15	<i>C. sinensis</i> Linn. 18
Unpooleable	No representatives found in Malaya 13	16	<i>C. limon</i> Linn. Two types unidentified 19

Should two characteristics of a population be considered at a time, then the two characteristics and their ranges of variation could be represented by two suitable graduated lines. These two graduated lines could be set perpendicular to one another to function in the same way as the axes in co-ordinate geometry. The individual variant, or a group of variants, of the population can then be defined with reference to the appropriate portions of the axes. This system of definition can never be as accurate as the definition of a point in co-ordinate geometry. However, it is satisfactory, on an empirical basis, for the classification of the position or relationship of a variant or a group of variants in terms of one another and of all the variants in the two characteristics in the biological

Table 2. SIMILAR BREEDING-SYSTEMS HAVE DEVELOPED IN THE CULTIVATION OF PLANT SPECIES IN EACH OF THE NINE CLASSES. The term "Reproductive tissue" is any tissue developed from parts of the flower including the inflorescence but specifically excludes endosperm and internal parts of seed.

Propagation by	Selection pressure on:		
	Seed	Reproductive tissue	Vegetative tissue
Seed only	Cereals: Rice, wheat Legume seeds: Peas, gram Other seeds: Arroz, coffee 1	Plants grown for Testa tissue: cotton, flax Gynecium tissue: papaya, lonsdale Other tissues: cloves, Casimiro 4	Plants grown for Leaf tissue: cabbage, tobacco Stem tissue: jute, timber trees Underground organ: beet, carrot 7
Both seed and vegetative means	Cocoa 2	Plants grown for Testa tissue: Nephelium Gynecium tissue: Citrus, apples Other tissues: hops 5	Plants grown for Leaf tissue: forage grasses Stem tissue: rubber, ramie Underground organ: onions 8
Vegetative means only	Pepper 3	Plants grown for Testa tissue: passion fruit Gynecium tissue: bananas Other tissues: flowering ornamentals 6	Plants grown for Leaf tissue: Agave, Calceol Stem tissue: sugar cane Underground organ: yams, ginger 9

population concerned. These ideas are the essential of the co-ordinate system of classification.

Let us now consider the practical aspects and the usefulness of such a co-ordinate system of classification. We have considered the system of classifying a variant, or a group of variants, with reference to the complete range of variation in two characteristics in a biological population. On the same basic principles a group of variants may be sub-classified and each sub-class be further sub-classified.

In this way it is ultimately possible to get one specific variant or a group of closely related variants of a population into one sub-class. This sub-class of variants can then be defined with reference to a series of pairs of characteristics and to suitable graduated portions of each axis representing each characteristic.

The number of classes and sub-classes of variants will be determined by the way the axes are graduated. It is, however, suggested that for practical purposes each of the axes should always be divided into three suitable portions. This will enable one to classify a population into three categories every time with reference to one characteristic as, for example: (a) Duration: annual; any other category; perennial. (b) Stem: woody; any other category; herbaceous. (c) Leaves: simple; any other category; compound. (d) Inflorescences: terminal; any other category; axillary. (e) Flowers: unisexual; any other category; bisexual. (f) Ovary: inferior; any other category; superior. (g) Petals: free; any other category; fused. Any other category is often an intermediate condition between extremes and is therefore placed in the centre.

On the basis of considering three such categories of a characteristic empirically, and considering two characteristics at a time in the co-ordinate system, it is easy to group a population into nine classes and each of the nine classes may be sub-grouped into multiples of nine sub-classes with reference to suitable pairs of characteristics. A taxon, therefore, in the co-ordinate system can be sub-grouped into 9 primary sub-taxa, 81 secondary sub-taxa and 729 tertiary sub-taxa. It is certain that some of these theoretically possible sub-taxa will be unrepresented in the population; absence may suggest possible explanations, which may be worth further investigation.

The 'decimal system of classification' used in libraries could be adapted to numbering the sub-classes which will always be in multiples of nine in the proposed co-ordinate system of classification. A constant system for numbering the sub-classes in the rows and the columns in each of the multiples of nine sub-classes, irrespective of the presence or absence of variants in some of the sub-classes, will make it possible to show the relationships between the sub-classes by numbers. Numbers that become too long could be shortened by using suitable letters of the alphabet or even names. A sub-taxon with the designation, say, *Citrus* 678 will mean that the sub-taxon belongs to sub-taxa 6 in the primary sub-taxa, the sub-taxon 7 in the secondary sub-taxa and the sub-taxon 8 in the tertiary sub-taxa in the taxon *Citrus*.

The 'clip card' and 'punch card' systems of keeping records could also be adapted in the proposed co-ordinate system of classification as the consistent consideration of three categories in a characteristic and of nine classes with reference to two characteristics makes mechanical operations simple and practicable. In such a system of classification all manner of variants including hybrids and sterile clones of known or doubtful origin will find a definite place in relation to all the possible variants in the population.

This technique of the co-ordinate system of classification has thrown considerable light on the relationships of the sub-taxa in the taxon, the genus *Citrus*. Tables 1 and 1a. The system has also been useful in the investigation of the nature of controlled evolution of breeding systems¹ in cultivated plants (Table 2).

In all these investigations it has been found that the proper and judicious choice of characteristics for the axes is essential in making the co-ordinate system of classification yield information that leads to an expression of real relationships, or at least in developing a convenient system of classification of biological populations.

I thank Prof. J. B. S. Haldane, Dr. R. E. Holttum, Prof. M. E. D. Poore, and many other helpful scientists who have, by discussion and advice, enabled me to express my ideas on the subject with increased clarity.

¹ Santiago, A., *Proc. Cent. Bicent. Cong. Biol. Singapore*, 326 (1958).

June 24, 1964

Mr. Bob Loomis
IBM
Time and Life Building
Rockefeller Center
New York, New York

Dear Bob:

Enclosed are two sets of data as requested by Jerry Rubin. In the first one there are 28 objects of Halimeda. A list of the species is enclosed giving the names of the 28 objects. There are 268 total attributes. It might be well to have reference to our paper in AIBS on the use of the Port-A-Punch cards on how the attributes are set up. I am enclosing a copy of the reprint for that purpose.

The other set of data applies to 140 objects in the family Chrysobalanaceae. In these the tables give the characteristics and attributes. The first 11 characteristics are single-state characteristics and are recorded as 1 for present and 0 for absent. Characteristics 12-21 are multiple-state characteristics. They are concerned with measurements. Characteristic 12, for instance, has four states. State 1 is recorded when the species possesses measurements of a particular defined range; state 2 another particular range of measurements, etc. The number to the right of the equal sign refers to the number of the attribute in our coding. The total number of attributes (properties) of these particular organisms is 49.

These two sets of data should give a good test to the requirements that Jerry had--namely, they are already pre-formed setor clusters and the analysis of the attributes should form the clusters given. If there are any questions concerning the data, let me know.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF
Enclosures

The first 11 characteristics are recorded as 1 for present & 0 for absent. (Char. 1-11 are single state)

Characteristics 12 to 21 are multiple state characteristics. They are concerned with measurements. Characteristic 12 for instance, has four states. State 1 is recorded when the specimen possesses measurements of a particular defined range; State 2 another particular range of measurements, etc. The number to the right of the equal sign refers to the number of the attribute in our coding. The total # of attributes (properties) of these particular organisms is 49.

HOSPITAL OF THE UNIVERSITY OF PENNSYLVANIA
DEPARTMENT OF RADIOLOGY
RICHARD H. CHAMBERLAIN, M.D., DIRECTOR
PHILADELPHIA 4

ASSOCIATES

ANTOLIN RAVENTOS, M.D.
THEODORE A. TRISTAN, M.D.
EDWARD M. DEYOUNG, M.D.
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MARK M. MISHKIN, M.D.
DAVID E. KUHLE, M.D.
MAUVINE BARNES, M.D.
T. GIFFIN DAUGHTRIDGE, M.D.
WALLACE T. MILLER, M.D.
EUGENE F. FOLEY, M.D.

EMERITUS PROFESSOR

EUGENE P. PENDERGRASS, M.D.

RADIOLOGIC PHYSICISTS

JOHN HALE, PH.D.
DAVID L. GEORGE, B.S.
CONSULTANT IN RADIOLOGIC PHYSICS
S. REID WARREN, JR., SC.D.

17 June 1964

Dr. David J. Rogers
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Doctor Rogers:

I was pleased to learn from your letter of June 12, 1964, that Mr. Robert Loomis of IBM had communicated to you my interest in the numerical taxonomy model which you and Doctor Tanimoto had developed.

The problem area I am concerned with currently is the analysis and interpretation of microscopic pictorial data, rather than X-rays. With CYDAC, a prototype microscopic scanning system, we are scanning fields as large as $50\ \mu \times 50\ \mu$ with a $1/2\ \mu$ diameter spot and recording optical densities on magnetic tape for computer analysis. The optical density scale has 256 levels. Thus, a single scan may produce as many as 320,000 bits.

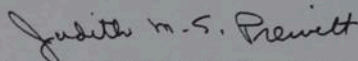
As I see our problem, a mathematical taxonomy may make a contribution to image analysis at two different stages: (1) it could serve to organize the information in digitized pictures directly, and in this sense constitute a complete image analysis, or (2) it could be used to organize derived information, e.g., numerical or logical parameters generated by computer processing of the images. The volume of data required for the first of these approaches makes it technologically prohibitive. There are also problems arising from the need for some image standardization,

Dr. David J. Rogers
Page Two
17 June 1964

especially with respect to orientation. The second possibility looks more promising and certainly is more tractable. I am considering its use as a potential approach in studying cell morphology. We are probably a year away from the stage of our work where we will have looked at a sufficient number of cell parameters to begin decision-making. However, for many applications of scanning and computer image analysis in biology and medicine, a data-generated taxonomy is a more sophisticated and costly approach to decision-making than seems to be necessary.

I would be very pleased to follow your development and application of the model, and in turn keep you informed about our activities in that area. You might like to know that I reviewed a report of Doctor Leonard Ornstein's on his use of an extended taxonomy model in disc electrophoresis research earlier this year.

Sincerely yours,



(Mrs.) Judith M.S. Prewitt
Instructor
Department of Radiology

JMSP:jmg

June 12, 1964

Mrs. Judith Prewitt
Institute of Radiology
University of Pennsylvania
Philadelphia, Pennsylvania

Dear Mrs. Prewitt:

Mr. Bob Loomis of IBM mentioned to me that at one time you had been interested in the use of a model developed by Tanimoto and me for work with the analysis of X-rays.

Mr. Loomis was not certain just exactly what applications were being made of this model or whether or not the use of our model had been of any value in your work. If you have pursued this work to the point where a publication is available concerning it, I would be very pleased to see a reprint thereof.

We have pursued the studies of the model developed by Tanimoto and have recently completed a new program in which the computer acts more as a decision maker for some of the constants than was done in the previous model. We think that this particular method has great merit but would like to know what you have found as a result of studies of this particular procedure. You may recall that the model was written up in an IBM publication in 1959.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

June 12, 1964

Dr. Robert B. Textor
Department of Anthropology
Harvard University
Cambridge, Massachusetts

Dear Dr. Textor:

In conversations with Dr. Tanimoto and Mr. Loomis of IBM, I have discovered your interest in the application of computer methods to anthropological studies.

Inasmuch as I have not kept abreast of the literature in your area in this relationship, I wonder if you have published any papers to which I might refer which indicate the nature of the work which you have done using computers. I enclose recent reprints of the work that we have done.

We have now produced a more workable model from the original work done by Tanimoto and me which was published in Science in 1960. This paper should be available some time this Fall. It is now in the hand of the printer.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF
Enclosure

May 11, 1964

Dr. Howard Levene, Chairman
Department of Mathematical Statistics
Columbia University
New York, New York

Dear Dr. Levene:

It was a pleasure to have discussed with you some of the problems that we are facing in the development of a research and training center for the mathematical-taxonomic (and ecologic) areas of biology.

I enclose herewith the promised copy of a paper we published in 1960. Needless to say, many changes have been made in the program since this paper appeared, and we will shortly submit a manuscript to BioScience, the AIBS Journal, that incorporates the changes that we have made to date.

I trust that we will be able to find areas of cooperation and collaboration with you and with the young man you mentioned as a possible worker with us. I am sorry that I do not recall his name.

We will have a grant starting about the first of June to employ a full time mathematician in our project. If you have any suggestions for persons interested in the general area that we talked about and in the problems indicated in the enclosed paper, we will be pleased to have your recommendations. I recognize that it is difficult to get a person to work in these relatively unexplored regions and particularly to find a mathematician who would be willing to work at a botanical garden.

Thank you for your assistance and interest in our activities.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF
Enclosure

May 4, 1964

Dr. Saul B. Salla
Computation Center
University of Rhode Island
Kingston, R. I.

Dear Dr. Salla:

still
It was a great pleasure to visit you and to see your operation there. I hope that we shall soon be able to provide some sort of collaborative service for the names of plants and animals. We are planning at the moment to ~~encourage~~ such an endeavor as part of a computer center here at the Garden where we will not only investigate information retrieval methods but will also continue our systematic analysis and computer program for biology.

I hope to have a visit from you folks as soon as you can come. Let me know in advance, and we will put out the red carpet.

Sincerely

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

May 4, 1964

Dr. John A. Knauss
Narragansett Marine Laboratory
Graduate School of Oceanography
University of Rhode Island
Kingston, Rhode Island

Dear John:

It was a great pleasure to visit you, and I appreciate the time you took to show us about. I was tremendously impressed with the operations there and hope that we can contribute something in terms of information retrieval.

I hope you will stop in to see us some day. We are looking forward to a visit from you.

Sincerely

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

April 24, 1964

Dr. John A. Knauss
Narragansett Marine Laboratory
Graduate School of Oceanography
University of Rhode Island
Kingston, Rhode Island

Dear John:

Thanks for the letter and the map. I will probably spend Thursday night at Providence and come to Kingston the next morning, Friday, by nine o'clock.

I will look you up at the Marine Laboratory at that time. I plan to spend the day Friday there, or as much time as you can find available.

Sincerely

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

April 20, 1964

Dr. David J. Rogers
New York Botanical Gardens
New York 58, New York

Dear Dave:

Enclosed is a map of the area. As you can see, the Marine Lab is on the water and is six miles east of the main campus. I told Saul Salla that you were coming and he is anxious to spend as much time with you as possible. I'm leaving for Washington in a few hours and will be back Wednesday, April 29. If, for any reason, you can't come on the first I would appreciate your letting my secretary, Helen Mosby, know.

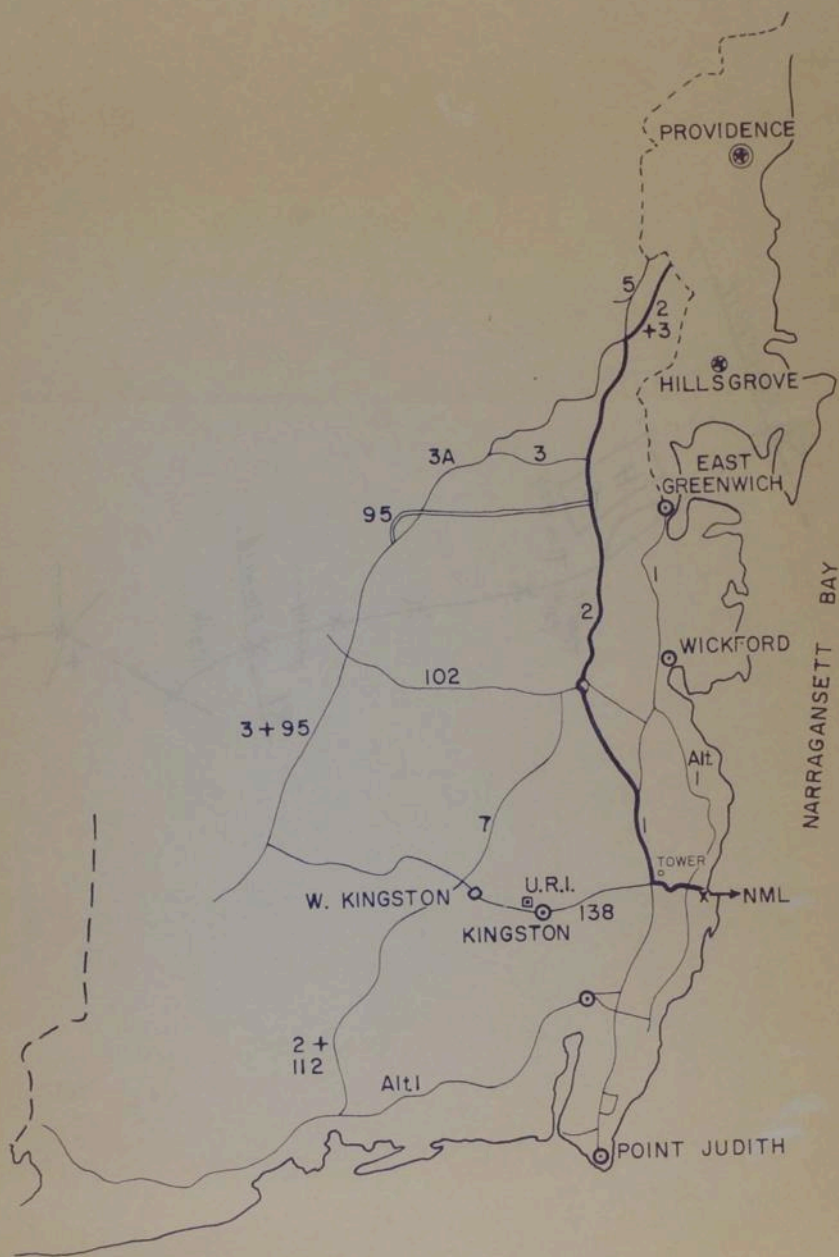
Best regards,



John A. Knauss
Dean

JAK:m
Encl

cc: S. B. Salla



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TENTATIVE
RECOMMENDATIONS
FOR THE
UNDERGRADUATE
MATHEMATICS PROGRAM
OF STUDENTS
IN THE
BIOLOGICAL,
MANAGEMENT AND
SOCIAL SCIENCES

FIRST DRAFT

Prepared to serve as a
basis for discussion.
Comments are invited.

COMMITTEE ON THE UNDERGRADUATE
PROGRAM IN MATHEMATICS

JANUARY, 1964

COMMITTEE ON THE UNDERGRADUATE PROGRAM IN MATHEMATICS

ALFRED B. WILLCOX
Executive Director
B. E. RHOADES
Associate Director
P. O. BOX 1024
BERKELEY 1, CALIFORNIA

TELEPHONE:
527-2363
AREA CODE
415

April 27, 1964

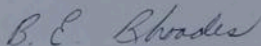
Mr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Mr. Rogers:

I am answering your letter of April 24 addressed to Dr. Sterling. Thank you very much for your remarks concerning the Tentative Recommendations of the BMSS Panel.

In the last paragraph of your letter, you asked if we had any suggestions about young mathematicians who are interested in the area of biology. I sincerely wish that we had a whole stableful so that I could recommend four or five, but unfortunately I don't have such a ready list. However, I will make your wishes known to people with whom I come in contact, and I wish you every success in finding a young man to your liking.

Sincerely yours,



B.E. Rhoades

BER:bt

April 24, 1964

Dr. Theodor D. Sterling
Committee on the Undergraduate Program in Mathematics
P. O. Box 1024
Berkeley 1, California

Dear Dr. Sterling:

We are very pleased to have received the first draft of the Tentative Recommendations for the Undergraduate Mathematics Program. This is an excellent proposal. We are very thankful to have received it inasmuch as we were floundering around trying to define what we thought would be an appropriate set of courses to give biologists, and particularly systematic biologists, to give them an insight into the working field of mathematics.

One comment that I would like to make is that it will be a number of years before we can expect that our graduate students will come with the background that you recommends here, and we will therefore likely have to put into their graduate training program the courses that you have recommended for undergraduate work. I am not sure how this will be worked in terms of recognized formal credit work for a graduate student (we have an informal arrangement with Columbia University's Department of Botany), but I am sure that we can work out some sort of detail.

We are expecting to put together a research program for the development of mathematical models for systematic biology. One of our objectives is a graduate training program between mathematics and biology, and we will need all the advice and assistance we can get in the appropriate development of this. It is therefore very welcome that we have received at this time your first output.

One thought occurs to me. We have just received grant funds to add a mathematician to our staff, and we think that the man should be developed further from the type of program that you have outlined here. If you have any suggestions about young mathematicians who are interested in applying their mathematics to biological problems, we would be pleased to hear of them.

Sincerely yours

DJR:MDF

David J. Rogers
Curator of Quantitative Taxonomy

COMMITTEE ON THE UNDERGRADUATE PROGRAM IN MATHEMATICS

ALFRED B. WILLCOX
Executive Director
B. E. RHOADES
Associate Director
P. O. BOX 1024
BERKELEY 1, CALIFORNIA

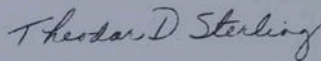
TELEPHONE:
527-2363
AREA CODE
415

Dear Colleague:

Because I thought you would be interested, I have made arrangements to have the enclosed document mailed to you. It is a first draft of a recommended mathematics program for prospective graduate students in the biological, management, and social sciences.

As you will note, your comments on these recommendations are invited.

Sincerely,



Theodor D. Sterling

Southern Illinois
University

ALTON, ILLINOIS

April 24, 1964

Graduate School

Dr. David J. Rogers
New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

It was good to hear from you after all these years, even if on a formal basis. We do not give a Ph.D. in mathematics, but might have someone with a master's degree. I will inquire around and let you know if anyone turns up. We are expanding rapidly and our own computing centers, one at Carbondale and one at Edwardsville, are in need of more people.

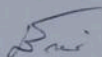
Are you still working on manioc? From your letter, I guess that you might be becoming an administrator.

It looks as though we may spend the next two years working with an Institute Pédagogique in Bamako, Mali. Ann will probably go to school in England. Winifred will stay here in a "Farm" for mentally retarded. John and Bette will go with me to Bamako.

We enjoy living in the St. Louis area, and have made a number of visits to the Climatron in Shaw's Garden. As I remember, you did some work there once.

Best regards to Connie.

Sincerely yours,



Eric A. Sturley
Assistant Dean

The New York Botanical Garden BRONX PARK • NEW YORK 58 • NEW YORK • LU 4-8500

CHARLES B. HARDING, President
FREDERICK S. MOSELEY, Jr., Vice President
MRS. HERMANN G. PLACE, Vice President
R. GORDON WASSON, Treasurer
WILLIAM C. STEERE, Director

File copy

April 20, 1964

Dr. Eric Sturley
Department of Mathematics
University of Illinois
East Alton, Illinois

Dear Eric:

I am writing to inquire whether you have any promising students coming along who might be interested in working in a group that we are developing here at The New York Botanical Garden to study some of the mathematical problems that face us in biology. We have recently received notice of a grant from the National Institutes of Health that will allow us to pay a mathematician up to \$10,000 a year for the first year with fairly generous increments for two further years. We would like to have a student who has completed his Ph.D., but failing that, would consider one who has at least done some graduate work. We are ourselves, as you likely know, not the most competent mathematicians and have until this time depended very strongly on the advice that Taffee Tanimoto could give us. The work that we have done seems to have been sufficiently well received by folks that they are willing to support our request for a staff member who is a competent mathematician.

The areas of mathematics that are particularly concerned are beyond me as to exact definition, but some of the types of things that have been appropriate for our work to date fall into statistical areas, information theory, etc. It would be nice to have a student who has had some programming experience and even better if he had a biology minor. We do not at the moment have our own computer but will soon be applying for funds to establish a computer center here at The New York Botanical Garden. The type of problems that will be most generally interesting to us are those that involve information retrieval, various correlative systems, matrix problems, clustering techniques and related problems.

From this rather poorly defined area it is, I am sure, difficult for you to get a feeling as to exactly what we are looking for. I apologize for the generalness of my description; yet I hope that between the lines you may get an idea of what sort of applicant we are looking for. If you have someone in mind who might work in this area we would be pleased to hear about it. I suspect the funds

Dr. Eric Sturley

-2-

April 20, 1964

will be available shortly after the first of June, and the individual could begin to work soon thereafter. I will be pleased to hear whatever you have to offer in this direction. In the event that there are no students available or persons whom you might suggest to us who have done their work under your direction, would you kindly let me have a few names and departments that might have young men available.

Best regards to you, Betty, and family.

Sincerely

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

April 22, 1964

Chairman, Department of Mathematics
Lincoln University
Pennsylvania

Dear Sir:

We are searching for a young mathematician who would like to work in an applied area. Specifically, we are looking for a person qualified to work in an interdisciplinary group here at The New York Botanical Garden where the mathematics would be applied to problems in biology.

The closest that we can come to a definition of the type of person we are searching for is one who has had training in mathematical statistics, is interested in information theory and cybernetics generally. We would like to have a person with some graduate training, if you have people in your department receiving such training. If you have undergraduates only, we would be interested to know if any of them would care to work part time and go on for graduate training part time.

Here at The New York Botanical Garden in the Department of Quantitative Taxonomy we have a group interested in the mathematical models for systematic biology. We have recently received notification of a grant which will permit us to add a temporary staff member for a three-year term. If you have any individuals who might be interested in this work and who have some of the qualifications listed above, we would be pleased to hear from you.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

April 22, 1964

Chairman, Department of Mathematics
Howard University
Washington 1, D. C.

Dear Sir:

We are searching for a young mathematician who would like to work in an applied area. Specifically, we are looking for a person qualified to work in an interdisciplinary group here at The New York Botanical Garden where the mathematics would be applied to problems in biology.

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Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

April 22, 1964

Chairman, Department of Mathematics
Fisk University
Nashville, Tennessee

Dear Sir:

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Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

April 22, 1964

Chairman, Department of Mathematics
Hampton Institute
Hampton, Virginia

Dear Sir:

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Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

April 22, 1964

Chairman, Department of Mathematics
Morehouse College
Atlanta 14, Georgia

Dear Sir:

We are searching for a young mathematician who would like to work in an applied area. Specifically, we are looking for a person qualified to work in an interdisciplinary group here at The New York Botanical Garden where the mathematics would be applied to problems in biology.

The closest that we can come to a definition of the type of person we are searching for is one who has had training in mathematical statistics, is interested in information theory and cybernetics generally. We would like to have a person with some graduate training, if you have people in your department receiving such training. If you have undergraduates only, we would be interested to know if any of them would care to work part time and go on for graduate training part time.

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Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR: MDF



THE UNCF in 1964

WHERE IT STANDS

WHY IT'S NEEDED

WHAT IT FACES

HOW IT OPERATES

Memo . . . *from the desk of*

LARRY PERKINS

April 15, 1964

Dr. David Rogers
New York Botanical Gardens
Bronx, New York

Dear Dave:

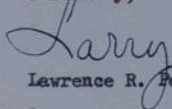
Sorry I have taken so long to send this information along to you, but I have really been on the go since I last saw you.

You will find the schools about which we spoke, listed on the back of the enclosed folder. In addition, I think you might want also to send an inquiry to Lincoln University at Lincoln University, Pennsylvania, and to Howard University in Washington, D.C.

As I said before, my feeling is that you should simply indicate to those concerned that you are interested in having a young Negro, recent graduate, to do some work in your field.

Say Hello! to your family, and if there is anything else I can do, please let me know.

Cordially,



Lawrence R. Perkins

LRP:tel
Enclosure

IBM

Data Processing Division
1271 Avenue of the Americas
New York 20, New York

International Business Machines Corporation

JUdson 6-2050 (Area Code 212)

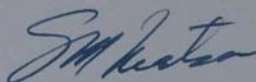
March 9, 1964

Dr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dr. Rogers:

I thank you very much for your letter of February 17, 1964 which did indeed strike a very responsive chord. The viewpoint you are discussing is part of a larger problem facing the scientific community. I have been reviewing your letter with a number of people in the Scientific Computing as well as the Systems Research and Development Departments of IBM and I will be getting in touch with you for further discussion as soon as some concrete suggestions are formulated.

Sincerely,



S.M. Matsa, Manager
Advanced Engineering Applications
Mathematics & Applications

SMM:mk

February 17, 1964

Mr. Samuel Matsa
Manager, Advanced Engineering Applications
Mathematics and Applications Department
International Business Machines
Time-Life Building, 4th Floor
1271 Avenue of the Americas
New York 20, New York

Dear Mr. Matsa:

Mr. Bob Loomis recently returned to us the first output from the three programs developed by Dr. Bonner, designed as a clustering technique for large matrices. The data, derived from my studies of plants, was originally collected for the purposes of classification of one particular group. Some of the implications of the output were made clear by Mr. Loomis, but a considerable amount of interpretation still remains for us. This will require some time because of the nature of the output, in octal, and the fact that less than a third of the objects fall into the clusters. Whether it is practical to continue with the programming or not will have to be determined. There are some general reactions, however, which we can already express. While we understand that one must use some thresholding techniques in order to be able to work with large numbers of objects, we find that the data lost by such thresholding is far more serious than we as biologists can permit. Furthermore, the eventual clusters are not as information-producing as we could hope for in that there are no good measures of the inter-relatedness of the clusters, and numbers of objects that do not show sufficient relationship to other objects are left "in space." While we understand that the programs do exactly that for which they were designed, we also feel that if these programs were designed with biological-medical data in mind, they miss the mark. Perhaps with appropriate guidance and inter-action between the biologist and the mathematician-programmer, some more appropriate means can be worked out.

With this in mind, I should like to present some ideas I have had along the lines of inter-disciplinary endeavor. But before proceeding, let me tell you of my first efforts in this direction. In 1958, Dr. T. T. Tanimoto and I, with the programming assistance of Mr. Loomis, worked out a model for classification procedures which eventually was written up in one of the IBM technical publications, and which was modified to some extent in a joint paper that Dr. Tanimoto and I published in SCIENCE. We were just getting some sort of feeling for the potentialities in that model when, due to a series of events, the work stopped. In our laboratory we have continued to work

with the development of the taxonomy application, and have, though very slowly, developed what we think is a much more suitable program for classifications in general, and plant classification in particular. The basic ideas in this method, we feel, come fairly close to the intuitive method used in biological classification which has proved to be one of the most useful predictive methods to be found in any science. We have, perhaps unrealistically, felt that we should worry more about the accurate reflection of the taxonomy than whether there was an adequately designed piece of hardware that would be able to handle the program. We had already reached the stage where Dr. Bonner is--how to cope with the fantastic load of data that we must work with to be realistic. We do not think that we should worry too much about this problem at this stage, for there is much theoretical work to be done with the output that we can now get. The unfortunate aspect of this work is that very few biologists are willing to leave their own work long enough to become sufficiently competent to work on these problems. It is also unfortunate that, though we have the potential for this work in our own department, we have great difficulty in convincing the appropriate authorities that we, as botanists, can produce a useful tool for a much greater group of scientists than those immediately concerned with plant classification.

We think we see some methods by which we can attack the various problems that are involved in the correlative aspects of biology, medicine, oceanography, sociology, anthropology, and indeed, in the physical sciences such as geology. However, these methods are at this time only in the advanced-idea stage and will require much time and effort to produce actualities from them. We need certain kinds of hardware at our disposal, much as one needs a microscope. We are in great need of sound mathematical advice, inasmuch as our own competence in mathematics is much less than that of the professional mathematician who has, as a part of his training and experience, the ability to pick and choose, indeed produce, the appropriate mathematical model.

The Director of The New York Botanical Garden is sufficiently convinced of the fundamental importance of this work that he established a new department, Quantitative Taxonomy, to pursue this type of investigation with more intensity. We now have a staff of three biologists, two of whom are supported by grants from The Office of Naval Research, all working on problems related to our major goal. We have received a grant from the National Institutes of Health to support programming work, and have applied to NIH for a second grant that will allow us to add a mathematician to the staff. At the moment we are using the facilities of The New York University computation laboratory, an arrangement that is not wholly satisfactory.

It is the intention of the new department, of which I am the head, to continue with our present endeavors and procedures to the point where we can convince the appropriate government granting authorities to support our work on a much more permanent basis than at present. It has been gratifying to have the confidence in our work already evidenced by the granting agencies mentioned above.

Since our work is and will, by its nature, be interdisciplinary, we are putting together a small staff of biologists and mathematicians to work in close conjunction. It has been our experience that either of the two disciplines separately cannot do justice to the job. Witness the work of Dr. Bonner, or for that matter any of several biologists who employ "cook-book" mathematics with the obvious results. You will no doubt realize that there are very few predictive, basic mathematical models in biology, and that in this respect, the physical sciences are very much farther ahead. The biologist, swamped with data from the organisms around him, has just about given up any thought of doing any more than gathering the data, lumping it into tabular findings, and reporting it undigested. Whatever predictive endeavors he pursues will be done in an intuitive style, without rigorous, explanatory models. Much of biological thought is based on verbal models which lack the necessary rigorous repetitive testing procedures so common in the physical sciences.

While we do not expect to solve all these problems, it is high time that someone started to attack them. Recently, an effort to put together a center for such work was made, where several different institutions in New York (among them The New York Botanical Garden) were loosely banded together, without any formal contractual ties. A rather large request for funds was made, and indeed, IBM was willing to help out with contributed hardware and other assistance. The whole program was rejected because the granting agency felt that there was insufficient control over the project, and without such control, it was feared that there would be little chance of success, no matter how altruistic were the workers. Our efforts will, we hope, avoid the objections raised against the above proposal. We fully intend to entertain workers who wish to collaborate, but with full control of the type of work that is done. We further do not propose to build a large staff immediately, but will work with a small number, and on a fairly reasonable scale, to determine the most appropriate direction. We intend to work largely on items of interest to the botanical world, but this should not be considered a deterrent as botanical endeavor is fundamental to any biological science, including the applied areas of medicine and agriculture.

Although I indicated earlier that we have not felt that we should design our program to fit the hardware, and that we are aware of the problems here, we have not completely ignored thoughts about the appropriate computer components and allied equipment. We do not have as much requirement for speed of computation as we do have need for large

storage capacity. I say this because our present intuitive methods are so very slow that we could, without harm, allow the computer to run for a week on one problem, and still be tremendously advanced over present operations. This may sound rather inefficient, and indeed it probably will be until we can actually see what is happening with our theoretical model on actual botanical data. It inevitably happens that one can see better procedures after some rather trial-and-error types of approach, but we must at first see what happens. Looking about, it seems that for our work, some sort of random-access auxiliary to core storage could be used with a moderately sized computer. Of course it would be most desirable to have one of the largest computers available, but from a practical standpoint, we cannot justify the development of programs that could only be run in the biggest facilities when many users will not have them available.

In summary, our aspirations are for some sort of computer facility under our direction, as an experimental tool, in the hands of biologically-oriented mathematicians and mathematically-oriented biologists, where both research and teaching could be accomplished. We feel that we have developed the competence and confidence of sufficient numbers of people to make sound advances in an un-mined area of science. I trust that you will understand our viewpoint, that we are definitely committed to work in these areas, and that you can get some feel for our needs. If this letter strikes a responsive cord, then I can give you any further detailed answers to questions that arise.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

February 17, 1964

Mr. Samuel Matsa
Manager, Advanced Engineering Applications
Mathematics and Applications Department
International Business Machines
Time-Life Building, 4th Floor
1271 Avenue of the Americas
New York 20, New York

Dear Mr. Matsa:

Mr. Bob Loomis recently returned to us the first output from the three programs developed by Dr. Bonner, designed as a clustering technique for large matrices. The data, derived from my studies of plants, was originally collected for the purposes of classification of one particular group. Some of the implications of the output were made clear by Mr. Loomis, but a considerable amount of interpretation still remains for us. This will require some time because of the nature of the output, in octal, and the fact that less than a third of the objects fall into the clusters. Whether it is practical to continue with the programming or not will have to be determined. There are some general reactions, however, which we can already express. While we understand that one must use some thresholding techniques in order to be able to work with large numbers of objects, we find that the data lost by such thresholding is far more serious than we as biologists can permit. Furthermore, the eventual clusters are not as information-producing as we could hope for in that there are no good measures of the inter-relatedness of the clusters, and numbers of objects that do not show sufficient relationship to other objects are left "in space." While we understand that the programs do exactly that for which they were designed, we also feel that if these programs were designed with biological-medical data in mind, they miss the mark. Perhaps with appropriate guidance and inter-action between the biologist and the mathematician-programmer, some more appropriate means can be worked out.

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With this in mind, I should like to present some ideas I have had along the lines of inter-disciplinary endeavor. But before proceeding, let me tell you of my first efforts in this direction. In 1958, Dr. T. T. Tanimoto and I, with the programming assistance of Mr. Loomis, worked out a model for classification procedures which eventually was written up in one of the IBM technical publications, and which was modified to some extent in a joint paper that Dr. Tanimoto and I published in SCIENCE. We were just getting some sort of feeling for the potentialities in that model when, due to a series of events, the work stopped. In our laboratory we have continued to work

with the development of the taxonomy application, and have, though very slowly, developed what we think is a much more suitable program for classifications in general, and plant classification in particular. The basic ideas in this method, we feel, come fairly close to the intuitive method used in biological classification which has proved to be one of the most useful predictive methods to be found in any science. We have, perhaps unrealistically, felt that we should worry more about the accurate reflection of the taxonomy than whether there was an adequately designed piece of hardware that would be able to handle the program. We had already reached the stage where Dr. Bonner is--how to cope with the fantastic load of data that we must work with to be realistic. We do not think that we should worry too much about this problem at this stage, for there is much theoretical work to be done with the output that we can now get. The unfortunate aspect of this work is that very few biologists are willing to leave their own work long enough to become sufficiently competent to work on these problems. It is also unfortunate that, though we have the potential for this work in our own department, we have great difficulty in convincing the appropriate authorities that we, as botanists, can produce a useful tool for a much greater group of scientists than those immediately concerned with plant classification.

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We think we see some methods by which we can attack the various problems that are involved in the correlative aspects of biology, medicine, oceanography, sociology, anthropology, and indeed, in the physical sciences such as geology. However, these methods are at this time only in the advanced-idea stage and will require much time and effort to produce actualities from them. We need certain kinds of hardware at our disposal, much as one needs a microscope. We are in great need of sound mathematical advice, inasmuch as our own competence in mathematics is much less than ~~those~~ of the professional mathematician who has, as a part of his training and experience, the ability to pick and choose, indeed produce, the appropriate mathematical model.

The Director of The New York Botanical Garden is sufficiently convinced of the fundamental importance of this work that he established a new department, Quantitative Taxonomy, to pursue this type of investigation with more intensity. We now have a staff of three biologists, two of whom are supported by grants from The Office of Naval Research, all working on problems related to our major goal. We have received a grant from the National Institutes of Health to support programming work, and have applied to NIH for a second grant that will allow us to add a mathematician to the staff. At the moment we are using the facilities of the New York University computation laboratory, an arrangement that is not wholly satisfactory.

It is the intention of the new department, of which I am the head, to continue with our present endeavors and procedures to the point where we can convince the appropriate government granting authorities to support our work on a much more permanent basis than at present. It has been gratifying to have the confidence in our work already evidenced by the granting agencies mentioned above.

Since our work is and will, by its nature, be interdisciplinary, we are putting together a small staff of biologists and mathematicians to work in close conjunction. It has been our experience that either of the two disciplines separately cannot do justice to the job. Witness the work of Dr. Bonner, or for that matter any of several biologists who employ "cook-book" mathematics with the obvious results. You will no doubt realize that there are very few predictive, basic mathematical models in biology, and that in this respect, the physical sciences are very much farther ahead. The biologist, swamped with data from the organisms around him, has just about given up any thought of doing any more than gathering the data, lumping it into tabular findings, and reporting it undigested. Whatever predictive endeavors he pursues will be done in an intuitive style, without rigorous, explanatory models. Much of biological thought is based on verbal models which lack the necessary rigorous repetitive testing procedures so common in the physical sciences.

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In summary, our aspirations are for some sort of computer facility under our direction, as an experimental tool, in the hands of biologically-oriented mathematicians and mathematically-oriented biologists, where both research and teaching could be accomplished. We feel that we have developed the competence and confidence of sufficient numbers of people to make sound advances in an un-mined area of science. I trust that you will understand our viewpoint, that we are definitely committed to work in these areas, and that you can get some feel for our needs. If this letter strikes a responsive cord, then I can give you any further detailed answers to questions that arise.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

February 20, 1964

Dr. Orr E. Reynolds
NASA, FOB 6, Room 5007S
400 Maryland Ave., S. W.
Washington 25, D. C.

Dear Dr. Reynolds:

I would just like to keep you up to date on what happened after our very productive interview with you and with Dr. Jenkins. We followed your advice and went to the NIH. There, instead of contacting Dr. Livingston as you had recommended, we got a colleague of his in the same office, Dr. Herbert Pahl. After having discussions with him, we were referred to the General Medical Science Section of the NIH, and there we talked to Mr. Leon Hellman. We found that they were very receptive to our proposals and that the next step in our operation should be the submission of a proposal for computers and staff under what they called the Program Project Type Grant. This sounds as though it has an ideal orientation for our operations.

There are still some areas that will need support--for instance, the business of training. We would be very much remiss if we had such a facility as this without including funds to bring graduate students in who would be given the interdisciplinary training between biology and mathematics necessary to have sufficient facility to work with the computer.

Another problem that we must face is to find some ~~place~~ ^{place} to house these operations, both the computers as well as the staff, and so far we have not run across any ideas to help in the solution of this problem. The New York Botanical Garden's present facilities are, shall we say, bulging with the present staff, and the addition of any other personnel makes it very difficult to find space for them. Our present plan is to work with whatever limited space we have, and after perhaps a couple of years of operation to show our capacities, to then request assistance for funds for an actual building.

I bring these matters to your attention merely because you were so very helpful in getting us on the right track in the first place and also because I feel that perhaps you will have some interest in this kind of operation.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

February 18, 1964

Dr. Edwin T. Moul
Box 247
Wood's Hole, Mass.

Dear Ed:

At long last I am sending a list of the Halimeda characteristics and attributes that I promised you when I saw you at the Torrey meeting in January.

There are several comments that we might make on the various characteristics and attributes as they are listed, particularly where the list deals with dimensional figures and averages of dimensions; but I think that probably the best thing to do is to allow you to glance through the list and find out where you might run into difficulty. Then you could ask us questions about those specific points, and I will be able to give you the details necessary on all points and questions.

I hope that this is helpful to you and that you will feel free to add on whatever else is important to make the characteristics and attributes more generally meaningful. We will be pleased to have your reactions to this.

Sincerely

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

February 3, 1964

Mr. Michael Galey
Dept. B 49
Bldg. 979
International Business Machines
Poughkeepsie, New York

Dear Mr. Galey:

I am enclosing a Zerox copy of the list of Halimeda characteristics and attributes. I shall send the cards under separate cover.

You possibly recall that the cards are for 28 objects with 48 possible punches over a choice of 265 attributes. Feel free to call me or come if you have further questions. We would also appreciate receiving the cards back as soon as convenient as we expect the author here soon. Perhaps you could just have them "duped."

We would appreciate a short account of how you intend to tackle the problem. We might be able to give you some help on possible biological restraints, etc.

Sincerely

Henry Fleming
Research Associate in
Quantitative Taxonomy

HF:MDF
Enclosure

January 27, 1964

Dr. Herbert Phal
Special Research Resources Branch
National Institute of Health
Bethesda Maryland

Dear Dr. Phal:

In preparation for our conference on Thursday morning, I should like to give you just a resume of the purpose of our visit.

Over the past few years in the Department of Quantitative Taxonomy we have been developing a computer system for the classification of plant materials. We have discovered to our pleasure that our procedures have considerable merit for many scientific classification purposes other than those specifically designed for plant classification. For example, we have definite knowledge that psychiatrists at Washington University have employed our program for special purposes that I shall not try to define. At another extreme we find that the sonar laboratories of the Navy at Hastings-on-Hudson have been employing our techniques for the classification of sonar sounds. Anthropologists have put our computer techniques to work in the correlation of sub-tribes of Buddhist sects in Burma. There are several other applications that we have become aware of where our processing procedures have been put to work.

Up to this time we have had to work on a sort of make-shift basis on a catch as catch can use of computers belonging to other institutions and have had to depend upon the mathematical skills of people not directly associated with our endeavor. Under these circumstances, although we have advanced our procedures, we find ourselves greatly hampered in forwarding our studies. I would like to present to you some of our aspirations and some of our problems to see whether there is any potentiality for support for our work. I will bring with me several descriptive papers that will help in orienting toward this particular task. You might be interested to know that we were referred to your office by Dr. Orr Reynolds of NASA.

Looking forward to seeing you Thursday morning at ten o'clock,
I am,

Sincerely yours



WILSON, NUTTALL, RAIMOND

ENGINEERS INC. CHESTERTOWN, MD. PHONE 778-0930

11 January 1964

Dr. Leonard S. Wilson
Army Research Office
3045 Columbia Pike
Arlington 4, Va.

Dear Dr. Wilson:

We enclose a copy of a letter from Dr. Dansereau re our recently submitted version four of our tropic study proposal, in which his participation as a consultant was involved. We are apparently guilty of reading too much into the brief contacts between the writer and Drs. Dansereau, Lems, and Rogers. We are taking immediate steps to clarify this, but until we have done so, it is apparent that those portions of the proposal relating to them are invalid.

Accordingly, we hereby withdraw our proposal at this time. We hope this will be only temporary.

Very truly yours

WILSON, NUTTALL, RAIMOND
Engineers, Incorporated

C. J. Nuttall
C. J. Nuttall, Jr.
President

encl.

cc. Dr. Pierre Dansereau
✓ Dr. D. Rogers
Dr. K. Lems



COPY

WILSON, NUTTALL, RAIMOND

ENGINEERS INC. CHESTERTOWN, MD. PHONE 778-0930

Ref.: P-156

7 January 1964

Dr. Pierre Dansereau
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dr. Dansereau:

Herewith for your information a copy of the proposal for the field study in Costa Rica as forwarded by us today to ARO. Please advise me immediately if I have, however, inadvertently misrepresented your interest in the matter. I, for my part, will keep you closely informed of developments over the next few weeks. We should have a firm reading quite shortly. The basic matter has been under consideration for nearly a year now. I am hopeful that the reaction will this time be entirely favorable.

Best regards,

WILSON, NUTTALL, RAIMOND
Engineers, Incorporated

C. J. Nuttall, Jr.
President

CJN:rbm
Enc.

COPY

January 9, 1964

Mr. C. J. Nuttall, Jr.
Wilson, Nuttall, Raymond Engineers Inc.
Chestertown, Maryland

Ref.: P-156

Dear Mr. Nuttall:

I am surprised, not to say appalled, by the form in which your proposal is presented. My responsibilities emerge in a very equivocal way, I am afraid. Please allow me to make the following statements.

1. I recommended that you get in touch with Dr. K. Lems. You talked to him on the telephone. He made no commitments to you. I saw him last week and he told me so. He is now in Costa Rica and will be away for three months.

2. I have had no contact whatsoever concerning this project with either Dr. Kuchler or Mr. MacNamara, both of whom are assigned as collaborators on Team No. 2. This may or may not be workable.

3. Dr. Rogers has absolutely not given you his consent as a collaborator either.

Moreover, I still feel that the whole project is over-ambitious and I doubt whether it can be done in one year. Anyone is welcome to test my system of recording and interpreting vegetation. But if you want it done by me or by someone recognized or authorized by me, this is a different matter! I make no extravagant claims for my methodology, but I do know what its requirements are if it is to be properly applied. I will not be a party to an experiment that does not meet these requirements.

Please believe that I am as distressed as you may be if there is any misunderstanding. I have just re-read my letters to you of November 22 and December 6, and yours of December 3, 1963. I am indeed sorry if I did not make it sufficiently clear that I would take a leading part only if Lems had the principal responsibility, which he apparently did not accept.

Please inform me whether you have already sent your proposal to the Army Research Office. I shall have, in that case, to send them a copy of the present letter. Otherwise, I should feel that Dr. Lems, Dr. Rogers and I are being committed to something that we never accepted.

I greatly enjoyed meeting you and your family when you were here, a few weeks ago. Please believe in my most cordial personal regards, even if we do not see eye to eye professionally.

Yours sincerely,

Pierre Dansereau

PD/vw

CC: Dr. K. Lens
Dr. D. Rogers

The University of Wisconsin - Milwaukee

• 3203 DOWNER AVENUE MILWAUKEE, WISCONSIN 53211 • WOODRUFF 4-4400

• COLLEGE OF LETTERS AND SCIENCE

November 13, 1963

File w/ computer stuff

Dr. David Rogers
New York Botanical Garden
Bronx Park
New York 58, New York

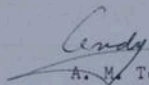
Dear Dave:

I'm shocked to learn of Bob Woodson's death, especially since I had visited with him in April and talked to him at the meeting in October. What in the world happened? I would greatly appreciate any further word.

Thank you for looking over our manuscript. We have just about decided to give up the idea of publishing this before we get some results on our tests. Then we will probably incorporate some of it into our study. I really am grateful to you for your comments. I know what you mean about models and no tests!

Thanks again Dave--you've been a great help.

Sincerely yours,


A. M. Torres
Assistant Professor of
Botany

AMT:tho

The University of Wisconsin - Milwaukee

• 3203 DOWNER AVENUE MILWAUKEE 11, WISCONSIN • WOODRUFF 4-4400

• COLLEGE OF LETTERS AND SCIENCE

October 21, 1963

Dr. David J. Rogers
New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dr. Rogers:

I'm sorry not to have seen you at the St. Louis meetings as I wanted to know if you would kindly assent to looking over a manuscript on numerical taxonomy for me. It is not an application but rather a critique, and I should like your criticisms.

Sincerely yours,

A. M. Torres

A. M. Torres
Assistant Professor of
Botany

AMT:tho

Ans by postcard 10/24

October 25, 1963

Dr. S. M. Walters
Botany School
Cambridge University
Cambridge, Great Britain

Dear Dr. Walters:

Just a note to say that I agree considerably with your statements in Taxon 12(7) on the criticism of the criticism of Gould's punch card system. Certainly a good deal more heat than light was shed by the earlier critique. If you have reprints of this article prepared, may we have one?

We enclose a reprint of our Science article which we do not believe that you have received.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

Yale University *New Haven, Connecticut*

Department of Biology

Josiab Willard Gibbs Research Laboratories

October 16, 1963

Personal note

Dr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Bronx Park
New York 58, N.Y.

Dear Dr. Rogers:

Thank you for your friendly letter of October 9 concerning the possibility that a stronger conceptual and quantitative foundation might produce unprecedented advances in biology. I am glad to learn that you and your colleagues are continuing work on numerical taxonomy. I suppose that the book which Sheath and Sokal have been writing on this subject will appear fairly soon, although I have not heard any details of publication plans. Our own book which we are editing on theoretical and mathematical biology is nearly finished, but the publishers have been sitting on the manuscript for three months without any obvious signs of activity. For your information I am enclosing a chapter list for this volume.

At the present time Yale does not have any explicit curriculum in theoretical and mathematical biology. However, as a follow-up on the course from which the book emerged, we had the late Henry Quastler as Visiting Professor of Theoretical Biology during the spring term last year. Although I was away on sabbatical, I gather that he gave a stimulating course discussing a variety of topics centered around systems analysis and information theory in biology. Dr. Harold Morowitz of our biophysics department, who is co-editor of the book with me, gives a graduate course in theoretical biology as a regular part of his teaching. We have a statistics lecturer, Dr. Hilary Seal in our department, who is much interested in the application of multivariate analysis to biology and who gives several courses for graduate students. In addition the university has a new department of statistics but, having just returned home, I do not know too much about its activities yet. Courses on computer applications,

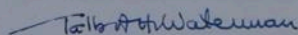
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systems analysis, the logic of science, and so on are given in various other parts of the university. However, there has as yet been no serious attempt to bring all this together.

If you are interested, we could have Yale course catalogs sent to you so that you could see these for yourself.

With best regards,

Yours sincerely,

A handwritten signature in dark ink, appearing to read "Talbot H. Waterman". The signature is written in a cursive style with a horizontal line extending from the left.

Talbot H. Waterman
Professor of Zoology

THW:bwf
encl.

THEORETICAL AND MATHEMATICAL BIOLOGY

List of Chapters

Edited by

Talbot H. Waterman and Harold J. Morowitz

Published by

Blaisdell Publishing Company (A Division of Ginn and Co.)

<u>Section</u>	<u>Chapter</u>	<u>Subject</u>	<u>Author</u>
I. Introduction	1.	The problem	T. H. Waterman
	2.	Historical origins	H. J. Morowitz
	3.	Models and mathematical principles in biology	N. Rashevsky
II. Physical and chemical analysis	4.	Thermodynamics and chemical kinetics	H. Eyring and D. W. Urry
	5.	Molecular structure, biochemical function and evolution	J. D. Bernal
	6.	Theory, experiment and the nerve impulse (Axon and membrane physics)	K. S. Cole
	7.	Cochlear mechanics	G. von Békésy
III. Statistical analysis	8.	Multivariate statistics	M. S. Bartlett
	9.	Morphometrics	R. E. Blackith
IV. Computer applications	10.	Scope of computer applications	R. S. Ledley
	11.	Computer simulation in biochemistry and ecology	D. Garfinkel
V. Systems analysis	12.	General principles of systems analysis	H. Quastler
	13.	Transients in metabolism: an approach to the chemical mechanism of metabolic control	B. Chance
	14.	Nervous processing of sensory information	W. Reichardt
	15.	Genetic consequences of natural selection	R. Levins
	16.	Ecological consequences of natural selection	R. H. MacArthur
VI. Conclusions	17.	Epilogue	Waterman and Morowitz

October 9, 1963

Dr. T. H. Waterman
272 Gibbs Laboratory
Yale University
New Haven, Connecticut

Dear Dr. Waterman:

We are pleased to have received your reprints recently sent to Dr. Fleming. I was particularly in agreement with the paper, "Revolution for Biology." The need for quantification of the traditional areas of biology is indeed most pressing.

I note that you had included in your discussion that systematics was one of the areas of great need and that you had cited the work in the area of quantitative methods by Sneath and Sokal. I also note that we have sent you a reprint of our paper on classification (SCIENCE 132(3434): 1115. 1960). We enclose a short paper, more recently published, on a method for quick recording of data for processing.

Dr. Fleming and I are continuing investigations along the same lines as the article in SCIENCE and have done a considerable revision of our thinking and will very shortly have a new program which reflects this thinking for systematics.

I should like to ask if you have a curriculum for students available. I would like to know your thoughts about the most practical way to join theoretical mathematics and biology. I would like to know also if there are any students in your program at the moment who will have completed their requirements for a degree in your new program within the next year. We feel here that there is a great need for a man broadly trained in mathematics with a good foundation in statistics inasmuch as biology is probably in need of mathematical models with a different set of postulates than the physical sciences. Semi-metric space affords a more appropriate and heuristic model than the conventional Boolean or statistical approaches for classification.

I would be interested in your comments and a copy of your curriculum if one is available.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF
Enclosures-2

SMITHSONIAN INSTITUTION
SCIENCE INFORMATION EXCHANGE

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1730 M STREET, N.W.
WASHINGTON, D. C. 20036

MONROE E. FREEMAN, Ph.D., Director

Telephone: 281-5511

Compta File

1 October 1963

Mr. David J. Rogers
Curator of Quantitative Taxonomy
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Mr. Rogers:

In response to your request of 11 September 1963, we are enclosing active and recently terminated Notices of Research Projects which we believe pertain to your area of interest.

Under the policies of the Exchange, Notices are provided with the understanding that they will not be used for publication or publication reference except with permission from the principal investigators concerned.

We appreciate this opportunity to serve you and look forward to your continued use of our services.

Sincerely yours,

William F. Davis, Jr.
William F. Davis, Jr. Ph.D.
Professional Assistant
Agricultural and Biological Sciences Branch

WFD/ig
Enclosures

Prepared for the Science Information Exchange.
Not for publication or publication reference.

JAN 2 - 1963
U.S. Department of
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE 5 R01
NOTICE OF RESEARCH PROJECT

PROJECT NO. (DO NOT USE THIS SPACE)

AI 04438-02

TMP

Submit with completed Application to: Division of Research Grants, National Institutes of Health, Bethesda 14, Md.

TITLE OF PROJECT:

Formerly E-4438

Numerical taxonomy in reclassification of mosquitoes

Give names, departments, and official titles of PRINCIPAL INVESTIGATORS or PROJECT DIRECTORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project. Include day-month-year of birth of principal investigators.

Robert R. Sokal - Professor of Statistical Biology
Department of Entomology

13 January, 1926

NAME AND ADDRESS OF APPLICANT INSTITUTION:

The University of Kansas - Lawrence, Kansas

SUMMARY OF PROPOSED WORK - (200 words or less - Omit Confidential data.)

In the Science Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research in the bio-sciences and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

The research is designed to further the theory and practice of numerical taxonomy. It will include a numerical taxonomic study of a group of medically important arthropods, most likely mosquitoes. New analysis in this field will be a study of correlations of characters in addition to correlation among operational taxonomic units. This work may provide objective procedures for estimating the relative taxonomic importance of morphological characters.

Classifications based on individual specimens will also be used in order to define low level taxonomic categories. The relations between underlying phyletic and visible phenetic evidence will be tested for several theoretical models of phylogeny. The model simulated on the digital computer will be that of a species doing a random walk in an n-dimensional character space.

Submitted for period
beginning April 1963

SIGNATURE OF
PRINCIPAL

INVESTIGATOR or PROJECT DIRECTOR Robert R. Sokal
Identify the Professional School (medical, dental, public health, graduate, or other) with which this project should be identified:
The Graduate School

SCHOOL The University of Kansas

JUN 12 1962

U. S. Department of
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH
NOTICE OF RESEARCH PROJECT

Prepared for the Bio-Sciences
Information Exchange.
Not for publication or publication
reference.

PROJECT NO. (DO NOT USE THIS SPACE)

E-4438

T.M.P. (1)

SUBMITTED TO: Public Health Service, National Institutes of Health, Division of Research Grants, Bethesda 14, Md.

TITLE OF PROJECT:

Numerical taxonomy: theory and applied to mosquitoes

Give names, departments, and official titles of PRINCIPAL INVESTIGATORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project.

Robert R. Sokal, Professor of Statistical Biology, Department of Entomology

F. James Rohlf, Research Associate, Department of Entomology

NAME AND ADDRESS OF APPLICANT INSTITUTION:

The University of Kansas, Lawrence, Kansas

SUMMARY OF PROPOSED WORK - (200 words or less - Omit Confidential data.)

In the Bio-Sciences Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research in the bio-sciences and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

This project should extend the theory of numerical taxonomy developed by Michener, Sneath and Sokal and also continue numerical taxonomic studies started on mosquitoes of the genus *Aedes*. We hope to undertake the following investigations: A new study of the mosquito genus *Aedes* to include, if possible, the majority of North American species and many of the Old World species. An analysis of correlations among characters in a data matrix for numerical taxonomy and the relations of these correlations to correlations among taxa. An attempt to undertake a classification of the lowest taxonomic categories, i.e. individual specimens, in an attempt to study the application of numerical taxonomy to infra-specific categories, which has not yet been done. We hope to set up certain theoretical models of phylogeny and test these by methods of numerical taxonomy in order to arrive at some generalizations about the nature of the phyletic deductions permissible from taxonomic evidence. These phylogenetic models will be prepared for a digital computer and evolutionary processes on a variety of assumptions are going to be simulated by the computer.

Submitted for period
beginning April 1962

SIGNATURE OF
PRINCIPAL
INVESTIGATOR

Identify the Professional School (medical, dental, public health, graduate,
or other) with which this project should be identified: Graduate
SCHOOL

NOV 2 - 1961

U. S. Department of

HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

NATIONAL INSTITUTES OF HEALTH 1 R01

NOTICE OF RESEARCH PROJECT

Prepared for the Bio-Sciences
Information Exchange.
Not for publication or publication
reference.

PROJECT NO. (Do not use this space)

GM 10002-01

COMP

SUBMITTED TO: Public Health Service, National Institutes of Health, Division of Research Grants, Bethesda 14, Md.

TITLE OF PROJECT:

Formerly RG 10002

Development of a Research Center in Biomathematics

Give names, departments, and official titles of PRINCIPAL INVESTIGATORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project.

Principal Investigator: Dr. Anthony F. Bartholomay, Assistant Professor
of Mathematical Biology in the Department of
Medicine

NAME AND ADDRESS OF APPLICANT INSTITUTION:

HARVARD UNIVERSITY-CAMBRIDGE MASSACHUSETTS
Harvard Medical School, 25 Shattuck Street, Boston 15, Massachusetts

SUMMARY OF PROPOSED WORK - (200 words or less - Omit Confidential data.)

In the Bio-Sciences Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research in the bio-sciences and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

"Biomathematics" is a generic term encompassing all aspects of mathematical thinking applied to the biological and life sciences and of mathematics arising from the study of such processes. Mathematical biology, biometrics, mathematical biophysics, biostatistics, and cybernetics, for example, would all fit into the interests and pursuits of the research unit which is being formed at the Harvard Medical School to promote the development of this field in close association with medicine, biology, and mathematics. The specific aims of this group have been defined as: (1). exploration of the mathematical aspects of biological systems in general, using mathematical models and analysis, (2). the development of new mathematical methods for dealing with the complex, multivariate problems of biology and the medical sciences, (3). the integration of the mathematical way of thinking into medical diagnosis, (4). the exploration of the role of high-speed digital computation in medical and biological research.

Submitted for period
beginning August 1962

SIGNATURE OF
PRINCIPAL
INVESTIGATOR

Dr. Anthony F. Bartholomay

Identify the Professional School (medical, dental, public health, graduate,
or other) with which this project should be identified:
SCHOOL

Harvard Medical School

NOTICE OF RESEARCH PROJECT
SCIENCE INFORMATION EXCHANGE
SMITHSONIAN INSTITUTION

NOT FOR PUBLICATION OR
PUBLICATION REFERENCE

PROJECT NO. (Do not use this space)

GF 2395

Department of the Army

SUPPORTING AGENCY:

U.S. Army Medical Research and Development Command

TITLE OF PROJECT:

Operation of an Entomology Storage and Retrieval System

Give names, departments, and official titles of PRINCIPAL INVESTIGATORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project.

Dr. Charles W. Shilling

NAME AND ADDRESS OF INSTITUTION:

American Institute of Biological Sciences
2000 P Street, NW, Washington 6, D. C.

SUMMARY OF PROPOSED WORK - (200 words or less. Omit confidential data.) - In the Science Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research, and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

Operation of a science information storage and retrieval system oriented towards DoD interests in the field of entomology. The system employs professionals at the input phase; utilizing an optical coincidence storage-retrieval principle reached by KWIC (keywords in context); coupled with an electronic typing-coding center.

The system is designed to be responsive to demands from within DoD. Presently, most of the equipment is on hand. Accession of information and system operation will begin on or about 15 March 1963.

SIGNATURE OF
PRINCIPAL
INVESTIGATOR

CW Shilling

Identify the Professional School (medical, dental, public health, graduate, or other) with which this project should be identified.

SCHOOL

Submitted February 1963

FEB 25 1963

NOT FOR PUBLICATION
OR PUBLICATION REFERENCEPrepared for
Veterans Administration
and
Science Information Exchange
Smithsonian Institution

VETERANS ADMINISTRATION

REPORT OF RESEARCH PROJECT

SIE Number

Z0

13961 C2

VA Project Number

11-61

Name and Address of Station

Veterans Administration Hospital
2002 Holcombe Blvd., Houston, Texas

Number: 5218

Subject
Category
ITopical
Area
McbCost
Center

Title of Project

Taxonomy of Various Strains of Atypical Mycobacteria in Houston, Texas, Area.

27 DEC 1962

Names, Departments, and Official Titles of All Professional Personnel

V. C. Whitcomb, M.S., Bacteriologist, VAH, Houston
M. C. Foster, M.S., Bacteriologist, VAH, Houston
C. C. McRoberts, M.S., Bacteriologist, VAH, Houston
C. D. Dukes, Ph.D., Consultant to VA; Assoc. Professor Microbiology, Baylor U.Initial Rpt. ☐ Progress Rpt. ☒ Final Rpt. ☐ Thesis ☐ FTF-VA ☐ No. of Related Projects ☐ Estimated Time ☐

Abstract (See reverse side for details to be included)

TAXONOMY OF VARIOUS STRAINS OF MYCOBACTERIA ISOLATED IN VAH

This study is an attempt to classify the atypical mycobacteria isolated from patients on the Tuberculosis Section, Houston VAH. Only patients whose diagnosis was confirmed by multiple isolation of the organism, or the recovery of the same organism from pulmonary resections as were found in sputa were considered. There are 82 such patients, 42 have had pulmonary resection.

Data have been transferred to key cards preparatory to analyzing. Other data is being re-checked.

Preliminary work on guinea pigs and mice is in progress.

Submitted F. Y. 1963

Active F. Y. 1961

PROJECT TERMINATED IN F. Y. 1963

Signature of Responsible Investigator

Frances B. Whitcomb

Date of Initial Report

Date of this Report

6-1-63

Prepared for the Bio-Science
Information Exchange.
Not for publication or publication
reference.

U. S. Department of
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH
NOTICE OF RESEARCH PROJECT

PROJECT NO. (DO NOT USE THIS SPACE)

WP-219 (CL)

E.S.E.-(5)

SUBMITTED TO: Public Health Service, National Institutes of Health, Division of Research Grants, Bethesda 14, Md.

TITLE OF PROJECT:

PHYSICAL BIOLOGY OF WASTE TREATMENT

SUPPORT FROM THIS SOURCE TERMINATED

Give names, departments, and official titles of PRINCIPAL INVESTIGATORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project.

Wesley O. Pipes, Jr.
Civil Engineering Dept.
Assistant Professor

REFER TO PREVIOUS "NOTICE" ATTACHED

NAME AND ADDRESS OF APPLICANT INSTITUTION:

Northwestern University, 619 Clark Street
Evanston, Illinois

SUMMARY OF PROPOSED WORK - (200 words or less - Omit Confidential data.)

In the Bio-Sciences Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research in the bio-sciences and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

SUMMARY

It is proposed to study some of the important factors in the ecology of biological waste treatment processes. The ultimate goal of this investigation is the development of analytical expressions which describe the reactions of microorganisms to changes in their environment. These formulations when adequately verified will be employed for the construction of mathematical models of biological waste treatment processes.

The test organisms employed in this investigation are microorganisms isolated from waste treatment facilities. The types of organisms, from the standpoint of their roles in waste treatment, which are being studied are 1.) the primary heterotrophs which feed directly upon the organic materials present in wastes, 2.) the secondary heterotrophs which metabolize upon the waste products of the primary heterotrophs, 3.) the predators which feed upon the primary and secondary heterotrophs, and 4.) the autotrophs which utilize the waste products of the other organisms present but produce oxygen as a by-product of photosynthesis.

Members of each of these types of organisms will be studied in pure cultures to determine their individual reactions to the environment and in mixed cultures to study the interspecies relationships and the reactions of microbial associations to environmental changes.

SIGNATURE OF
PRINCIPAL
INVESTIGATOR

Identify the Professional School (medical, dental, public health, graduate, or other) with which this project should be identified

Submitted for period
beginning January 1962

MAR 11 1960

Department of
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH
NOTICE OF RESEARCH PROJECT

Prepared for the Bio-Sciences Information Exchange.
Not for publication or publication reference.

PROJECT NO. (Do not use this space)

PC-7749- 7 WP 219

ESE

-823H-(1)

SUBMITTED TO: Public Health Service, National Institutes of Health, Division of Research Grants, Bethesda 14, Md.

TITLE OF PROJECT:

Physical Biology of Waste TreatmentGive names, departments, and official titles of PRINCIPAL INVESTIGATORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project.

Principal Investigator: W. O. Pipes, Assistant Professor of Civil Engineering

Consultants: H. B. Gotaas, Dean, The Technological Institute
A. Charnes, Professor of Applied Mathematics and Economics,
The Technological Institute
R. A. Slepecky, Assistant Professor of Biology

NAME AND ADDRESS OF APPLICANT INSTITUTION:

Northwestern University, Evanston, Illinois

SUMMARY OF PROPOSED WORK - (200 words or less - Omit Confidential data.)

In the Bio-Sciences Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research in the bio-sciences and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

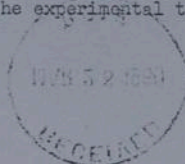
The purpose of this research project is to provide a firm basis for the development of mathematical models of biological waste treatment processes and polluted natural environments. It is proposed to tabulate and test experimentally assumptions upon which these models may be based. These assumptions will describe analytically the relationships between microbial growth and metabolism and the chemical, physical, and biological environment. Once this is done it will be possible to formulate models of some of the less complex situations which occur in waste treatment and to study methods for the analysis of the models.

It is also proposed to isolate by enrichment culture technique a few specific types of microorganisms which are of importance in the decomposition of organic wastes. These organisms will be employed for the experimental testing of the assumptions and models.

Submitted for period
beginning - January 1961

SIGNATURE OF
PRINCIPAL
INVESTIGATOR

Identify the Professional School (medical, dental, public health, graduate, or other) with which this project should be identified:
School: The Technological Institute



Information for the investigator who
fills in this space.
Not for publication or publication
reference.

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH
NOTICE OF RESEARCH PROJECT

PROJECT NO. (See page 1 of this form)
744 62-0130
NIAMD-OMP-3

SUBMITTED TO: Public Health Service, National Institutes of Health, Division of Research Grants, Bethesda 14, Md.

TITLE OF PROJECT:

Analysis of Kinetics Data

Give names, departments, and official titles of PRINCIPAL INVESTIGATORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project.

Moses Berman
Marjory Weiss

NAME AND ADDRESS OF APPLICANT INSTITUTION:

National Institutes of Health
National Institute of Arthritis and Metabolic Diseases

SUMMARY OF PROPOSED WORK - (200 words or less - Omit Confidential data.)

In the Bio-Sciences Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research in the bio-sciences and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

The project for the analysis of kinetic data deals with the development of a mathematical and computational methodology for the synthesis of biological models from experimental data.

SIGNATURE OF
PRINCIPAL
INVESTIGATOR

Moses Berman

Identify the Professional School (medical, dental, public health, graduate, or other) with which this project should be identified:

SCHOOL

INVESTIGATOR - DO NOT USE THIS SPACE

Summary submitted April 1962
Active F.Y. 1962

PROJECT TERMINATED IN F.Y. 1962

PHS-111
REV. 3-61

Form Approved
Budget Bureau No. 52-25012



CONTINENTAL OIL COMPANY

P. O. DRAWER 1267
PONCA CITY, OKLAHOMA
Research and Development Department
September 26, 1963

*Put name on
address card
Computer operations*

Dr. D. J. Rogers
New York Botanical Gardens
Bronx 58, New York

Dear Dr. Rogers:

Thank you for sending the reprint and cards so quickly. The method is certainly expeditious for recording classes of information. I am setting up a system for automating rock classification, the data of which can be put into classes, but I have not decided yet which will be best. We have adequate key-punch facilities and personnel; so if the data is recorded on a form which can be read by the key-punch girls, we can get a print-out in the form with which we can work.

Regarding the use of your program for the 704 which was used by an Oklahoma oil company; we have never had a 704 and those who have worked with the programs do not recall having it, so it does not look like we can be of any help there. We have a 7090 now. However, if other developments occur which I think would be of interest to you, I will try to pass them on.

Thanks again for sending the material.

Sincerely yours,

Max Pitcher

Max Pitcher
Research Geologist
Exploration Research Division

MP-PH

September 13, 1963

Dr. Erling Dessau
I/S Datacentralen af 1959
Ved Stadsgraven 15
Copenhagen S, Denmark

Dear Dr. Dessau:

Your letter of the 30th of July has just come to my attention. We have not yet published our FORTRAN program for the 1604. We trust that it will be available some time this fall.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

I/S DATACENTRALEN

af 1959

VED STADSGRAVEN 15
KØBENHAVN S

TELF. ASTA 1022*

Copenhagen/Denmark

Copenhagen, 30th July, 1963

Dr. D. J. Rogers
The New York Botanical Garden
Bronx Park
New York 58
N.Y.
U. S. A.

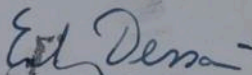
Dear Sir,

It appears from TAXOMETRICS No. 3 that you at present are working out a FORTRAN-program for CDC 1604 computer concerning TAXONOMY. (Ref. TAXOMETRICS No. 3, page 8). If possible please forward this program on my account.

Yours faithfully,

I/S DATACENTRALEN

af 1959



Erling Dessau.

(head of the mathematical and
statistical department.)

September 13, 1963

Dr. Jacques Zaneveld
Department of Biology
College of William and Mary
Williamsburg, Virginia

Dear Dr. Zaneveld:

I am sorry that I did not have the opportunity to see you on your recent visit here at the Garden. Henry Fleming indicated that you are interested in our procedures for species analysis using the computer.

I don't know whether you have had a chance to see the paper that we published in the AIBS Bulletin or not, but in the event that you did not we are enclosing a reprint of it. We consider this to be a nice little technique for preparing data for the computer. You might be interested in thinking along these lines in your own program.

Our program is going forward, and we are beginning to have some interesting output. One of our pieces of work deals with the genus Halimeda using the monograph of Hillis. This should provide some very interesting results. We will keep you informed of our progress in this connection.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

September 10, 1963

Prof. L. G. Silvestri
Universita di Milano
Istituto P. Stazzi
Via Caloria 10
Milano 4, Italy

Dear Professor Silvestri:

In response to your letter of August 27, I enclose the only additional material available for your discussions. Unfortunately, I fear that what we have here does not apply directly to the processes of the computer, but you may be interested to note that we have been concerned about the input methods and this reports one potential solution to the problem.

We are preparing a comprehensive paper that will detail the changes we are at present making in our original IBM 704 program. I am not prepared at the moment to indicate the total nature of the changes, but you should at least be aware of the fact that the original program has been considerably modified in light of our recent investigations and will, we trust, be much more flexible than the original.

I would be pleased to receive any reprints that you have available that we have not already seen.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

UNIVERSITÀ DI MILANO

Istituto • P. STAZZI •

Via Celoria, 10 - Tel. 25.61.928

MILANO, 4

Milan, 27 August, 1963

Progetto Sistematico Altimiceli
PSA/LGS/Dp

DR. D.J. ROGERS
The New York Botanical Garden,
Bronx Park,
New York 58, U.S.A.

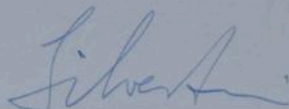
Dear dr. Rogers,

I am preparing a paper for the Symposium on "Phenetic and phylogenetic classification" which will be held at Liverpool, organized by the Systematics Association, on April 8 and 9, 1964.

I am collecting the literature for this paper and I would particularly appreciate your collaboration in sending me reprints of your more recent papers dealing with the taxometric approach.

Thanking you in advance,

Truly yours.



Prof. L.G. Silvestri

September 3, 1963

Dr. Marc P. Marthaler
World Health Organization
Palais des Nations
Geneva, Switzerland

Dear Dr. Marthaler:

In reply to your post card requesting
publication concerning marine algal taxonomy
and the use of computers, we will put you
on our mailing list as soon as anything appears.

Sincerely yours

David J. Rogers
Curator of Quantitative Taxonomy

DJR:MDF

Marc P. Marthaler
of the World Health
Organization would
greatly appreciate re-
ceiving

de l'Organisation Mon-
diale de la Santé vous
serait reconnaissant de
bien vouloir lui envoyer

de la Organización Mun-
dial de la Salud agra-
decera vivamente le
remitiera

Any publications related to project no. GLC 624 (The use of
computers in marine algal taxonomy)

and wishes to be kept
on your mailing list
for further material on
this subject.

et serait heureux de con-
tinuer à recevoir toute
étude publiée à l'avenir
sur le même sujet.

y ruega a Ud. se sirva
seguir enviándole cual-
quier otro estudio que
publique en lo futuro
sobre este tema.

June 4, 1963

Dr. and Mrs. Taffee T. Tanimoto
156 Bellevue Avenue
Newton, Mass.

Dear Mary Mae and Taffee:

I have to be in Boston on the 12th of June
and would like to stop over with you on that night
if possible. By then we should have a considerable
number of things done, and I would like to talk
about them. Okay? If not, let me know.

Sincerely

DJR:MDF

November 26, 1962

Dr. David J. Rogers
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

I shall list your project as "Application of Computers to Taxonomy" with a brief statement on its use in defining taxonomic categories. If this does not suitably define it, let me know.

Thanks for the information on Manihot. I'll let you know if there are any inquiries about this group.

Sincerely,

Ray Jackson
Associate Professor

RJ:sh

Dear Dave:

*Either the U.S. mail, you, or my
secretary lost the original. ^{the} Thanks
anyway for the ~~complete~~ the additional
information*

R. J.

April 25, 1963

Dr. R. C. Jackson
Dept. of Botany
University of Kansas
Lawrence, Kansas

Dear Ray:

On 15 November last, we wrote requesting whether or not you were interested in including in your research projects in taxonomy our activities in the use of computers. Since we have not heard from you, I suspect that the press of business has kept you from answering anything specific. Therefore, I assume that we may go ahead with the idea. I would give you a write-up as follows:

David J. Rogers, principal investigator. Henry Fleming, research associate. Title of project: Use of computers in taxonomy. Short description: The assessment of the value of characters in taxonomic work with the major ranking based on large numbers of characteristics for all the objects of a taxon. Typicality is evaluated on the basis of all matching and non-matching characteristics, and clustering of the objects is based on a subjective filtering factor. Both objects and attributes are analyzed in order to provide a sound basis for differentiation into taxa of different levels.

I hope that this is satisfactory and will be useful to you.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF

Nov. 15, 1962

Dr. R. C. Jackson
Dept. of Botany
University of Kansas
Lawrence, Kansas

Dear Ray:

I don't know how you could list it in your present categories of activities of taxonomists, but I wonder if you want to mention such work as the application of computers to taxonomy.

We've been working on a project with a grant from ONR to define taxonomic categories using electronic computers. I want to be sure that the work we are doing has nothing to do with Gould's punch-card indexing system. Too many people have the idea that computers and punched cards are synonymous, which is far from the actuality.

The work will, we hope, have value for those interested in doing either monographic or floristic types of taxonomy.

I am the principal investigator, and Mr. Henry Fleming is working full time on the project.

Let me know if you want to include this type of activity, and whether you need some better way of defining the activity. I'll try, if you find it worth the effort.

Sincerely,

David J. Rogers
Curator of Economic Botany

April 12, 1963

Dr. Ulrich Hamann
Konigin-Luise-Strasse 6-8
Berlin, Germany

Dear Dr. Hamann:

I note with interest your publication "Vorschläge für eine Ergebnisdokumentation mit Hilfe von Lochkartenverfahren in der systematischen Botanik" with the recommendation for the formation of an international commission for the standardization of terminology, etc. I concur that this is an important area for the taxonomist.

I wonder whether or not you have considered more than just the punch card as a method. The punch card by itself is an extremely limiting device. Should there be any standardization of methodology, we definitely should employ the computer, not the punch card. The greater flexibility of the computer makes it possible to deal with the complexities of taxonomy more adequately than they can be dealt with by the use of the punch card itself.

I will be glad to hear further of your endeavors in this direction.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF

THE FORD FOUNDATION
477 MADISON AVENUE
NEW YORK 22, N. Y.

April 5, 1963

Mr. David J. Rogers
Curator of Economic Botany
The New York Botanical Garden
Bronx Park
New York 58, New York

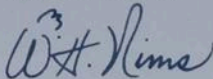
Dear Mr. Rogers:

This will acknowledge your inquiry of February 15, 1963, about the possibility of support by this Foundation of development by you and your colleagues at the New York Botanical Garden of a program of mathematical study in a biological framework. I regret to tell you that the Foundation would not be in a position to support such a program.

The policy under which the Ford Foundation considers such grants is one in which many factors of region, uniqueness, the size and scope of the activity, nationwide needs, and the availability of other support all must be weighed.

At the present time these factors would operate against our consideration of a formal proposal for the activity you describe. I know you will understand that this negative answer to your inquiry does not constitute a reflection on the worth of the program or the administration of the New York Botanical Gardens. It is simply the result of the pressure on our resources of a very large number of quite admirable proposals, a circumstance that forces us to limit our range of activities and that makes it impossible, even within that limited range, to support the majority of worthwhile projects that come to our attention.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "W. H. Nims". The signature is fluid and cursive, with a large, stylized "N" and "M".

William H. Nims
Assistant Secretary

February 15, 1963

Secretary, Ford Foundation
477 Madison Avenue
New York 22, New York

Dear Sir:

This is a letter of inquiry to determine the possibility of support for a broad-scale research and education program at The New York Botanical Garden.

For the past several years I have been interested in the potentials of the application of computers to problems in systematic biology. The work has progressed to a stage where we find that further investigations will be greatly hampered unless a broad-scale program both for research and education are brought to bear on this complex subject. My efforts have primarily been in the field of classification of cultivated plant materials, and to that end, working with mathematicians and programmers from IBM, a preliminary program was developed. We have been pleased to find that the program has been tried and found useful on a broad range of both social and biological sciences, in addition to its applicability to our own work. For example, an anthropologist has used the program to make comparative studies of various Buddhist sects in Burma; a psychologist working for the Air Force has been able to classify personnel; and a group of mycologists in Italy used the program to classify Actinomycetes.

We think that one of the most significant potential tools for gathering and correlating biological information is that known as the taxonomic method. The taxonomic method which has been developed and refined on an intuitional basis has produced one of the finest methods for information correlation and storage that has developed anywhere in the sciences. Unfortunately, no satisfactory mathematical models have been established and the best minds both of systematic biology and mathematics are needed to work out the most appropriate models.

At the moment we find ourselves in a position where we could be generally helpful with many problems if we were given more hands and minds to work. We find that our own skills as biologists are lacking in the general field of mathematics which is, of course, fundamental to the appropriate use of computers. We also find mathematicians generally uninformed in the biological sciences.

We would like to establish a program whereby students would be given the benefit of the best modern mathematical training and at the same time work in a biological framework. We would like to establish a small group of biologists oriented toward mathematics and mathematicians oriented toward biology

Secretary, Ford Foundation

-2-

February 15, 1963

who would be able to generate the needed background materials for education and research. The general field which might be termed mathematical biology or biological mathematics is of such recent development that no one has settled upon a program of training. Indeed, there may be no one "best" program.

We feel that The New York Botanical Garden through its connections with Columbia University, through its background and history as a leading institution of systematic botany, and as a center where students from all over the world come to study, is perhaps the best location for such endeavors.

We would like to know if the Ford Foundation has interests in this broad area of investigation and education. I would be very pleased to have an opportunity to present my ideas for a broad program to the Ford Foundation if this is puitable.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF

March 21, 1963

Dr. E. Calvin Johnson
Bendix Corporation
Research Laboratories Division
Southfield, Michigan

Dear Dr. Johnson:

In the January, 1963, issue of Communications of the ACM, I saw the announcement of the 1963 Spring Joint Computer Conference.

Could you please let me know what papers are going to be presented at this conference and what the activities of the conference are to be?

I shall appreciate hearing from you.

Sincerely yours

Henry S. Fleming
Research Associate

HSF:MDF

March 21, 1963

Dr. W. H. Eichelberger
University of Denver
Denver 10, Colorado

Dear Dr. Eichelberger:

In the January, 1963, issue of Communications of the ACM, I saw the announcement of the ACM National Conference to be held in Denver this coming August.

Could you please let me know what papers are going to be presented at this conference and what the activities of the conference are to be?

I shall appreciate hearing from you.

Sincerely yours

Henry S. Fleming
Research Associate

HSP:MDF

March 1, 1963

Dr. Lamont Cole
Department of Zoology
Cornell University
Ithaca, New York

Dear Dr. Cole:

We have seen preliminary announcements that you are one of a group working on a symposium to be presented at the AIBS meetings on the use of computers in biology.

Inasmuch as we are rather firmly committed to the computer in taxonomy, I wonder whether you have firmed up your program to the extent of selecting speakers for it. I would also like to know if it would be appropriate to include a discussion of our program. We have just finished preparing the program in FORTRAN and are at the beginning of the process of debugging it. We should have some actual classification problems on several groups of plants run through the program and have some idea of its applicability in general within the next few weeks.

If you can see any place on your program where a discussion of this activity would fit, I will be pleased to hear from you.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF

February 25, 1963

Dr. T. M. Barkley
Department of Botany
Kansas State University
Manhattan, Kansas

Dear Ted:

Your letter of the 22nd just opened. I cheer the business of florist's cinerarias. I trust that their flowering is indicative of something.

I just had an idea and wondered if you would be interested. Our "computerology" is developing nicely. We have a technique whereby you can punch data on to your own cards without having a 400 pound machine in your office. It is a neat little gadget that costs \$2.50, and you can take data directly from specimens, put it on to the punch card, and run it right into the computer with our program. Would you like to try it?

If this interests you at all, we could do a few trial runs with the cinerarias. We would probably be able to get a trial run or two that won't cost you a penny. Let me know if I have tickled your fancy here at all; and if so, I will inundate you with mimeographed instructions on the use of this particular punch card.

Sincerely

DJR:MDF

Kansas State University

Manhattan, Kansas

Department of Botany and Plant Pathology
Dickens Hall

February 22, 1963

Dr. David J. Rogers
New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

Just a note to tell you that my florist's cinerarias are just coming into flower in the greenhouse. This is my first venture at greenhouse work and it's coming along nicely. This year is devoted pretty much to the techniques of the group, but the matter of how the "hand-of-man" has manipulated what appears to be three taxa in nature into the complex assemblage of the florist's trade gets more fascinating all the time.

The cytology of the group is typical for Senecio; the chromosomes are small and numerous. Here the n number seems to be thirty.

With best regards,

Ted

T. M. Barkley
Assistant Professor
Curator of the Herbarium

TMB/km



100 YEARS OF SERVICE TO KANSAS, THE NATION AND THE WORLD

February 15, 1963

Mr. L. R. Hill
Progetto Sistematica Actinomiceti
Istituto "P. Stazzi"
Via Celoria 10
Milano, Italy

Dear Mr. Hill:

Enclosed is a statement of our activities with the computers in taxonomy. We have followed the general style requested as a write-up for this particular project.

We very likely will have the program available to investigators when it is completed. At the moment, we are still debugging the program and do not have it in final form available for distribution.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF
Enclosure

UNIVERSITY of PENNSYLVANIA

PHILADELPHIA 4

The School of Medicine

JOHNSON RESEARCH FOUNDATION
DEPARTMENT OF
BIOPHYSICS AND PHYSICAL BIOCHEMISTRY

January 11, 1963

Dr. David J. Rogers
Curator of Economic Botany
New York Botanical Garden
New York 58, New York

Dear Dr. Rogers:

In response to your letter of January 9, I had best give you a description of our operation. This is a medical school computer facility set up and completely supported by a grant from the National Institutes of Health. In effect, we have a regional responsibility (i.e. to handle problems in the life sciences coming from the Philadelphia area, especially several Philadelphia medical schools) and we have a subject matter responsibility (we can accept problems from any place in the specific area of model building we have been working on in the past). Within these limits, we can (not to an unlimited extent, since our resources are definitely finite) offer mathematical and programming assistance and time on our computer, all without charge. I doubt if I could go so far as to pick up any problems in the life sciences from any place, even if it were paid for.

(NIM won't let us pay visiting user's travel expenses, though)

The programs we have functioning (we are now making the transition from the Univac I to the CDC 160-A) are primarily to simulate chemical systems, but they act as fairly generalized differential equation compilers, and we have had no trouble in getting them to simulate ecological systems. We would be interested in writing an ecological simulation language if a reasonable number of ecologists were interested in using it and could agree as to what it ought to be like. When I originally wrote you I was in the hopes that you, or some of your associates, might be interested in using such a language. I enclose two reprints dealing with the method of operation of the program we have, and two more explaining what can be done with it on the biochemical side. We are now actively engaged in further ecological research (at the moment we are studying a system with six species in it in an effort to determine the stability problems of systems of this type) and if anything interesting turns up, and you wish to hear of it, I will keep you informed.

Sincerely yours,

David Garfinkel

David Garfinkel

January 9, 1963

Dr. David Garfinkel
Johnson Research Foundation
Department of Biophysics and Physical Biochemistry
University of Pennsylvania
Philadelphia 4, Pennsylvania

Dear Dr. Garfinkel:

I have read your letter of the 2nd with interest and the enclosed reprint, "Digital Computer Simulation of Ecological Systems," and I have the following questions.

In your letter you state that you have a setup in which you are able to run computations for interested investigators from elsewhere. Could you give us more details on exactly how this works? For example, do you have programmers available for consultation or mathematicians who are able to assist in the basic formulation of the program? Are the charges for computer operations supported by overhead charges, etc?

The second comment deals specifically with our own interests in terms of biological operations. Our major endeavor has been in systematic analysis of data, whether it be taxonomic, ecologic, or otherwise, and we have devoted our efforts in the program in this direction. We are hoping to have some ecological people to collaborate with us to see if it is possible to use our program, but we have no idea at the moment how successful such an operation will be. It is very likely that your operation would be more appropriate. Do you have any program written for your ecological simulation system? It would be interesting to know something of the rationale of the system from beginning to end. If there are any publications which give more of the details of the technique, we would be very pleased to see them. It might be that some of the ecological work being done would better fit your program than ours. At the moment, I can't really contrast the two.

Dr. David Garfinkel

-2-

January 9, 1963

If you have an opportunity to stop in to see us, we would be very pleased to have you visit us here at The Garden for a session on the potentialities in both systems. We are sending you a thermofax of our Science article which gives some details of the rationale and mathematics in the program. I am sorry that we have completely exhausted our supply of reprints.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF

UNIVERSITY of PENNSYLVANIA

PHILADELPHIA 4

The School of Medicine

JOHNSON RESEARCH FOUNDATION
DEPARTMENT OF
BIOPHYSICS AND PHYSICAL BIOCHEMISTRY

January 2, 1963

Dr. David Rogers
New York Botanical Gardens
New York 58, New York

Dear Dr. Rogers:

Unfortunately I was unable to catch up with you at the BIO meeting last week, so I must take this method of contacting you. Max Woodbury suggests that you would be interested in some of the work on computer simulation of ecological systems we are doing here. Our setup here is such that we will be able to run computations for interested investigators from elsewhere.

I enclose a reprint of a (somewhat preliminary) paper on the subject.

I hope this is of interest to you.

Sincerely yours,

David Garfinkel

David Garfinkel

UNIVERSITY of PENNSYLVANIA

PHILADELPHIA 4

The School of Medicine

JOHNSON RESEARCH FOUNDATION
DEPARTMENT OF
BIOPHYSICS AND PHYSICAL BIOCHEMISTRY

Jan 2, 1963

Dear Dr. Rogers,

Please pardon the oversight, but
this reprint was accidentally omitted
from my letter to you earlier today.

David Garfield

(Reprinted from *Nature*, Vol. 194, No. 4831, pp. 856-857,
June 2, 1962)

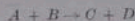
DIGITAL COMPUTER SIMULATION OF ECOLOGICAL SYSTEMS

By Dr. DAVID GARFINKEL

Johnson Research Foundation, University of Pennsylvania,
Philadelphia, 4

THE mathematical representation of ecological systems has been investigated for several decades, starting with the pioneer work of Volterra¹ and Lotka². Most of this work has been done with pencil and paper and has necessarily been limited to systems simple enough to permit the analytical solution of the resulting equations. Some work has been done with analogue computers³, and an application of digital computers to the problem has been made by Watt^{4,5}. It is the purpose of this article to describe a general computer method of representing ecological systems of any desired degree of complexity in terms of simultaneous first-order differential equations, with some simple illustrative applications.

The calculations thus far performed are based on the assumption^{1,2,6} that the rate at which two species interact is proportional to the product of their numbers. This rate law is identical to the mass action law of chemistry and therefore permits the use of a computer programme^{7,8} developed to represent complex chemical systems with the *Univac I* computer. This programme enables the computer, when given as input a set of chemical equations of the form:



automatically to write instructions to solve the associated set of differential equations:

$$-\frac{dA}{dt} = -\frac{dB}{dt} = k(A)(B)$$

and then perform the solution by numerical methods when given a set of initial conditions. It is possible to write and solve sets of equations having no relationship to chemistry, and it would be possible to substitute some other interaction law for the mass action law, or to make allowance for its limitations⁹.

The system examined here (represented by the 'chemical' and differential equations shown in Table 1) consists of a prey, grass (*GRS*), and a predator, rabbits, which may be either adequately fed (*FRB*) or starved (*SRB*). The starved rabbits are assumed to die at a moderately rapid rate if unable to feed; the fed ones, to reproduce. In most of the calculations, it has been

December 7, 1962

Dr. William Siler
Department of Physics
Memorial Hospital
444 East 68th Street
New York 21, New York

Dear Dr. Siler:

I note the formation of BIO. May we be
included in this group? I am a member of
ACM.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF

December 4, 1962

Dr. Frank L. Mercer
St. Louis College of Pharmacy
Euclid Avenue and Parkview Place
St. Louis 10, Missouri

Dear Frank:

I am sorry that you have gotten the run-around on the business of the IBM cards. Thinking the matter over, it would probably be useless to send you the cards anyway inasmuch as they were put into octal digitry for machine operation and would therefore be nonsense unless you were made aware of the whole operation.

In place of sending the cards, we are sending you a copy of the program as it was proposed by the IBM'ers. This program write up gives much more of the rationale of our operations, and I think it would be suitable to some of the work you are interested in.

You should know, however, that we are continuing with this work and have devised a completely new method of data incorporation, and I think that this would be something that would excite you as much as it does us. Rather than my describing it, however, why don't you plan to stop by here some time, perhaps in connection with the AAAS meetings in Philadelphia. We would be pleased to have you visit us here. Then we could go through the details and answer whatever questions may arise.

Best regards and hoping to see you soon,

Sincerely

DJR:MDF
Enclosure

ST. LOUIS COLLEGE OF PHARMACY

EUCLID AVENUE AND PARKVIEW PLACE

ST. LOUIS 10, MO.

November 28, 1962

Dr. Dave Rogers
The New York Botanical Garden
Bronx Park
New York 58, N. Y.

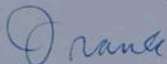
Dear Dave:

By the time I got around to requesting IBM cards from the IBM Research Center at Yorktown Heights that you described in your paper, "A Computer Program for Classifying Plants", they apparently had been sent back to you.

I would appreciate sample cards and methods of indexing that you have used. I have gathered a fair amount of data on my chemotaxomy study and would like to begin punching data. One of my problems involves multiple entries ie. above ten items in a category. I am sure that this may have been involved in your study and a study of your card and indexing may suggest a solution to my problem.

Hope that all is well with you and your family.

Sincerely,



Frank L. Mercer,
Dean of Students

FLM:MB

UNIVERSITY OF CALIFORNIA

DEPARTMENT OF PSYCHOLOGY
BERKELEY 4, CALIFORNIA

November 9, 1962

Dr. David Rogers
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Dave:

It was good to get your letter. I'm happy to be able to report that Nancy's arthritis has almost completely disappeared, and the family life has resolved itself into a more or less usual routine once again.

I'm glad to learn that ONR is taking multivariate analysis seriously, and I am flattered that you think that I might be able to make some contribution to the problem. You must understand, however, that my own understanding of multivariate techniques is extremely limited, and that I rely almost completely upon the judgment of Bill Meredith. I really believe that the contribution Bill could make would far exceed anything that I could provide.

I shall be in New York City on the 19th and 20th of November, and perhaps we could talk in more detail about the matter at that time. I will be staying at the Barclay Hotel in case you wish to get in touch with me. I have a very full schedule, but perhaps we could at least have a lengthy phone conversation. Best regards to you and the family.

Cordially,

Gerry
Gerald E. McClearn
Associate Professor

GEM:ac

PL 5-5900
521

October 24, 1962

Dr. William D. Reese
University of Southwestern Louisiana
Lafayette, Louisiana

Dear Bill:

Thanks for your letter of the 18th. I am glad to know that I am considered as "campus correspondence." When are you going to put me on the roll?

I agree that what you have indicated so far wouldn't make much of a scratch in the programming, but I also guess that you have a heck of a lot more information that needs to be correlated. If you do and feel like going ahead with this whole project, why don't you send us a list which includes each of the characteristics and for each of the characteristics, the characteristic's ~~strength~~. For example, you have listed degrees of thickness of margin with three states: heavy, moderate, and light. When you have a list of ~~each~~ *state* thing you wish to correlate and when you send this list to us, we can then look at it and suggest how it be set up for appropriate handling. Then after we have made those suggestions as to how it should be handled, then we can proceed to the business of seeing how we can work up some sort of a run on the computer for all of the data. I won't make any promises on how long it will be before we can get a computer run because we still have many things to do to get the computer organization worked out. I will be glad to work with you on it. *every-*

I will be glad to see any propagating material of yuca that you may wish to gather. If you send me propagating material, would it be too much to ask for a documenting herbarium specimen with it. Thanks.

Sincerely

DJR:MDF

University of Southwestern Louisiana

18 Oct., 1962

CAMPUS CORRESPONDENCE

Dear Dave:

I was looking at an issue of Econ. Bot. today and it reminded me of you. Being a man of action I immediately dug out the old work sheet upon which I attempted to correlate certain characteristics in a series of moss specimens, and which I had promised to send you if it seemed worthwhile. Here is what I had done: for a total of 35 specimens (some of them duplicates of the same collection). I observed the following characteristics:

angle of cancellinae: acute or broad
degree of thickness of margin: heavy, moderate, light
degree of serration of margin: strong, light
relative size of leaves: large, small, medium
nature of cell wall: thick or thin

From the small size of the sample you will guess, correctly, that I gave up on the project as soon as I realized that I would be quite unable to make any sense out of all those little check-marks I was putting down.

Because of the small amount of material I don't suppose that you could do much with this information; so if it is of no use to you don't hesitate to say so. Of course I would be glad to send the stuff along if you wanted to see it.

I am still keeping the uca in mind and will get around to putting some up for you one of these days.

Hello to Henry, Mary & Carol

Best wishes

Bill

William D. Reese

Hudson Laboratories of Columbia University

145 Palisade Street
Dobbs Ferry, N. Y.

Telephone Code 914, OWens 3-5800

Serial No. 1757-LR
July 16, 1962

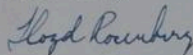
Dr. David Rogers
New York Botanical Gardens
Bronx Park
New York, New York.

Dear Dr. Rogers:

I would appreciate it very much if you could tell me how to obtain a flow chart and any other information necessary in preparing the program described in your article, "A Computer Program for Classifying Plants," appearing in "Science," October 21, 1960. Since I will be away until August 20, 1962, could you please send any correspondence to Dr. M. Klerer.

Thank you very much.

Yours truly,



Lloyd Rosenberg
Research Scientist
Contract Nonr-266(84)

LR:df

They have a General Electric 225

June 25, 1962

Mr. Abraham D. Beame
Office of the Comptroller
530 Municipal Building
New York 7, N. Y.

Dear Mr. Beame:

The New York Botanical Garden would very much appreciate having your permission to use for research purposes the IBM 7080 computer belonging to the Comptroller's Office of the City of New York. The research project for which this computer is needed is under the direction of Dr. David Rogers, Curator of Economic Botany, The New York Botanical Garden, and is supported by funds from the Office of Naval Research. Dr. Rogers tells me that he does not need much time on the computer this year but only a few "runs" to test various aspects of his research program.

If you can grant this permission to use the computer in the Comptroller's Office, Dr. Rogers will work out details with those specifically in charge of the machinery. Dr. Rogers is also prepared to place in the budget of his project the necessary amount of funds for use of the computer and to defray any extra expenses of personnel involved, in time spent during the day or after hours.

If you can grant this permission, as I hope you may be able to do, please let us know the official in charge or with whom Dr. Rogers should talk.

Sincerely yours,

William C. Steere
Director

WCS/gd

June 4, 1962

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

Dear Sirs:

Would you kindly consider placing us on
your mailing list for the forthcoming Special
Scientific Report of the U. S. Bureau of Com-
mercial Fisheries on a bibliography of the
Indian Ocean.

Sincerely yours

David J. Rogers
Curator of Economic Botany

Henry Fleming
Research Associate

April 13, 1962

Dr. Edwin Moul
Botany Department
New Jersey Hall
Rutger University
New Brunswick, New Jersey

Dear Dr. Moul:

We wish to thank you again for your kind reception and aid given to us when we saw you earlier this month. We expect we will be able to return the reception soon when you visit the herbarium here.

We have definitely decided to translate Hillis' Halimeda paper for the computer, and the work has been progressing satisfactorily. You mentioned an additional two species being described by Taylor in Bull., Torrey Club. Would you be kind enough to find out when it will appear (perhaps J. Gunckel would know) and let us know.

I am enclosing the bibliography that we promised you. Thank you again. Hope to see you soon.

Sincerely yours

Henry Fleming
Research Associate

HF:MDF

April 4, 1962

Dr. Janet R. Stein
Biology and Botany Department
University of British Columbia
Vancouver 8, Canada

Dear Dr. Stein:

Dr. Rogers and I are currently engaged in a project involving the use of computers in algal taxonomy.

We would find it very useful to have a copy of the 1962 membership list of the Phycological Society of America.

Thank you for your consideration.

Respectfully

Henry Fleming
Research Associate

HF:MDF

February 6, 1962

Mr. Joe H. Ward, Jr.
Computer Analysis Section
Box 1557
Lackland Air Force Base
Texas

Dear Mr. Ward:

Thank you for sending the publications which
I recently requested. We shall be happy to keep
you informed of our work here.

Sincerely yours

Henry Fleming
Research Associate

HF:MDF

HEADQUARTERS
6570TH PERSONNEL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION (AFSC)
UNITED STATES AIR FORCE
BOX 1557, LACKLAND AIR FORCE BASE, TEXAS

REPLY TO
ATTN OF: PRM

31 JAN 1962

SUBJECT: Grouping Procedures

TO: Mr Henry Fleming
The New York Botanical Garden
Bronx Park
New York 58, New York

Dear Mr Fleming:

I am inclosing the publications that you requested, and I hope that they will be of some assistance in your project concerned with "The Use of Computers in Marine Algal Taxonomy."

We are writing our grouping programs in FORTRAN for use on the IEM 7090 and CDC 1604. I would be interested in hearing of any of your plans for grouping and classification.

Joe H Ward, Jr.
JOE H WARD, JR.
Computer Analysis Section
Statistical Methodology
and Analysis Branch

3 Atch
1 - TR-57-5
2 - TN-61-29
3 - TN-61-30

January 22, 1962

Mr. Joe H. Ward, Jr., Chief
Computer Analysis & Programming Section
Box 1557
Lackland Air Force Base, Texas

Dear Mr. Ward:

Thank you for sending your publication, "A Hierarchical Grouping Procedure Applied to a Problem of Grouping Profiles," to Dr. Rogers. I am sure that Dr. Rogers will be happy to see it when he returns from South America in March.

Dr. Rogers recently received a grant from the Office of Naval Research entitled "The Use of Computers in Marine Algal Taxonomy." Mr. Henry Fleming is working with him as Research Associate on this project.

Mr. Fleming would appreciate it very much if you could send to him at this address the following three publications listed as references on page 8 of your latest publication:

1. Bottenberg, & Christal. An iterative technique for clustering criteria which retains optimum predictive efficiency.
2. Thorndike, Hagen, and Orr. An empirical approach to the determination of Air Force job families.
3. Ward. Hierarchical grouping to maximize payoff.

We hope that you will find it possible to send us these publications.

Sincerely yours

Secretary to Dr. Rogers

HEADQUARTERS
6570TH PERSONNEL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION (AFSC)
UNITED STATES AIR FORCE
BOX 1557, LACKLAND AIR FORCE BASE, TEXAS

REPLY TO
ATTN OF: PRM

15 JAN 1962

SUBJECT: Hierarchical Grouping

TO: Dr David J Rogers
Curator of Economic Botany
New York Botanical Gardens
New York 58, New York

Dear Dr. Rogers

1. I am enclosing the latest publication related to our hierarchical grouping procedures. I hope that you will find it of interest.
2. Are you doing any more work with the grouping of plants? I will be interested in hearing of any new developments that may occur in your work.

Sincerely

Joe H Ward, Jr.
JOE H. WARD, JR.
Chief, Computer Analysis
& Programming Section

act by [signature] 1/18/62

September 26, 1961

Dr. Joe H. Ward, Jr.
Chief, Computer Analysis & Pro-
gramming Section
Box 1357
Lackland Air Force Base, Texas

Dear Dr. Ward:

I have just returned from vacation and found your IBM rosters and reprint on "Hierarchical Grouping to Maximize Payoff."

I am excited about your process, and when I have had a real chance to dig into it, I shall let you know my reactions more specifically. I might say that you have put your finger on a critical problem on the number of mutually exclusive categories, and I am worried about this. Certainly there will have to be some sort of ~~weighting~~ ^{weighting} process ~~with~~ it.

Thanks for your interest and also your good ideas on this subject.

Sincerely yours

David J. Rogers
Curator of Economic Botany

DJR:MDF

SMITHSONIAN INSTITUTION
SCIENCE INFORMATION EXCHANGE
National 8-1810, Extension 514

Mailing Address

SUITE 113 UNIVERSAL BUILDING
1821 CONNECTICUT AVENUE, N.W.
WASHINGTON 9, D. C.

MONROE E. FREEMAN, Ph.D., Director

SUPPORTING AGENCIES

ATOMIC ENERGY COMMISSION
DEPARTMENT OF DEFENSE
PUBLIC HEALTH SERVICE
VETERANS ADMINISTRATION
NATIONAL SCIENCE FOUNDATION
NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
FEDERAL AVIATION AGENCY

December 11, 1961

Dr. David J. Rogers
New York Botanical Garden
New York, New York

Dear Doctor Rogers:

The supporting agency identified below and the Science Information Exchange request you to cooperate in this clearinghouse for current research by completing and returning the attached Notice of Research Project form.

A return envelope is provided for your convenience.

Although compliance with this request is purely voluntary, we shall very much appreciate your cooperation.

Sincerely,

Monroe E. Freeman
Monroe E. Freeman
Director

Enclosure

Project No. GLC 624

Agency Office of Naval Research

The simplest and most important objective of the proposed work is to test the computer program against standard taxonomic treatments of several taxonomic groups of marine algae of differing size and complexity. Testing the program involves the following questions: Does the system adequately represent the monographic treatment? Is there any advantage in the program of speed determination of an unknown? Is the program economical?

To the taxonomist, the importance of the machine operations is as follows:

- a. A rapid assessment of the value of a characteristic or attribute as a "key" characteristic.
- b. A rapid correlation of those characteristics found to have weight, which essentially makes the work of providing keys to the species a much simpler operation.
- c. Correlation of many characteristics simultaneously, rather than one by one, as is necessary in non-machine operations.
- d. The species may be grouped, in varying levels of taxa, at the discretion of the taxonomist. That is, if the program acts as a "splitter," it may be modified to suit the philosophy of the individual taxonomist.
- e. All information concerning a species, or group of species, whether of significance to the taxonomy or not, is kept in the storage or memory of the computer and can be printed out as a part of the species description.