Hunt Institute for Botanical Documentation
5th Floor, Hunt Library
Carnegie Mellon University
4909 Frew Street
Pittsburgh, PA 15213-3890
Telephone: 412-268-2434
Email: huntinst@andrew.cmu.edu
Web site: www.huntbotanical.org

The Hunt Institute is committed to making its collections accessible for research. We are pleased to offer this digitized item.

Usage guidelines
We have provided this low-resolution, digitized version for research purposes. To inquire about publishing any images from this item, please contact the Institute.

Statement on harmful and offensive content
The Hunt Institute Archives contains hundreds of thousands of pages of historical content, writing and images, created by thousands of individuals connected to the botanical sciences. Due to the wide range of time and social context in which these materials were created, some of the collections contain material that reflect outdated, biased, offensive and possibly violent views, opinions and actions. The Hunt Institute for Botanical Documentation does not endorse the views expressed in these materials, which are inconsistent with our dedication to creating an inclusive, accessible and anti-discriminatory research environment. Archival records are historical documents, and the Hunt Institute keeps such records unaltered to maintain their integrity and to foster accountability for the actions and views of the collections' creators.

Many of the historical collections in the Hunt Institute Archives contain personal correspondence, notes, recollections and opinions, which may contain language, ideas or stereotypes that are offensive or harmful to others. These collections are maintained as records of the individuals involved and do not reflect the views or values of the Hunt Institute for Botanical Documentation or those of Carnegie Mellon University.

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.

28 July 1969

Dr. Howard L. Mills
Department of Biological Sciences
Marshall University
Huntington, West Virginia 25701

Dear Howard:

I am assuming that you will follow the same consulting fee arrangement as we have in the past, and have therefore included herewith an invoice for consulting services for two days at our usual rate.

We look forward to running your full study and hopefully producing the results you have waited for. It was good to see you.

Sincerely,

David J. Rogers
Professor of Biology

DJR:gm
Enc.

28 July 1969

INTERDEPARTMENTAL ORDER AND INVOICE UNIVERSITY OF COLORADO

To: Marshall University
Huntington, W. Va. 25701
(Federal Programs Account)

IN 68529

☐ PURCHASING OPERATIONS ☐ FOOD ☐ LAUNDRY ☐ OTHER (EXPLAIN)

☐ LINEN ☐ BOOK STORE ☐ PHYSICAL PLANT ☐ ALCOHOL

☐ PHARMACY ☐ PRINTING SERVICES ☐ MOTOR POOL ACCT. NO. OF DEPT. RENDERING SERVICES

DEPARTMENT NUMBER	SUB	BUD. CODE	OBJECT CLASS

QUANTITY	DESCRIPTION	UNITS ISSUED	UNIT PRICE	AMOUNT
	Consulting fee, Mr. Howard Mills, 2 days at $100/day			200.00

DELIVER TO: Taximetrics Laboratory, David J. Rogers, Director

ADDRESS: University of Colorado, Armory 101
Boulder, Colorado 80302

TOTAL $200.00

REQUESTED BY | EXTENSION | DATE 28 July | CHARGE ACCOUNT

APPROVED BY

RECEIVED BY

DEPARTMENT NUMBER	SUB	BUD. CODE	OBJECT CLASS

FINANCE OFFICE FORM NO. 14

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESFT

11 July 1969

Dr. David J. Rogers
Taximetrics Laboratory
University of Colorado
Boulder, Colorado 80302

Dear Dr. Rogers:

Mr. Gene Addor and I plan to arrive in Denver on Braniff Flight No. 160 at 6:05 p.m. on 16 July. Since this is so late in the evening, we will find accomodations and report to your office sometime after 8:00 a.m. Thursday morning.

Dr. Mills will arrive at Denver on TWA Flight No. 459 at 4:50 p.m. on Thursday. We have not decided whether to pick him up at the airport or let him rent a car and travel to Boulder.

Sincerely yours,

Albert R. Hornbrook

ALBERT R. HORNBROOK
1LT, OrdC

30 July 1969

Dr/ Howard L. Mills
Department of Biological Sciences
Marshall University
Huntington, West Va. 25701

Dear Howard:

It was a pleasure talking to pou and your colleagues recently. Enclosed is the plan of work as I understand it. Included is the instruction for the Data Reduction Program which we discussed. If these are correct as you understand them, please forward copies to the concerned parties in Vicksburg. If wou wish to discuss any of the points here, please call me between 4 August and 15 August and we can straighted any dubious points out. Best of success with the continued effort. When reduced data is ready, we can schedule another meeting to process and discuss it further.

Very truly yours,

George F. Estabrook
Research Mathematician

GFE:gm

Invoice

Marshall University
Huntington, W. Va
25701

Federal Programs Acct
Dr. Mills

Consulting Fee $100.00 per day

Computer Expenses

11 October 1968

Dr. Howard L. Mills
Department of Biological Sciences
Marshall University
Hungington, West Va. 25701

Dear Dr. Mills:

Here is a new invoice (in triplicate, since that seems to be what business offices want) and a photocopy of the previous one.

Dr. Rogers is at home with "flu", but he asked me th thank you for your letter and extend the hope that it will not be too long before you can get to Boulder again.

Sincerely yours,

(Mrs.) Genevra Metcalf
Secretary

8 July 1968

INTERDEPARTMENTAL ORDER AND INVOICE UNIVERSITY OF COLORADO

To: Marshall University
Huntington, W. Va. 25701
(Federal Programs Acct)

IN 28577

☐ GENERAL STORES ☐ FOOD ☐ LAUNDRY ☐ OTHER (EXPLAIN)

☐ LINEN ☐ BOOK STORE ☐ PHYSICAL PLANT ☐ ALCOHOL

☐ PHARMACY ☐ PRINTING SERVICES ☐ MOTOR POOL

ACCT. NO. OF DEPT. RENDERING SERVICES

DEPARTMENT NUMBER	SUB	BUD. CODE	OBJECT CLASS
1708	48	5	

QUANTITY	DESCRIPTION	UNITS ISSUED	UNIT PRICE	AMOUNT
	Computer Time, Central and Peripheral Processing			70 00
	Consulting Fee, 5 days @ $100 per day			500 00
	(Mr. Howard Mills received this assistance.)			
	Mailed out 9 July			
			TOTAL	$570 00

DELIVER TO: Taximetrics Laboratory (Dr. David J. Rogers)

ADDRESS: University of Colorado (Armory 101)
Boulder, Colorado, 80302

REQUESTED BY	EXTENSION	DATE	CHARGE ACCOUNT

MARSHALL UNIVERSITY
HUNTINGTON, WEST VIRGINIA 25701

DEPARTMENT OF BIOLOGICAL SCIENCES

3 October, 1968

Dr. David J. Rogers
Professor of Biology
Taximetrics Laboratory
Department of Biology
Armory 101
University of Colorado
Boulder, Colorado 80302

Dear Dave:

Please excuse my not writing sooner but I have been snowed under with work and have delayed time and time again a return trip to Boulder.

I have checked throughly with the Office of Business and Finance and they inform me that they have no record of having received an invoice from you. My suggestion would be to send a copy of the invoice either to me or to Mr. Richard Vass, Treasurer, Marshall University.

We have been working on data reduction and transformation into characters for additional work with you. I am anticipating that I will be in position to run this within the next month. If I can't get away any sooner I would like to return to Boulder during the Thanksgiving recess. At any rate I will probably call you when the situation clears sufficiently to make a decision.

I am certainly appreciative of your hospitality and cooperation.

Sincerely,

Howard

Howard L. Mills
Professor of Botany

18 September 1968

Dr. Howard Mills
Marshall University
Huntington, West Va. 25701

Dear Howard:

Since we haven't heard from you we wonder what happened to the agreement on the ecological study. Sometime back I also sent an invoice for the agreed-on costs for consultation. I wonder if you would mind checking out and see what happened - whether or not the right office received it, or what has happened to it.

We are looking forward to a continuation of our studies together.

Sincerely,

David J. Rogers
Professor of Biology

DJR:gm

Howard Mills Data -

CROWN CHARACTERS

K_1 Crown Shape

(a) Round
(b) Spindle
(c) Pointed
(d) Flat-Top
(e) Not Applicable
(f) No Data

$$\text{Crown Shape Ratio} = \frac{\text{Height of Widest Horizontal - Lowest Crown Branch}}{\text{0.5 Vert. Crown Diameter}}$$

$$\text{Crown Symmetry Ratio} = \frac{\text{Width of Widest Horizontal}}{\text{Length of Vertical}}$$

K_1=Crown Shape	Crown Shape Ratio	Crown Symmetry Ratio
(a) Round	1 ± 0.25	1 ± 0.25
(b) Spindle	1 ± 0.25	0 - 0.75 1.25 - 2.0
(c) Pointed	0 - 0.75	Any Value
(d) Flat-Top	1.25 - 2.0	Any Value
(e) Not Applicable		
(f) No Data		

K_2 Crown Volume

(a) ~~1~~ - 12 1,000 cc
(b) 1,000 -- 10,000 cc
(c) 10,000 -- 100,000 cc
(d) 100,000 -- 1,000,000 cc
(e) 10^6 -- 10^7 cc
(f) 10^7 -- 10^8
(g) 10^8 -- 10^9
(h) 10^9 -- 10^{10}
(i) Not Applicable
(j) No Data

Horizontal Crown Area:

(a) When major axis and minor axis are equal:

$$= 3.1416 \left(\frac{\text{Major Axis X Minor Axis}}{4} \right) = 0.7854 \text{ (Major X Miner)}$$

(b) When major axis and minor axis are not equal:

$$= 3.1416 \text{ (Major Axis X Miner Axis)}$$

Crown Volume:

When Crown Shape is:

Spherical = $0.523 \text{ (Horizonal Crown Area)}^3$

Flat-Top or Pointed = Crown Vertical Depth $\left(\frac{\text{Horizontal Crown Area}}{3} \right)$

Spindle = 4.18 (Horizontal Crown Area X Vertical Depth)

K_3 Crown Stratification Maxima

(a) 0 -- 1 cm
(b) 10 -- 30 cm
(c) 30 -- 100 cm
(d) 100 -- 200 cm
(e) 200 -- 500 cm
(f) 500 -- 1300 cm
(g) 1300 -- 3500 cm
(h) 3500 cm or above
(i) Not Applicable
(j) No Data

For Each Structural Type Determine:

Mean Height of Greatest Horizontal = (1) $\frac{\Sigma \text{ Height of Widest Horizontal Diameter}}{\text{Number in Population}}$

Crown Cover % Cover = (2) $\frac{\Sigma \text{ Horizontal Crown Area}}{\text{Total Area of Structural Cell } (Y_p \text{ Area})}$

%	a	b	c	d	e	f	g	h	i	j
0 -- 20										
20 -- 40										
40 -- 60										
60 -- 80										
80 -- 100										

K_4 Crown Depth----Structural Type Height Ratio

(a) 0. -- 0.2
(b) 0.2 -- 0.4
(c) 0.4 -- 0.6
(d) 0.6 -- 0.8
(e) 0.8 -- 1.0

For Each Structural Type Determine:

(1) $\frac{\Sigma \text{ Crown Depths}}{\text{Number in Population}}$ = Height - Height Lowest Crown Branch

(2) $\Sigma \frac{\text{Structural Type Heights}}{\text{Number in Population}}$

Ratio = $\frac{\text{Mean Crown Depth}}{\text{Mean Structural Type Height}}$

HEIGHT CLASS

	1	2	3	4	5	6	7	8			
a											
b											
c											
d											
e											

K_5 Crown Concentricity

(a) Concentric when Concentricity Ratio = 0 - 0.2
(b) Slightly Excentric when Concentricity Ratio = 0.2 - 0.4
(c) Moderately Excentric when Concentricity Ratio = 0.4 - 0.6
(d) Highly Excentric when Concentricity Ratio = 0.6 - 0.8
(e) Extremely Excentric when Concentricity Ratio = 0.8 - 1.0
(f) Not Applicable
(g) No Data

$$\text{CONCENTRICITY} = \frac{0.25\,(A_1 + A_2 + B_1 + B_2) - S}{0.25\,(A_1 + A_2 + B_1 + B_2)} \times \frac{0.25\,(XA_1 + XA_2 + XB_1 + XB_2)}{0.25\,(XA_1 + XA_2 + XB_1 + XB_2) - XS_1}$$

Where:

X = Point of Location of Rangetiuder (= Center of Measurement)

XA_1 = Distance between points X and Azimuth A_1

XA_2 = Distance between points X and Azimuth A_2

XB_1 = Distance between points X and Azimuth B_1

XB_2 = Distance between points X and Azimuth B_2

S_1 = Azimuth of Stem

XS_1 = Distance between points X and Azimuth S_1

K_6 Stem Branching Height -- Plant Height Ratio

(a) 0. -- 0.001
(b) 0.001 -- 0.01
(c) 0.01 -- 0.1
(d) 0.1 -- 1.0
(e) None
(f) No Data

Mean Branch Heights by Height Classes

Mean Plant Heights by Height Classes

Mean Branch Height / Mean Plant Height	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

HEIGHT CLASSES

K_7 Stem Diameter / Plant Height Ratio

(a) 0. -- 0.001
(b) 0.001 -- 0.01
(c) 0.01 -- 0.1
(d) 0.1 -- 1.0
(e) None
(f) No Data

Mean Stem Diameter by Height Class

Mean Plant Heights by Height Class

HEIGHT CLASSES

	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

Stem Diameter / Plant Height

K_8 Stem Attitude

(a) 0. -- 0.2
(b) 0.2 -- 0.4
(c) 0.4 -- 0.6
(d) 0.6 -- 0.8
(e) 0.8 -- 1.0
(f) Not as Above
(g) No Data

Mean Height of Vertical Line from Stem To Horizontal Plane Thru Base of Plant (200 cm if Plant Height Exceeds 200 cm) For Plants Population of Height Class

Mean Lenght of Horizontal Line from Plant Base to Vertical Line Intersect

HEIGHT CLASSES

Stem Attitude	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								
g								

K_9 Sinuosity Ratio

(a)	0. -- 0.2	Extremely Sinuous
(b)	0.2 -- 0.4	Very Sinuous
(c)	0.4 -- 0.6	Moderately Sinuous
(d)	0.6 -- 0.8	Slightly Sinuous
(e)	0.8 -- 1.0	Not Sinuous
(f)	Not as above	
(g)	No Data	

$$\frac{\sqrt{(BV)^2 + (XV)^2}}{\text{Length L Measured}} \quad \begin{matrix}\text{(Mean for each Height Class)} \\ \text{(Mean for each Height Class)}\end{matrix}$$

HEIGHT CLASSES

Sinuosity Ratio	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								
g								

K_{10} Stem Base Spread Ratio

(a)	0 -- 1	No Spread
(b)	1 -- 2	Very Slightly Spreading Base
(c)	2 -- 3	Slightly Spreading Base
(d)	3 -- 5	Moderate Spreading Base
(e)	5 -- 15	Entanged Spreading Base
(f)	15 -- 45	Extremely
(g)	45 --	
(h)	Not applicable	
(i)	No Data	

$$\frac{(\text{Base measure } 1 + 2 + 3)\ \left(\frac{1}{\text{base measure } 3}\right)}{3}$$

$$= \quad 0.33\ (\text{Base measure } 1 + 2 + 3)\ \left(\frac{1}{\text{Base measure } 3}\right)$$

For Each Height Class

HEIGHT CLASS

	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								
g								
h								
i								

K_{11} Spines Equal to or Less than 5mm

(a) 0- 20 % of Population Height Class
(b) 20-40 % of Population Height Class
(c) 40-60 % of Population Height Class
(d) 60-80 % of Population Height Class
(e) 80-100 % of Population Height Class
(f) No Data

$$\frac{\text{Number of Individuals Col. 24}}{\text{Total Individuals in Calculated Height Class}}$$

HEIGHT CLASS

	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

ARMATURES

K_{12} Spines Greater Than 5mm

(a) 0 -- 20 %
(b) 20 -- 40 %
(c) 40 -- 60 %
(d) 60 -- 80 %
(e) 80 -- 100 %
(f) No Data

Number of Individual Col. 25 for Height Class
Total No. of Individuals in Height Class

HEIGHT CLASS

	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

K_{13} CUTTING EDGES

(a) 0 -- 20 %
(b) 20 -- 40 %
(c) 40 -- 60 %
(d) 60 -- 80 %
(e) 80 -- 100 %
(f) No Data

$$\frac{\text{Number of Individuals Col. 26 for Height Class}}{\text{Total Number of Individuals in Height Class}}$$

HEIGHT CLASS

	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

K_{14} Stinging Organs

(a) 0 -- 20 %
(b) 20 -- 40 %
(c) 40 -- 60 %
(d) 60 -- 80 %
(e) 80 -- 100 %
(f) No Data

Number of Individuals col. 27 For Height Class
Total Number of Individuals in Height Class

HEIGHT CLASS

	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

K_{15} Leaf Size

(a) 0.1 -- 1 sq cm
(b) 1 -- 150 sq cm
(c) More Than 150 sq cm
(d) No Data
(e) None
(f) No Data

(Mean Length Within Height Class Columns 69-70) • (Mean Width/ Length Ratio Columns 71-72)

HEIGHT CLASS

	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

K_{16} Leaf Shape

(a) 0.1 -- 0.2 Width/ Length Ratio
(b) 0.2 -- 0.4 Width/ Length Ratio
(c) 0.4 -- 0.8 Width/ Length Ratio
(d) 0.8 -- 1.0 Width/ Length Ratio
(e) Not Applicable
(f) No Data

$$\frac{\text{Mean Width}}{\text{Mean Length}}$$

HEIGHT CLASS

Mean Width / Length Ratio	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								

K_{17} Leaf Texture

(1) Felony Percent
(2) Membranous Percent
(3) Hard Percent
(4) Succulent Percent
(5) Absent Percent
(6) No Data Percent

Mean % Column 73 for Each Height Class

HEIGHT CLASS

Texture %	1	2	3	4	5	6	7	8
1								
2								
3								
4								
5								
6								

K_{18} Density (Number of Individuals Per SQ CM)

(a) 0.000000017 -- 0.00000069 -- YP = 38400 $\frac{cm}{--}$ 19200
(b) 0.00000069 -- 0.0000028 -- YP = 19200 -- 9600 .
(c) 0.0000028 -- 0.0000011 -- YP = 9600 -- 4800
(d) 0.0000011 -- 0.000044 -- YP = 4800 -- 2400
(e) 0.000044 -- 0.000018 -- YP = 2400 -- 1200
(f) 0.000018 -- 0.0004 -- YP = 1200 -- 800
(g) 0.0004 -- 0.0015 -- YP = 800 -- 400
(h) 0.00015 -- 0.00063 -- YP = 400 -- 200
(i) 0.00063 -- 0.00254 -- YP = 200 -- 100
(j) 0.00254 -- 25.4 -- YP = 100 -- 1

$$Y_p = \frac{4.47 \cdot 2 \left(\text{Max. Distance (cm) From Plot Center For Height Class} \right)}{\sqrt{\text{Number of Individuals in Population of Height Class}}}$$

HEIGHT CLASS

Density Classes	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								
g								
h								
i								
j								

K_{19} Population Valence

(a) 0.0 -- 0.2
(b) 0.2 -- 0.4
(c) 0.4 -- 0.8
(d) 0.8 -- 1.6
(e) 1.6 -- 3.2
(f) 3.2 -- 6.4
(g) 6.4 -- 12.8
(h) 12.8 -- 25.6
(i) 25.6 -- 51.2
(j) 51.2 -- 102.4
(k) 102.4 -- 204.8
(l) 204.8 -- 409.6
(m) NO Data

$$\text{Valence of Plants of a Population} = \text{Mean Height} \times \frac{\text{Sum of Horizontal Crown Area}}{\text{Sum of Area of Population}} \times \left(\frac{Y_{pn}}{Y_{p1}}\right)^2$$

Height Class

Valence	1	2	3	4	5	6	7	8
a								
b								
c								
d								
e								
f								
g								
h								
i								
j								
k								
l								
m								