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About the Institute

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

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

- Taxinetrics Laboratory

April 18, 1967

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

Dear Harold:

We are anxious to hear from you as soon as you have had a chance to analyse the results, but, of course, you have to work at your own pace. Good luck on your language exams.

Very truly yours,

George F. Estabrook

GFE/ch

FIELD MUSEUM
OF NATURAL HISTORY

April 11, 1967

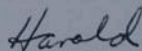
George F. Estabrook
Dept. of Botany and Plant Pathology
Taximetrics Laboratory
Colorado State University
Fort Collins, Colorado 80521

Dear George,

Sorry to be so quiet here. As you might guess, I am busy with peripheral work for my Ph.D. They have this little rule about being able to read two foreign languages. Three weeks from now I hope to pass my second. In other words, I have made little or no progress on your output beyond what I had sent you. While studying German I have done some of the busy work on the thesis so that once I get the language out of the way it should not be too long before you hear from me concerning some more careful comparisons.

I appreciate your interest and look forward to having something soon.

Sincerely yours,



Harold Voris

- Taximetrics Laboratory

March 21, 1967

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

Dear Harold:

We are all anxious to hear of your progress, especially as it was enhanced or hindered with the computer techniques. Please communicate when you get a chance.

Very truly yours,

George F. Estabrook

GFE:ch

- Taxonomy Laboratory

October 20, 1966

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

Dear Harold:

Thanks for the post card. We are anxious to hear of the results in more detail as soon as you can say more. If you feel that object 52 should have been removed, it is a simple matter to ignore it and any of its affinities when you are making graph (in my sense of the word), and then later place it "by hand" when a satisfactory classification of the "good" object has been made. Even in classical studies missing information makes the work difficult and in general, I favor not trying to include poor specimens in a machine analysis.

We are getting ready to mimeo a new copy of "How to Read the Printout" which is up-to-date. I am sending you one of these herewith. It should make the job of graphing a little easier for you.

Yours very truly,

George F. Estabrook

GFE:ch

Enc.

- Taxonomy Laboratory

October 18, 1966

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

Dear Mr. Voris:

Thank you for your offer to aid in defraying computer expenses. So far the actual cost of your runs have been very small. Running time for your test case was only 5 minutes 17 seconds. Since this cost is very small, I would suggest that it would be better for us to delay charge for this item until such time as we can combine it with the possible longer run that you will want to make on your data. The longer run (I am hypothesizing that you will want a considerable larger number of objects) combined with the short test run as one bill seems to be the easiest way to handle it.

I trust that the test run has had some merit for you. We will be pleased to hear of your reactions.

Sincerely,

David J. Rogers
Professor of Botany

DJR:ch

FIELD MUSEUM
OF NATURAL HISTORY

Oct. 6, 1966

Dear Dr. Rogers,

George Estabrook asked me to contact you concerning the computer expences for my snake data. My department has agreed to pay the "token fee" of \$50.00. What would be the most satisfactory mode of payment for you? It is best for us if you simply send a bill. The bill should be sent to the Zoology Department, Univ. of Chicago, Chicago 37, Illinois.

Thank you for your attention.

Sincerely,

Harold K. Voris

Harold K. Voris
Div. of Reptiles

*Boulder job no.
324 087
Time 317 secs. = 5 min, 17 sec.*

- Taxonomy Laboratory

September 28, 1966

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

Dear Harold:

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

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

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

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

Very truly yours,

George F. Estabrook

- Taxonomy Laboratory

September 28, 1966

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

Dear Dr. Wolpert:

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

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

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

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

Sincerely yours,

David J. Rogers
Professor of Botany

DJR:ch

Enc.

To be added following references on article by Estabrook entitled "A Mathematical Model in Graph Theory for Biological Classification."

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

9/12/66

Dear George,

I am sorry. It seems that I can't do right for your program. When I prepared that deck I was keenly aware that I had screwed up a couple of times already and was determined to do a perfect job. I did see the 300 limit but must have miscounted the matrix elements.

With regard to the missing data problem I agree with your solution, removal of the OTU's lacking large amounts of data. We (Joe and I) have observed the results you mentioned in Joe's programs and although we have left all species in the study, the positioning of data-poor species is not reliable.

Within the week I will prepare for you a set of character sheets and a copy of a tree which one of Joe's programs got which I feel is a reasonable interpretation of the family's phenetic relationships. If you would like additional information I will be glad to send it upon request.

Thank you for your time and patience.

Sincerely,

Harold Voris
Harold K. Voris

- Taxonomy Laboratory

September 22, 1966

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

Dear Harold:

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

Very truly yours,

George F. Estabrook

GFE:ch

- Taxonomy Laboratory

August 31, 1966

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

Dear Harold:

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

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

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

I hope to be sending you a big package soon.

Very truly yours,

George F. Estabrook

GFE:ch

- Taxonomy Laboratory

June 2, 1966

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

Dear Harold:

I received your packet today. I hurry to tell you that because of new information concerning flowering times in Manihot, our trip has been postponed until 1 July, 1966. This would conceivably give you a chance to get one or both of your two runs in before we left, if you still desire. We should be back from Mexico toward the end of July to continue with your work (and ours).

Feel free to run as many matrices as you need to. They were designed for just the purpose you wish to apply them to. I notice one small detail from your example, namely; don't name any state "zero" unless an organism coded into that state lacks the information (through incomplete specimens) necessary to code it into a "real" state for that character. Zero names the missing information state, any other state must be named with a positive integer.

I look forward to hearing from you real soon.

Very truly yours,

George F. Estabrook

GFE:ch

P.S. Are you going to the AIBS meetings in Maryland this August? If you are, I would appreciate any "drum beating" you would be willing to do for the methods we are using for your snakes.

June 23, 1966

Dear George,

70% 80%
Guess what? I'm not ready with my data. And what else isn't new? I am sending you the first 14 species 80%-90% done. Please look them over as if they were final and then return them to me. The rest of the species are done this far also but I have not transcribed the data onto the IBM sheets yet. I have delayed this because of species mix-ups in one or two instances. In other words, I would prefer to have the extra couple weeks at this time to get the first run worked up in what I will be sure is a reasonable final form. My first run, as you will notice from the character state sheets, contains both logical and biological interrelation of characters. My character states are hypothesis laden in several ways. My second run will probably make a reach for the other extreme, pure phenetics. Character states few in number and always an assumption of total similarity or dissimilarity would help serve this purpose. Ideally all characters would be + or -.

The two runs will be of interest to me for two major reasons. I will be interested in comparing the more purely phenetic method with that of Sokal's using several coefficients. I suspect there will be much in common, but maybe not. Second and more important to me I would like to compare the two graph theory runs with my ideas on phylogeny and the results I get on the phylogenetic programs. (Joe's and Sokal's) My arm chair guess is (after coding ect.) that the hypothesis laden run of the graph theory model will differ greatly from the non hypothesis laden ("pure phenetic") run and the differences from the latter to the former will tend to approach phylogeny. In short, I think that your method, although clearly phenetic, may have the property of obtaining a good measure of phylogeny upon "enlightened" character coding. If this proves to be so it will be of interest because although it is hypothesis laden it is not laden with the same central hypothesis which both Joe's and Sokal's phylogeny programs are laden with, namely, character state trees.

Please ignore the trees which are on "your" sheets, but these sheets are doubling for other coding, with minor changes.

There are other questions I am interested in, such as, a medium amount of "hypothesis ladenness" (say with logical assumptions only, eg, with quantitative characters we can assume that 2 of something is more similar to 3 of something than it is to 4 of something) or the problem of character repetition which you may note among my characters. Where does similarity end and redundancy begin? And more importantly, what, if any, is the effect of your choice on the final results? I would be interested in working on these (and other) problems with you if you so desired. This would have to be separate from my thesis for the most part for two reasons. One, I'm in the process of trimming so that I can finish within the year so new projects for inclusion are taboo. Second, I don't think I could muster a financial contribution towards computer time for this additional work. ~~Three~~ Briefly, if you have the inclination and the computer time I would be ~~glad~~ glad to prepare data.

A couple of things of note. Again, I am sending a sort of final packet to you which I believe is completed in the correct fashion. Please look it over and return it. I enclosed only sample character sheets but I am sure they are representative. ~~*****~~ I will send the first run to you some time in July. If you would like I can have the punching done here and send you the cards and a proof read listing. In fact, I'll do that unless I hear otherwise from you.

I won't make it to the meetings in Washington this fall but both Dr. Inger and Dr. Throckmorton have been asked to be speakers at a symposium on something like "Imperical weighting of characters" at the Systematic Zoology meetings in Washington in December. These meetings are held with the AAAS meetings as usual. I will be attending these meetings.

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Thank you for your cooperation. Have a good trip and I will look forward to hearing from you sometime in August after you have begun to tangle with the Hydrochilidae.

Sincerely,

Harold
Harold K. Voris
Div. of Reptiles

P.S. Please excuse ~~the~~ the form of this letter, it's "Home Made".

CHICAGO NATURAL HISTORY MUSEUM

FORMERLY FIELD MUSEUM OF NATURAL HISTORY
ROOSEVELT ROAD AND LAKE SHORE DRIVE
CHICAGO 5, ILLINOIS

April 19, 1966

Mr. George F. Estabrook
Taxonomy Laboratory
Department of Botany and Plant Pathology
Colorado State University
Fort Collins, Colorado 80521

Dear George:

Thank you for your letter. I was just about to write you when I received your letter today. My work has progressed and I think that we will be able to get in a run before you leave. There is a good chance that these first runs will not include a knowledge of my final sample because some specimens are still on their way here. However, all species will be represented and what I won't have by June will amount to less than 2% ~~of the data~~.

I now have about one-third of my data on cards and by the end of this week the rest of the data will also be on cards. (Obviously I am not doing the punching myself). So far I have just been sorting and organizing. I have external anatomy data on over 600 specimens. Of the specimens which I have skull data, tail data, and hemipenis data I have a total of 140 characters. Thank God for computers! Actually I am sure I will end up with many fewer characters but I am ^{46.5%}sure it will exceed Sokal's "magic 60". A friend and myself have set up what we call a "Scatter Gram" program which, just today, functioned correctly for the first time. It plots anything VS anything on a standard scale. It should be a great aid in "eye balling" the raw data. Jim Bacon's general statistics program is not yet in running order and may not be for some time. As you know I was planning to use it to prepare species' data for your program. I think it best that I go ahead and try to prepare the species' data without a full statistical knowledge of the data. We can plan on a rerun in the fall with the rest of the specimens included in the making up of the species' data and also small changes in the coding, depending on what we find out from the general statistics program.

May 9 I have to give a seminar which will require considerable preparation. Because of this I will probably not have all of the data to you before May 15. If I run into any snags you will hear from me.

Save your paper in Systematic Zoology. Well done!

Sincerely,



Harold K. Voris
Division of Reptiles

George F Estabrook
Taxonomy Lab
Colorado State University
Ft Collins, Colorado
10 May 66

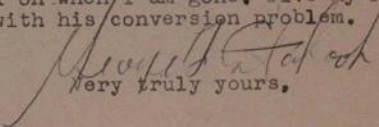
Harold K. Voris
Division of Reptiles
Chicago Natural History Museum
Chicago Ill.

Dear Harold,

It is a pleasure to learn of the continuing interest in computing machine applications to Biology. I'm sure that we could make two or three different computer runs if you want to examine the effects of different codings. I am presently preparing a paper on character coding and I too would be interested in further examining the effects of different codings.

I will be leaving for Mexico during the second week of June. You have about four weeks to get me data. The Theoretical limits of our programs are 750 objects, 120 characters, and 31 states per character. However, I strongly (very strongly) advise that you keep the number of objects to below 200 or so for two reasons: 1. machine time varies with the square of the number of objects and 2. the effort required of you to interpret the results varies roughly with the cube of the number of objects. (100 objects about 10 hours of your time) Feel free to use as many characters (up to 120) as you wish. Machine time varies somewhat less than linearly with the number of characters but there is no other penalty. I also suggest that unless very unusual conditions obtain that you keep the number of states per character to a maximum of 6 or 7.

I look forward to hearing from you soon. It would be nice to get a run before I leave for Mexico so that you will have something to work on when I am gone. Give my regards to Joe. I wish him luck with his conversion problem.


Very truly yours,

George F Estabrook

CHICAGO NATURAL HISTORY MUSEUM

FORMERLY FIELD MUSEUM OF NATURAL HISTORY
ROOSEVELT ROAD AND LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605

May 4, 1966

Mr. George Estabrook
Department of Botany
Taxonomy Laboratory
University of Colorado
Fort Collins, Colorado

Dear George:

This quarter we ^{SOME OF} the students and faculty of the University of Chicago and the Museum) have been holding a seminar once a week. The topics are directed at problems in taxonomy. The last discussion topic was coding of characters ~~and~~ ^{into} ~~the~~ discreet states and then relating the character states to one another. I presented part of Kendrick's work and your three methods of relating characters, simple, orderable and matrix. Some very interesting points emerged from the discussion. The up-shot of this is that I would be very interested in seeing your method run two or three times on my snakes with various amounts of hypotheses built into my constructing of the matrixes. This would mean that in one run I would code my data in a purest fashion, all character states being totally different. Another run would include some basic assumptions about the data so that I would begin to have various values in the matrixes. I believe this sort of information will be useful in my thesis. Have you done this kind of thing?

Would you be interested in making more than one run with my data? I believe I can handle the cost. If possible, I would like to keep the program in your hands because of the problems involved in changing from one computer to another. Joe has been tearing his hair lately with Sokal's program because he can't get it to run on our machine.

Since I have been sort of rambling I would like to pose directly the questions I have: (1) Could I make multiple runs on my snakes? (2) Would this procedure be of interest to you? (3) When do you leave for Mexico, that is, how much time do I have to get the data to you? (4) How many characters (maximum) can your program handle? (5) How many character states can it handle? (6) How many species or OTU's can it handle?

The last three questions you have probably answered ^{For ME} at least once but I don't have it written down so I would like to make sure.

Thank you for your cooperation and I will look forward to hearing from you.

Sincerely,

Harold Voris

Harold K. Voris
Division of Reptiles

- Taxonomy Laboratory

April 15, 1966

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

Dear Harold:

Some time has passed since our discussions this past January. I am very interested in the progress that you have made on your problem since that time. Perhaps you would care to send me a copy of the characters and states which you have established for the description of your snakes, together with any problems that might have arisen since our last meeting. In this way we might be able to expedite your work and conceivably get a preliminary run on the computer before I leave for Mexico this June. Otherwise, this initial step must be put off until late summer.

I look forward to hearing from you soon.

Yours very truly,

George F. Estabrook

GFE:ch

- Taxonomy Laboratory

January 20, 1966

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

Dear Harold:

I have looked over the coding that you sent me. It looks good. If you finish the coding as you have started, then I think we will have no problem with the structure of the characters. Of course, what descriptive information to code remains your decision.

I think we can be sure that \$50.00 will be an upper bound on computing costs. I am sure that you need not apply for more than that amount.

A "program graph" is still being rewritten to run on the equipment available to us here and is not quite finished. I cannot say exactly what field on the card will correspond to object numbers but I'm sure that that field will contain columns 76 77 78 79. If you put your object numbers in these four columns you will be safe. If you use more than 72 characters and thus require more than one card per object the 80th column is then used to indicate the first (1) and second (2) cards by punching 1 and 2 in column 80 respectively. Otherwise, column 80 is blank.

Tell your "office mate" to write us if he is genuinely interested in running some of his data with us.

Give my regards to the rest of the staff at the Museum.

I hope your work progresses well.

Very truly yours,

George Estabrook

GE/pam

CHICAGO NATURAL HISTORY MUSEUM

FORMERLY FIELD MUSEUM OF NATURAL HISTORY
ROOSEVELT ROAD AND LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605

January 11, 1966

Mr. George Estabrook
Botany Department
Colorado State University
Fort Collins, Colorado 80521

Dear George:

Thank you very much for your visit. It is evident that your method has aroused much interest.

I have enclosed a sample run which I believe is complete. Please look it over and return it. If it is in an acceptable form I will code the rest of the data in the same manner. With most of the characters I will have to wait until I have run the basic statistics program before I can do the final coding. I would guess it will be summer before I get the complete set of data to you.

I have a couple of specific questions for you: (1) What is the space limit for the identification number on the right side of the Fortran Coding Form? (2) When $K=1$ on a simple ordered character is .5 automatically the value of the partial comparison?

Dr. Inger has suggested that we should make sure we understand our respective positions with regard to publications that may result from our cooperative effort. He has made my position clear. As this will be part of my thesis work, it will be published with the thesis. If you would like the work to be published separately I would be agreeable, with one consideration. That is, that the separate publication be timed to be published at approximately the same time or after the thesis has been submitted for publication. I ask this consideration for one reason. It has been pointed out to me that the faculty at the University of Chicago prefer theses to be original, i.e., previously unpublished.

If the above arrangement is not to your liking please let me know. I am sure we can come to an understanding.

My office mate, Jim Bacon, is interested in your program. He will write you concerning his work before too long.

Sincerely yours,

Harold

- Taxonomy Laboratory

December 8, 1965

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

Dear Mr. Voris:

I am looking forward to our meeting. I appreciate your offer to meet my flight (A.A. 199, 6:53 P.M., Jan. 5). You should have little trouble recognizing me as I am tall and thin and will be wearing a sweater (probably).

Your choice of hotels sounds fine to me. Why do you not reserve the single room and bath?

I would be delighted to participate in an informal seminar, the morning of the sixth, with as many as wish to attend. You might choose a room with a blackboard for this, as I am sure we will find it useful. A blackboard might also be useful in our subsequent discussions.

As my flight from Chicago to Denver does not leave until 8:15, we should have plenty of time in the afternoon of the sixth to establish a good coding for your material.

Very truly yours,

George F. Estabrook

DEC - 8 1965

CHICAGO NATURAL HISTORY MUSEUM

FORMERLY FIELD MUSEUM OF NATURAL HISTORY
ROOSEVELT ROAD AND LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605

December 6, 1965

Mr. George F. Estabrook
Department of Botany and Plant Pathology
Taxonomy Laboratory
Colorado State University
Fort Collins, Colorado 80521

Dear Mr. Estabrook:

Thank you for your letter of November 29. I am looking forward to your visit to Chicago. Your advice on data collection is appreciated and has been pretty closely satisfied in my data collection.

I will meet your flight (Number 199) on the evening of January 5th. Within the next week or two I will make reservations for you at the Chicago Y.M.C.A. Hotel, 826 South Wabash Avenue. It is centrally located and reasonably nice. Single room with bath is from \$6.00 to \$7.50 and the single room without private bath is \$4.10. I will make you a reservation for both and sometime before your arrival you can drop me a note expressing your preference or a desire to stay somewhere else. There is, of course, a variety of hotels from which to choose, but I believe you would find the above satisfactory.

I would like to make a suggestion concerning your visit. There are ^{here} about a half dozen people that are interested in your approach and methods for one reason or another. Dr. Throckmorton, for example, also heard the discussion of your Graph Theory Model at the meetings last December and became interested. He is one of the co-advisors on my thesis program. At any rate, these individuals consist of two to three graduate students and two to three professors. I would like to suggest an informal seminar for the morning of the 6th in which you would present ~~your~~ ^{the} basic methods and approach to your Graph Theory Model. Because of schedule, 1 1/2 hours is the maximum time for this meeting. You are, of course, under no obligation. Please advise me as to your decision around or before the first of the year. In either case we will have most of the 6th for my indoctrination.

Thank you very much for your cooperation.

Sincerely,

Harold Voris

Harold K. Voris
Division of Reptiles

*Dr. Rogers has
seen this -*

- Taxonomy Laboratory

November 29, 1965

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

Dear Mr. Voris,

I read your letter of November 9th with interest. I look forward to speaking with you personally soon. I expect to arrive in Chicago from Indianapolis on January 5th at 6:53 P.M. via American Airlines flight #199. I expect to leave Chicago on January 6th at 8:15 P.M. I trust that we will be able to hold a meaningful discussion of coding procedures in that time. I would indeed appreciate it if you would make arrangements for my stay in Chicago as I am totally unfamiliar with the city.

I can say little at this point of what data you should collect and how you should collect it. These few fairly obvious points can be made:

1. Any information which you might conceivably wish to incorporate into your classification should be gathered if at all possible. as it is easier to ignore collected data that is later judged not useful than it is to rediscover information which was initially ignored and later judged to be desirable.
2. As much as is possible, the same type of information should be collected for each object you wish to classify. If a character is known to be useful in differentiating some group in your study but not others, even then is it necessary to collect information for that character for as many objects as is possible.

Letter to Mr. H.K. Voris
November 29, 1965

Page 2.

3. For some character it may not be possible to collect information for some object. It is important to classify the reasons for this into two types: (1) The collection for the object is incomplete e.g. "Body Length" (#6 in your letter of Nov. 9th) for some object where the entire body of the object might not be in the collection; or (2) Availability of information logically depends on some other character. e.g. "Scale Shape" (#5 in your letter of Nov. 9th) would not apply to an organism without scales. (This, as a matter of fact, may be impossible in your group, but I think the example explains what is meant by this type of missing information.)

I hope your work progresses well, I look forward to our meeting.

Very truly yours,

George F. Estabrook

NOV 12 1965

CHICAGO NATURAL HISTORY MUSEUM

FORMERLY FIELD MUSEUM OF NATURAL HISTORY
ROOSEVELT ROAD AND LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605

November 9, 1965

Dr. David J. Rogers
Department of Botany and Plant Pathology
Colorado State University
Fort Collins, Colorado 80521

Dear Dr. Rogers:

Thank you for your letter of November 1. Your suggested visit with Mr. Estabrook is acceptable to me and I will plan to be in Chicago after the first of the year. This personal communication should facilitate a more complete understanding of your method. Please advise me as to Mr. Estabrook's specific plans. I would be glad to help in making arrangements for his stay in Chicago.

By Christmas much of my data collecting should be done. Thus, there is no need for data coding before the first of the year. However, if there are points I should know for actual data collection, the sooner I know the better.

Below is a sample list of the characters which I am using. This is to give you an idea of the kinds of data I will have.

1. Number of ventral scales
2. Number of scales around the body in different regions
3. Relative size of the eye with relationship to the distance from the lower edge of the orbit to the lip.
4. Degree of spinose (1 - 4)
5. Scale shape (6 states)
6. Body length, tail length, head width

Thank you for your cooperation.

Sincerely,

Harold Voris

Harold K. Voris
Division of Reptiles

- Taxonomy Laboratory

November 1, 1965

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

Dear Mr. Voris:

This is in partial answer to your letter of October the 22nd. We are definitely interested in seeing what sorts of comparisons can be made between our methodology and others. Because of this interest, we find that it would probably be best for one of us to have a personal visit with you.

Mr. George Estabrook, the mathematician of our group, is planning a trip to the East in December. He will probably be able to stop by Chicago on his return, and visit with you if it is convenient after the beginning of the new year.

One reason for his making a personal appearance is that there are several aspects to our study which apparently need some background information so that you can understand what really can be done with our program. We started to write down a list of instructions for the preparations of characters, and discovered that we have a paper in production at the moment. Since this is the case, it probably will be better to give personal instructions so that there can be some understanding of what is intended. Therefore, if it is convenient to you, we will make these arrangements. If, on the other hand, you need to have this information sooner, we will send you a copy of our instructions and discussions on the characters themselves.

I hope this is satisfactory to you. Will you please let me know if you will be in Chicago after the first of the year?

Sincerely yours,

David J. Rogers
Professor of Botany

DJR/ec

CHICAGO NATURAL HISTORY MUSEUM

FORMERLY FIELD MUSEUM OF NATURAL HISTORY
ROOSEVELT ROAD AND LAKE SHORE DRIVE

CHICAGO, ILLINOIS 60605

October 22, 1965

Dr. David J. Rogers
Department of Botany & Plant Pathology
Colorado State University
Fort Collins, Colorado 80521

Dear Dr. Rogers:

Thank you for your letter of October 15. I am interested in obtaining your graph theory model program. To begin with, I would like to explain why I would like to use your program and for what purpose, and then I will proceed to answer your questions concerning the group to which the methods are to be applied.

Briefly, my thesis is to be an attempt at a critique of taxonomic methods of several types. Numerical taxonomy being one of these, I am interested in obtaining one or two of what I feel are the most useful and clearest approaches to numerical taxonomy. Dr. Du Praw's method (SSZ 14 (1): 1-25), for example, may be useful for species problems which exist within one of my large species groups. In this situation I can "feed in" specimens, which is exactly what I need to do in this particular instance because there are specimens which I have had difficulty in placing into groups. The rest of the species are well defined and with these and the other species, once I have them sorted out, I will be interested in higher categories and characteristics of species, not specimens; these will be the described objects. This is where I believe your program would be of most use to me.

The group I am working on, the Hydrophiidae, is a family of marine snakes. The group as a whole has been treated once, in 1926, by Malcolm Smith. This work is a classical monograph and includes little more than keys and species descriptions. The following answers to your questions are based on this work and my opinions from the work I have done so far.

Number of objects?	47-50 species (a mean of about 10 specimens per species)	
	15-20 species groups (15 genera are now existant)	
	1-2 families	
Number of characters?	External anatomy	25-30
	Skull	15-20
	Vertebrae	5
	Hemipenis	?
	Internal Anatomy	2-5
	Total	60+

(continued)

October 22, 1965

None of these aspects of the work are completed, but I am sure characters will be in excess of 60.

Number of character states? This varies a great deal. About half are 2-state characters, while the rest range from 3-8 states. Some of these may be reducible to fewer states.

The computer here at Chicago is an IBM 7094. Thus, the program which you are re-writing will also be usable on this computer. Since I am not finished collecting my data there is time for me to modify my procedure of data recording and also to rearrange the data I already have. I would appreciate your instruction for data preparation for your graph theory model.

Thank you very much for your cooperation.

Sincerely,

Harold Voris

Harold K. Voris
Division of Reptiles

October 15, 1965

Mr. Harold K. Voris
Division of Reptiles
Chicago Natural History Museum
Chicago, Illinois 60605

Dear Mr. Voris,

Your letter to Dr. Wirth has been sent along to me. Dr. Wirth is no longer involved in the project in which he was participating at the time he gave the paper at the meetings in Knoxville, Tenn. However, he was a member of a team of which I am Director which has moved in its entirety from New York Botanical Garden to the above address. We are continuing our endeavors in line with the paper presented by Dr. Wirth, and we have a working program. At the moment a description of this program is in the hands of the Editor of Systematic Zoology for publication; but I fear it will not appear for some time. If you are interested in running your data using the graph theory model (the basis of Dr. Wirth's paper in Knoxville), we can provide you with instructions which will allow you to prepare your information for input into the program. We have quite a number of suggestions about preparation of data that you should know about. If you wish to prepare your data in our manner, please let me know and we will send sufficient instructions to permit you to go ahead.

I would like to know something about the size of the group of reptiles you are studying -- How many objects will be involved? Do you have already some classification? How many characters describing each of the objects? Approximately how many character states are involved?

We have to re-write the computer program because in New York we used a CDC machine. Here, we will be using an IBM 7094, and the two programs are not compatible. This may take a few months to do. We hope no more than two. I will be pleased to hear from you.

Sincerely,

David J. Rogers
Professor of Botany

DJR/ec

CHICAGO NATURAL HISTORY MUSEUM

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ROOSEVELT ROAD AND LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605

Sept. 16, 1965

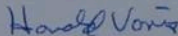
Mr. Michael Woirth
The New York Botanical Garden
Bronx Park
Bronx, New York

Dear Mr. Woirth

Last December at the Systematic Zoology meetings I heard your paper concerning numerical approach to arriving at a taxonomy of orchids. This summer I was in Costa Rica and meet Both Dr. Dodson and Dr. Dressler. Dr. Dressler knew of your work and gave me your address. I ~~was~~ am interested in numerical approaches to taxonomy and yours as presented at the meetings seemed especially useful. If you have published this work would you please notify me as to where it has or will appear. If you ~~not~~ have yet published it I would like to know if it would be possible to obtain the method from you personally and try using it on a group of snakes I am working on for my thesis. The thesis itself is mostly concerned with comparing methods of approach to evolutionary problems and taxonomic problems and will include other numerical approaches as well for a comparative study.

Thank you very much for you attention,

Sincerely,



Harold K. Voris
Div. of Reptiles