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Studies in Variation of Red Clover

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STUDIES IN VARIATION OF RED CLOVER.

BY EDNA C. PAMMEL AND CLARISSA CLARK.

Variation in *Trifolium pratense* presents many interesting problems, some of which have been under consideration during the past two seasons by the contributors to this paper.

General relationships between number of flowers in the head, and number of seeds produced, the influence of soils, and seasons, comparative dimensions of the flowers, and of pollen grains, were the particular features studied.

The present paper records thesis work of Miss Edna Pammel in determination of variation in number of flowers in the heads of red clover, from four different soil areas, and the thesis study of Miss Clark in variation in size of pollen grains; notes are included from the work of Miss Emma Wennholz and Miss Vera Mills in variation in number of clover flowers in heads miscellaneously collected, and from the study of Miss Mildred Walls upon variation in length of flower (stamen tube).

Miss C. M. King rendered much assistance in arranging the materials of the paper, and in the preparation of the curves.

A STUDY IN VARIATION IN NUMBER OF FLOWERS IN HEADS OF RED CLOVER.

Countings were made from first, second and third crop clover on three different kinds of soil, alluvial, black loam, and black loam underlaid with gravel. All material was gathered in in the vicinity of Ames, and only well developed heads were counted.

The following formulæ from Davenport's Statistical Methods have been used in working out the mean, index of variability, the coefficient of variability, and the probable error in each case.

$$A = \frac{\Sigma (v. f.)}{n}$$

where A=mean or average, Σ =sign of summation, v=magnitude of any class, f=frequency, or number of variates in that class, and n=total number of variates.

$$D = \sqrt{\frac{\sum (x^2 \cdot f)}{n}} \cdot \lambda$$

where D=index of variability, or the amount the group as a whole varies from the mean, x=amount of the deviation of any class from the mean, f=number of units in the class range, or in the present calculation, unity.

$$C = \frac{D}{a} \cdot 100\%$$

where C=coefficient of variability. The 100% is used to get the result into more convenient form, and is entirely arbitrary.

$$E_a = \pm .6745 \frac{\delta}{\sqrt{n}}$$

where E_a =probable error of the mean.

$$E_\delta = \pm .6745 \frac{\delta}{\sqrt{2n}}$$

where E_δ =the probable error of the index of variability.

$$E_C = \pm .6745 \frac{C}{\sqrt{2n}} \left(1 + 2 \left[\frac{C}{100} \right]^2 \right)^{\frac{1}{2}}$$

where E_C =the probable error of the coefficient of variability.

CONSTANTS FOR BLACK LOAM, FIRST CROP.

n=85 Total number of specimens.
 A=71.1764 Mean average.
 δ =21.7296 Index of variability.
 C=30.52% Coefficient of variability.
 E_a =1.5897 Probable error of mean.
 E_δ =1.1241 Probable error of index.
 E_C =2.6018 Probable error of coefficient.

CONSTANTS FOR BLACK LOAM, SECOND CROP.

n=133	E_a =1.7343
A=98.1127	E_δ =1.2263
δ =29.6532	E_C =2.179
C=30.22%	

CONSTANTS FOR BLACK LOAM UNDERLAID WITH GRAVEL.

n=394	E_a =98.57
A=101.038	E_δ =.6969
δ =29.0086	E_C =1.205
C=28.71	

CONSTANTS FOR ALLUVIAL SOIL, THIRD CROP.

n=110	Ea=1.0075
A=68.7363	Eδ=.7125
δ=15.6697	Ec=1.908
C=22.79%	

CONCLUSIONS.

From the foregoing it may be seen that the second crop clover has more flowers in the head than the first crop clover, and that black loam underlaid with gravel is the best soil for the production of red clover.

COUNT FOR BLACK LOAM—FIRST CROP.

Magnitudes	.....35	36	37	38	39	40	41	42	44	45	46	47	48	49	50	51	52
Frequencies	1	1	1	2	1	2	1	1	1	1	2	2	1	2	3	1	1
Magnitudes	.....53	54	57	59	60	61	62	64	65	67	68	70	71	72	73	76	
Frequencies	.....	1	1	2	2	2	2	2	2	1	3	1	4	2	2	1	2
Magnitudes	.....77	79	80	82	83	84	89	92	95	97	98	99	100	102	103		
Frequencies	.....	1	2	2	1	2	2	1	2	3	1	2	1	1	1	1	
Magnitudes	.....104	105	106	108	112	115	128	140									
Frequencies	.....	1	1	1	1	1	1	1	1	1	1	1	1	1			

COUNT FOR BLACK LOAM—SECOND CROP.

Magnitudes	.....35	36	40	41	42	44	45	47	48	51	52	55	58	61	62	64	65
Frequencies	.....	1	1	2	1	1	1	1	1	1	1	3	2	1	1	1	1
Magnitudes	.....66	67	68	69	70	71	72	73	75	76	78	79	80	81	83	84	85
Frequencies	.....	1	1	1	1	4	1	1	1	1	2	1	1	2	1	2	2
Magnitudes	.....87	88	89	90	91	92	94	95	96	97	98	100	101	102	103	110	
Frequencies	.....	2	3	1	2	3	2	4	2	4	1	2	3	1	2	2	4
Magnitudes	.....111	112	113	114	116	117	118	120	121	123	124	125	126	127			
Frequencies	.....	5	4	4	5	3	2	1	2	3	1	1	1	1	1	1	
Magnitudes	.....128	132	134	135	136	137	140	147	148	150							
Frequencies	.....	1	2	1	1	1	1	1	2	1	1	1	1				

COUNT FOR ALLUVIAL SOIL—THIRD CROP.

Magnitudes	.....33	40	44	46	47	48	50	51	52	53	56	57	58	59	60	61	
Frequencies	.....	1	1	2	1	1	1	4	4	4	4	5	1	1	1	1	5
Magnitudes	.....62	63	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Frequencies	3	2	2	2	1	1	1	5	1	1	1	1	5	2	3	3	2
Magnitudes80	81	82	83	84	85	86	87	88	91	92	94	95	97	98	99	103	
Frequencies	3	3	4	2	3	2	2	2	1	3	3	1	1	1	1	1	1
Magnitudes104	123																
Frequencies	1	1															

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COUNT FOR BLACK LOAM WITH GRAVEL—SECOND CROP.

Magnitudes	39	40	41	42	43	44	45	46	47	48	49	50	51	52	54	55	56	
Frequencies	1	1	1	1	1	1	1	2	2	1	3	5	3	2	4	2	8	
Magnitudes	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	
Frequencies	2	4	4	4	1	4	2	1	8	1	8	3	4	3	5	10	14	
Magnitudes	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
Frequencies	6	6	3	3	2	9	4	14	1	5	2	8	2	6	5	6	4	4
Magnitudes	92	93	94	95	97	99	100	101	102	104	105	106	107	108	109	112		
Frequencies	5	9	3	4	6	2	7	5	3	8	4	9	3	4	5	3		
Magnitudes	113	115	118	119	120	121	122	123	124	125	126	127	128					
Frequencies	8	2	4	3	7	2	4	1	7	6	6	5	1					
Magnitudes	129	130	133	135	136	137	138	139	140	141	142	143	144					
Frequencies	2	1	3	2	6	4	4	1	2	2	2	2	4					
Magnitudes	145	146	148	161	162	170	171	176	183									
Frequencies	1	3	1	2	1	2	1	2	1									

An additional study was made* in the fall of 1910; the flowers of 983 heads were counted. The material was taken from various soils, and localities, in the neighborhood of Jefferson, Iowa, during a period extending from June to September.

According to the results of this study, variation of clover heads: between fifty-three and sixty-eight flowers each, is quite irregular, but from sixty-eight to eighty-three it is very smooth; in fact this with small breaks at eighty-three and again at eighty-eight, reached to the central mode at ninety-eight. The drop on the other hand, is much more irregular.

COUNT FOR FLOWERS IN HEADS OF RED CLOVER.

Magnitudes	54,	59,	60,	61,	64,	65,	67,	68,	70,	71		
Frequencies	7,	4,	5,	3,	2,	1,	11,	4,	15,	1		
Magnitudes	72,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83
Frequencies	6,	3,	2,	13,	16,	9,	8,	15,	17,	9,	30,	7
Magnitudes	84,	85,	86,	87,	88,	89,	90,	91,	92,	93,	94,	95
Frequencies	18,	25,	14,	24,	16,	15,	17,	40,	45,	32,	24,	32
Magnitudes	96,	97,	98,	99,	100,	101,	102,	103,	104,	105,	106,	107
Frequencies	22,	27,	24,	37,	25,	11,	16,	20,	36,	16,	22,	18
Magnitudes	108,	109,	110,	111,	112,	113,	114,	115,	116,	117,	119,	120
Frequencies	10,	28,	16,	30,	22,	1,	13,	21,	5,	21,	1,	9
Magnitudes	121,	122,	123,	124,	125,	126,	128,	130,	131,	135,	136,	138
Frequencies	8,	2,	3,	3,	9,	2,	2,	3,	2,	4,	3,	1

The range extended from fifty-three to one hundred forty-two flowers. The mean, as derived from the frequencies shown is 90.44 flowers.

*By Miss Wennholz and Miss Mills.

For the curve the magnitudes were grouped eighteen classes, each class being a group of 5 of the magnitudes. The mode is found to lie at class 9 (the magnitude group 39-97 flowers).

CONSTANTS.

n=983	Number of heads.
A=90.44	Average.
δ =15.72	Index of variability.
C=17.38	Coefficient of variability.
Ea=.502	Probable error of mean.
E δ =.354	Probable error of index.
E c =.0275196	Probable error of coefficient.

Class 1=	53— 57 flowers.
Class 2=	58— 62 flowers.
Class 3=	63— 67 flowers.
Class 4=	68— 72 flowers.
Class 5=	73— 77 flowers.
Class 6=	78— 82 flowers.
Class 7=	83— 87 flowers.
Class 8=	88— 92 flowers.
Class 9=	93— 97 flowers.
Class 10=	98—102 flowers.
Class 11=	103—107 flowers.
Class 12=	108—112 flowers.
Class 13=	113—117 flowers.
Class 14=	118—122 flowers.
Class 15=	123—127 flowers.
Class 16=	128—132 flowers.
Class 17=	133—137 flowers.
Class 18=	138—142 flowers.

A STUDY OF THE VARIATION IN LENGTH OF FLOWERS (STAMEN TUBES)
OF THE RED CLOVER.*

A large collection of clover heads was gathered from the college campus; and from these 493 flowers were selected for measurement.

The magnitudes and frequencies observed were as follows:

Magnitudes .....	.6 cm.,	.68 cm.,	.7 cm.,	.72 cm.,	.75 cm.,	.76 cm.
Frequencies.....	1,	1,	6,	1,	3,	5,
Magnitudes .....	.77 cm.,	.78 cm.,	.79 cm.,	.8 cm.,	.81 cm.,	.83 cm.
Frequencies.....	1,	3,	5,	9,	1,	1,
Magnitudes .....	.84 cm.,	.85 cm.,	.86 cm.,	.87 cm.,	.88 cm.,	.89 cm.
Frequencies.....	16,	18,	25,	21,	43,	60,

*From a study by Miss Mildred Walls.

Magnitudes .....	.9 cm.,	.91 cm.,	.92 cm.,	.93 cm.,	.94 cm.,	.95 cm.
Frequencies.....	87,	39,	49,	4,	17,	29,
Magnitudes .....	.96 cm.,	.97 cm.,	.98 cm.,	.99 cm.,	1. cm.	
Frequencies.....	28	1,	7,	1,	5,	

The length was found to vary from .6 cm. to 1. cm., with the mode at Class 10 (.88—.9).

CONSTANTS.

n=493	Number of flowers.
A=.8918	Mean length.
δ =.1494	Index of variability.
C=.16751	Coefficient of variability.
Ea=.0045306	Probable error of mean.
E δ =2.9524	Probable error of index.
Ec=.041707	Probable error of coefficient.

For use in plotting a curve the magnitudes were seriated into 14 classes, each class a group of three magnitudes, from .6 cm. to 1.02 cm., supplying omissions with ciphers. The mode lies at class 10 (group .88-.9 cm.) it is quite regular and not wide, and is abrupt in the direction of greater dimension.

The magnitudes are seriated into classes as follows:

- Class 1= .16— .63 cm.
- Class 2= .64— .66 cm.
- Class 3= .67— .69 cm.
- Class 4= .7 — .72 cm.
- Class 5= .73— .75 cm.
- Class 6= .76— .78 cm.
- Class 7= .79— .78 cm.
- Class 8= .82— .84 cm.
- Class 9= .85— .87 cm.
- Class 10= .88— .9 cm.
- Class 11= .91— .93 cm.
- Class 12= .94— .96 cm.
- Class 13= .97— .99 cm.
- Class 14=1. —1.02 cm.

SIZE OF POLLEN GRAINS OF RED CLOVER.

A study of pollen grains was made from red clover blossoms gathered miscellaneously at Ames in October, 1910, to determine variations in width and length of grains. Four to six counts were made from each head. Measurements of 1,024 pollen grains were made, with the micrometer scale, and curves constructed using units of this scale; each unit represented 4π .

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MEASUREMENTS FOR WIDTH OF POLLEN GRAIN.

Magnitudes	20 μ ,	24 μ ,	28 μ ,	32 μ ,	36 μ ,	40 μ
Frequencies	.....	1,	23,	238,	594,	164,	8

The width as shown, varied from 20 μ —40 μ , with the mode at 32 μ .

MEASUREMENTS FOR LENGTH OF POLLEN GRAIN.

Magnitudes	.....	28 μ ,	32 μ ,	36 μ ,	40 μ ,	44 μ ,	48 μ ,	52 μ ,	56 μ ,	60 μ ,	64 μ ,	68 μ
Frequencies	.....	1,	1,	2,	1,	2,	14,	161,	548,	283,	14,	1

The length varied from 28 μ to 68 μ , with the mode at 56 μ .

CONSTANTS FOR MEASUREMENTS OF WIDTH OF POLLEN GRAIN.

n=1024.	Ea=.2448.
A=31.7068.	E δ =.1731.
δ =11.6156.	Ec=.6119.
C=36.634%.	

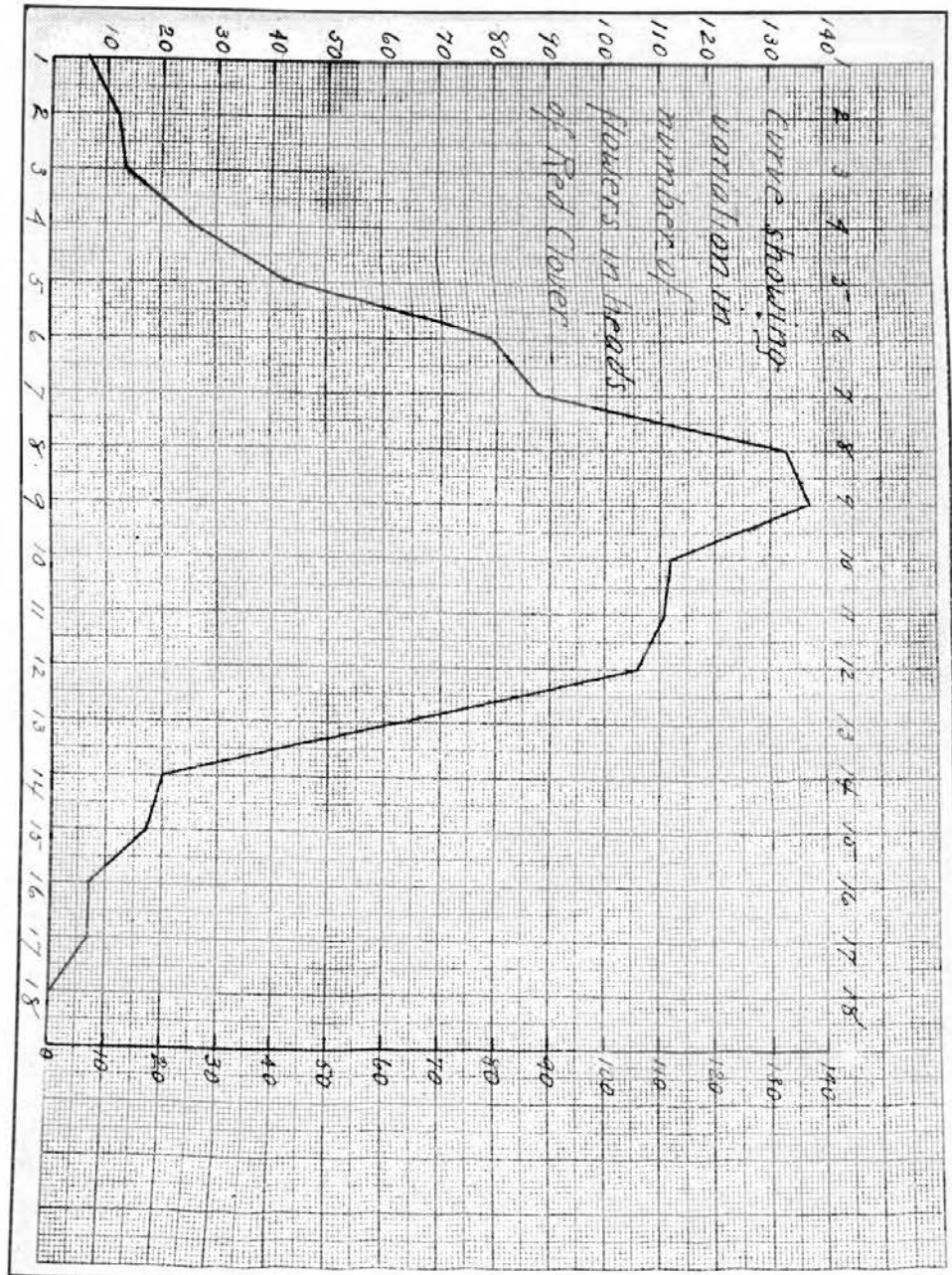
CONSTANTS FOR MEASUREMENTS OF LENGTH OF POLLEN GRAIN.

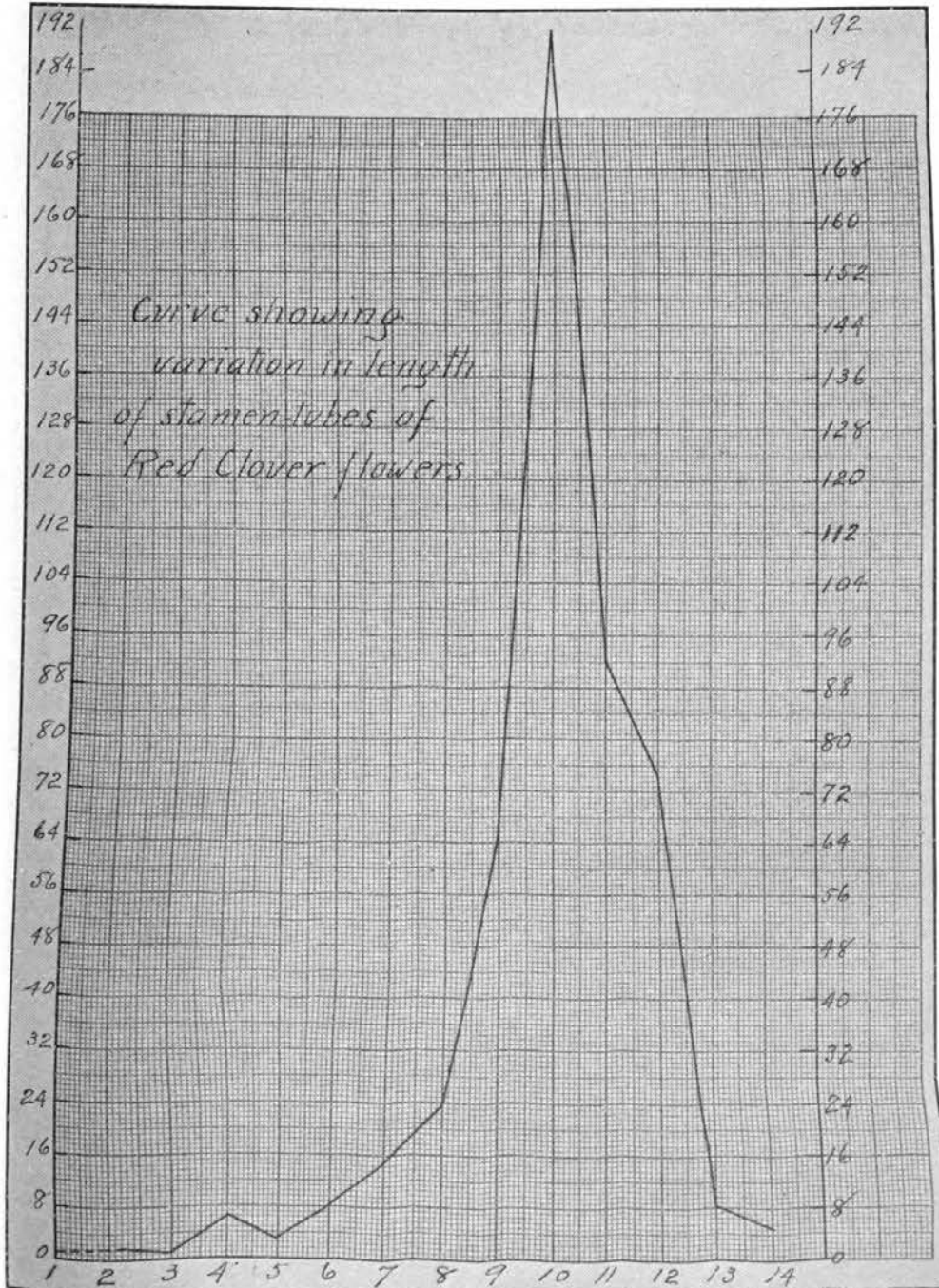
n=1024.	Ea=.27052.
A=56.1328.	E δ =.198.
δ =13.32.	Ec=.3727.
C=23.729.	

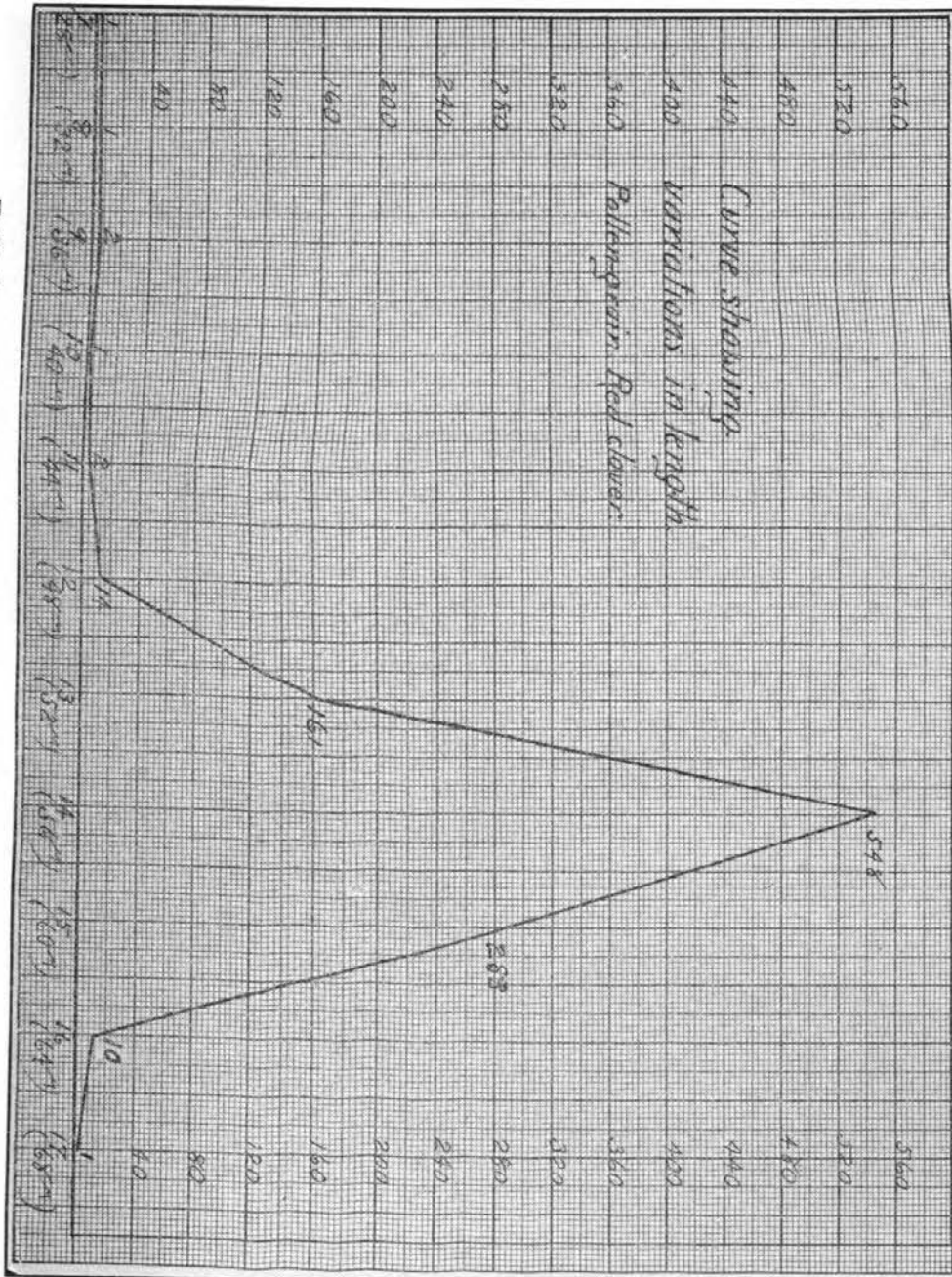
The average size was found to be 31.7 μ by 56.29 μ .

Both curves exhibit the more abrupt side in the direction of greater dimensions; the tendency therefore, so far as indicated by this study, is toward greater width and length of pollen grains.

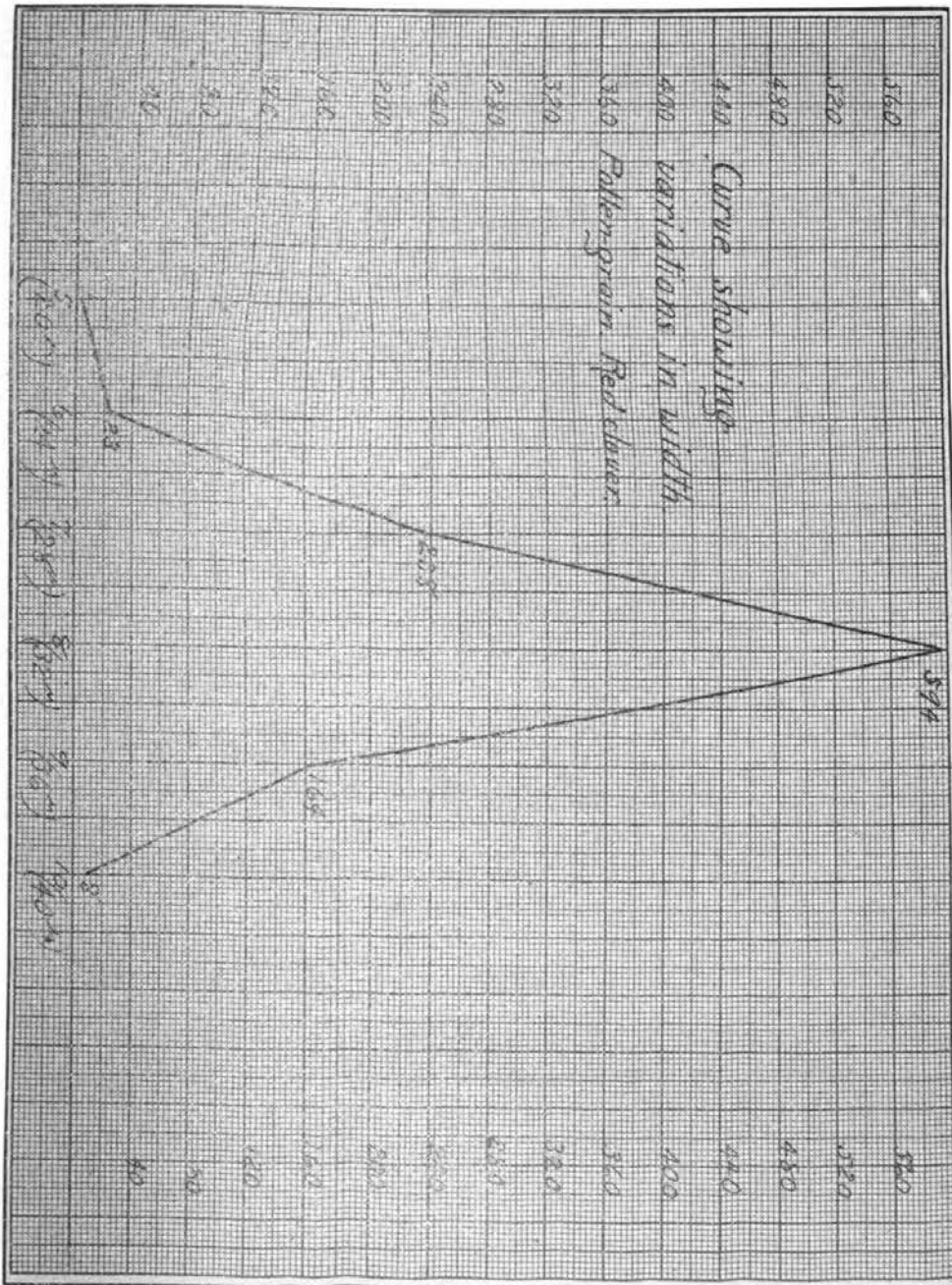








Each class of series = 4μ. 28μ—68μ. Av. 56.1328. Av. 14.09 units 56.36μ.



Each class of series = 4μ . 20μ — 10μ . Av. 31.7μ . Average 7.89 units =