

RAINFALL AND RUNOFF DATA FOR HINKSON AND
GRINDSTONE CREEKS AT COLUMBIA, MO.

by

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A T H E S I S

for the

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DIGITIZATION NOTE:

Large-format plates, tables, charts or images are not included in this pdf, but are available in separate pdfs under the same item in MOspace.

F O R E W O R D

The investigation presented in these notes has resulted more satisfactorily than was anticipated when the work was first undertaken.

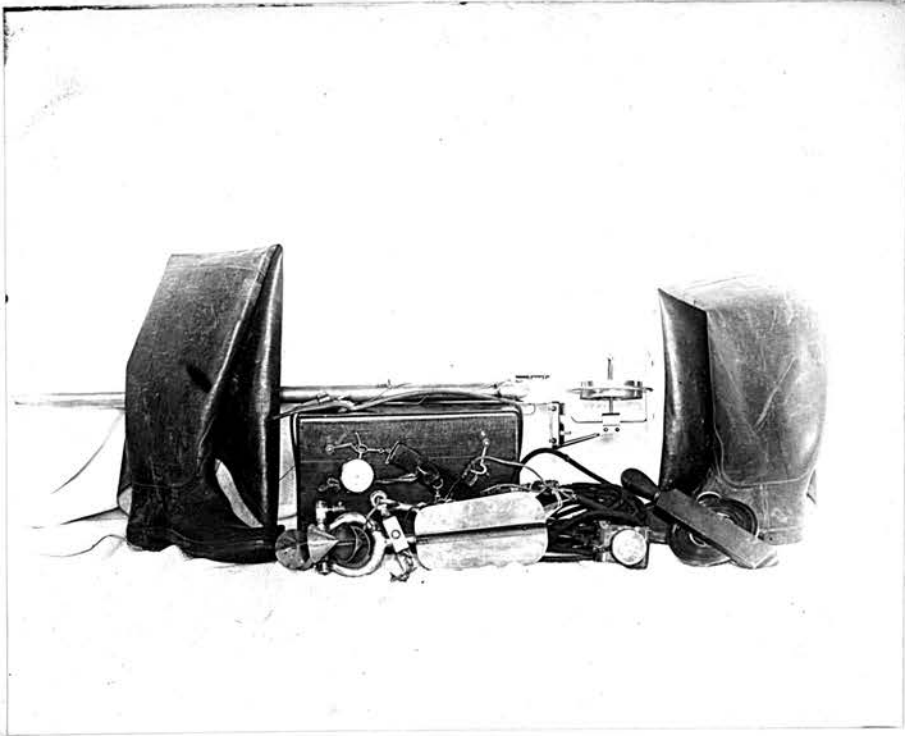
We feel perfectly satisfied with the results herewith submitted as far as they go, but regret that the period of investigation was not of sufficient duration to give more nearly average results, particularly in regard to the conditions during the summer months.

In the preparation of this paper, we are especially indebted to Professor T. J. Rodhouse, in charge of the Hydraulic Engineering, University of Missouri, under whose supervision the work was carried out and whose counsel has guided us throughout the work. Our appreciation and thanks are justly due Mr. George Reeder, Director Missouri Section, U.S. Weather Bureau, who furnished the rainfall data, with other valuable information; to the members of the Engineering faculty in general, for their suggestions and assistance; and to the members of the senior Engineering class who have assisted in some of the field work.

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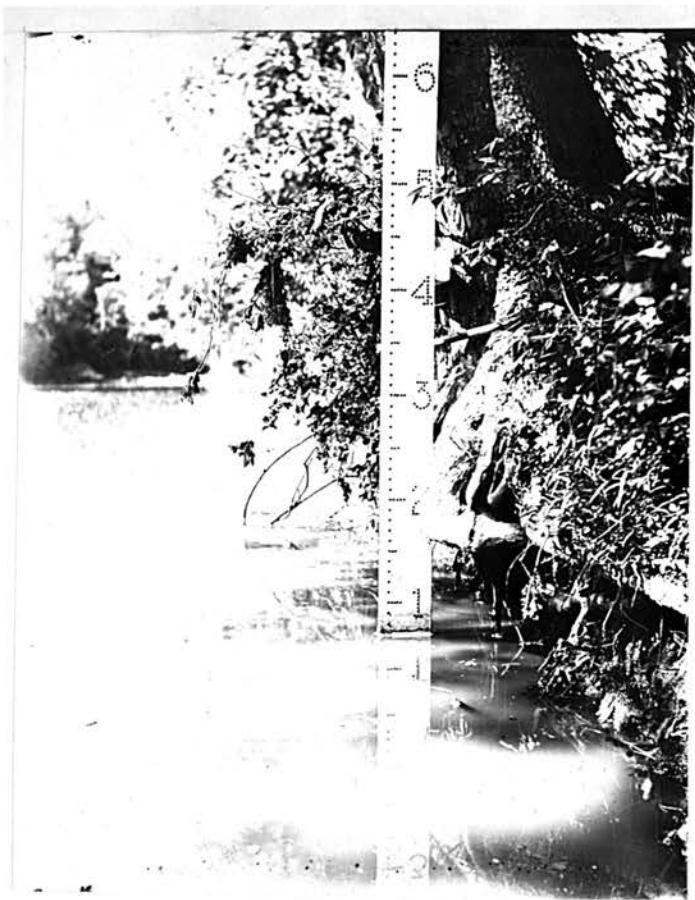
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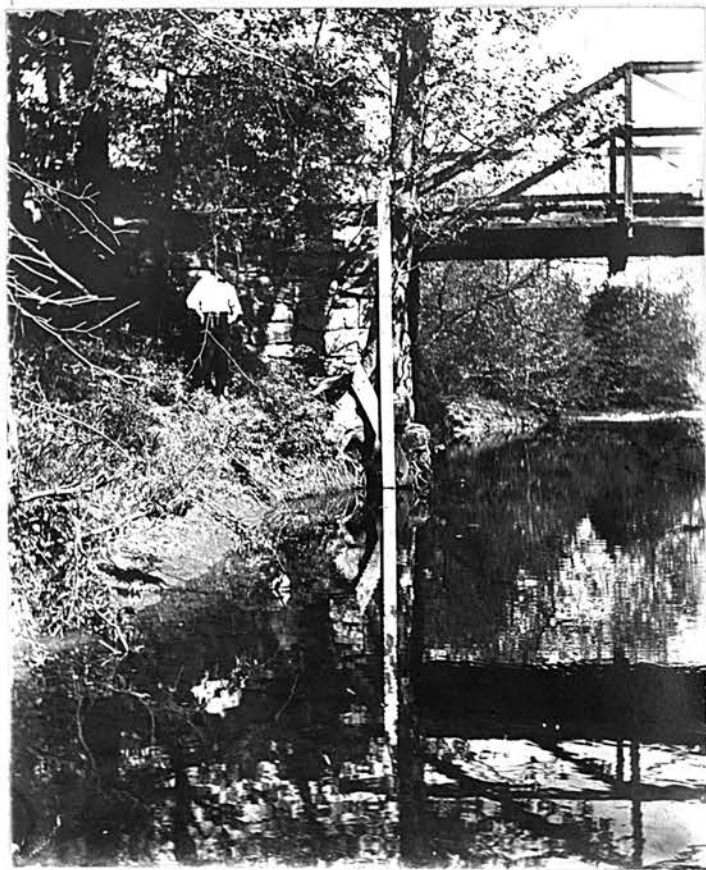
The Apparatus



The Weir
Showing results of failure of dam.



Hinkson Creek Gage
(In Detail)



Grindstone Creek Gage
(General)



Wading Section with Fteley Meter



Wading Section with Price Meter



Method of taking High Water
Observations

OBJECT OF THE INVESTIGATION

During the past few years there has existed a growing tendency among the members of the senior classes in the School of Engineering of the University of Missouri toward the design and estimates on water supply and water power projects on the creeks and minor streams in the vicinity of Columbia. This tendency has had little encouragement because of the fact that accurate data concerning the relation of run off to rainfall for this locality has not been heretofore accurately determined. The U. S. Geological Survey has compiled accurate and abundant data for some regions of the country where the need of such data is more necessary to developmental interests than it is in Missouri, as a result there is a marked scarcity of these data recorded for that state. From the aforesaid data, however, it is true that certain general rules can be laid down in order to roughly determine the amount of run off from the rain-fall. These rules do not give the desired information for accurate and reliable design of hydraulic works as satisfactorily as a special determination of the conditions in the locality in which the projected work is to be done. In order to compile these needed data and furnish accurate information in

regard to rainfall and run off conditions at this place, this investigation was begun.

The purpose of this report is to place such data as are available for use at the time of publication of these notes within reach of those who may be interested in hydraulic problems in the vicinity of Columbia. In using the final conclusions drawn regarding the rainfall and run-off conditions, due allowance must be made for the fact that the run off observations have extended over a comparatively short period, hence the conclusions and relations probably represent only an approximate average for this place and will need to be revised as further information is obtained in the future.

CLIMATOLOGY OF COLUMBIA, MO.

The following notes are quoted from the report of Mr. Geo. Reeder, Director of Missouri Section of U. S. Weather Bureau:-

"Columbia, the county seat of Boone County, is situated near the geographical center of the county, in latitude 38°56', longitude 92° 19', and is 761 feet above mean sea level. The city is reached by the M.K. & T. and Wabash railroads. It is 114 miles west

of St.Louis, 128 miles east of Kansas City, and 9 miles north of the Missouri River. The surrounding country is rolling, well watered and fairly well timbered, and is rich in the important agricultural products.

Columbia is unprotected by mountain ranges and lies far from any large body of water. Its climate, therefore, is one of extremes in heat and cold, moisture and drought. A station of the U.S.Weather Bureau was established at Columbia in August, 1899, and continuous records of temperature, precipitation, wind, cloudiness, etc., have been maintained since that date. These records show that the average annual temperature, covering a period of sixteen years, is 54.4°. The warmest months are July and August, with an average temperature of 76.6° and 75.8°, respectively, and the coldest months are January and February, with an average temperature of 30.2° and 29.5°, respectively. The highest temperature recorded is 111°, on July 12, 1901, and the lowest, 26° below zero, on February 12, 1899, making an absolute range of 137°. The average daily range of temperature (difference between the highest and lowest temperatures of each day) is 23°, and the greatest daily range recorded is 54°, occurring on November 21, 1898, when the temperature fell from 66°

in the morning to 12° at midnight. The average number of days during the year with maximum temperature above 90° is 44, and the average number with minimum temperature below 32° (freezing) is 111. The longest period with temperature continuously below freezing was 21 days, from January 28 to February 18, inclusive, 1905."

LOCATION OF THE STREAMS OBSERVED.

Hinkson Creek, the larger and longer of the streams observed, rises about 12 miles north and 8 miles east of Columbia and flows in a generally southwesterly direction following a somewhat winding channel about 18 miles in length. It flows around the eastern and southern sides of Columbia and at a distance from the town of about one mile.

Grindstone Creek is much smaller and shorter than the Hinkson. It rises about five miles due east of Columbia and follows a rather regular course of about 5 miles to the southwest emptying into the Hinkson just south of Columbia.

DESCRIPTION AND GEOLOGY OF WATERSHEDS.

The watersheds cover an area which is underlaid with the crystalline limestone as a base. Overlying

the crystalline limestone are fire clays, lime stone, coal and shale varying in depth and number over the drainage area. The surface is uniformly covered with an impervious glacial clay. The number of springs in these watersheds is very small, showing the percolation in this vicinity is probably small.

The watersheds of these streams are fairly well wooded, the woods being confined to small separated areas. The soil is generally unbroken, the land being used largely for grazing though possibly a third of the Hinkson area is tilled land.

The course of Hinkson Creek lies in rolling country, the banks in general being very steep and rugged on one side while gradually receding on the other. It is to be noted, however, that the high bank does not always exist on the same side of the stream but appears alternately on the east and west sides as if the stream wound back and forth across the valley.

The area of the Hinkson water-shed is approximately 51.28 sq.mi.

Grindstone Creek flows through country of much the same character as does the Hinkson although the slopes are generally slightly steeper than those of the latter. The banks of the Grindstone are fairly regular and

slightly wooded.

The area of the Grindstone watershed is approximately 14.67 sq.mi.

PERIOD OF INVESTIGATION.

The period of investigation for this work extended from October 10, 1908, to May 1, 1909.

METHOD OF INVESTIGATION.

As a preparatory step to this investigation, gages for reading stream heights were designed, made and set on the Hinkson and Grindstone Creeks. These gages were read regularly during the period of observation.

At various stages of the streams discharge measurements were made by means of a weir and current meters. From the computed discharge at various gage heights a discharge curve was plotted, thus giving the discharge for different gage heights. For gage heights higher than could be taken from the discharge curves, the mean velocity curve at the standard section was plotted, also the area for various gage heights. By taking the products of the probable mean velocity for a gage height

and the corresponding sectional area, the discharge is found for the desired gage height.

Rainfall data were obtained from the Columbia Station and tabulated for all years since 1897.

The relation of runoff to rainfall was obtained from the computed runoff as found from the discharge curve for the period and the rainfall over the respective drainage areas for the corresponding period.

(a) GAGES

The gages used in this work were of the ordinary vertical type and were not self reading. Each consisted of a well seasoned 2" x 6" cypress timber, 14 feet long graduated to feet and tenths of a foot by the use of brass-headed tacks and heavily coated with white paint.

The gages were prepared in the following manner. Two clear cypress boards were chosen and planed to a straight, smooth surface. These were then given four coats of good quality white paint. After the paint dried perfectly hard the boards were graduated to feet and tenths of a foot and marked in the following manner: At each foot-mark five brass headed tacks were placed tangent to each other in a horizontal line; at each half foot mark, three tacks were placed similarly; at each tenth of a foot not already marked one tack was

placed. The number of feet from the zero was marked at each foot by the proper numeral formed by driving the tacks tangent. The outside of the graduation marks is one inch from the edge of the board. After the boards were finished they were taken to the creeks and erected.

The gage on the Hinkson is located about 150 feet above the Ashland Gravel Road bridge. It is securely attached to a large sycamore tree by means of spikes and a wooden cross brace. This location gives easy access for the reader and also protected the gage in high water and floods.

To check the elevation of the gage on Hinkson creek, a bench mark consisting of a nail in the root of the sycamore tree that supports the gage, is 4.77 feet above the zero of the gage. The top of the lower chord of the bridge on the upstream side is 16.16 feet above the zero of the gage.

The gage on Grindstone Creek is attached by means of spikes and cross bracing to a sycamore tree just below the Ashland Gravel Road bridge over the creek. This location is also easily accessible for the reader and is well protected. The zero of the gage is 3.50' below a bench mark on the North pier of the bridge.

The top of the lower chord of the bridge on the upstream side is 13.25 feet above the zero of this gage.

Both gages were set up on October 10, 1908, by the writers and Professor T. J. Rodhouse.

After the date of setting, the gages were read every day for several months, after which readings were taken only on alternate days when the creek was stationary but taken every day when any appreciable variation was likely to occur.

In reading these gages, readings were taken to the hundredth of a foot by estimating between the tenths. The readings were taken by the writers except in a few instances when readings by thoroughly competent persons were accepted.

For recorded gage heights see tables XVIII and XIX, for curve of gage variation see plates 25-38 inclusive.

(b) THE WEIR.

For the measurement of small quantities of water flowing in Grindstone Creek a large part of the year, it was deemed advisable to construct a weir on this creek. The site chosen for the weir was about two hundred feet below the gage previously located.

The weir was a six foot sharp-crested Bazin type

without end contractions. The side walls and weir were of concrete with a 3-1/2" x 3-1/2" x 3/8" angle iron for the crest. The angle was placed with the vertical leg upstream and then solidly bolted to the masonry weir. The cutting edge was machined down to 1/16" thickness.

Above the concrete weir and approach, a low diversion dam of large stones was thrown up to direct the water to the weir channel. This failed to operate satisfactorily, however, as high water damaged the diversion wall and caused leakage at the upper entrance to the weir approach. This leak caused a loss of too much water to give sufficiently accurate results to be of any service in this investigation, consequently no use has been made of the weir up to the present.

(c) STREAM MEASUREMENT.

All stream measurement was done with current meters at sections close to the gages. Standard methods were employed in locating the meter in the sections as is shown in the computations of the various sections.

Observations made during low water were taken by wading across the section holding the meter at the required depth at the point of observation. Low water

observations were uniformly made with the meter at six-tenths depth to read directly the mean velocity in the vertical line at the point.

High water observations made when wading was impossible, were taken from the bridges over the creeks. The sections at these points were obtained during low water in such a way that the distance from the lower chords of the bridges to the bottom of the creeks were known at various points across the bridges. In this way the depth of water at a point could be obtained by subtracting the distance from the chord to the water level from the known distance. It could be obtained graphically by consulting profiles of the sections for a given gage height. (See tables XVI and plates 21 & 22.)

The meters used were of two kinds--Fteley, No.4723 and Price Acoustic, No.516. These meters were rated on Brushwood Lake over a course 200 feet in length. Rating curves were plotted from data in tables XIV and XV, as shown in plates 19 and 20.

In computing the discharge of the sections, two methods were considered, namely, Single Section Method and Double Section Method. The former method was because:-

(1) The mean velocity obtained in this method is probably more nearly the average than in the other method because of the wide variations in velocities in short distances across the stream.

(2) The widths of the streams and the nature of the banks made suitable observations for the double section method practically impossible.

(3) Owing to the impossibility of taking proper observations, the computation of results by the second method was extremely laborious and the time could more profitably be employed on other parts of the work.

RAINFALL DATA.

The rainfall data compiled for this work were furnished by the U. S. Weather Bureau Station at Columbia. These data were all taken for Columbia, the rain-gage being located at the Weather Bureau Station at that place. The gage was thus located on the extreme western edge of the drainage areas.

The following is quoted, with modifications, from a report of Mr. George Reeder, Director of Missouri Section of U. S. Weather Bureau:-

The average annual precipitation for Columbia, covering a period of nineteen years, is 38.21 inches,

distributed as follows: Spring, 11.59 inches; summer, 12.45 inches; autumn, 8.07 inches, and winter, 6.10 inches. May and June are the wettest months, each with an average of 4.84 inches, and December is the driest, with an average of 1.75 inches. The greatest annual precipitation recorded is 54.62 inches, in 1892, and the least, 21.35 inches, in 1901. The longest period recorded without a measurable amount of precipitation is 36 days, from November 18 to December 23, 1890.

The average seasonal snowfall is 19 inches, and the heaviest fall during any one storm was 13.9 inches, on February 27-28th, 1900.

Tables I to XVIII contain the following records:-

- (a) Daily Rainfall since 1897.
- (b) Monthly Rainfall since 1889.
- (c) Annual Rainfall since 1889.

Plates 2 to 18 inclusive, give the hydrographs of the above named tables.

RUNOFF DATA.

The runoff data have been collected since October 10, 1908. It consists of daily gage readings, the stream measurement data and computations, the daily and monthly runoff computed from the discharge curves, and the total discharge for the period observed.

The discharge curve was plotted for the gage heights. This discharge was then referred to the standard sections at the bridges, where areas of cross-section were taken for corresponding gage heights; from the discharge and cross-sectional area the mean velocity curves are plotted for the same section. The sectional area curve can be plotted to any desired gage height accurately, while the velocity curve can be drawn to a more nearly correct value than the discharge curve for the same gage height, thus giving more accurate results for the higher gage readings.

Tables XV, XVI, XVII, XVIIa contain the data observed in tabular form.

Plates 23-38 inclusive, contain the curves graphically representing the above data.

COMPUTATIONS.

A. Hinkson Creek.

Area of Watershed = 51.28 sq.mi. = 1,429,604,352 sq.ft.

October 1908.

Precipitation = .90 in. = .0750 ft.

Cu.ft.Rainfall = .0750 x 1,429,604,352 = 107,220,326 cu.ft.

Cu.ft.Runoff = 86400 x 63.5 = 5,486,400 cu.ft.

Percentage = 5486400/107220326 = 5.12 %

November 1908.

Precipitation = 3.80 in. = .3167 ft.

Cu.ft.Rainfall = .3167 x 1,429,604,352 = 452,755,798 cu.ft.

Cu.ft.Runoff = 86400 x 475 = 41,040,000.

Percentage = 41040000/452755798 = 9.08 %

December 1908.

Rainfall = 1.23 in. = .1026 ft.

Cu.ft.Rainfall = .1026 x 1,429,604,352 = 146,677,407 cu.ft.

Cu.ft.Runoff = 86400 x 284.3 = 24,563,520.

Percentage = 24563520/146677407 = 16.75 %

January 1909.

Rainfall = 2.48 in. = .2067 ft.

Cu.ft.Rainfall = .2067 x 1,429,604,352 = 295,499,220 Cu.ft.

Cu.ft.Runoff = 86400 x 1261.5 = 108,993,600 Cu.ft.

Percentage = 108993600/295499220 = 36.90 %

February 1909.

Rainfall = 2.87 in. = .2390 ft.

Cu.ft.Rainfall = .2390 x 1429604352 = 341685440 cu.ft.

Cu.ft.Runoff = 86400 x 3515.0 = 303696000 cu.ft.

Percentage = 303696000/341685440 = 88.95 %

March 1909.

Rainfall = 1.67 in. = .1391 ft.

Cu.ft.Rainfall = .1391 x 1429604352 = 198857965 cu.ft.

Cu.ft.Runoff = 86400 x 667.0 = 57628800 cu.ft.

Percentage = 57628800/198857965 = 48.15 %

April 1909.

Rainfall = 3.55 in. = .2795 ft.

Cu.ft.Rainfall = .2795 x 1429604352 = 399574416 cu.ft.

Cu.ft.Runoff = 86400 x 1516.0 = 130982400 cu.ft.

Percentage = 130982400/399574416 = 32.75 %

Mean percentage Oct.to March inc. = 33.96 %

Runoff in cu.ft. per sec. per sq.mi. is as follows:

October 1908--	$\frac{1.86}{31} = .06$
November 1908--	$\frac{9.26}{30} = .31$
December 1908--	$\frac{5.55}{31} = .18$
January 1909--	$\frac{24.61}{31} = .79$
February 1909--	$\frac{68.55}{29} = 2.36$
March 1909--	$\frac{13.05}{31} = .42$
April 1909--	$\frac{29.54}{30} = .98$
Mean --	$\frac{21.78}{30} = 0.729$

Corrected
April 1, 1910 J. J. R.

B. Grindstone Creek.

Area of watershed = 14.67 sq.mi. = 408976128 sq.mi.

October 1908.

Rainfall = .90 in. = .0750 ft.

Cu.ft.Rainfall = .0750 x 408976128 = 30967672 cu.ft.

Discharge = 86400 x 27.9 = 2410560 cu.ft.

Percentage = $2410560/30967672 = 7.78\%$

November 1908.

Rainfall = 3.80 in. = .3167ft.

Cu.ft.Rainfall = .3167 x 408976128 = 129522740 cu.ft.

Cu.ft.Runoff = 86400 x 156.6 = 13530240 cu.ft.

Percentage = $13530240/129522740 = 10.45\%$

December 1908.

Rainfall = 1.23 in. = .1026 ft.

Cu.ft.Rainfall = .1026 x 408976128 = 41960950 cu.ft.

Cu.ft.Runoff = 86400 x 55.9 = 4829760 cu.ft.

Percentage = $4829760/41960950 = 11.51\%$

January 1909.

Rainfall = 2.48 in. = .2067 ft.

Cu.ft.Rainfall = 408976128 x .2067 = 84535167 cu.ft.

Cu.ft.Runoff = 86400 x 412.6 = 35648640 cu.ft.

Percentage = $35648640/84535167 = 42.20\%$

February 1909.

$$\text{Rainfall} = 2.87 \text{ in.} = .2390 \text{ ft.}$$

$$\text{Cu.ft. Rainfall} = .2390 \times 408976128 = 97745295 \text{ cu.ft.}$$

$$\text{Cu.ft. Runoff} = 86400 \times 594.2 = 513388800 \text{ cu.ft.}$$

$$\text{Percentage} = 513388800 / 97745295 = 52.7 \%$$

March 1909.

$$\text{Rainfall} = 1.67 \text{ in.} = .1391 \text{ ft.}$$

$$\text{Cu.ft. Rainfall} = .1391 \times 408976128 = 56888580 \text{ cu.ft.}$$

$$\text{Cu.ft. Runoff} = 86400 \times 87.8 = 7585920 \text{ cu.ft.}$$

$$\text{Percentage} = 7585920 / 56888580 = 13.35 \%$$

April 1909.

$$\text{Rainfall} = 3.35 \text{ in.} = .2795 \text{ ft.}$$

$$\text{Cu.ft. Rainfall} = .2795 \times 408976128 = 114308828 \text{ cu.ft.}$$

$$\text{Cu.ft. Runoff} = 86400 \times 194.4 = 167961600 \text{ cu.ft.}$$

$$\text{Percentage} = 167961600 / 114308828 = 14.56 \%$$

Mean percentage Oct. to March inc. = 21.80 %

Runoff in cu.ft. per sec. per sq.mi. is as follows

$$\text{October 1908} -- \frac{2.85}{31} = 0.09$$

$$\text{November 1908} -- \frac{10.68}{30} = 0.36$$

$$\text{December 1908} -- \frac{3.81}{31} = 0.12$$

$$\text{January 1909} -- \frac{28.14}{31} = 0.91$$

$$\text{February 1909} -- \frac{40.50}{29} = 1.40$$

$$\text{March 1909} -- \frac{5.98}{31} = 0.19$$

$$\text{April 1909} -- \frac{13.27}{30} = 0.44$$

$$\text{Mean} -- \frac{15.03}{30} = 0.501$$

*Corrected
Apr. 1, 1910 - J.J.R.*

CONCLUSIONS.

The writers present the following conclusions based on the data and computations with general observations:-

1. The average percentage of runoff, as observed for a period of seven months, for the Hinkson watershed, is 33.96 ; the maximum is 88.95 in February 1909; the minimum is 5.12 for October 1908.

The average percentage of runoff for the Grindstone is 21.80 ; the maximum is 52.70 for February 1909; the minimum is 7.78 for October 1908.

2. From the study of the percentages it appears that for small amount of rainfall, the runoff from partly tilled land is less than from uncultivated land; while for larger rainfall the reverse is the case.

3. As is generally admitted, the percentage of runoff is much larger in months when the ground is frozen.

4. The writers believe that the rain-gage at Columbia will indicate the average rainfall for the whole drainage area if observations are made for a long period of time. However, they believe that rain-gages placed near the head waters of these streams would be of much service in getting the correct average

over the water-shed if used in conjunction with the
rain gage at Columbia.

B I B L I O G R A P H Y

Lea's Hydrographic Surveying.

Hoyt & Grover, "River Discharge".

D.W.Mead's "Notes on Hydrology".

STATION LOCATED 300 FT. BELOW ASHLAND GRAVEL BRIDGE

METER USED FTELEY #4723

GAUGE READING 1.60

STAGE RISING

PARTY

 RODHOUSE
 FAIRMAN
 BELL
 STAVA
 HUNTER

OBSERVATION NO. 1

DATE OBSERVED NOV. 30, 1908

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0												
2	0.9	0.54	47-44-57-33	181	.91	1.01	.505	2	.450	.900	.455		
3	0.9	0.54	45 43	88	.88	0.97	.990	1	.900	.900	.891		
4	1.0	0.60	63 68	131	1.31	1.41	1.190	1	.950	.950	1.130		
5	0.77	0.46	86 84	170	1.70	1.80	1.605	1	.885	.885	1.420		
6	1.04	0.60	66 66	132	1.32	1.42	1.610	1	.905	.905	1.457		
7	0.98	0.60	76 74	150	1.50	1.60	1.510	1	1.010	1.010	1.525		
8	0.70	0.42	67-50-53	170	1.10	1.19	1.395	1	.840	.840	1.172		
9	0.65	0.40	58 55	113	1.10	1.19	1.190	1	.675	.675	.803		
10	0.60	0.36	47 46	93	.93	1.04	1.115	1	.625	.625	.697		
14	0						.520	4	.300	1.200	.624		
													Total Area = 8.89
													Mean Velocity = 1.14
													Area at Bridge = 41.2
													Mean Velocity = 0.25

 UNIVERSITY OF MISSOURI,
 HYDRAULIC ENGINEERING.

TOTAL 10.174 CU. FT. SEC.

STATION LOCATED 750 FT. BELOW BELOW ASHLAND GRAVEL BRIDGE

METER USED FTELEY #4723

GAUGE READING 0.69

STAGE SLOWLY RISING

PARTY { HUNTER
PHILLIPS

OBSERVATION NO. 2

DATE OBSERVED MARCH 6 1909

OBSERVATIONS					VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA		
0	0.0												
2	0.62	0.36	10.5-10.25-9.75		29.6	.7	0.32	.160	2	.310	.620	.099	
4	0.80	0.48	11.1	11.4	22.5	.23	0.35	.335	2	.710	1.420	.476	
6	0.91	0.54	14.8	15.5	30.3	.30	0.42	.385	2	.855	1.710	.658	
8	1.00	0.60	18.2	19.0	37.2	.37	0.49	.455	2	.955	1.910	.870	
10	1.15	0.69	18-19-19.3		56.3	.38	0.50	.495	2	1.075	2.150	1.065	
12	1.12	0.66	19.7	21.5	41.2	.41	0.52	.510	2	1.135	2.270	1.158	
14	0.89	0.53	23.8	24.9	48.7	.49	0.60	.560	2	1.005	2.010	1.127	
16	0.97	0.60	30.3	30.7	61.0	.61	0.72	.660	2	.930	1.860	1.228	
18	0.72	0.42	29.0	28.2	57.2	.57	0.69	.705	2	.845	1.690	1.191	
20	0.62	0.36	25.6	26.7	52.3	.52	0.65	.670	2	.670	1.340	.898	
21.5	0.0							.325	1.5	.310	0.465	.151	
													Total Area = 17.45
													Mean Velocity = 0.51
													Area at Bridge 76.0
													Mean Vel = 0.12

STATION LOCATED 400 FT. BELOW BRIDGE ON ASHLAND GRAVEL

METER USED FTELEY #4723

GAUGE READING 1.96

STAGE RISING

PARTY {
RODHOUSE
HUNTER
PHILLIPS

OBSERVATION NO. 4

DATE OBSERVED MARCH 9, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA		
0	0											
2	1.0	0.6	85-79-75	239	1.60	1.69	.845	2	.500	1.000	.845	
3	1.2	0.72	83 94	177	1.77	1.86	1.775	1	1.100	1.100	1.950	
4	1.5	0.90	51-27-38	116	1.16	1.26	1.560	1	1.350	1.350	2.105	Rock 8" high above meter
5	1.5	0.90	122 115	237	2.37	2.46	1.860	1	1.500	1.500	2.793	
6	1.5	0.90	100 107	207	2.07	2.16	2.310	1	1.500	1.500	3.470	
8	1.6	0.96	87 80	167	1.67	1.76	1.960	2	1.550	3.100	6.080	
10	1.4	0.84	73 79	152	1.52	1.62	1.690	2	1.500	3.000	5.070	
12	1.0	0.60	65 72	137	1.37	1.46	1.540	2	1.200	2.400	3.695	
14	0.5	0.30	29 36	65	.65	0.76	1.110	2	.750	1.500	1.665	
16	0.0						.380	2	.250	.500	.190	
												Total Area = 16.95
												Mean Velocity = 1.65
												Area at Bridge = 49.6
												Mean Velocity = 0.56

UNIVERSITY OF MISSOURI,
HYDRAULIC ENGINEERING.

TOTAL 27,863 CU. FT. SEC.

STATION LOCATED 7.50 FT. BELOW BRIDGE ON ASHLAND GRAVEL

METER USED FTELEY #4723

GAUGE READING 0.67

STAGE STATIONARY

PARTY

HUNTER

PHILLIPS

OBSERVATION NO. 5

DATE OBSERVED MARCH 20, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0.0												
2	0.7	0.42	13	12	25	.25	0.37	.185	2	.350	.700	.129	
4	0.88	0.52	16	15	31	.31	0.45	.410	2	.790	1.580	.648	
6	1.00	0.60	17	18	35	.35	0.48	.465	2	.940	1.880	.875	
8	1.20	0.70	22	21	43	.43	0.55	.515	2	1.100	2.200	1.134	
10	1.10	0.66	23	21	44	.44	0.56	.555	2	1.150	2.300	1.276	
12	1.00	0.60	29	28	57	.57	0.68	.620	2	1.050	2.100	1.302	
14	0.90	0.54	25	25	50	.50	0.61	.645	2	.950	1.900	1.225	
16	1.00	0.60	27	28	55	.55	0.67	.640	2	.950	1.900	1.217	
18	0.70	0.42	28	27	55	.55	0.67	.670	2	.850	1.700	1.139	
20	0.55	0.33	23	21	44	.44	0.55	.610	2	.625	1.250	.823	
21	0.0							.275	1	.275	0.550	.151	
													Total Area = 18.16
													Mean Velocity = 0.51
													Area at Bridge = 77.0
													Mean Vel. = 0.12

STATION LOCATED 200 FT. BELOW ASHLAND GRAVEL BRIDGE

METER USED PRICE \$516

GAUGE READING 1.30

STAGE STATIONARY

PARTY { HUNTER
PHILLIPS

OBSERVATION NO. 7A-7B

DATE OBSERVED APRIL 5, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0	0											Area at Bridge=34.2
1	0.45	0.27	4	4	8	.08	0.20	.100	1	.225	.225	.023	Mean Velocity = 0.06
2	0.55	0.33	10	9	19	.19	0.43	.315	1	.500	.500	.158	
3	0.70	0.42	8	8	16	.16	0.39	.410	1	.625	.625	.256	
4	0.65	0.39	15	14	29	.29	0.70	.545	1	.675	.675	.368	Total Area = 3.45
5	0.65	0.39	19	19	38	.38	0.91	.805	1	.650	.650	.524	Mean Velocity = 0.51
6	0.45	0.27	15	14	29	.29	0.70	.805	1	.550	.550	.443	
7	0							.350	1	.225	.225	.079	
										Total 3.45		1.851	
0	0												
1	0.45	0.27	6	6	12	.12	0.30	.150	1	.225	.225	.034	Area at Bridge=34.2
2	0.55	0.33	9	8.5	17.5	.18	0.42	.360	1	.500	.500	.180	Mean Velocity = 0.055
3	0.70	0.42	6.5	7.5	14.	.14	0.36	.390	1	.625	.625	.244	
4	0.65	0.39	17	16.5	33.5	.34	0.83	.895	1	.675	.675	.401	
5	0.65	0.39	21	21	42.	.42	1.01	.920	1	.650	.650	.599	Total Area = 3.45
6	0.45	0.27	13	13	26	.26	0.62	.815	1	.550	.550	.448	Mean Velocity = 0.545
7	0							.310	1	.225	.225	.070	
										Total		1.976	

STATION LOCATED 150 FT. BELOW ASHLAND GRAVEL BRIDGE

METER USED PRICE #516

GAUGE READING 0.70

STAGE STATIONARY

PARTY { PHILLIPS
HUNTER

OBSERVATION NO. 8

DATE OBSERVED APRIL 5, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0												
2	0.75	0.45	6.25	6	12.25	.12	0.30	.150	2	.375	.750	.112	
4	0.90	0.54	7	7.75	14.75	.15	0.35	.325	2	.825	1.650	.537	
6	1.08	0.65	9	9	18	.18	0.42	.385	2	.990	1.980	.762	
8	1.27	0.76	9	9	18	.18	0.42	.420	2	1.175	2.350	.988	
10	1.25	0.65	10	9.5	19.5	.20	0.49	.455	2	1.260	2.520	1.148	
12	1.00	0.60	11.5	11.5	23.0	.23	0.58	.535	2	1.125	2.250	1.205	
14	1.10	0.66	11.25-10-10		31.25	.21	0.51	.545	2	1.050	2.100	1.145	
16	1.00	0.60	13	12.5	25.5	.26	0.62	.565	2	1.050	2.100	1.188	
18	0.85	0.43	14	14	28	.28	0.69	.655	2	.925	1.850	1.212	
20	0.62	0.31	15	14.5	29.5	.30	0.72	.705	2	.735	1.470	1.038	
21	0							.360	1	.310	0.310	.112	
													Total Area = 19.53
													Mean Velocity = 0.47
													Area at Bridge 19.0
													Mean Velocity 0.12

UNIVERSITY OF MISSOURI,
HYDRAULIC ENGINEERING.

TOTAL 9.447 CU. FT. SEC

STATION LOCATED 750 FT. BELOW ASHLAND GRAVEL BRIDGE

METER USED PRICE 516

GAUGE READING 1.09

STAGE RISING

PARTY { HUNTER
PHILLIPS

OBSERVATION NO. 9

DATE OBSERVED APRIL 12, 1909

OBSERVATIONS					VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0													
2	0.45	0.27	17	17	34	.34	0.82	.410	2	.225	.450	.185		
4	0.75	0.45	12	12	24	.24	0.59	.705	2	.600	1.200	.846		
6	0.87	0.52	11.5	11	22.5	.23	0.56	.575	2	.810	1.620	.932		
8	0.65	0.39	8.5	7	15.5	.16	0.37	.465	2	.760	1.520	.707		
10	1.18	0.71	18.5	17	35.5	.35	0.85	.610	2	.915	1.830	1.116		
12	1.25	0.65	25	25	50	.50	1.20	1.025	2	1.215	2.430	2.490		
14	1.40	0.84	25	25	50	.50	1.20	1.200	2	1.325	2.650	3.180		
16	1.50	0.90	33	31	64	.64	1.54	1.370	2	1.450	2.900	3.970		
18	1.70	1.02	36	35	71	.71	1.72	1.630	2	1.600	3.200	5.220		
20	1.65	0.99	32	31	63	.63	1.52	1.620	2	1.675	3.350	5.420		Area at Bridge 10.50
22	1.40	0.84	35	34	69	.69	1.65	1.585	2	1.525	3.050	4.840		Mean Velocity 0.46
24	1.60	0.96	36	36	72	.72	1.74	1.695	2	1.500	3.000	5.080		
26	1.50	0.90	38	37	75	.75	1.80	1.770	2	1.550	3.100	5.480		
28	1.20	0.72	37-35-36		108	.72	1.74	1.770	2	1.350	2.700	4.780		
30	0.80	0.48	34	34	68	.68	1.63	1.685	2	1.000	2.000	3.370		
31	0							.815	1	.400	.400	.326		
														Total Area: 33.40
														Mean Velocity: 1.45

UNIVERSITY OF MISSOURI,
HYDRAULIC ENGINEERING.

TOTAL 47.942 CU. FT. SEC.

STATION LOCATED 400 FT. BELOW ASHLAND GRAVEL BRIDGE

METER USED PRICE 516

GAUGE READING 1.93

STAGE RISING

PARTY { PHILLIPS
HUNTER

OBSERVATION NO. 10

DATE OBSERVED APRIL 12, 1909

OBSERVATIONS					VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA		
0	1.0	0.6	0	0									
2	1.15	0.69	22	23	45	.45	1.08	.540	2	1.075	2.150	1.162	
4	1.55	0.93	47	47	94	.94	2.25	1.665	2	1.350	2.700	4.500	
6	1.55	0.93	28-28-29		85	.56	1.34	1.795	2	1.550	3.100	5.570	
8	1.10	0.66	39	35	74	.74	1.79	1.565	2	1.325	2.650	4.145	
10	1.30	0.78	32	33	65	.65	1.55	1.670	2	1.200	2.400	4.010	
12	1.00	0.60	18	18	36	.36	0.86	1.205	2	1.150	2.300	2.775	
14	0.50	0.30	5.5	5.5	11	.11	0.29	.575	2	.750	1.500	.862	
16	0							.145	2	.250	.500	.073	
													Total Area = 17.30
													Mean Velocity = 1.33
													Area Bridge = 48.1
													Mean Velocity = 0.48

STATION LOCATED 750 FT. BELOW ASHLAND GRAVEL BRIDGE

METER USED PRICE *516

GAUGE READING 1.15

STAGE RISING

PARTY { PHILLIPS
HUNTER

OBSERVATION NO. 11

DATE OBSERVED APRIL 13, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 60 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0												
2	0.20	0.12	7-9-6	22	.15	0.35	.175	2	.100	.200	0.035		
4	0.50	0.30	16 15.5	31.5	.32	0.77	.560	2	.350	.700	0.392		
6	0.60	0.36	21 21	42	.42	1.00	.885	2	.550	1.100	0.974		
8	0.80	0.48	20 21	41	.41	0.99	.995	2	.700	1.400	1.395		
10	0.88	0.53	8.25 8.75	17.0	.17	0.40	.695	2	.840	1.680	1.168		
12	0.88	0.53	12 10	22	.22	0.51	.455	2	.880	1.760	0.800		
14	1.25	0.75	25 25	50	.50	1.20	.855	2	1.065	2.130	1.820		
16	1.31	0.79	29 29	58	.58	1.40	1.300	2	1.280	2.560	3.330		
18	1.45	0.87	35.5-33-35	103.5	.69	1.68	1.540	2	1.380	2.760	4.250		
20	1.52	0.91	36 36	72	.72	1.72	1.700	2	1.485	2.970	5.050		
22	1.65	0.99	32 33	65	.65	1.57	1.645	2	1.585	3.170	5.210	Area at Bridge = 109.5	
24	1.72	1.03	38 38	76	.76	1.82	1.695	2	1.685	3.370	5.710	Mean Velocity = 0.53	
26	1.67	1.00	36 36	72	.72	1.75	1.785	2	1.695	3.390	6.050		
28	1.62	0.97	39 40	79	.79	1.90	1.825	2	1.645	3.290	6.005		
30	1.45	0.87	39 38	77	.77	1.85	1.875	2	1.535	3.070	5.750		
32	1.25	0.75	41 40	81	.81	1.95	1.900	2	1.350	2.700	5.130		
33	0.95	0.57	39 39	78	.78	1.90	1.925	1	1.100	2.200	4.235	Total Area = 39.40	
33.4	0						.950	1.4	.475	0.950	0.904	Mean Velocity = 1.48	

STATION LOCATED 500 FT. BELOW ASHLAND GRAVEL BRIDGE

METER USED PRICE #516
 GAUGE READING 1.61
 STAGE FALLING

PARTY { PHILLIPS
 HUNTER

OBSERVATION NO. 12
 DATE OBSERVED APRIL 13, 1909

OBSERVATIONS					VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0													
1	0.95	0.57	7	7	14	.14	.35	.175	1	.475	.475	.083		
2	1.12	0.67	20	21	41	.41	.97	.660	1	1.035	1.035	.683		
3	1.20	0.72	21	20	41	.41	.97	.970	1	1.160	1.160	1.125		
4	1.13	0.68	16	18	34	.34	.80	.885	1	1.165	1.165	1.032		
5	1.00	0.60	28	28	56	.56	1.35	1.075	1	1.065	1.065	1.145		
6	0.95	0.57	28	26	54	.54	1.33	1.340	1	.975	.975	1.368		
7	1.00	0.60	34-36-37		107	.71	1.70	1.515	1	.975	.975	1.479		
8	0.80	0.48	39	39	78	.78	1.88	1.790	1	.900	.900	1.610		
9	0.60	0.36	16	17	33	.33	0.80	1.340	1	.700	.700	.938		
10	0.44	0.26	14	14	28	.28	0.67	.735	1	.520	.520	.383		
11	0.30	0.18	11	12	23	.23	0.55	.610	1	.370	.370	.226		
12	0							.275	1	.150	.150	.041		
														Total Area = 9.49
														Mean Velocity = 1.06
														Area of Bridge = 42.0
														Mean Velocity = 0.24

STATION LOCATED ON ASHLAND GRAVEL BRIDGE

METER USED PRICE \$516

GAUGE READING 1.78

STAGE FALLING

PARTY { HUNTER
PHILLIPS

OBSERVATION NO. 13

DATE OBSERVED APRIL 19, 1909

OBSERVATIONS					VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.) (Surface)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA		
0	0												
3	1.22	0	19	19	38	.38	0.91	0.36	3	0.61	1.83	0.66	
8	2.18		28	28	56	.56	1.36	0.91	5	1.70	8.50	7.74	
13	2.30		30	31	61	.61	1.46	1.13	5	2.24	11.20	12.65	
18	2.62		33	33	66	.66	1.59	1.26	5	2.46	12.30	15.50	
23	2.90	SURFACE READINGS	32	33	65	.65	1.55	1.26	5	2.76	13.80	17.38	
28	2.86		32	33	65	.65	1.55	1.24	5	2.88	14.40	17.85	
33	2.84		32	30	62	.62	1.50	1.22	5	2.85	14.25	17.39	
38	2.70		29	29	58	.58	1.40	1.16	5	2.77	13.85	16.05	
43	2.52		27	27	54	.54	1.32	1.09	5	2.61	13.05	14.23	
48	2.30		26	26	52	.52	1.26	1.03	5	2.41	12.05	12.41	
53	2.26		22	23	45	.45	1.09	.94	5	2.28	11.40	10.71	
58	2.00		18	18	36	.36	0.86	.82	5	2.13	10.65	8.73	
63	1.40		16	16	32	.32	0.80	.66	5	1.70	8.50	5.61	
68	0.80		13	13	26	.26	0.64	.58	5	1.10	5.50	3.19	
73	0.35		11	11	22	.22	0.54	.47	5	.58	2.90	1.36	
75.5	0							.22	2.5	.18	.45	.10	
												Total Area = 154.43	
												Mean Velocity = 1.04	

STATION LOCATED 400 FT BELOW ASHLAND GRAVEL ROAD BRIDGE

METER USED PRICE #516

GAUGE READING 1.42

STAGE RISING

PARTY { PHILLIPS
HUNTER

OBSERVATION NO. 14

DATE OBSERVED APRIL 19, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0												
2	0.8	0.48	9	9	18	.18	0.44	.22	2	0.40	0.80	0.17	
4	1.10	0.66	15	14	29	.29	0.70	.57	2	0.95	1.90	1.08	
6	1.10	0.66	12	12	24	.24	0.59	.65	2	1.10	2.20	1.43	
8	0.91	0.55	10	11	21	.21	0.51	.55	2	1.01	2.02	1.11	
10	0.55	0.33	8	8	16	.16	0.40	.45	2	.73	1.46	0.66	
11.5	0							.20	1.5	.27	0.41	0.82	
													Total Area = 8.79
													Mean Velocity = 0.60
													Area at Bridge = 36.9
													Mean Velocity = 0.14

UNIVERSITY OF MISSOURI,
HYDRAULIC ENGINEERING.

TOTAL 5.27 CU. FT. SEC.

STATION LOCATED ON ASHLAND GRAVEL BRIDGE

METER USED PRICE \$516

GAUGE READING 1.60

STAGE FALLING

PARTY { PHILLIPS
HUNTER

OBSERVATION NO. 15

DATE OBSERVED APRIL 20, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.) SURFACE	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0												
5	1.34		18	17	35	.35	0.85	0.34	5	0.67	3.35	1.14	
10	2.40		25	24	49	.49	1.18	0.81	5	1.87	9.35	7.57	
15	2.10		28	28	56	.56	1.36	1.02	5	2.25	11.25	11.48	
20	2.50	SURFACE READINGS	28	28	56	.56	1.36	1.09	5	2.30	11.50	12.52	
25	2.70		28	27	55	.55	1.35	1.09	5	2.60	13.00	14.17	
30	2.56		25	25	50	.50	1.20	1.02	5	2.61	13.05	13.30	
35	2.60		25	26	51	.51	1.23	0.97	5	2.58	12.90	12.52	
40	2.40		24	24	48	.48	1.16	0.95	5	2.50	12.50	11.88	
45	2.20		23	22	45	.45	1.09	0.90	5	2.30	11.50	10.35	
50	2.16		22	21	43	.43	1.05	0.86	5	2.18	10.90	9.38	
55	1.96		17	17	34	.34	0.84	0.76	5	2.06	10.30	7.83	
60	1.50		14	14	28	.28	0.68	0.61	5	1.73	8.65	5.28	
65	1.24		12	11	23	.23	0.57	0.50	5	1.37	6.85	3.43	
70	0.86	11	10	21	.21	0.52	0.44	5	1.05	5.25	2.31		
75	0.80	6	6	12	.12	0.32	0.34	5	0.83	4.15	1.41		
76	0						0.13	1	0.40	2.00	0.26		
													Total Area = 146.50
													Mean Velocity = 0.85

UNIVERSITY OF MISSOURI,
HYDRAULIC ENGINEERING.

TOTAL 124.83 CU. FT. SEC.

STATION LOCATED ON ASHLAND GRAVEL ROAD BRIDGE

METER USED PRICE \$516

GAUGE READING 3.25

STAGE FALLING

PARTY

PHILLIPS

HUNTER

OBSERVATION NO. 16

DATE OBSERVED APRIL 21, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 60 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.) SURFACE	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
7	0												
10	1.30		35	36	71	.71	1.71	0.68	3	.65	1.95	1.33	
15	2.85		58	56	114	1.14	2.74	1.78	5	2.08	10.40	18.61	
20	3.90		70	70	140	1.40	3.40	2.46	5	3.38	16.90	41.55	
25	3.60		78	74	152	1.52	3.66	2.82	5	3.75	18.75	52.80	
30	4.00	SURFACE READINGS	78	79	157	1.57	3.78	2.98	5	3.80	19.00	56.60	
35	4.10		77	81	158	1.58	3.80	3.03	5	4.05	20.25	61.40	
40	4.10		77	80	157	1.57	3.78	3.03	5	4.10	20.50	62.20	
45	4.10		82	83	165	1.65	3.95	3.09	5	4.10	20.50	63.40	
50	3.90		75	76	151	1.51	3.64	3.04	5	4.00	20.00	60.80	
55	3.60	73	71	144	1.44	3.45	2.84	5	3.75	18.75	53.20		
60	3.60	68	67	135	1.35	3.25	2.68	5	3.60	18.00	48.30		
65	3.40	58	58	116	1.16	2.76	2.44	5	3.50	17.50	42.70		
70	3.00	48	47	95	0.95	2.27	2.02	5	3.20	16.00	32.32		
75	2.50	44	44	88	0.88	2.08	1.74	5	2.75	13.75	23.90		
80	1.90	40	41	81	0.81	1.95	1.61	5	2.20	11.00	17.70		
85	1.10	33	32	65	0.65	1.15	1.24	5	1.50	7.50	9.31		
89.5	0						0.46	4.5	0.55	2.75	1.26	Total Area - 253.50	
												Mean Velocity - 2.54	

STATION LOCATED ON ASHLAND GRAVEL ROAD BRIDGE

METER USED PRICE #516

GAUGE READING 2.40

STAGE FALLING

PARTY { HUNTER
PHILLIPS

OBSERVATION NO. 17

DATE OBSERVED APRIL 21, 1909

OBSERVATIONS					VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA		
0.75	0												
3	3.50		28	27	55	.55	1.35	0.54	2.25	1.75	3.94	2.12	
6	3.60	SURFACE READINGS	34	36	70	.70	1.69	1.22	3	3.55	10.65	13.00	
9	3.48		34	35	69	.69	1.65	1.34	3	3.54	10.67	14.22	
12	2.75		34	34	68	.68	1.63	1.31	3	3.12	9.36	12.25	
15	2.21		29	30	59	.59	1.41	1.22	3	2.48	7.44	9.07	
18	1.70		27	26	53	.53	1.30	1.09	3	1.96	5.88	6.42	
21	1.10		23	23	46	.46	1.10	0.96	3	1.40	4.20	4.03	
24	0.91		15	14	29	.29	0.68	0.71	3	1.01	3.03	2.15	
27	0.40	4.5	3	7.5	.08	0.20	0.35	3	0.66	1.98	0.69		
30	0						0.08	3	0.20	0.60	0.05		
													Total Area = 57.10
													Mean Velocity = 1.11

STATION LOCATED ON ASHLAND GRAVEL ROAD BRIDGE

METER USED PRICE \$516

GAUGE READING 2.55

STAGE FALLING

PARTY { BROWN
HUNTER

OBSERVATION NO. 18

DATE OBSERVED APRIL 21, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.) SURFACE	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
8.5	0												
10	0.50		21	22	43	.43	1.04	0.42	1.5	0.25	0.38	0.16	
15	2.20		38	41	79	.79	1.88	1.17	5	1.35	6.75	7.89	
20	3.20		51	50	101	1.01	2.42	1.72	5	2.70	13.50	23.25	
25	2.90		52	51	103	1.03	2.45	1.95	5	3.05	15.25	29.70	
30	3.30		57	54	111	1.11	2.65	2.04	5	3.10	15.50	31.64	
35	3.40	SURFACE READINGS	57	56	113	1.13	2.70	2.14	5	3.35	16.75	35.85	
40	3.40		56	55	111	1.11	2.65	2.14	5	3.40	17.20	36.80	
45	3.40		57	58	115	1.15	2.75	2.16	5	3.40	17.20	37.16	
50	3.20		56	56	112	1.12	2.67	2.17	5	3.30	16.50	35.80	
55	2.90		54	53	107	1.07	2.55	2.09	5	3.05	15.25	33.95	
60	2.90		48	48	96	.96	2.30	1.94	5	2.90	14.50	28.16	
65	2.70		42	41	83	.83	1.99	1.72	5	2.80	14.00	24.08	
70	2.30		32	33	65	.65	1.55	1.42	5	2.50	12.50	17.76	
75	1.80	28	28	56	.56	1.57	1.25	5	2.05	10.25	12.80		
80	1.20	26	26	52	.52	1.49	1.22	5	1.50	7.50	9.15		
85	0.40	18	17	35	.35	0.84	0.93	5	0.80	4.00	3.72		
87	0						0.33	2	0.20	0.40	0.13		
													Total Area = 195.43
													Mean Velocity = 1.87

METER USED PRICE \$516

GAUGE READING 2.06

PARTY

BROWN
HUNTER

OBSERVATION NO. 19

DATE OBSERVED APRIL 21, 1909

STAGE FALLING

OBSERVATIONS					VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0	0													
3	1.05	0.63	9	8	17	.17	0.40	0.20	3	0.53	1.59	.32		
6	1.36	0.82	12	13	25	.25	0.60	0.50	3	1.20	3.60	1.80		
9	1.34	0.80	13	13	26	.26	0.61	0.60	3	1.35	4.05	2.43		
12	1.45	0.87	22	22	44	.44	1.05	0.83	3	1.39	4.17	3.45		
15	1.10	0.66	34	34	68	.68	1.64	0.84	3	1.28	3.84	3.22		
18	1.32	0.79	32	29	61	.61	1.48	1.56	3	1.21	3.63	5.66		
21	1.06	0.64	26-22-24		72	.72	1.75	1.62	3	1.19	3.57	5.78		
24	1.08	0.65	34	36	70	.70	1.69	1.72	3	1.07	3.21	5.53		
27	0.62	0.37	23	23	46	.46	1.10	1.40	3	0.85	2.55	3.57		
29	0							.55	2	0.31	0.62	.34		
														Total Area=30.83
														Mean Velocity=1.04
														Area Bridge=53.2
														Mean Velocity=0.60

STATION LOCATED ON ASHLAND GRAVEL ROAD BRIDGE

METER USED PRICE \$516

GAUGE READING 2.19

STAGE FALLING

PARTY { BROWN
HUNTER

OBSERVATION NO. 20

DATE OBSERVED APRIL 21, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.) SURFACE	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
3.5	0												
10	0.20		15	17	32	.32	.77	.31	1.5	0.10	0.15	.46	
15	1.75		32	32	64	.64	1.52	.92	5	0.98	4.90	4.51	
20	2.80		41	43	84	.84	2.00	1.41	5	2.28	11.40	16.09	
25	2.50	SURFACE READINGS	43	42	85	.85	2.02	1.61	5	2.65	13.25	21.30	
30	2.90		44	44	88	.88	2.11	1.65	5	2.70	13.50	22.30	
35	3.00		46	45	91	.91	2.19	1.72	5	2.95	14.75	25.38	
40	3.00		44	45	89	.89	2.12	1.73	5	3.00	15.00	25.85	
45	3.00		43	44	87	.87	2.05	1.67	5	3.00	15.00	25.05	
50	2.80		45	45	90	.90	2.15	1.68	5	2.90	14.50	24.35	
55	2.50		42	42	84	.84	2.00	1.66	5	2.65	13.25	22.00	
60	2.50		37	37	74	.74	1.79	1.52	5	2.50	12.50	19.00	
65	2.30		31	31	62	.62	1.49	1.31	5	2.40	12.00	15.71	
70	1.90		24	25	49	.49	1.16	1.06	5	2.10	10.50	11.12	
75	1.40	21	21	42	.42	1.03	.88	5	1.65	9.25	8.14		
80	0.80	21	21	42	.42	1.03	.82	5	1.10	5.50	4.51		
85	0.80	12	12	24	.24	0.58	.65	5	0.80	4.00	2.60		
86.8	0						.23		1.8	0.40	2.00	.46	
											Total Area = 371.45		
											Mean Velocity = 1.45		

STATION LOCATED ASHLAND GRAVEL ROAD BRIDGE

METER USED PRICE \$316

GAUGE READING 1.37

STAGE FALLING

PARTY { PHILLIPS
HUNTER

OBSERVATION NO. 21

DATE OBSERVED APRIL 22, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.) SURFACE	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
10.5	0												
15	1.05		13	13	26	.26	0.61	.24	4.5	.53	2.39	.57	
20	2.10		19	19	38	.38	0.91	.61	5	1.58	7.90	4.81	
25	1.80		21	20	41	.41	1.00	.76	5	1.95	9.75	7.41	
30	2.20		20	21	41	.41	1.00	.80	5	2.00	10.00	8.00	
35	2.30	SURFACE READINGS	21	19	40	.40	.97	.79	5	2.25	11.25	8.89	
40	2.30		19	17	36	.36	0.86	.73	5	2.30	11.50	8.40	
45	2.30		19	19	38	.38	0.91	.71	5	2.30	11.50	8.17	
50	2.10		19	17	36	.36	0.86	.71	5	2.20	11.00	7.81	
55	1.80		18	17	35	.35	0.85	.68	5	1.95	9.75	6.63	
60	1.80		15	16	31	.31	0.76	.64	5	1.80	9.00	5.76	
65	1.60		14	14	28	.28	0.68	.58	5	1.70	8.50	4.93	
70	1.20		12	11	23	.23	0.55	.49	5	1.40	7.00	3.43	
75	0.70	9	9	18	.18	0.44	.39	5	0.95	4.75	1.85		
80	0.20	8	8	16	.16	0.37	.32	5	0.45	2.25	.72		
85	0						.15	5	0.10	0.50	.08	Total Area = 117.04 Mean Velocity = 0.64	

METER USED PRIGE #516

GAUGE READING 1.73

STAGE FALLING

PARTY

PHILLIPS

HUNTER

OBSERVATION NO. 22

DATE OBSERVED APRIL 22, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 60 SECS.		TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH			AREA
0	0.57	0.34	12	11	23	.23	57						
2	0.70	0.42	42	42	84	.84	2.04	1.31	2	0.63	1.26	1.65	
4	1.15	0.69	34	33	67	.67	1.56	1.80	2	0.93	1.86	3.35	
6	1.06	0.60	25	25	50	.50	1.21	1.39	2	1.08	2.16	3.00	
8	1.17	0.70	11	10	21	.21	0.52	0.86	2	1.09	2.18	1.88	
10	1.20	0.72	9	8	17	.17	0.42	0.47	2	1.18	2.36	1.11	
13.5	0							0.21	3.5	0.60	2.10	.44	
													Total Area = 11.92 sq ft
													Mean Velocity = 0.875
													Area at Bridge = 44.2
													Mean Velocity = 0.26

STATION LOCATED ON ASHLAND GRAVEL ROAD BRIDGE

METER USED PRICE #516
 GAUGE READING 2.64
 STAGE FALLING

PARTY { PHILLIPS
 HUNTER

OBSERVATION NO. 23
 DATE OBSERVED MAY 9, 1909

OBSERVATIONS				VELOCITY COMPUTATIONS				AREA COMPUTATIONS			DISCHARGE CU. FT. SEC.	REMARKS	
DISTANCE FROM INITIAL POINT	DEPTH	DEPTH OF METER	REVOLUTIONS PER. 50 SECS.	TOTAL REVS.	R. P. S.	VELOC. (FT. SEC.)	MEAN VELOC.	WIDTH L	MEAN DEPTH	AREA			
0.75	0												
3	3.71	SURFACE READINGS	34	34	68	.68	1.62	.65	2.25	1.86	4.19	2.72	
6	3.85		45	44	89	.89	2.11	1.49	3	3.78	11.34	16.90	
9	3.75		44	45	89	.89	2.11	1.68	3	3.80	11.40	19.16	
12	3.02		44	42	86	.86	2.04	1.66	3	3.38	10.14	16.82	
15	2.51		42	42	84	.84	2.00	1.61	3	2.77	8.31	13.38	
18	1.95		35	37	72	.72	1.75	1.50	3	2.23	6.69	10.03	
21	1.40		35	34	69	.69	1.64	1.36	3	1.68	5.04	6.85	
24	1.20		22	24	46	.46	1.11	1.10	3	1.30	3.90	4.29	
27	1.18		14	13	27	.27	0.67	.71	3	1.19	3.57	2.53	
30	0.25		7½	7	14½	.15	0.35	.41	3	.72	2.16	.88	
33	0						.18	3	.13	.39	.07		
													Total Area = 67.13
													Mean Velocity = 1.40

TABLE I
See Plate 2

Station: Columbia, Mo.-----

Data Daily Precipitation-----

1906 1898	January	February	March	April	May	June	July	August	September	October	November	December
1	0	0	0	T	1.06	.66	0	0	T	.03	0	.01
2	0	.02	T	.02	0	0	0	.05	0	T	0	0
3	0	0	0	.01	.37	0	0	.25	0	0	T	.03
4	0	T	0	.67	.25	1.05	0	0	.20	0	0	.02
5	0	0	0	0	.05	T	0	0	T	0	.54	0
6	0	0	0	0	.11	0	.07	0	1.08	0	0	T
7	0	0	0	0	0	1.02	.20	T	0	T	0	0
8	0	0	0	.07	0	.02	.28	0	0	0	.28	0
9	.66	1.01	0	0	.16	.16	0	0	0	.35	.29	0
10	0	0	.57	0	.25	T	0	0	0	.32	.10	0
11	.65	.08	.97	0	.02	.48	0	0	T	.02	0	0
12	.49	0	.34	.02	.09	.26	0	0	.60	0	0	.32
13	0	0	.06	.95	.13	0	0	.05	.49	0	.02	0
14	.16	0	0	.01	.41	0	0	0	0	0	0	0
15	.05	T	.17	0	1.40	3.18	0	0	.40	0	0	0
16	0	0	0	0	1.14	.55	0	.01	.01	.31	0	T
17	0	.08	0	T	T	0	.11	.08	.54	.60	0	T
18	0	.01	.74	.29	.35	0	0	T	0	.06	0	.09
19	.03	.64	.01	.01	.67	0	0	0	0	.11	0	.52
20	.50	T	T	0	T	0	2.21	0	0	.04	0	.01
21	T	T	.24	.10	.48	0	.25	0	1.60	.03	.97	T
22	.53	0	1.03	.20	0	.01	.01	0	.08	T	T	.52
23	.05	0	0	T	0	0	0	T	0	0	0	0
24	T	0	0	0	0	T	0	.03	0	T	0	0
25	.25	0	0	.04	0	.06	.70	0	0	.74	.02	T
26	T	0	.08	0	0	1.55	.21	0	0	0	.04	0
27	0	0	.14	0	.19	.02	0	0	.42	0	0	0
28	0	T	0	T	.03	0	.17	0	0	0	.02	0
29	T		0	0	1.23	0	.35	0	0	0	.01	0
30	T		.06	.37	0	0	.04	0	.01	0	T	0
31	0		0		0		T	0		0		0
SUM	3.37	1.84	4.41	2.76	8.39	9.02	4.60	0.47	5.43	2.61	2.29	1.52
MEANS												

TABLE II
See Plate 3

Station: Columbia, Mo

Data Daily Precipitation

1899	January	February	March	April	May	June	July	August	September	October	November	December
1	0	0	0	0	0	.90	0	0	0	0	0	0
2	0	T	0	.06	.11	0	.41	0	0	0	T	0
3	0	.03	0	.51	.10	0	.02	0	0	0	0	.06
4	.27	T	.35	.05	0	.15	.46	0	0	0	0	.04
5	0	0	T	0	T	0	0	.28	0	0	0	0
6	.05	.04	T	.11	.10	.09	.28	.43	0	0	0	0
7	0	0	0	T	.05	.67	.41	.21	.02	0	.09	0
8	.03	T	0	T	.04	.52	0	.20	.01	0	.02	0
9	0	0	0	0	.06	.54	0	.33	0	0	0	.23
10	0	.28	0	0	.81	0	0	.03	.96	.04	0	.25
11	0	.10	.37	0	0	0	0	0	0	T	0	.52
12	0	0	0	0	T	0	0	0	0	0	0	.10
13	.02	0	0	0	0	0	0	1.32	0	0	T	.18
14	0	0	.61	0	0	.19	.07	T	0	0	.04	.30
15	0	0	.01	T	0	.28	.95	0	0	0	0	T
16	0	0	0	0	0	0	.13	0	0	.77	0	0
17	T	.01	.34	0	.33	0	0	0	2.42	0	.37	0
18	T	0	.45	.12	0	0	0	0	.02	0	0	.11
19	0	0	0	0	.12	0	0	0	0	.02	0	.02
20	0	0	0	.01	.90	0	0	T	0	0	.30	0
21	0	.06	0	.26	.60	0	T	0	0	0	.24	0
22	0	0	T	1.16	0	0	0	.36	.10	0	.16	.01
23	.17	.20	0	.06	0	0	0	0	0	0	T	.03
24	0	0	0	.06	0	.04	T	.03	0	0	0	.20
25	0	1.45	0	0	0	1.55	T	0	0	T	0	.07
26	T	.02	.02	0	.04	T	0	T	0	.72	0	T
27	0	0	.16	.14	.04	.02	0	.02	0	.88	0	.16
28	.10	0	.14	0	.27	0	0	0	.02	.30	0	0
29	0		0	0	.15	0	T	0	0	0	0	0
30	.07		.26	.07	.10	0	T	0	0	0	0	0
31	0		T		1.07		1.02	0		0		.01
SUMS	1.89	2.19	2.71	2.61	4.89	4.95	3.75	3.21	3.55	2.73	1.22	2.29
MEANS	0.71											

TABLE III
See Plate 4

Station: Columbia, Mo.

Data Daily Precipitation.

1900	January	February	March	April	May	June	July	August	September	October	November	December
1	T	0	0	T	0	.15	.19	0	.29	0	T	0
2	0	0	0	0	.31	0	0	0	.51	0	0	0
3	0	.03	0	0	0	0	0	0	.15	0	0	0
4	0	.16	T	0	T	0	.07	0	0	0	0	T
5	.01	T	.97	0	0	0	.11	0	0	0	0	0
6	.04	0	.18	0	.02	.08	0	0	0	0	0	.16
7	.02	.12	0	0	.16	1.19	0	0	0	2.03	0	.07
8	T	.38	0	T	0	0	.29	0	0	0	0	0
9	.03	0	0	0	0	0	0	0	0	0	0	0
10	.01	0	0	.81	0	.10	.11	0	0	0	.01	0
11	0	0	0	.40	0	0	0	0	T	0	.01	0
12	.03	.03	0	.03	0	T	T	T	0	0	0	0
13	0	.18	0	0	0	1.13	0	.40	0	0	0	0
14	0	.04	0	0	0	0	0	0	T	0	0	0
15	0	.01	.01	.33	.31	0	.14	T	0	0	0	0
16	.01	.01	.01	.30	.17	0	.03	0	T	0	.32	T
17	1.27	0	0	.14	.16	.16	.50	0	0	0	0	T
18	.01	0	0	0	.21	0	0	T	.10	0	.02	0
19	.03	0	.17	0	.02	0	T	T	.42	0	.23	0
20	0	.07	0	0	0	0	.35	0	0	0	.27	0
21	0	.74	0	.53	0	.05	0	.14	0	.89	T	0
22	0	.01	0	.06	.01	.23	0	.12	0	.22	T	.01
23	0	.29	.09	.28	.02	.94	T	.35	T	T	.32	.01
24	0	0	.03	T	.36	.64	.75	.09	.17	0	.06	.05
25	0	T	.05	.14	0	.09	.40	2.79	0	0	T	T
26	0	T	0	0	0	0	0	.10	.08	0	0	0
27	0	.86	0	0	0	T	0	.06	.36	T	0	.03
28	0	.93	T	0	T	.01	0	0	.91	2.90	0	T
29	0		0	T	T	0	T	0	.15	.38	0	0
30	0		T	0	T	.25	0	0	0	.28	0	0
31	0		0		0		0	T		1.03		.05
MEAN	1.46	3.76	1.51	3.02	1.75	5.02	2.94	4.05	3.14	7.73	1.24	0.38

TABLE IV
See Plate 5

Station: Columbia, Mo.

Data Daily Precipitation

1901	January	February	March	April	May	June	July	August	September	October	November	December
1	0	T	0	.17	0	0	T	0	0	0	0	.02
2	0	.26	0	.23	0	0	T	0	0	0	0	T
3	0	.94	0	T	0	.06	.27	0	0	0	.11	0
4	0	T	T	0	T	T	0	1.22	0	0	0	T
5	0	0	T	.48	T	T	0	T	0	T	0	.10
6	T	0	0	.03	T	.40	0	0	0	.01	0	0
7	0	.01	0	0	.03	0	0	0	0	0	0	.09
8	T	.26	0	0	.08	.22	0	0	T	.32	T	.68
9	1.97	T	.58	0	0	0	0	.12	T	.01	T	0
10	T	0	1.41	0	0	.19	0	.22	.04	0	0	0
11	.01	.11	0	T	T	0	0	T	.64	.01	.10	0
12	T	0	T	.12	0	.12	0	0	0	.65	0	T
13	0	0	T	.83	0	0	T	0	0	T	0	.97
14	0	0	.03	.03	0	0	0	.04	T	0	0	0
15	0	0	T	0	T	0	0	0	0	0	0	0
16	0	0	0	.23	T	0	.07	0	.10	T	0	.10
17	0	0	0	.26	T	0	1.36	.05	.14	0	0	T
18	.04	0	0	T	0	0	0	.02	0	0	0	.26
19	0	0	.69	0	.19	T	0	T	.21	0	0	0
20	0	T	.04	0	T	.22	0	T	T	0	0	0
21	0	.10	T	0	.05	T	0	0	0	0	.01	0
22	0	T	0	0	0	0	T	T	0	0	.58	0
23	.01	T	.21	T	T	0	0	T	0	0	T	0
24	0	0	.02	0	T	0	0	0	0	0	0	T
25	T	0	0	0	T	0	0	T	.21	0	0	.05
26	.29	0	0	0	0	0	T	0	T	.07	0	0
27	0	0	0	0	0	.02	.10	0	0	0	0	0
28	0	.11	0	0	0	0	.09	0	0	0	0	.02
29	T		.24	0	0	0	.30	0	.03	.06	0	0
30	0		.03	0	0	0	.55	0	0	0	0	0
31	0		0	0	0	0	0	0		.03		0
SUMS...	2.32	1.79	3.25	2.38	0.35	1.23	2.74	1.67	1.37	1.16	0.80	2.29
MEANS..												

TABLE V
See Table 6

Station: Columbia, Mo. -----

Data Daily Precipitation -----

1902	January	February	March	April	May	June	July	August	September	October	November	December
1	0	.14	.02	0	0	2.91	2.30	0	0	0	T	0
2	0	T	.01	0	.04	0	0	0	0	.04	.07	.54
3	0	0	0	.62	0	T	0	.18	0	.69	0	.01
4	0	T	0	0	T	.38	0	0	0	.38	.44	T
5	0	.07	0	T	.17	T	0	.02	0	.13	.48	0
6	0	T	0	T	.85	.01	0	0	1.03	0	0	.07
7	0	0	.15	0	0	.02	.64	0	0	0	0	.01
8	0	0	.02	0	0	.33	0	T	.12	0	T	0
9	0	0	0	0	0	0	.70	0	.02	0	0	0
10	0	T	.03	0	0	0	0	1.01	0	0	T	.07
11	0	.08	.45	T	0	0	0	0	.22	0	T	.24
12	0	0	1.22	0	0	0	0	0	.01	.42	0	.15
13	0	0	0	0	0	0	0	0	0	0	.35	.02
14	0	T	0	T	T	T	0	0	0	0	.54	.42
15	0	0	.12	0	.19	.18	T	.11	0	0	0	.30
16	0	T	0	T	0	0	0	T	0	0	.08	T
17	0	T	T	T	0	T	0	0	.35	.84	0	0
18	0	0	0	T	0	.01	.06	3.15	.04	0	0	0
19	0	0	0	0	T	.02	3.25	.25	0	0	0	T
20	.30	0	.04	0	.01	.79	T	0	T	0	0	.30
21	.04	0	.14	0	T	0	0	T	.02	0	0	.02
22	0	0	0	.09	1.25	0	T	.16	.12	0	0	T
23	0	0	0	0	.29	T	0	T	.12	0	0	0
24	T	0	T	.27	.79	.12	T	0	.32	0	.70	0
25	.55	0	T	1.09	.31	0	0	.24	T	T	0	0
26	T	.01	.37	T	.15	.12	T	.58	0	0	T	T
27	0	.41	0	.01	0	.18	.04	.80	.01	T	T	0
28	T	.19	T	.37	0	.87	T	0	0	.01	.19	.05
29	.15		.44	.14	0	.62	0	0	0	.01	.04	T
30	T		.57	.83	T	T	0	0	.22	.01	0	0
31	T		0		.28		.67	.14		T		0
MEANS	1.84	.90	3.58	3.42	4.33	6.56	7.66	6.64	2.60	2.52	2.89	2.20

TABLE VI
See Plate 7

Station: Columbia, Mo.

Data Daily Precipitation

1903	January	February	March	April	May	June	July	August	September	October	November	December
1	0	T	0	0	0	.08	0	.05	0	0	.01	.01
2	.74	T	0	0	0	.20	T	.10	0	T	0	0
3	.02	1.78	.04	1.39	0	.06	.18	0	0	T	T	0
4	.07	T	.09	0	0	.09	.02	0	0	.01	.07	T
5	T	0	.19	0	.28	.06	0	.01	.10	0	T	0
6	0	0	.09	0	T	0	0	.65	0	.08	0	0
7	T	.02	1.60	.03	.01	0	0	.01	0	2.06	0	0
8	0	.01	T	0	0	T	0	.24	.11	0	0	T
9	0	0	T	0	T	.13	0	0	.15	0	0	.03
10	.03	.03	.14	.32	T	0	0	0	1.56	0	0	.11
11	.16	.09	T	.23	.33	0	.80	.07	0	0	.39	.01
12	0	0	0	T	.04	0	.01	.58	0	T	0	.38
13	0	T	0	.01	.23	0	0	.91	.80	T	0	0
14	0	.10	0	.06	.01	0	.01	0	1.00	.06	0	0
15	0	.49	T	T	0	0	0	0	.77	.06	0	0
16	.01	T	.44	.01	0	.01	.13	T	0	T	.10	0
17	T	0	0	0	.09	0	.03	0	0	0	0	0
18	0	T	T	.02	.03	0	.62	0	0	0	0	0
19	0	T	.49	.98	.13	.58	0	T	0	0	0	.22
20	.01	0	.20	.70	T	0	0	0	0	0	0	0
21	0	0	0	0	.37	.01	.53	0	0	0	0	0
22	0	0	0	0	0	.33	T	0	0	0	0	0
23	.68	0	.04	0	.05	0	.01	0	0	0	0	.03
24	.06	0	.04	.02	.04	0	0	T	0	0	.05	.08
25	0	0	0	0	1.96	.02	0	.24	0	0	.09	T
26	T	.08	0	0	T	.57	0	.88	.69	0	0	0
27	.12	.06	.06	0	.06	.02	0	.47	.02	0	0	0
28	T	T	.04	0	0	0	0	.88	0	0	0	0
29	T		0	.14	.24	0	.02	T	.02	0	T	0
30	0		0	.75	.28	0	0	0	.02	.13	T	0
31	0		0		1.11		T	0		.01		0
Sums	1.90	2.66	3.46	4.66	5.26	2.16	2.36	5.09	5.24	2.41	0.71	0.97
Means												

Station: Columbia, Mo.

Data Daily Precipitation

1904	January	February	March	April	May	June	July	August	September	October	November	December
1	.03	T	0	0	0	0	0	.01	0	1.23	0	0
2	.17	0	0	0	0	T	0	0	.30	0	0	0
3	0	0	T	0	0	.73	0	0	0	0	0	T
4	.06	0	0	0	.49	1.73	.60	T	0	0	0	0
5	0	0	.13	.38	.05	0	.23	0	0	0	0	T
6	0	0	.12	.01	.88	0	.04	0	0	0	0	0
7	0	.25	0	.32	.06	0	.05	0	0	0	0	0
8	0	T	0	1.14	.33	0	.46	0	0	.05	0	0
9	T	T	0	T	T	0	0	T	0	0	.17	.05
10	.19	T	.06	0	0	0	.59	.33	0	.01	.11	0
11	T	0	0	0	0	0	.25	0	0	0	0	.32
12	.25	0	0	0	0	0	0	0	0	0	0	.01
13	.01	0	.16	0	.32	0	0	.01	.40	0	0	T
14	0	0	T	0	0	.01	0	.02	.04	0	0	0
15	0	0	0	0	0	.81	0	0	0	0	0	0
16	0	T	T	0	.79	0	0	.92	0	0	0	.23
17	0	.60	.31	0	.01	T	0	0	0	0	0	.19
18	0	.03	0	0	.01	.58	T	.72	.13	0	0	.06
19	0	0	0	T	0	T	0	3.08	4.25	T	0	0
20	.42	.01	.01	.97	0	.38	0	.01	.36	0	0	0
21	.44	.12	.01	0	0	.24	0	.02	0	.07	0	0
22	T	0	.81	T	.04	0	T	.87	0	0	0	0
23	T	0	0	.50	.45	0	T	0	0	0	0	T
24	0	0	1.27	2.50	0	0	0	0	.31	0	0	.01
25	.40	0	.05	1.52	T	.66	0	.09	0	0	0	.02
26	.03	0	0	.01	.83	.19	.18	0	0	0	0	.45
27	0	0	0	0	0	.22	T	0	0	0	0	.58
28	T	0	0	0	T	.01	0	0	0	0	0	.04
29	0	T	T	0	1.13	0	0	.07	0	0	0	0
30	.01		.11	0	.01	T	0	.01	0	0	0	0
31	.08		.65	0	0		.02	.01		0	0	0
SUMS	2.09	1.01	3.69	7.35	5.39	5.56	2.42	6.17	5.79	1.36	0.28	1.96
MEANS												

TABLE VIII

See Plate 9

Station: Columbia, Mo. -----

Data - Daily Precipitation -----

1905.	January.	February	March.	April	May.	June.	July.	August	September.	October.	November.	December
1	T	.04	0	0	0	0	.08	0	0	.08	0	.04
2	.16	0	0	.05	0	0	1.50	.85	.06	0	T	0
3	0	.26	0	.02	0	0	.01	1.07	0	0	0	0
4	0	.10	0	0	.35	0	.07	0	0	0	.49	0
5	0	.54	0	T	.34	0	T	0	.06	0	.29	0
6	.02	0	T	0	.10	0	.46	.19	.54	0	T	0
7	.05	0	.01	0	0	0	.20	0	.07	0	0	0
8	.16	.56	.07	0	.20	0	0	0	0	0	0	0
9	0	0	0	.04	.23	0	.31	0	1.12	.06	0	0
10	.32	0	0	.22	0	.10	.80	0	.12	.02	0	0
11	1.13	.10	0	0	1.46	0	.19	0	0	0	0	0
12	0	.04	0	0	0	0	0	0	.01	0	0	0
13	0	0	0	0	.89	0	0	.13	0	0	0	0
14	T	.05	0	0	0	0	0	.89	.24	.56	0	0
15	0	0	0	.02	.41	0	0	0	1.20	0	0	0
16	0	.09	T	0	.27	0	0	.06	5.98	1.49	0	0
17	0	0	.25	0	0	0	0	0	.40	1.72	0	0
18	.09	0	.24	0	0	T	0	1.12	1.73	.60	.13	0
19	0	.02	.01	0	0	.61	0	.10	0	.06	.11	0
20	0	0	T	.15	0	.57	.23	0	0	0	0	.38
21	0	0	0	0	0	0	0	0	0	0	0	T
22	0	0	0	0	T	0	0	2.44	0	0	0	T
23	0	0	.19	.01	0	0	0	T	0	.31	.27	T
24	.04	.11	0	.49	0	0	0	0	0	.67	0	0
25	0	0	T	.61	.17	0	0	0	0	.07	0	0
26	0	0	0	.14	0	.06	.10	0	0	0	0	0
27	0	0	.03	.16	0	0	.10	.06	0	T	.11	.02
28	T	0	.11	.74	.03	0	0	0	0	.04	0	.52
29	T		.01	0	.08	1.15	0	0	0	.04	T	0
30	T		0	0	T	1.34	T	0	.01	.61	0	0
31	0		0		0		0	0		T		.03
SUMS	1.97	1.91	0.92	2.65	4.53	3.83	4.05	6.91	11.54	6.33	1.40	0.99

TABLE IX
See Plate 10

Station: Columbia, Mo.

Data - Daily Precipitation -

1906	January	February	March	April	May	June	July	August	September	October	November	December
1	0	0	0	0	.18	0	.10	T	.04	0	0	.12
2	1.05	0	.21	0	.01	0	.24	0	.36	0	0	.03
3	1.15	0	.02	.01	0	T	.02	0	0	.01	0	0
4	0	.10	T	.21	0	.04	T	0	T	0	0	.09
5	0	0	0	.32	T	0	0	.76	0	.01	0	.15
6	0	T	.25	0	0	0	0	.55	0	0	0	0
7	.02	0	.02	.01	0	1.23	0	.65	.32	0	T	0
8	0	0	T	.21	0	.14	T	0	.75	0	0	0
9	0	0	0	0	0	0	T	.14	0	0	0	.16
10	.05	0	.15	0	0	0	0	0	T	0	0	.01
11	.03	0	.12	0	0	0	0	.14	T	0	0	0
12	0	0	.03	.01	T	0	T	T	T	0	0	0
13	0	.59	.10	.81	0	0	.03	0	0	0	.16	0
14	0	.02	.05	T	0	.02	0	0	0	0	.27	.22
15	.10	0	T	0	T	0	.08	0	0	.04	0	0
16	0	0	.04	0	0	0	0	0	0	.01	.29	0
17	0	.07	0	0	0	.14	0	0	0	T	0	0
18	0	0	.50	0	.63	.14	0	T	0	0	0	0
19	0	0	.30	0	0	.02	.09	T	T	0	.45	0
20	0	.81	0	0	0	.04	.01	0	0	T	.53	.05
21	.10	0	0	0	0	0	0	.01	.48	0	.48	0
22	.44	0	0	0	.18	T	.70	0	0	0	0	0
23	0	.54	.52	.06	.18	.76	0	0	0	.33	0	0
24	0	T	0	0	.03	.78	0	T	0	0	0	T
25	0	0	.01	0	.20	0	0	.67	0	0	.01	0
26	0	.43	.51	0	.02	0	0	.02	0	0	0	.01
27	0	0	.0	.24	T	0	0	0	0	T	0	.01
28	0	0	0	0	0	0	.06	0	2.23	0	0	0
29	0	0	0	0	0	.72	0	0	.62	0	.07	.25
30	0	0	0	.08	.68	.18	0	0	0	T	.67	.50
31	0	0	0	0	.62	0	0	0	0	0	0	0
SUMS	3.94	2.56	2.83	1.96	2.73	4.21	1.33	2.94	4.80	0.40	2.93	1.60
MEANS												

TABLE X

See Plate 11

Station: Columbia, Mo.

Data Daily Precipitation

1907	January	February	March	April	May	June	July	August	September	October	November	December
1	.01	0	.31	0	0	.01	.23	.28	0	.10	.09	0
2	.05	0	0	0	0	0	0	0	.09	T	0	0
3	.06	.10	0	.38	.46	.01	0	0	0	.89	0	0
4	0	.11	0	.03	0	0	0	.04	0	0	0	0
5	0	.04	0	0	.40	0	0	.25	0	0	0	0
6	0	.02	T	.31	.21	.01	0	T	0	0	0	0
7	.05	0	0	.27	.01	.55	0	0	0	T	0	T
8	T	0	0	.01	.25	0	0	.56	0	0	0	0
9	0	0	.63	0	0	.54	.01	0	T	0	0	T
10	0	0	.01	0	0	0	T	0	0	0	T	0
11	.03	0	.23	.13	0	.24	.08	0	0	0	T	0
12	0	0	.41	0	0	.01	0	0	0	0	0	0
13	.02	0	.09	0	.01	0	0	.01	0	0	0	.18
14	.20	0	0	0	2.22	1.59	1.35	.05	0	0	0	.11
15	1.00	0	0	.05	0	0	1.26	.07	0	.13	0	0
16	1.55	0	0	T	0	0	.13	.56	0	0	0	0
17	.06	0	0	0	.01	0	.11	.05	0	0	0	.08
18	1.20	0	0	.15	T	0	.31	.01	0	0	0	0
19	1.03	0	0	0	.40	.24	0	1.18	0	0	0	0
20	0	.13	0	0	T	.01	0	.14	.33	0	1.10	0
21	0	0	0	0	0	.13	0	.0	0	0	0	0
22	0	0	0	.24	0	.39	0	T	0	0	0	.58
23	0	.16	T	.48	0	.02	0	T	0	0	0	.31
24	T	0	0	T	0	T	0	0	0	0	0	0
25	0	0	0	.01	0	.94	.06	0	0	.27	T	0
26	.02	.01	.05	0	T	0	.17	0	.26	.63	0	0
27	.05	0	.30	0	0	T	.02	.27	.13	0	0	0
28	0	T	.95	0	T	0	1.47	0	0	0	0	0
29	0		.01	1.76	T	.07	0	0	.08	.04	0	0
30	.08		0	.03	.05	.10	0	0	.04	.10	0	0
31	.24		0	.03			.29	0		0		0
	5.65	0.57	2.99	3.85	4.05	5.04	5.49	3.48	1.01	2.16	1.19	1.26

PJH '09

TABLE XI

See Plate 12

Station: Columbia, Mo.

Data Daily Precipitation

1908	January	February	March	April	May	June	July	August	September	October	November	December
1	0	.05	0	T	0	T	.01	0	.04	0	1.09	0
2	0	0	0	0	0	.37	.06	0	0	0	.01	0
3	.27	0	T	0	.37	1.72	0	0	0	0	0	T
4	0	.36	.44	.64	.54	0	0	0	.10	0	0	.32
5	0	.25	0	T	.87	.37	0	.18	0	0	0	0
6	0	0	0	.01	.02	.01	.53	1.30	0	.01	0	0
7	0	0	.10	.66	0	.13	0	.36	0	T	0	0
8	0	0	.74	.67	0	.59	0	0	0	0	0	0
9	0	0	0	T	0	0	0	0	0	0	.20	0
10	0	T	0	.05	0	0	0	0	0	0	.01	0
11	.30	.15	.05	0	.01	0	0	.08	0	0	T	0
12	.28	.31	0	0	0	.28	0	.12	0	0	0	0
13	0	.20	0	0	.51	.63	0	0	0	0	T	0
14	0	.92	0	.53	.04	.01	T	0	0	0	.07	0
15	T	.16	0	.90	0	0	0	0	0	0	0	0
16	0	0	0	0	0	.01	.01	0	T	0	0	0
17	0	0	0	.14	.75	.02	.36	0	0	0	0	T
18	0	1.04	.09	0	.05	0	0	0	0	0	0	0
19	0	.07	0	0	0	.24	0	.36	0	0	0	0
20	0	0	0	0	0	0	.37	0	0	.02	0	0
21	0	0	0	0	.75	0	0	0	0	0	0	0
22	0	0	0	T	0	0	0	0	.62	T	.58	0
23	0	0	0	.32	.24	1.14	0	0	.06	.20	.62	0
24	T	.47	0	.12	0	0	1.55	.31	0	.63	.02	0
25	0	.04	0	T	.66	0	0	0	0	T	.50	0
26	0	.04	0	.22	0	0	0	T	1.73	.04	0	0
27	0	0	.06	T	.29	0	.08	0	.42	.01	.02	0
28	0	0	0	0	1.03	.08	0	2.03	.02	0	.06	0
29	0	0	0	0	.04	.92	0	0	0	0	.62	.91
30	0		.31	T	0	0	0	0	0	0	0	0
31	.28		0		0		T	0				
SUMS--	1.13	4.06	1.79	4.26	6.17	6.52	2.97	4.74	2.99	.91	3.80	1.23
MEANS--												

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TABLE XII

Station: Columbia, Mo.

See Plate 13

Data Daily Precipitation

1909	January	February	March	April	May	June	July	August	September	October	November	December
1	0	0	0	.03								
2	T	0	0	.01								
3	0	0	0	0								
4	.03	T	0	0								
5	0	.21	0	.01								
6	0	.09	0	.60								
7	0	0	.20	0								
8	0	.34	.75	0								
9	.03	T	.04	0								
10	.18	T	0	0								
11	.51	0	0	0								
12	0	.34	.03	.91								
13	0	.40	0	0								
14	0	.49	0	.01								
15	0	.54	T	0								
16	T	.07	0	0								
17	0	0	0	.03								
18	0	.13	.13	.48								
19	T	T	T	.25								
20	T	0	T	.68								
21	0	0	0	.07								
22	0	.24	0	0								
23	0	0	.08	0								
24	0	.02	.44	0								
25	.04	0	T	0								
26	0	0	0	0								
27	0	0	0	0								
28	1.16	0	0	.02								
29	.53		0	.25								
30	0		0	T								
31	0		0									
SUMS	2.48	2.87	1.67	3.35								
MEANS												

TABLE XIII
See Plates 14-18

Station: Columbia, Mo.

Data - Monthly Precipitation

	January	February	March	April	May	June	July	August	September	October	November	December	Totals
1890	4.02	2.34	2.80	2.17	3.92	3.40	4.97	5.47	3.97	2.10	2.34	0.38	37.88
1891	0.97	2.63	3.43	4.97	4.29	4.69	3.74	5.52	0.46	1.51	3.90	1.04	37.15
1892	2.27	6.80	3.50	5.60	10.58	3.60	7.62	3.56	4.50	1.87	2.44	2.28	54.62
1893	0.39	1.97	2.82	11.30	6.00	6.83	6.63	0.94	2.45	0.59	1.16	0.55	42.63
1894	2.46	1.35	1.84	2.02	4.33	3.04	1.20	1.29	7.57	0.98	1.60	1.20	28.88
1895	1.23	0.31	3.41	1.04	6.09	5.78	4.93	2.30	1.48	0.25	4.19	7.82	38.83
1896	1.03	1.58	1.13	3.08	5.61	4.33	3.79	1.85	3.61	2.45	1.61	1.11	31.18
1897	6.87	1.22	5.33	4.83	3.19	6.59	4.28	1.89	0.51	0.69	2.55	2.20	40.15
1898	3.37	1.84	4.41	2.76	8.39	9.02	4.60	0.47	5.43	2.61	2.29	1.52	46.71
1899	0.71	2.19	2.71	2.61	4.89	4.95	3.75	3.21	3.55	2.73	1.22	2.29	34.81
1900	1.46	3.76	1.51	3.02	1.75	5.02	2.94	4.05	3.14	7.73	1.24	0.38	36.00
1901	2.32	1.79	3.25	2.38	0.35	1.23	2.74	1.67	1.37	1.16	0.30	2.29	21.35
1902	1.04	0.90	3.58	3.42	4.33	6.56	7.66	6.64	2.60	2.52	2.89	2.20	44.34
1903	1.90	2.66	3.46	4.66	5.26	2.16	2.36	5.09	5.24	2.41	0.71	0.87	36.78
1904	2.09	1.01	3.69	7.35	5.39	5.56	2.42	6.17	5.79	1.36	0.28	1.96	43.07
1905	1.97	1.91	0.92	2.65	4.53	3.83	4.05	6.91	11.54	6.33	1.40	0.99	47.03
1906	3.94	2.56	2.83	1.96	2.73	4.21	1.33	2.94	4.30	0.40	2.93	1.60	32.23
1907	5.65	0.57	2.99	3.85	4.05	5.04	5.49	3.48	1.01	2.16	1.19	1.26	36.74
1908	1.13	4.06	1.79	4.26	6.17	6.52	2.97	4.74	2.99	9.1	3.80	1.23	40.57
1909	2.48	2.87	1.67										
Means	2.36	2.22	2.86	3.99	4.84	4.84	4.08	3.53	3.84	2.16	2.07	1.75	38.21

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TABLE XIV
CURRENT METER RATING DATA

Price Meter * 516

Observations made March 27 and April 3, 1909
on Brushwood Lake. Length of course=200 ft.

Time (sec.)	Revolutions	Velocity $\frac{Ft}{Sec}$	Rev. per Sec.
97	86.5	2.06	0.89
113	82.	1.77	0.73
208	88	0.96	0.42
184	85	1.09	0.46
51	81	3.92	1.59
39	82	5.13	2.10
65	85	3.08	1.31
68	84	2.94	1.24
40	85	5.00	2.12
34	82	5.88	2.41
35	79	5.72	2.26
78	83	2.56	1.06
68	87	2.94	1.28
77	84	2.60	1.09
120	86	1.67	0.72
83	85	2.41	1.02
77	86	2.60	1.12
63	84	3.18	1.33
60	84	3.34	1.40
65	84	3.08	1.29
79	82	2.53	1.04
109	83	1.89	0.76
95	82	2.10	0.87
131	84	1.53	0.64
148	83	1.34	0.56
50	83	4.00	1.66
41	77	4.87	1.88
43	81	4.65	1.89

See Plate 19

TABLE XV
CURRENT METER RATING DATA

Fteley Meter 4723

Observations made March 27 and April 3, 1909
on Brushwood Lake. Length of course=200ft

Time (sec)	Revolutions	Velocity $\frac{Fy}{sec}$	Rev. per Sec.
73	194	2.74	2.66
64	205	3.12	3.20
56	188	3.57	3.36
61	199	3.28	3.26
76	201	2.63	2.64
56	193	3.57	3.45
67	197	2.98	2.94
72	192	2.78	2.67
81	202	2.47	2.49
88	200	2.27	2.27
72	177	2.78	2.46
111	203	1.80	1.83
93	197	2.15	2.12
137	193	1.46	1.41
152	193	1.31	1.27
198	177	1.01	0.90
146	184	1.37	1.26
219	190	0.91	0.87
150	171	1.33	1.14
35	195	5.72	5.57
37	203	5.40	5.49
44	207	4.55	4.70
46	195	4.85	4.74
88	192	2.27	2.18
93	196	2.15	2.11
94	191	2.13	2.03
92	193	2.17	2.10
144	186	1.39	1.29
162	192	1.24	1.18
207	185	0.97	0.90
219	186	0.91	0.85
80	193	2.50	2.41
59	186	3.39	3.15
48	182	4.16	3.80
41	182	4.87	4.45
41	185	4.87	4.51
60	189	3.33	3.15
65	193	3.08	2.97

See Plate 20

TABLE XVI DEPTHS OF STANDARD SECTIONS

HINKSON CREEK

Section located on upstream side of bridge under lower chord
Depth to bottom of creek from top of lower chord of the bridge

Distance from west side	Depth	Distance from West side	Depth
0		30	17.0
2	6.6	35	17.1
4	7.5	40	17.1
6	8.9	45	17.1
8	13.5	50	16.9
10	14.3	55	16.6
12	15.3	60	16.6
14	15.7	65	16.4
16	16	70	16.0
18	16.4	75	15.5
20	16.9	80	14.9
22	16.6	85	14.8
25	16.6	90	13.2

See Plate 21

GRINDSTONE CREEK

Section located on upstream side of bridge under lower chord
Depth to bottom of creek from top of lower chord of the bridge

Distance from west side	Depth	Distance from West Side	Depth
0	0	24	11.4
2	14.3	26	11.1
4	14.4	28	10.7
6	14.4	30	10.4
8	14.5	32	10.2
10	14.0	34	10.1
12	13.5	36	10.0
14	13.2	38	9.8
16	12.6	40	9.7
18	12.3	42	9.6
20	12.0	44	9.6
22	11.6	46.5	9.7

See Plate 22

TABLE XVII
DISCHARGE FOR GAGE HEIGHTS
HINKSON CREEK
CU. FT / SEC *

Gage	Q	Gage	Q	Gage	Q	Gage	Q	Gage	Q
0	0	1.0	37	2.0	213	3.0	534	4.0	1072
0.1	0	1.1	49	2.1	240	3.1	580	4.1	1142
0.2	0	1.2	61	2.2	263	3.2	626	4.2	1213
0.3	0	1.3	76	2.3	290	3.3	680	4.3	1285
0.4	0	1.4	90	2.4	319	3.4	737	4.4	1356
0.5	.3	1.5	108	2.5	352	3.5	800	4.5	1435
0.6	.6	1.6	125	2.6	382	3.6	832	4.6	1520
0.7	1.0	1.7	145	2.7	420	3.7	887	4.7	1595
0.8	18	1.8	165	2.8	455	3.8	947	4.8	1678
0.9	28	1.9	190	2.9	492	3.9	1008	4.9	1770

* Values taken or computed from Discharge Curves, Pl. 23

TABLE XVII a
DISCHARGE FOR GAGE HEIGHTS
GRINDSTONE CREEK
CU. FT / SEC. *

Gage	Q	Gage	Q	Gage	Q	Gage	Q	Gage	Q
0	0	1.0	0.8	2.0	25.0	3.0	144.7	4.0	321.0
0.1	0	1.1	1.0	2.1	34.0	3.1	161.2	4.1	342.6
0.2	0	1.2	1.4	2.2	41.4	3.2	175.5	4.2	362.5
0.3	0	1.3	2.6	2.3	50.2	3.3	192.0	4.3	382.8
0.4	0	1.4	4.1	2.4	61.2	3.4	209.0	4.4	405.5
0.5	0.1	1.5	6.1	2.5	71.8	3.5	226.8	4.5	428.0
0.6	0.2	1.6	8.5	2.6	84.3	3.6	245.0	4.6	453.0
0.7	0.2	1.7	10.9	2.7	98.0	3.7	262.1	4.7	476.0
0.8	0.3	1.8	14.6	2.8	117.0	3.8	282.0	4.8	501.3
0.9	0.7	1.9	19.2	2.9	130.2	3.9	302.5	4.9	523.0

* Values taken or computed from Discharge Curves, Pl. 24

TABLE XVIII
DAILY GAGE READINGS FOR HINKSON CREEK

See plates 25-31 for curves of gage heights

DAY	1908			1909				
	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY
1		0.49	1.10		1.00	0.78	0.63	
2		0.69	0.72		0.94	0.72	0.63	
3		0.62	0.65	0.70				
4		0.61	0.67	0.70	1.50			
5		0.60	0.70	0.70	2.39		0.57	
6		0.60	0.69		1.20	0.69	0.70	
7		0.58	0.69	0.60	1.20	0.69		
8		0.60	0.65	0.57	1.11	0.69	0.68	
9		0.61	0.64	0.58	1.60	1.86	0.66	
10	0.47	0.58	0.62	0.59		1.30	0.60	
11	0.47	0.57	0.65		0.89	1.04		
12	0.48	0.55	0.64		0.89		1.09	
13	0.45	0.55	0.62		1.07	0.81	1.15	
14	0.44	0.56	0.63		3.82	0.79	1.00	
15	0.42	0.55	0.60		1.29	0.76	0.80	
16	0.42	0.56	0.60		1.30		0.70	
17	0.40	0.55	0.59	0.54				
18	0.40	0.55	0.57		1.21	0.70	0.65	
19	0.41	0.54	0.56	0.51	2.25		1.80	
20	0.41	0.54	0.55		1.50	0.67	1.60	
21	0.41	0.54	0.55	0.81	1.60	0.66	3.30	
22	0.40	0.55	0.53	0.80	1.39	0.66	1.38	
23	0.40	0.85		0.82	2.52	0.67	1.02	
24	0.51	1.10		0.79	1.54	0.70	1.00	
25	0.55	1.22			1.12		0.82	
26	0.57	1.12		0.68	0.97		0.75	
27	0.52	0.80			0.90	0.80		
28	0.51	0.70		3.38	0.83	0.70		
29	0.51	1.02		1.50			0.65	
30		1.37		1.30		0.65	0.72	
31	0.50		1.10	1.05				

TABLE XIX
DAILY GAGE READINGS FOR GRINDSTONE CREEK
See plates 31 - 38 for curves of gage heights

DAY	1908			1909				
	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY
1		0.89	1.42		1.53	1.38	1.24	
2		1.25	1.29		1.60	1.37	1.25	
3		1.18	1.25					
4		1.16	1.30	1.33	1.90			
5		1.15	1.38	1.31	2.20		1.15	
6		1.15	1.35		1.52	1.25	1.30	
7		1.15	1.30	1.15	1.60	1.28		
8		1.15	1.24	1.19	1.48	1.28	1.20	
9		1.16	1.22	1.20	1.73	1.96	1.20	
10	0.74	1.12	1.23	1.20		1.65	1.20	
11	0.70	1.15	1.23		1.41	1.44		
12	0.68	1.14	1.23		1.73		1.93	
13	0.65	1.13	1.21		1.55	1.39	1.62	
14	0.62	1.13	1.20		3.48	1.33	1.47	
15	0.57	1.12	1.20		1.89	1.30	1.40	
16	0.53	1.13	1.20		1.72		1.34	
17	0.49	1.10	1.19					
18	0.43	1.12	1.17	1.15	2.20	1.29	1.28	
19	0.49	1.12	1.17	1.06	2.12		1.42	
20	0.53	1.11	1.16		1.91	1.27	1.60	
21	0.55	1.11	1.15	1.50	1.82	1.26	2.42	
22	0.52	1.12		1.44	1.62	1.26	1.73	
23	0.52	1.17		1.46	1.91	1.25	1.54	
24	1.18	1.78		1.39	1.81	1.34	1.45	
25	1.59	2.24			1.50		1.40	
26	1.60	1.50		1.30	1.47		1.35	
27	1.05	1.37			1.40	1.35		
28	1.03	1.30		3.33	1.40	1.30		
29	1.03	2.31		2.40			1.27	
30		1.73		2.00		1.25	1.25	
31	1.00		1.55	1.65				

TABLE XX
 DAILY DISCHARGE FOR HINKSON CREEK
 CU.FT. PER SEC.
 See Plates 25-31 for Discharge curve

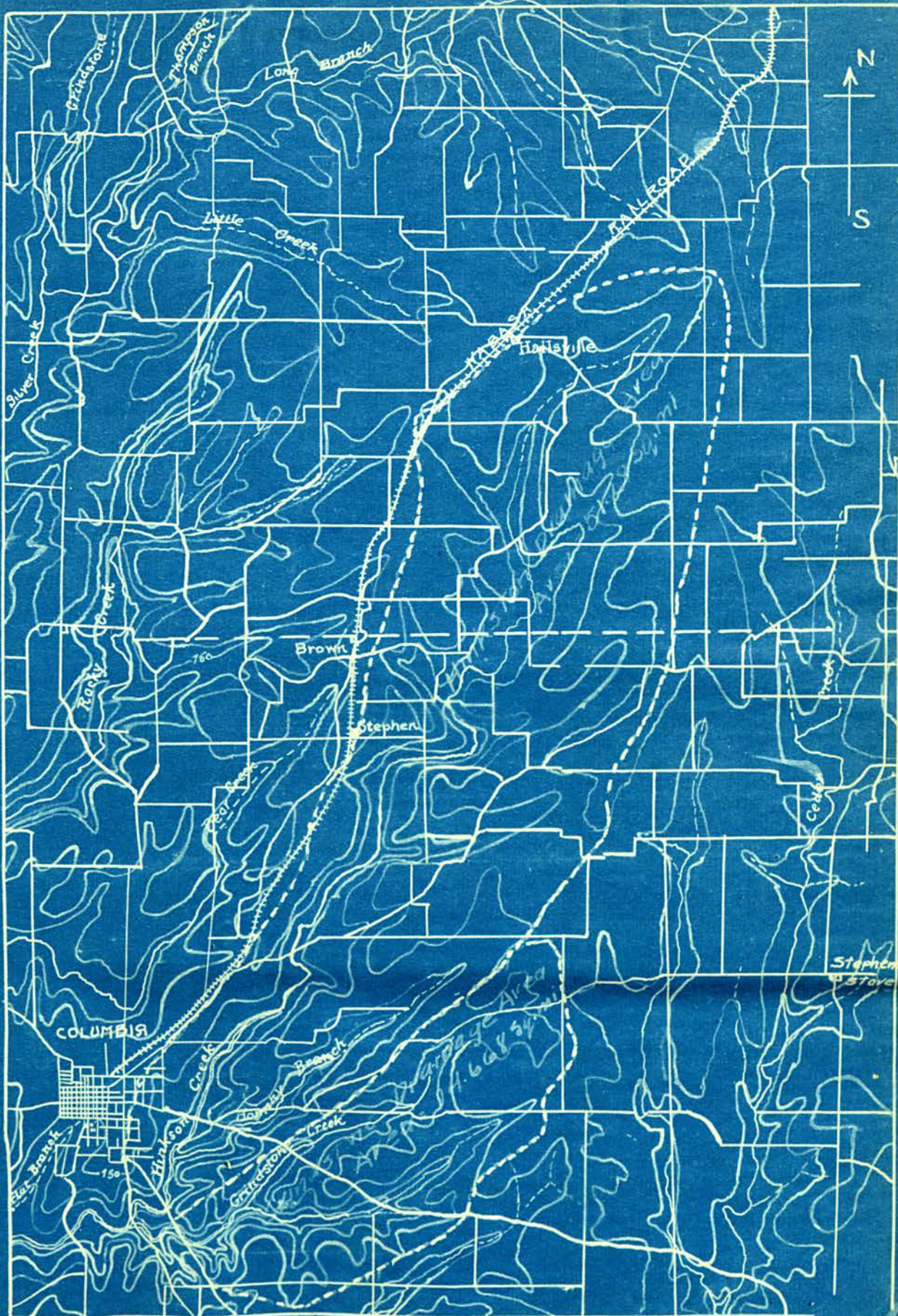
DAY	1908			1909				
	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY
1		3.0	50.0	30.0	36.0	16.0	8.0	
2		11.0	11.6	20.0	32.0	14.0	8.0	
3		7.0	8.5	12.0	66.0	14.0	7.0	
4		6.0	10.0	12.0	100.0	13.0	5.0	
5		6.0	9.3	12.0	316.0	13.0	4.0	
6		5.5	9.3	9.0	60.0	12.0	16.0	
7		5.5	8.7	7.0	60.0	12.0	13.0	
8		6.0	8.7	4.0	50.0	12.0	10.0	
9		6.0	8.7	4.0	125.0	182.0	8.0	
10	3.0	5.0	7.0	4.0	69.0	72.0	6.0	
11	3.0	4.0	8.0	4.0	28.0	44.0	5.0	
12	2.5	4.0	8.5	4.0	29.0	31.0	50.0	
13	2.0	4.0	7.0	4.0	47.0	22.0	68.0	
14	2.0	4.0	8.0	3.0	1018.0	18.0	38.0	
15	2.0	4.0	6.0	3.0	74.0	16.0	20.0	
16	1.5	4.0	6.0	3.0	76.0	15.0	12.0	
17	1.5	4.0	6.0	3.0	70.0	13.0	10.0	
18	2.0	4.0	4.5	2.5	64.0	12.0	8.0	
19	2.0	4.0	4.5	2.0	276.0	10.0	164	
20	2.0	4.0	4.0	8.0	108.0	9.0	124.0	
21	2.0	4.0	4.0	20.0	114.0	8.0	686.0	
22	2.0	4.0	4.0	20.0	87.0	8.0	84.0	
23	1.5	24.0	4.0	22.0	359.0	9.0	42.0	
24	4.0	50.0	4.0	20.0	112.0	9.0	37.0	
25	5.0	74.0	4.0	15.0	52.0	13.0	20.0	
26	5.5	52.0	4.0	10.0	34.0	16.0	15.0	
27	4.0	20.0	4.0	9.0	29.0	20.0	14.0	
28	4.0	12.0	4.0	720.0	24.0	9.5	10.0	
29	4.0	42.0	4.0	108.0		8.5	8.0	
30	4.0	92.0	4.0	78.0		8.0	16.0	
31	4.0		50.0	44.0		8.0		
SUMS	63.5	475.0	284.3	1261.5	3513.0	667.0	1516.0	

TABLE XXI
 DAILY DISCHARGE FOR GRINDSTONE CREEK
 CU.FT. PER SEC.
 See Plates 32-38 for Discharge curve

DAY	1908			1909				
	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY
1		0.1	4.4	4.4	6.6	3.6	2.4	
2		2.0	2.6	3.6	8.0	3.6	2.2	
3		1.2	1.9	3.2	12.6	3.0	2.2	
4		1.2	2.6	2.5	18.8	2.6	2.0	
5		1.1	3.3	2.5	41.0	2.2	1.6	
6		1.0	2.9	1.8	6.4	1.8	2.6	
7		0.8	2.6	1.2	8.0	2.0	2.4	
8		0.8	1.8	1.5	5.2	2.0	2.2	
9		0.9	1.8	1.5	12.8	5.7	2.2	
10	1.0	0.9	1.8	1.5	6.6	9.5	1.9	
11	1.0	0.9	1.8	1.5	4.0	4.8	3.2	
12	0.8	0.8	1.8	1.4	12.8	4.1	21.6	
13	0.7	0.8	1.7	1.3	7.2	3.5	10.4	
14	0.5	0.8	1.4	1.2	22.4.0	2.8	5.7	
15	0.3	0.8	1.4	1.2	19.4	2.1	4.0	
16	0.1	0.8	1.4	1.2	12.2	2.0	3.2	
17	0.0	0.8	1.4	1.1	19.1	2.0	3.0	
18	0.1	0.8	1.3	1.0	40.8	2.0	2.5	
19	0.2	0.8	1.1	0.8	29.8	1.9	2.4	
20	0.3	0.8	1.1	0.8	20.2	1.8	8.8	
21	0.5	0.8	1.0	6.0	16.8	1.8	66.0	
22	0.3	0.8	0.9	4.8	8.8	1.8	12.8	
23	0.3	1.2	0.9	5.2	19.6	1.6	6.6	
24	1.2	14.6	0.9	3.4	16.0	2.8	4.8	
25	8.8	46.0	0.9	2.8	5.7	2.8	4.0	
26	9.0	6.6	0.8	2.4	6.4	2.9	3.6	
27	0.8	3.2	0.8	41.6	3.7	3.0	3.1	
28	0.7	2.4	0.8	222.0	3.7	2.2	2.8	
29	0.5	50.4	0.8	52.0		2.0	2.2	
30	0.5	12.4	0.8	24.0		2.0	2.0	
31	0.3		7.2	12.2		1.9		
SUMS	27.9	156.6	55.9	412.6	594.2	87.8	194.4	

MAP OF WATERSHEDS

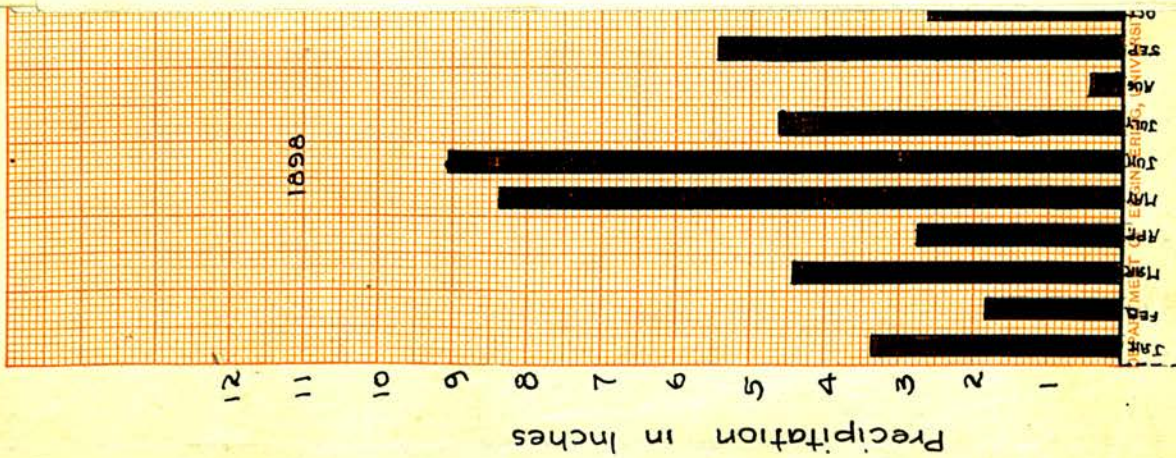
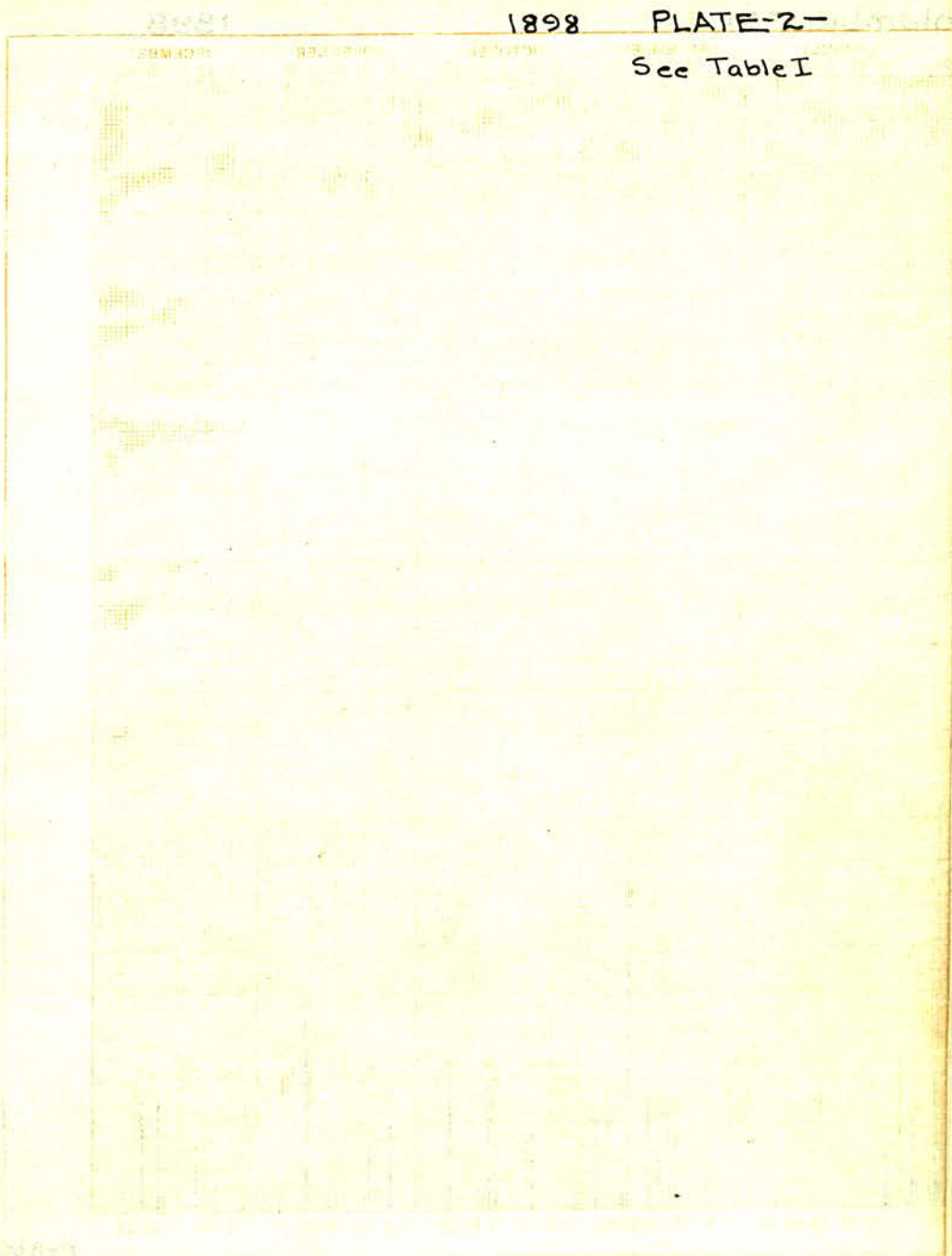
PLATE I



See Table I

Precipitation in Inches

5.0
4.0
3.0
2.0
1.0
.8
.6
.4
.2

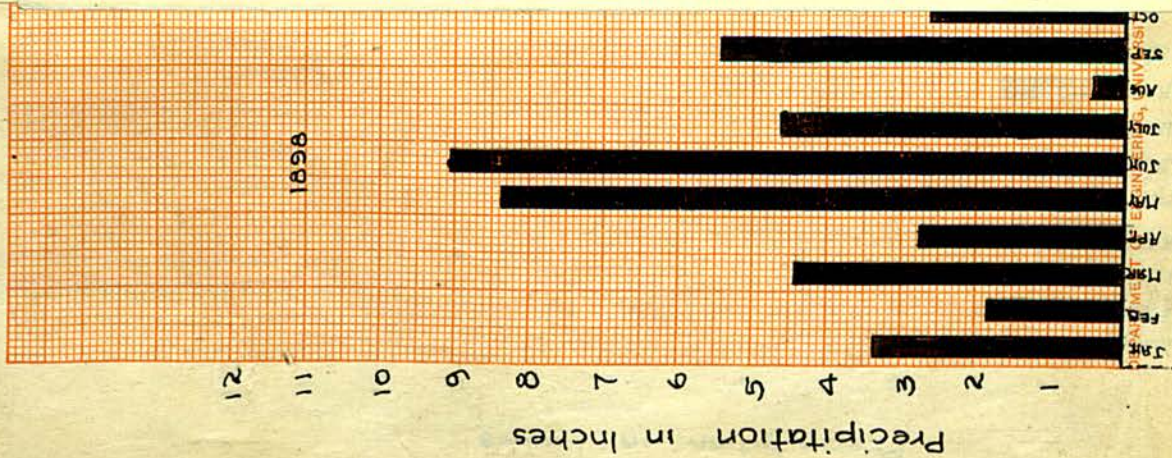
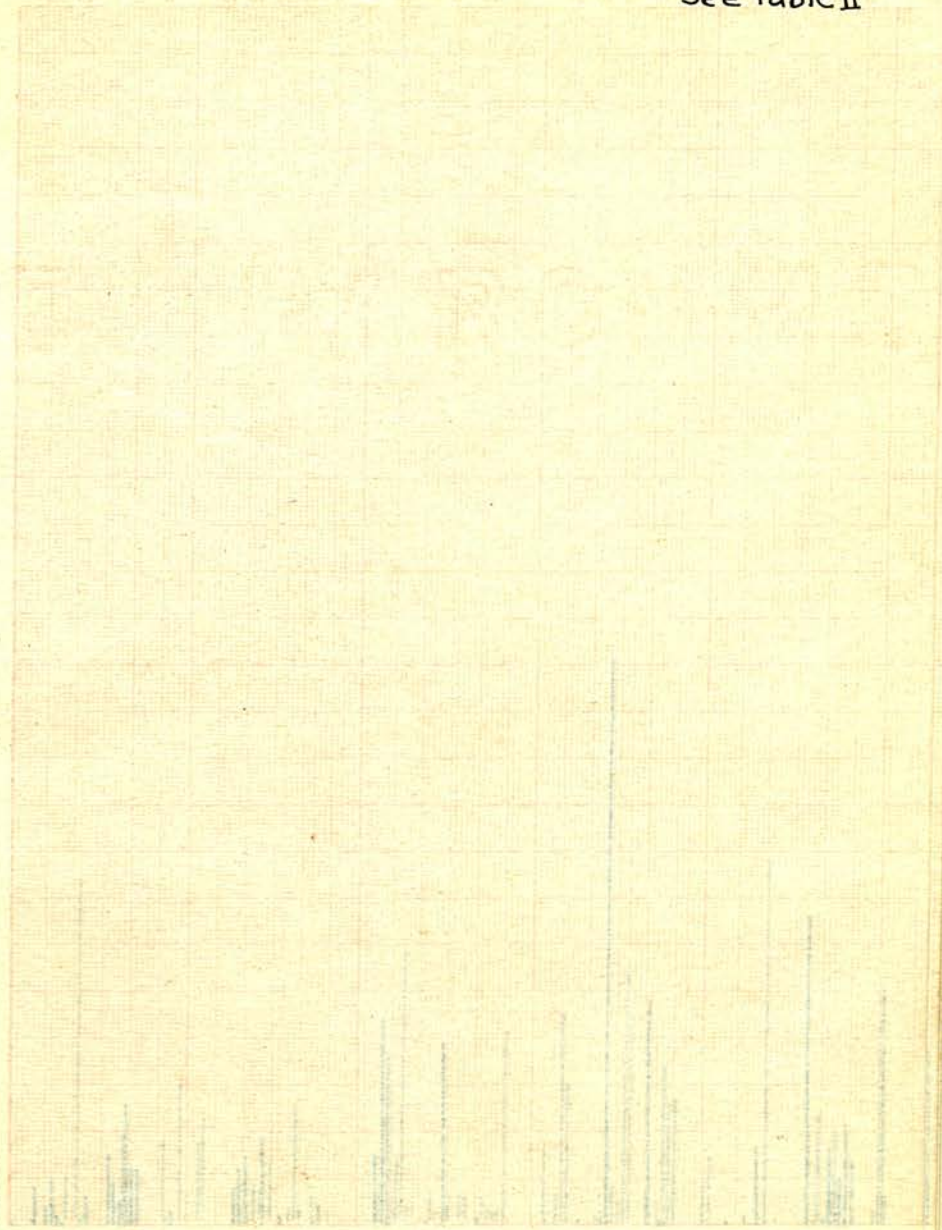


1898

1898

See Table II

Precipitation in Inches
5.0
4.0
3.0
2.0
1.0
.8
.6
.4
.2

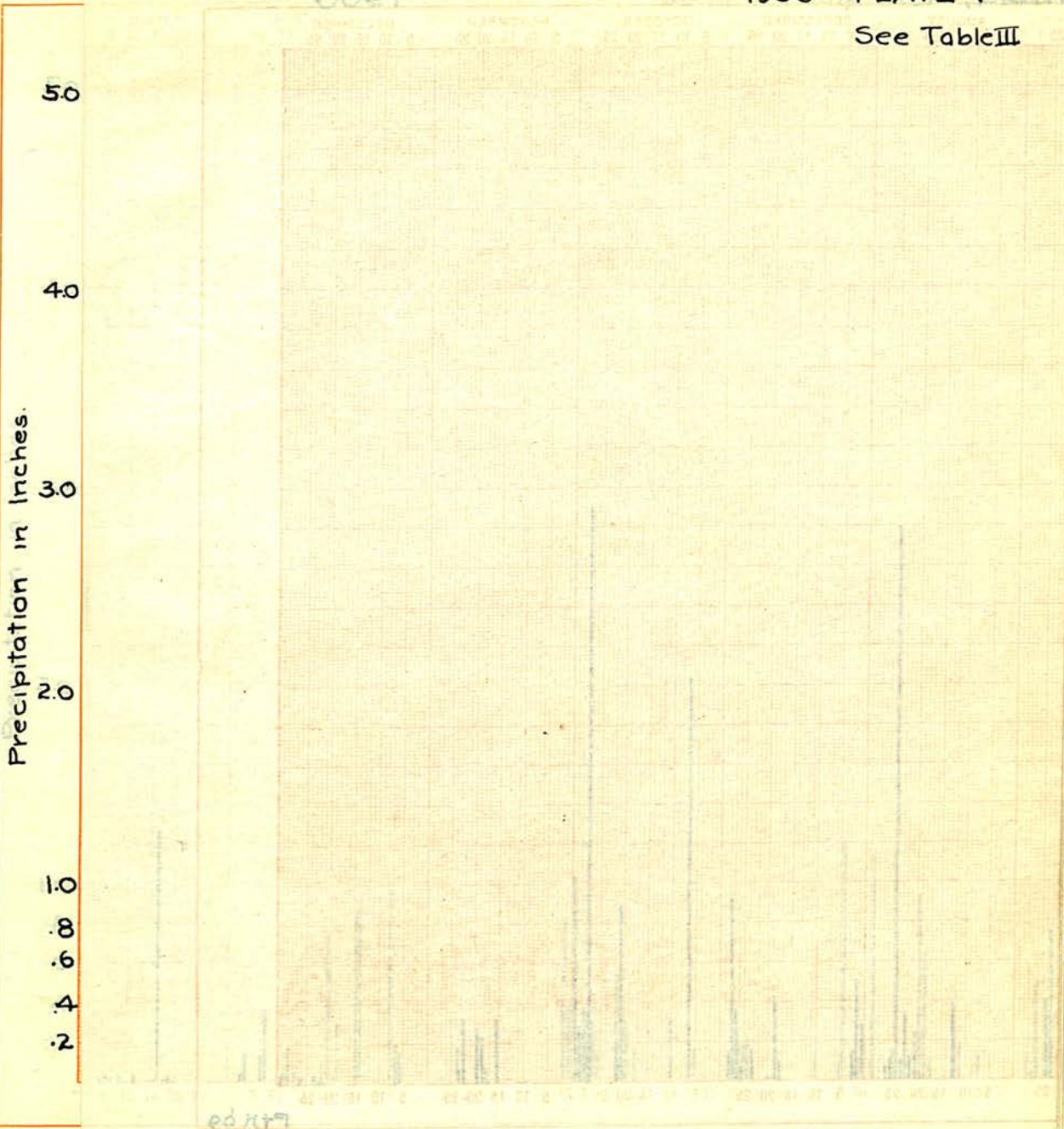


1898

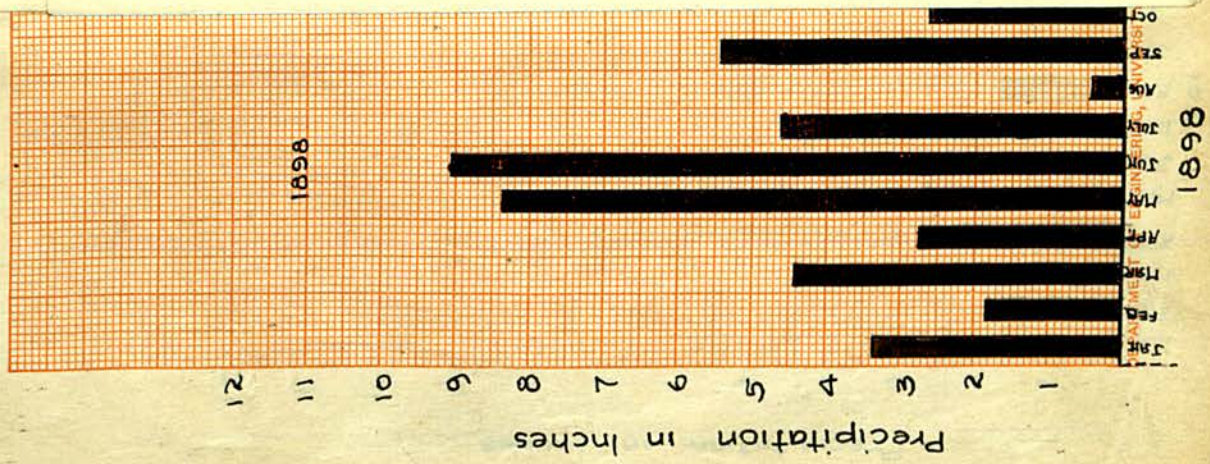
Precipitation in Inches
12
11
10
9
8
7
6
5
4
3
2
1
0

See Table III

1899



1899



1898

1898

1091

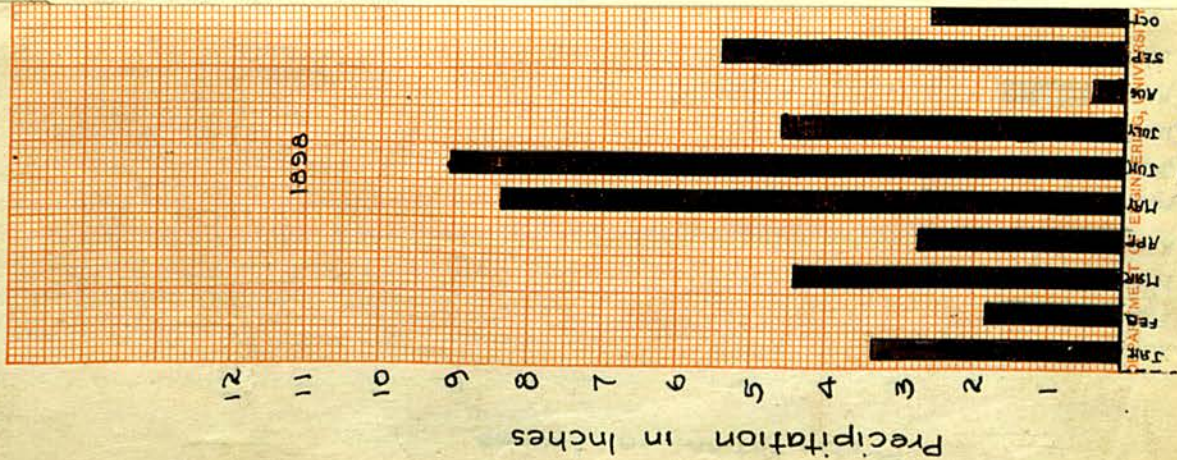
1901 PLATE-5-

See Table IV

Precipitation in Inches

5.0
4.0
3.0
2.0
1.0
.8
.6
.4
.2

1901



1901

Precipitation in Inches

12
11
10
9
8
7
6
5
4
3
2
1
0

1902

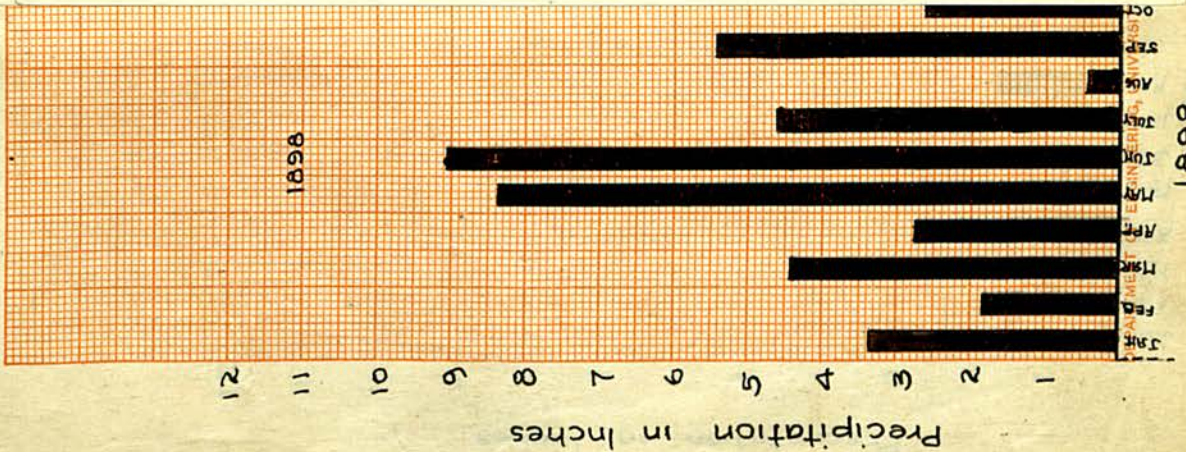
1902

PLATE-6

See Table Y

Precipitation in Inches
Precipitation in Inches
5.0
4.0
3.0
2.0
1.0
.8
.6
.4
.2

1902

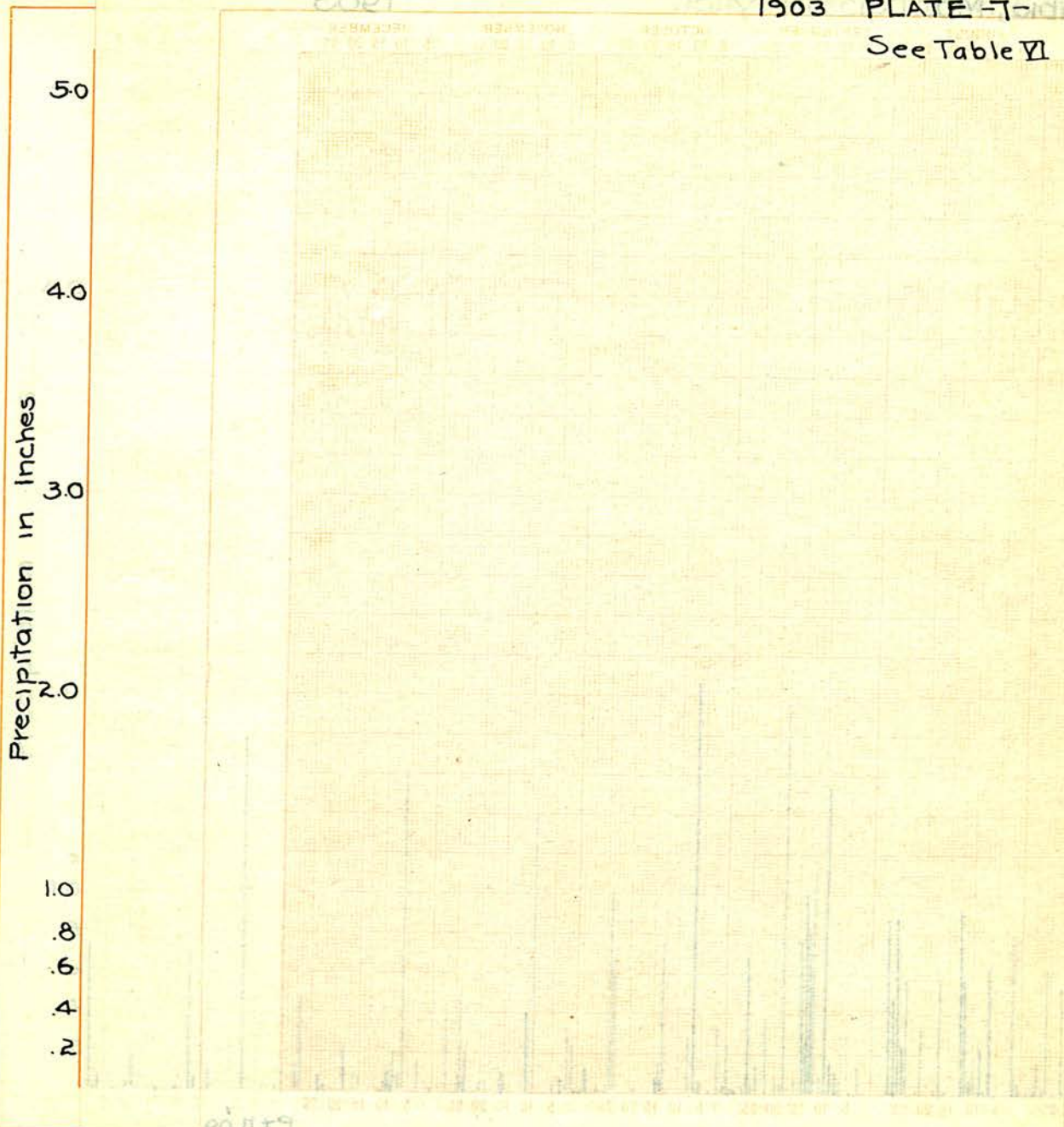


1898

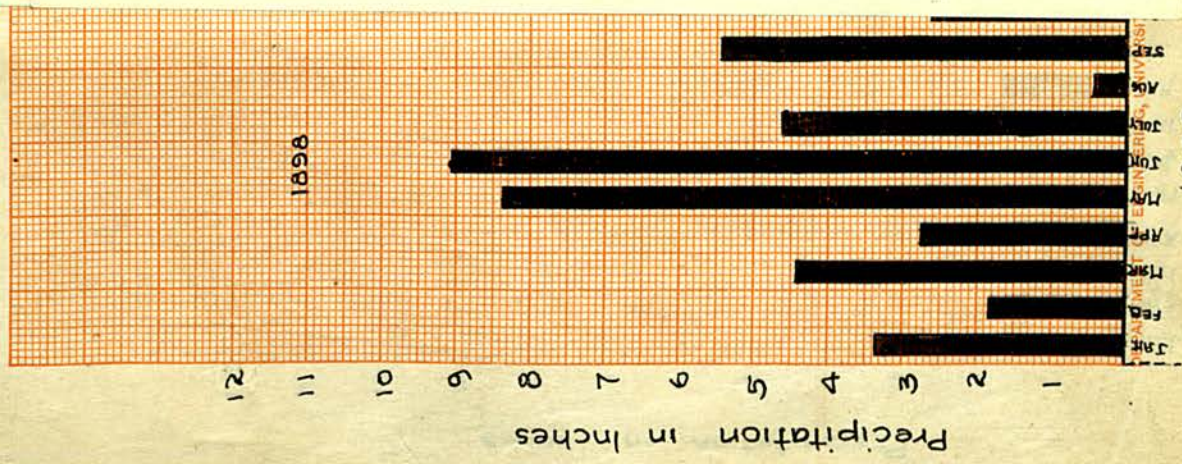
1898

See Table VI

5021



5021



1898

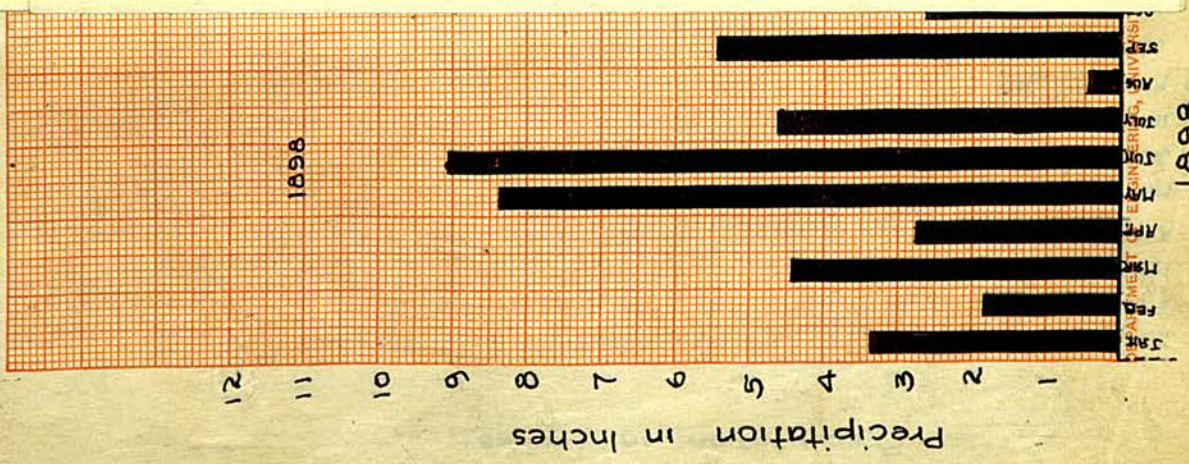
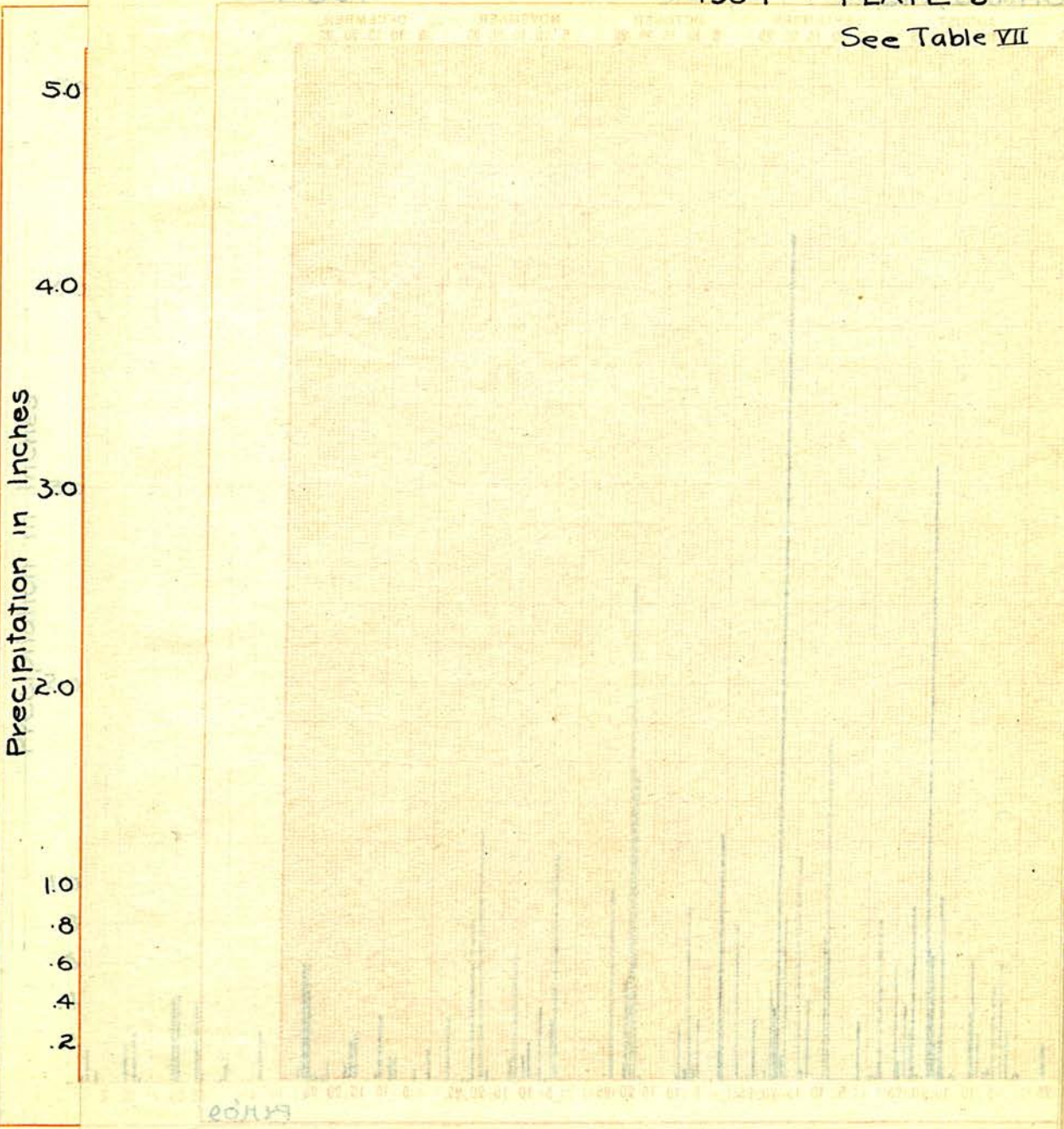
Precipitation in Inches

1898

1904

PLATE-8-

See Table VII



1901

1891

1898

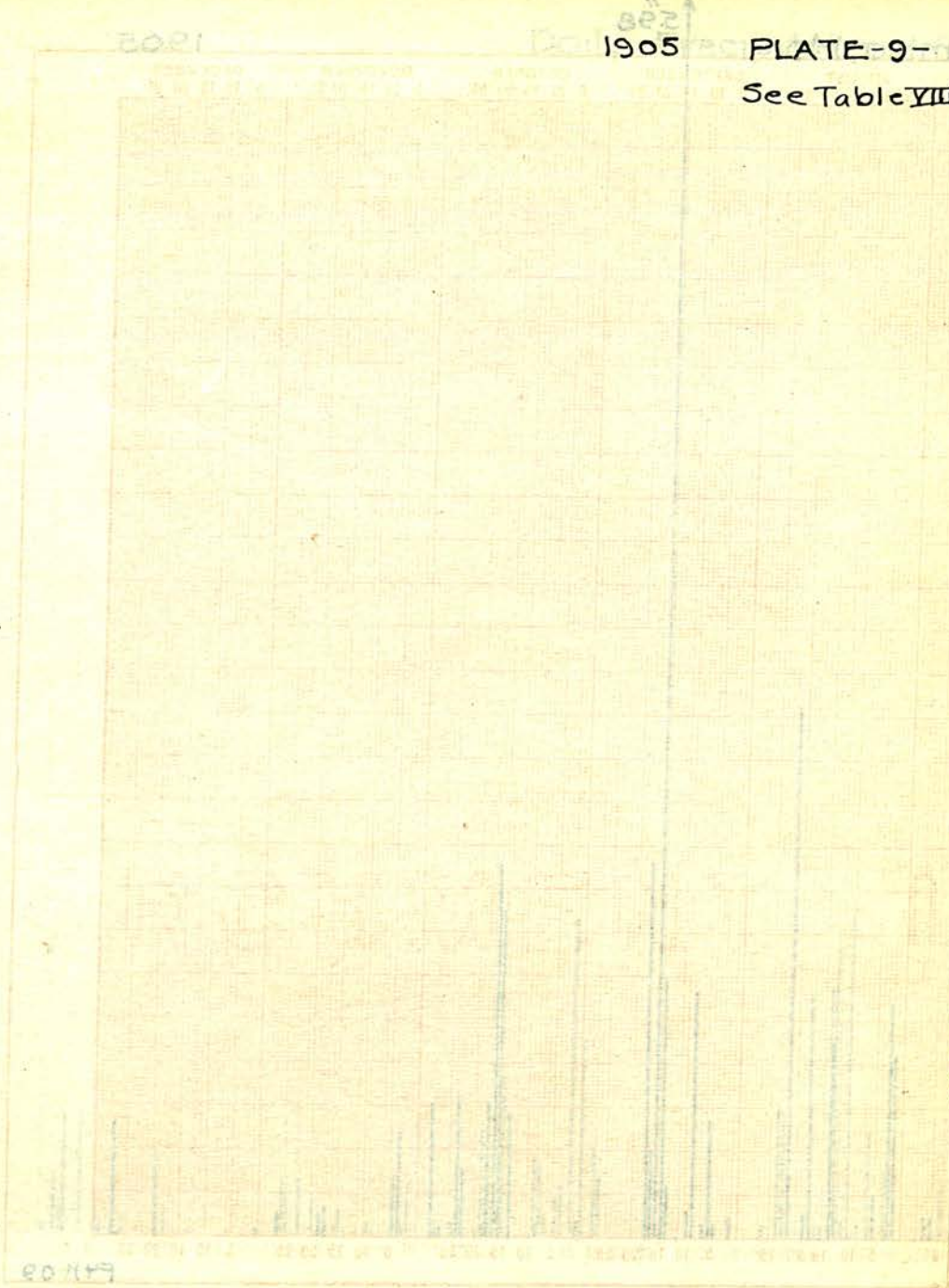
1905

PLATE-9-

See Table VIII

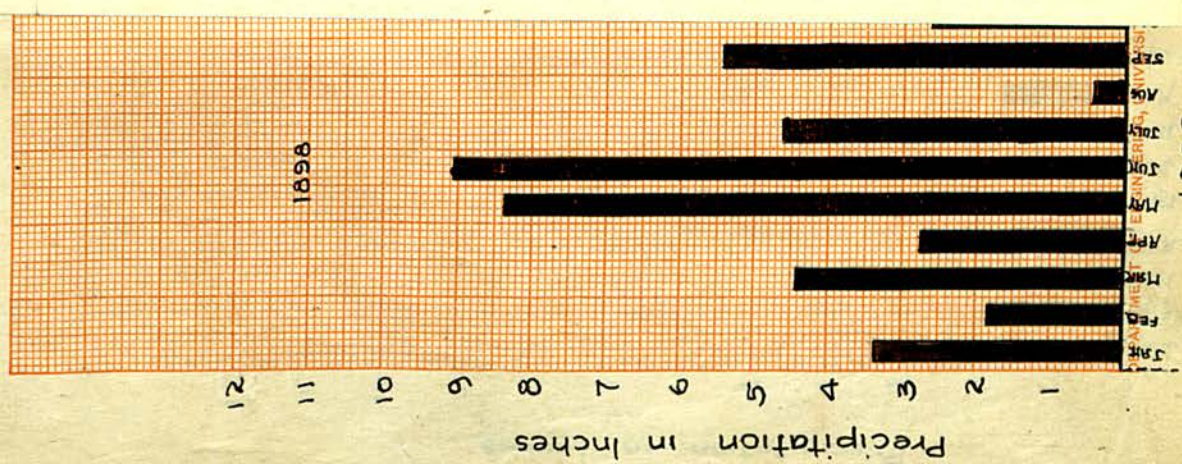
Precipitation in Inches

5.0
4.0
3.0
2.0
1.0
.8
.6
.4
.2



1900

1899



1898

Precipitation in Inches

12
11
10
9
8
7
6
5
4
3
2
1

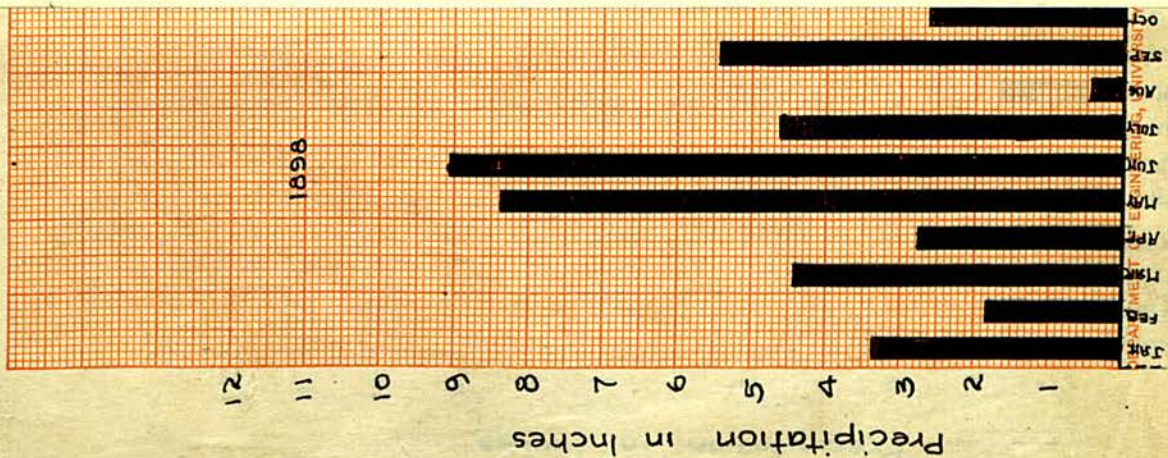
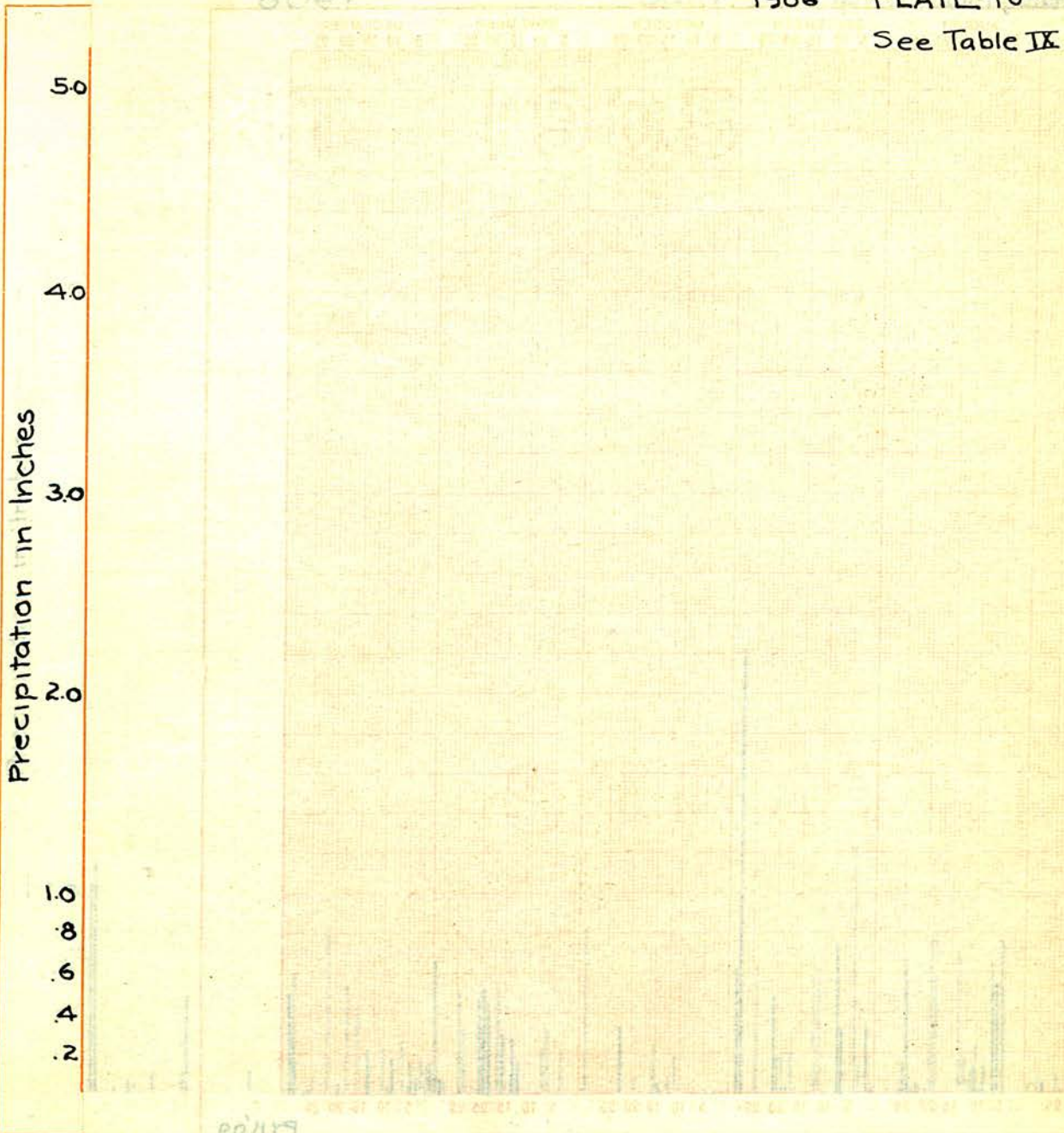
SEP
AUG
JULY
JUN
MAY
APR
MARCH
FEB
JAN

8691

Daily 1906

PLATE-10

See Table IX



1907

1907

PLATE - 11

See Table X

Precipitation in Inches

5.0
4.0
3.0
2.0
1.0
.8
.6
.4
.2

1908

1908

Precipitation in Inches

12
11
10
9
8
7
6
5
4
3
2
1

JAN
FEB
MAR
APR
MAY
JUN
JULY
AUG
SEP
OCT

1908

1907

1907

1908

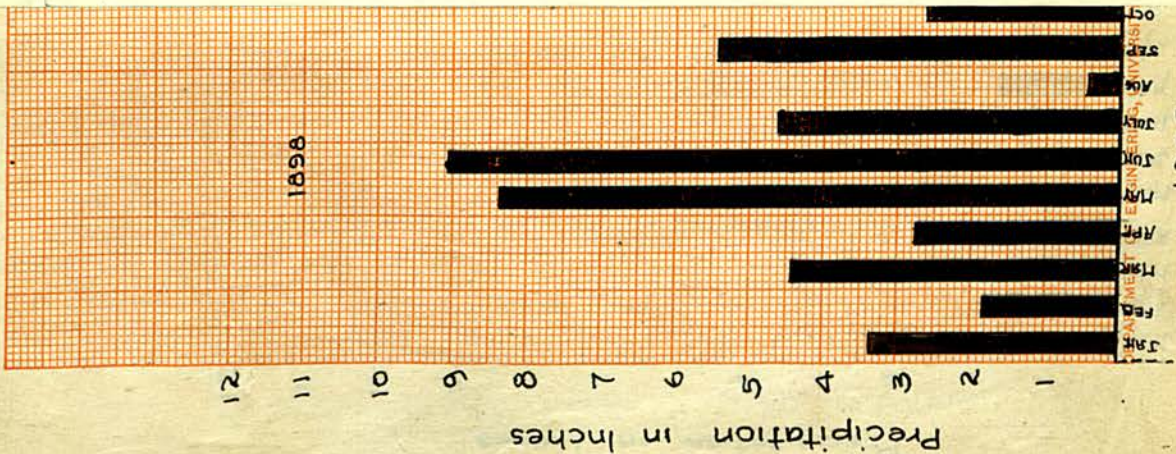
PLATE-12-

See Table XI

Precipitation in Inches

5.0
4.0
3.0
2.0
1.0
.8
.6
.4
.2

1898



1898

Precipitation in Inches

12
11
10
9
8
7
6
5
4
3
2
1
0

Precipitation in Inches
 Monthly Precipitation, Columbia, Mo.

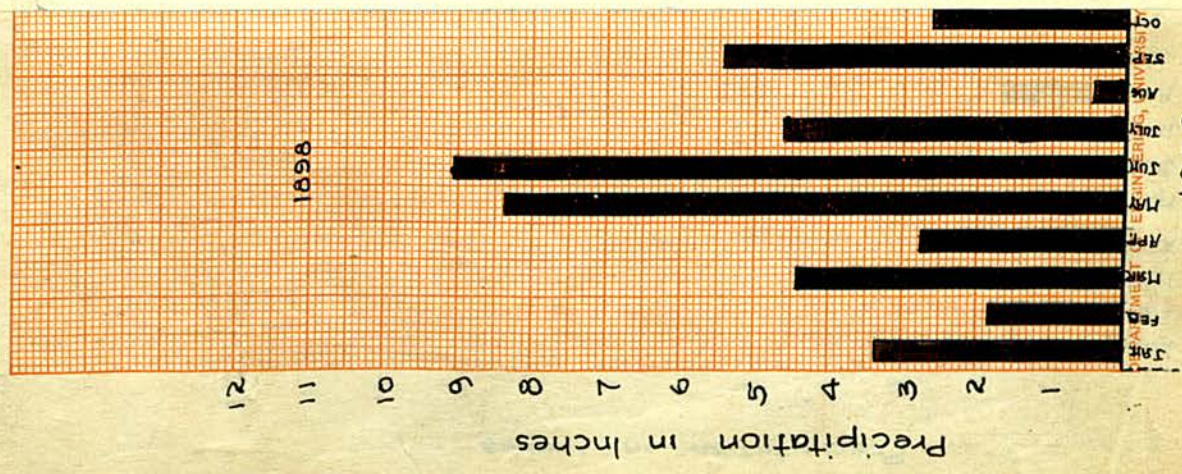
5.0
4.0
3.0
2.0
1.0
0.6
0.4
0.2

1909

1909

PLATE 13
 See Table XII

1900
1901



1898

1898

10

Monthly Precipitation, Columbia, Mo.

1898 - 1899 - 1900

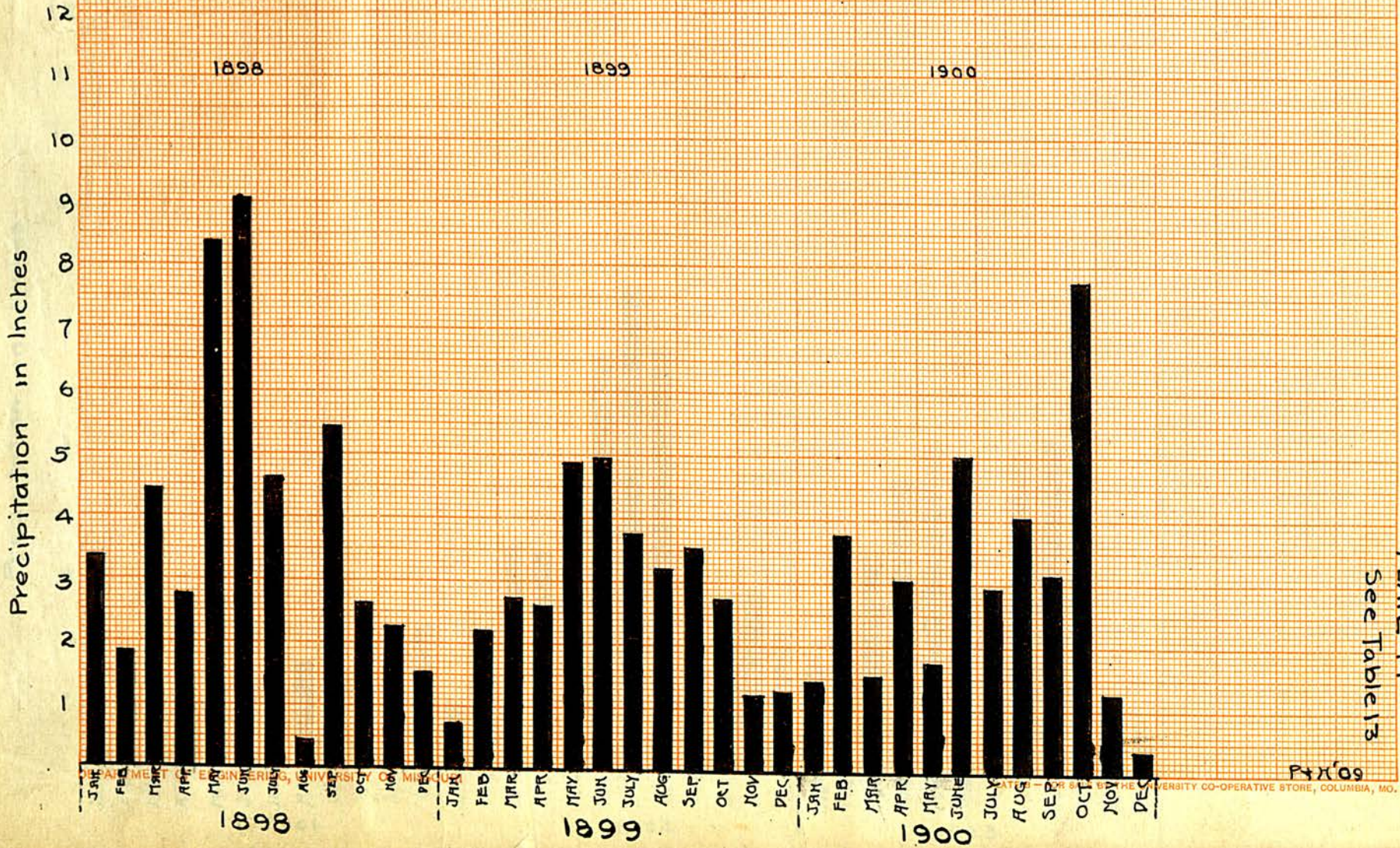


PLATE-14--
See Tables 13

1909
UNIVERSITY CO-OPERATIVE STORE, COLUMBIA, MO.

Monthly Precipitation, Columbia, Mo. 1901-1902-1903

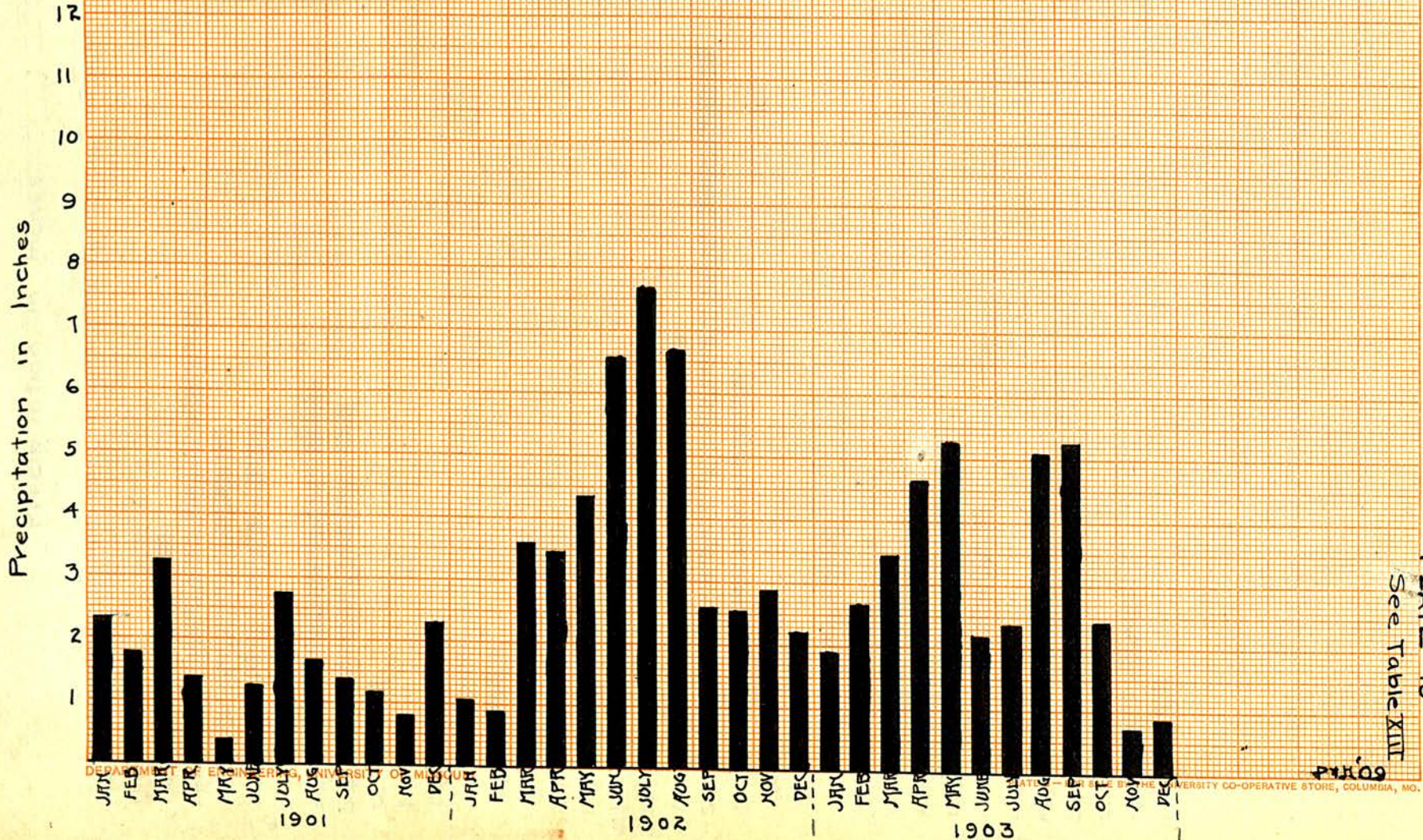
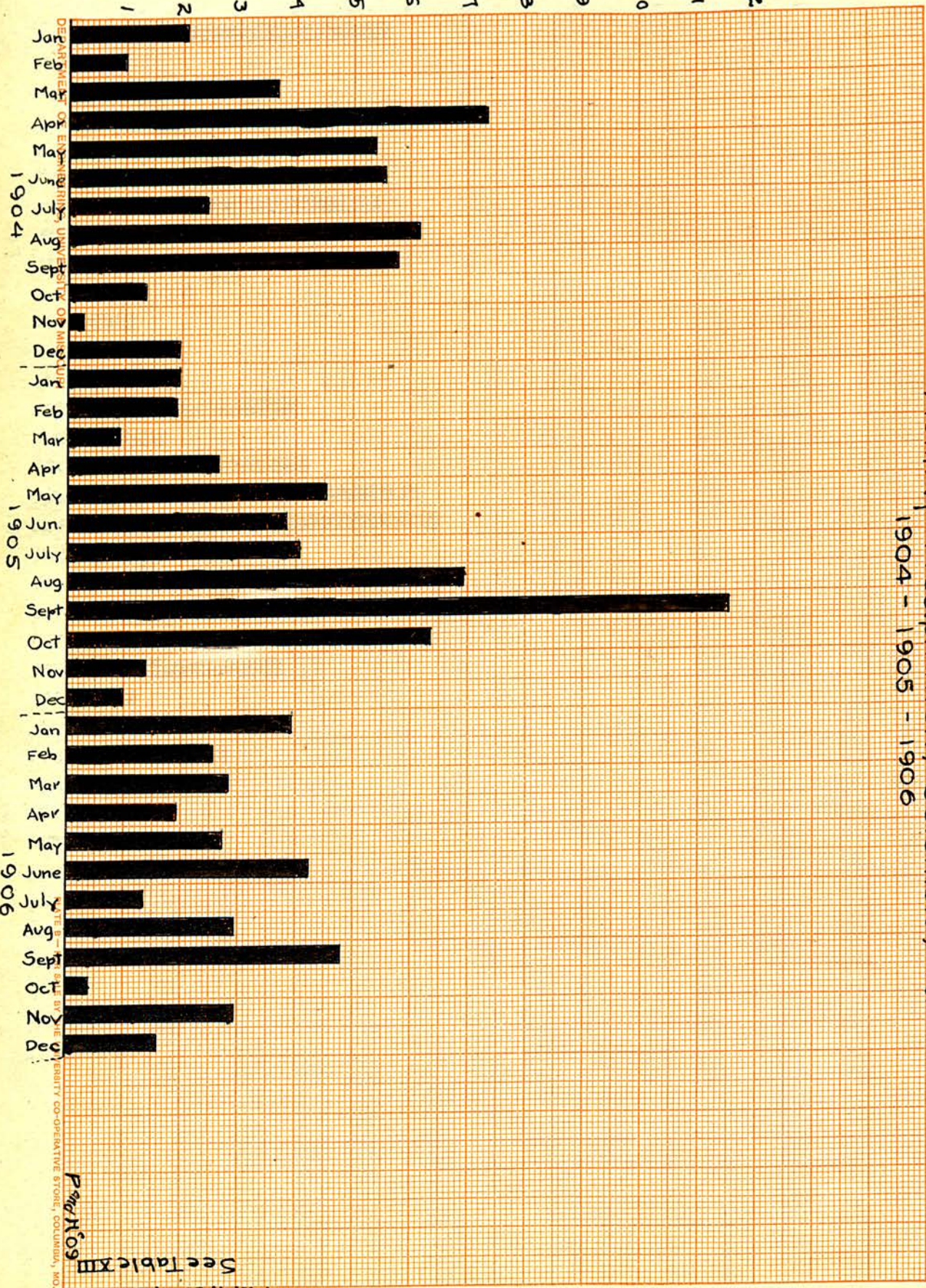


PLATE - 15 -
See Table XIII

1903

Precipitation in Inches

1 2 3 4 5 6 7 8 9 10 11 12



Monthly Precipitation, Columbia, Mo.
1904 - 1905 - 1906

PLATE-16-

See Table XIII
P. H. H. '09

DEPARTMENT OF AGRICULTURE, BUREAU OF WEATHER, WASHINGTON, D. C.

Monthly Precipitation, Columbia, Mo. 1907-1908-1909

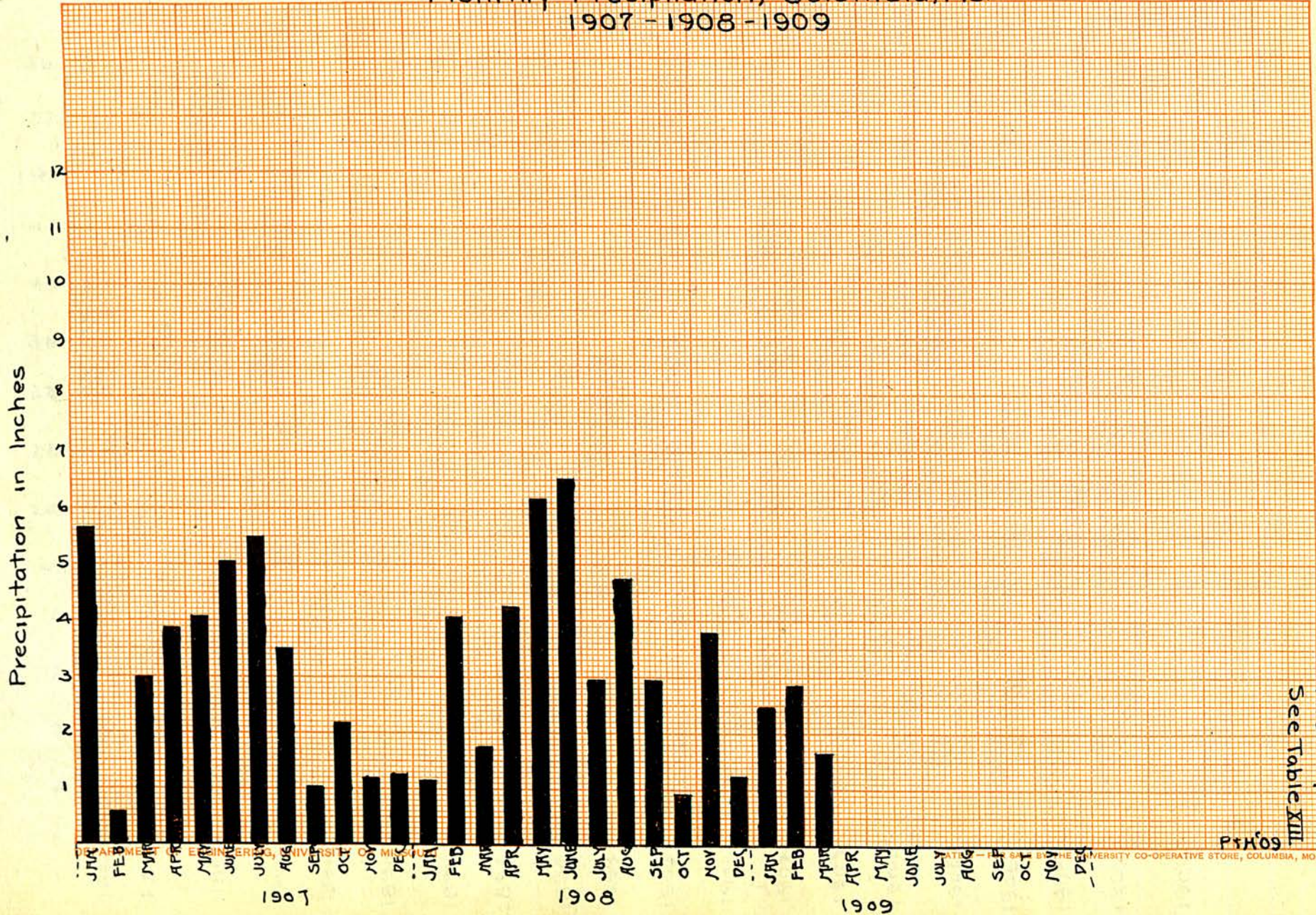


PLATE-17-
See Table XIII

Annual Precipitation, Columbia, Mo. 1890 - 1909

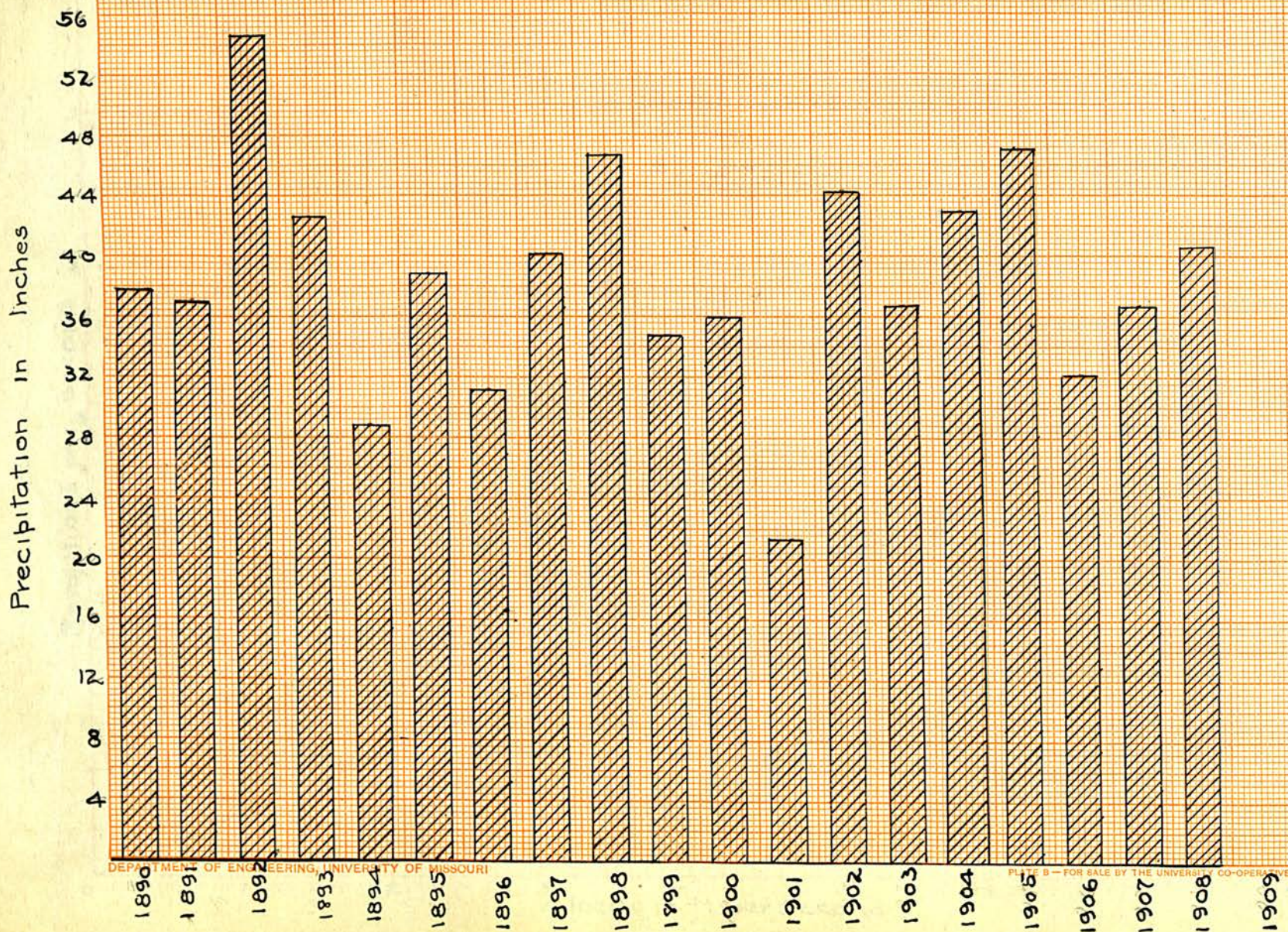


PLATE-18-
 See Table XIII
 6
 11
 11

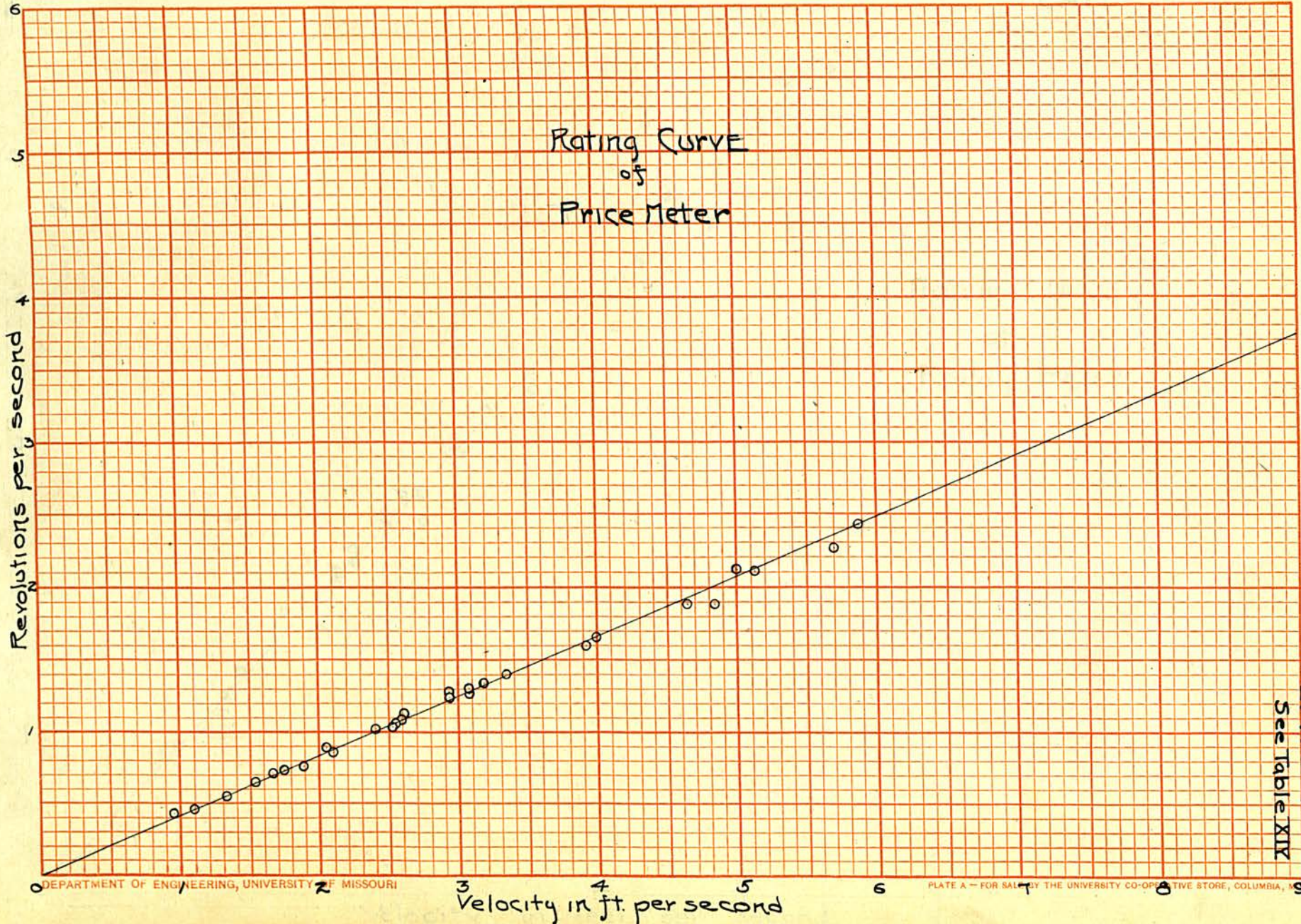
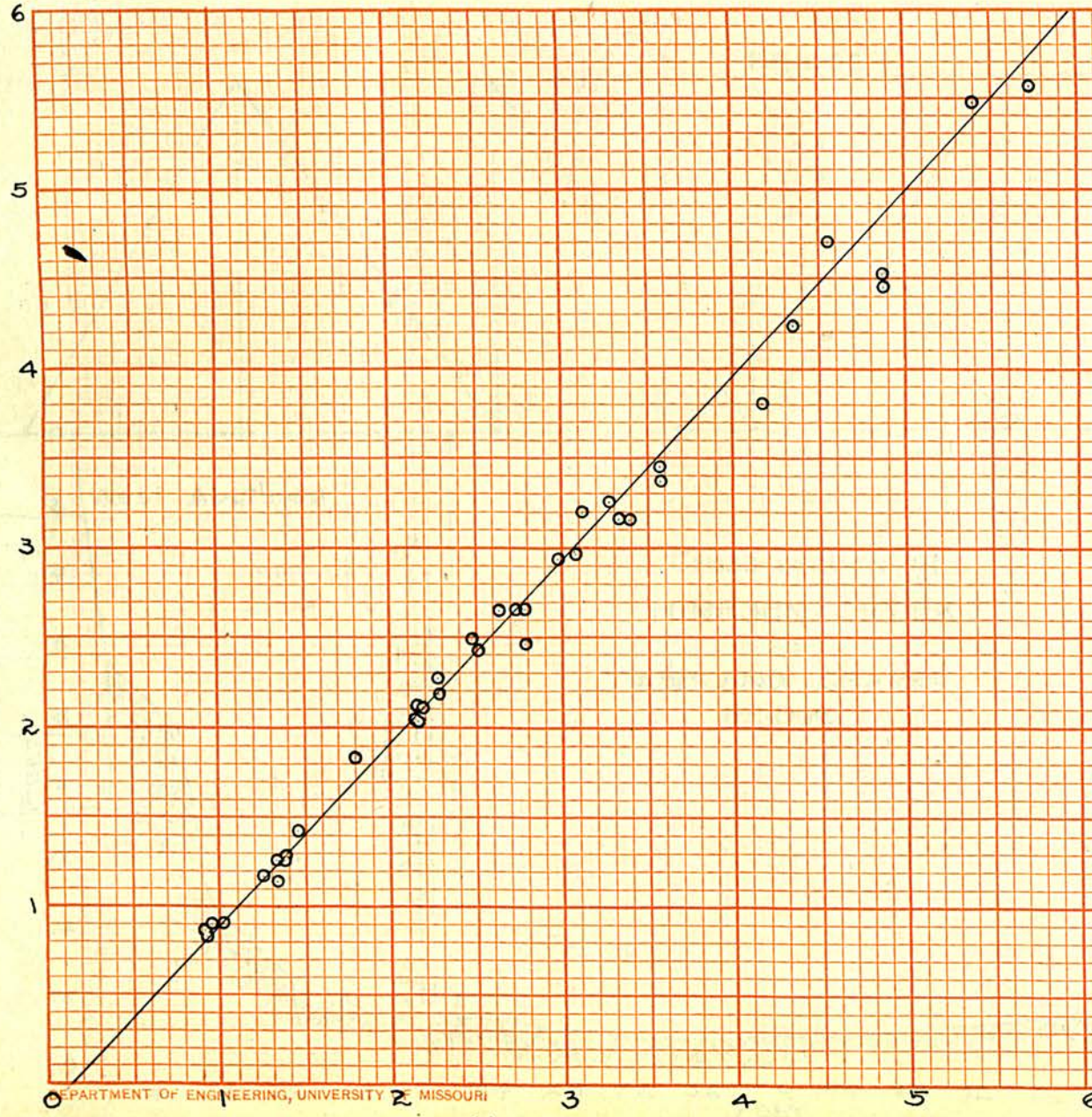


PLATE-19-
See Table XIV

Revolutions per second



Rating Curve
of
Fteley Meter

PLATE-20-
See Table XX

Velocity in feet per second

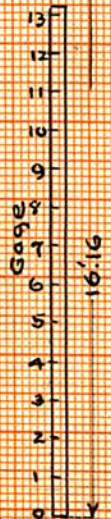
BRIDGE

West Abutment

EAST ABUTMENT

Cross-section of
HINKSON CREEK
at
ASHLAND GRAVEL
BRIDGE.

FEET

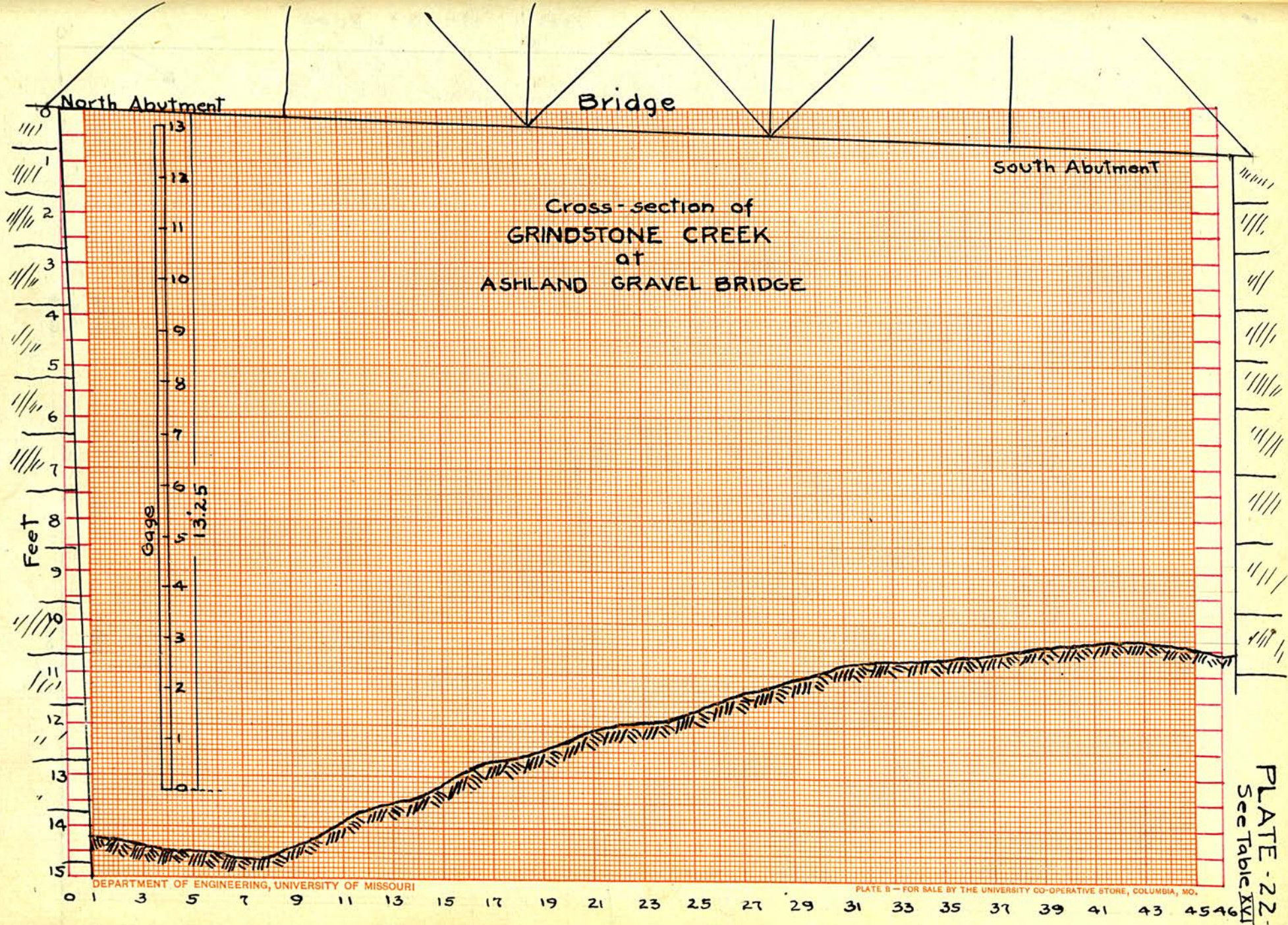


DEPARTMENT OF ENGINEERING, UNIVERSITY OF MISSOURI

FEET

PLATE 8 - FOR SALE BY THE UNIVERSITY CO-OPERATIVE STORE, COLUMBIA, MO.

PLATE-21-
See Table 16



DISCHARGE CURVES FOR HINKSON CREEK

October 1908 - April 1909 (inc)

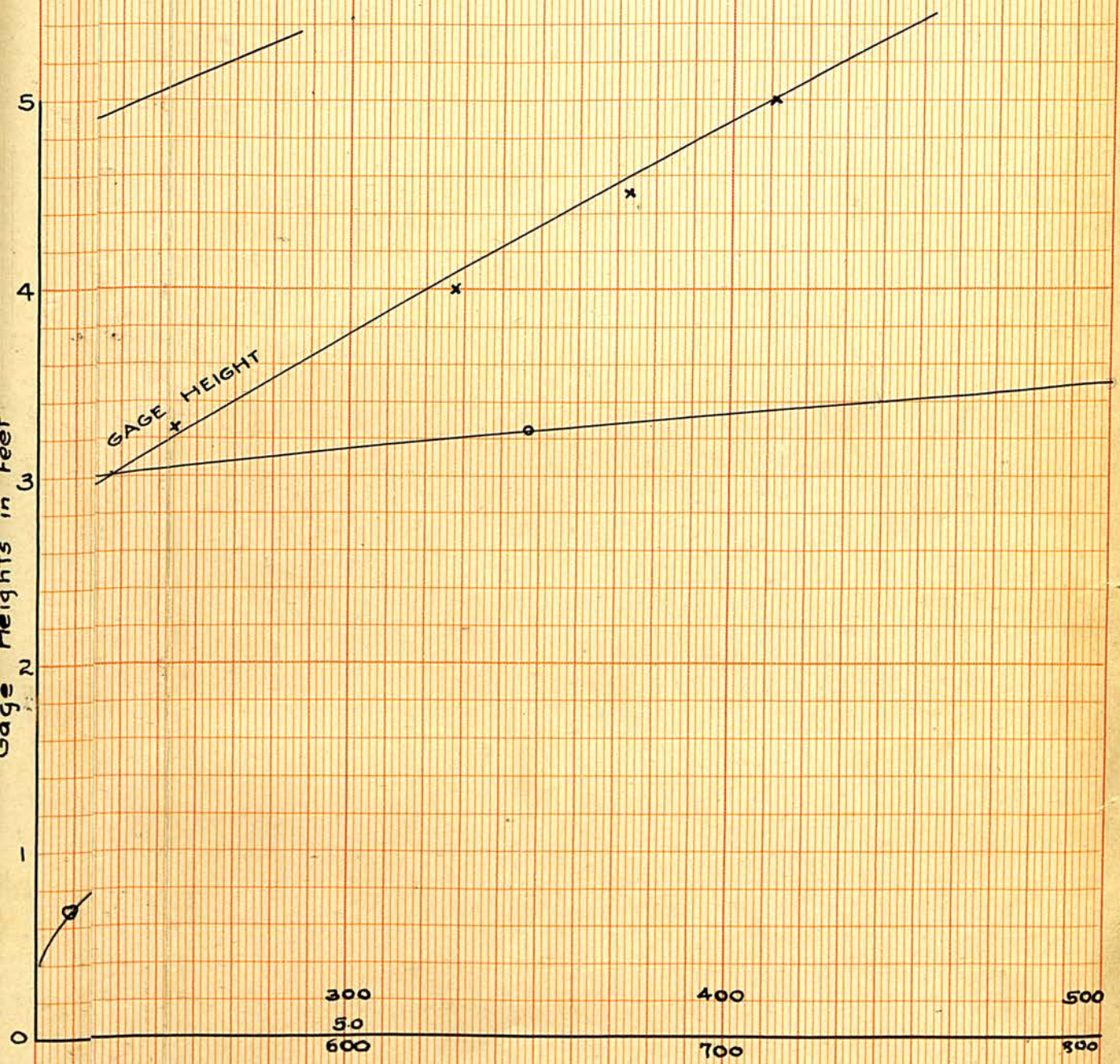
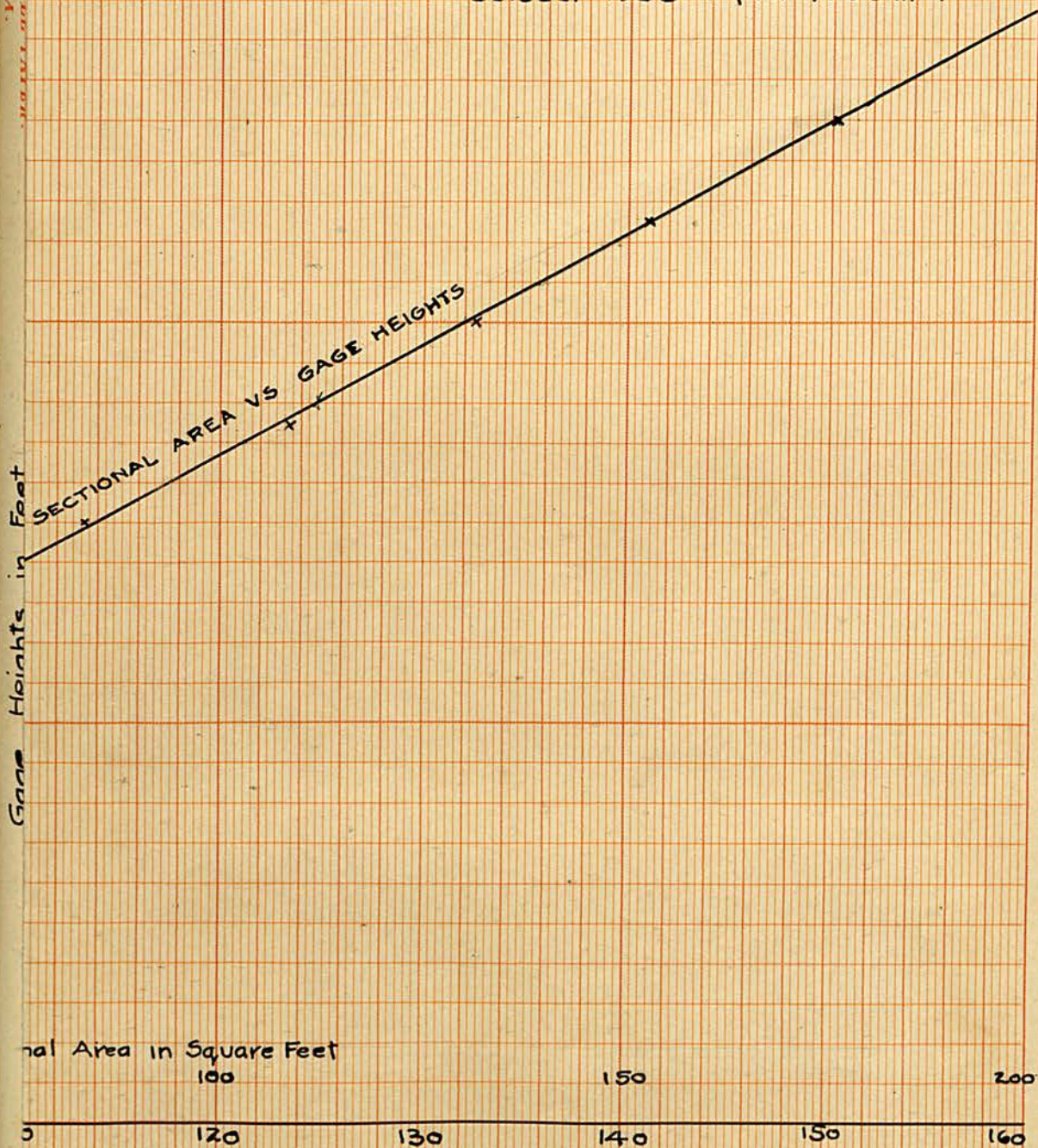


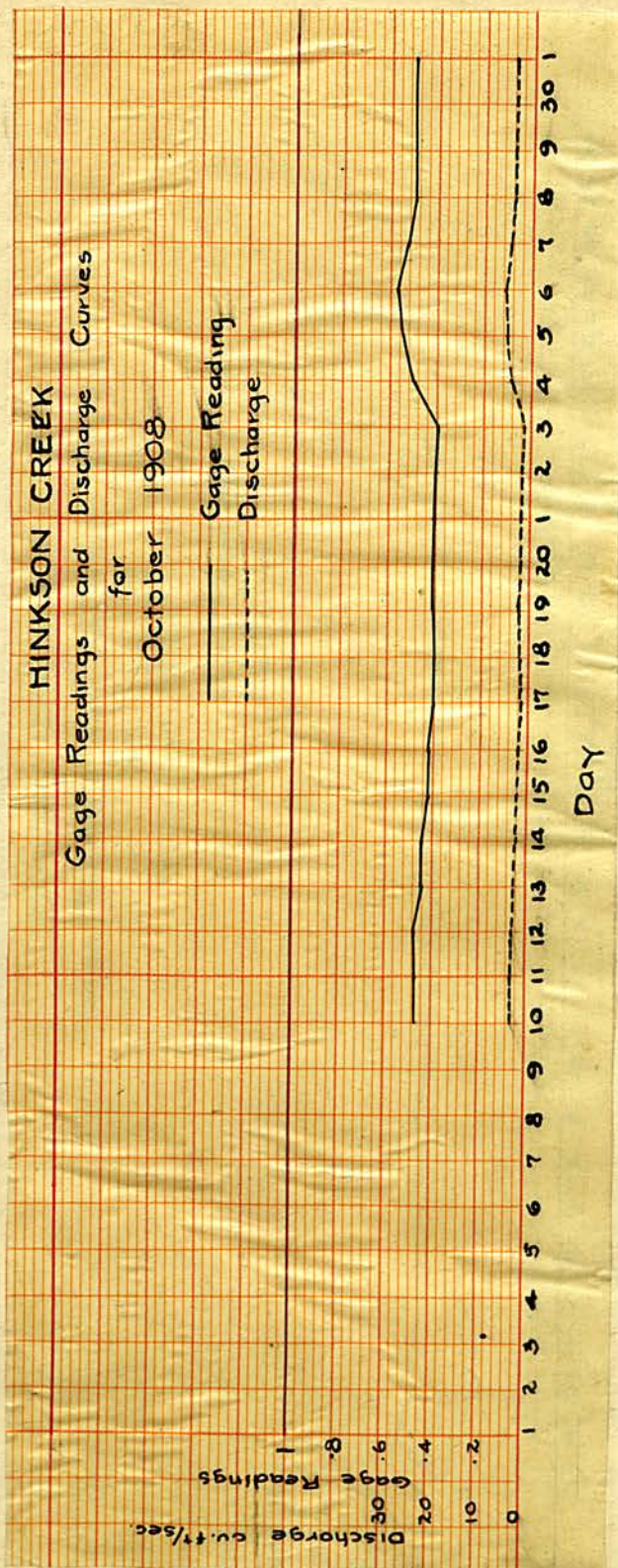
PLATE - 24-

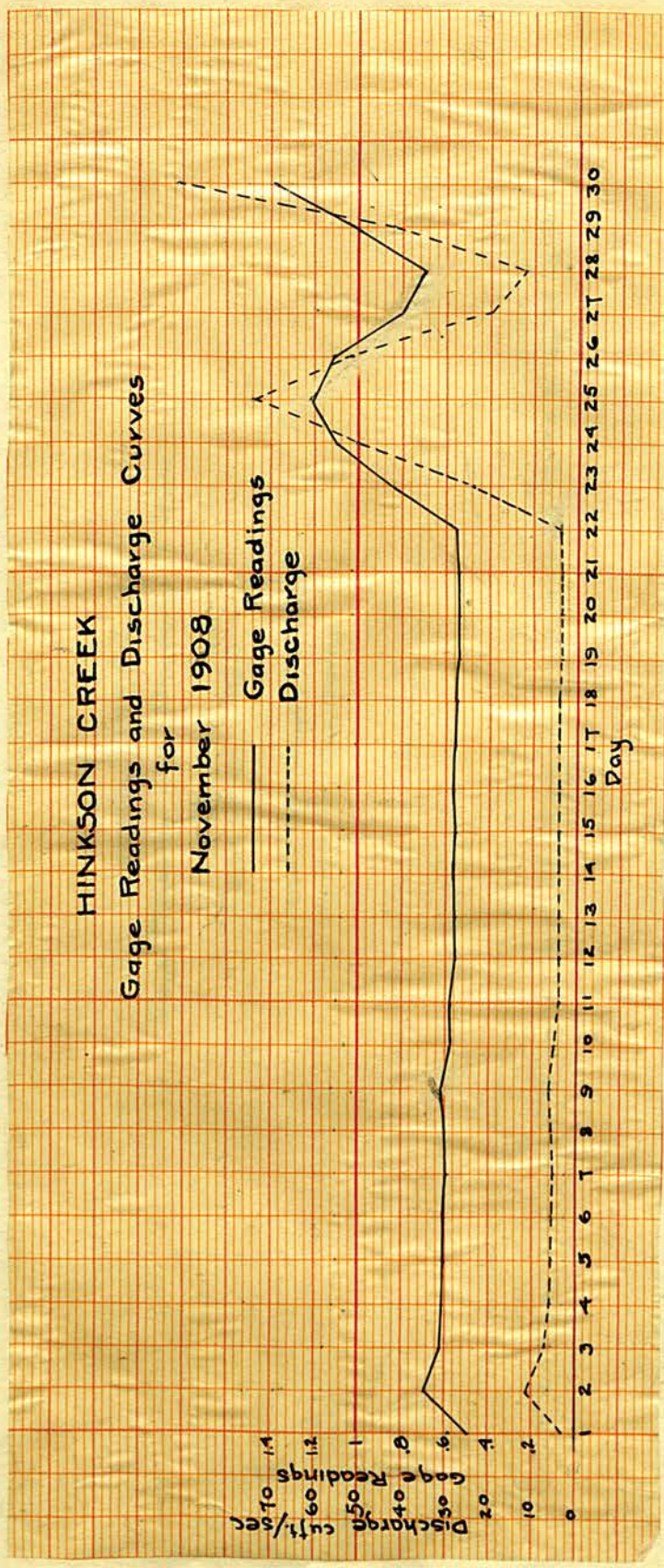
See Table XVIII a

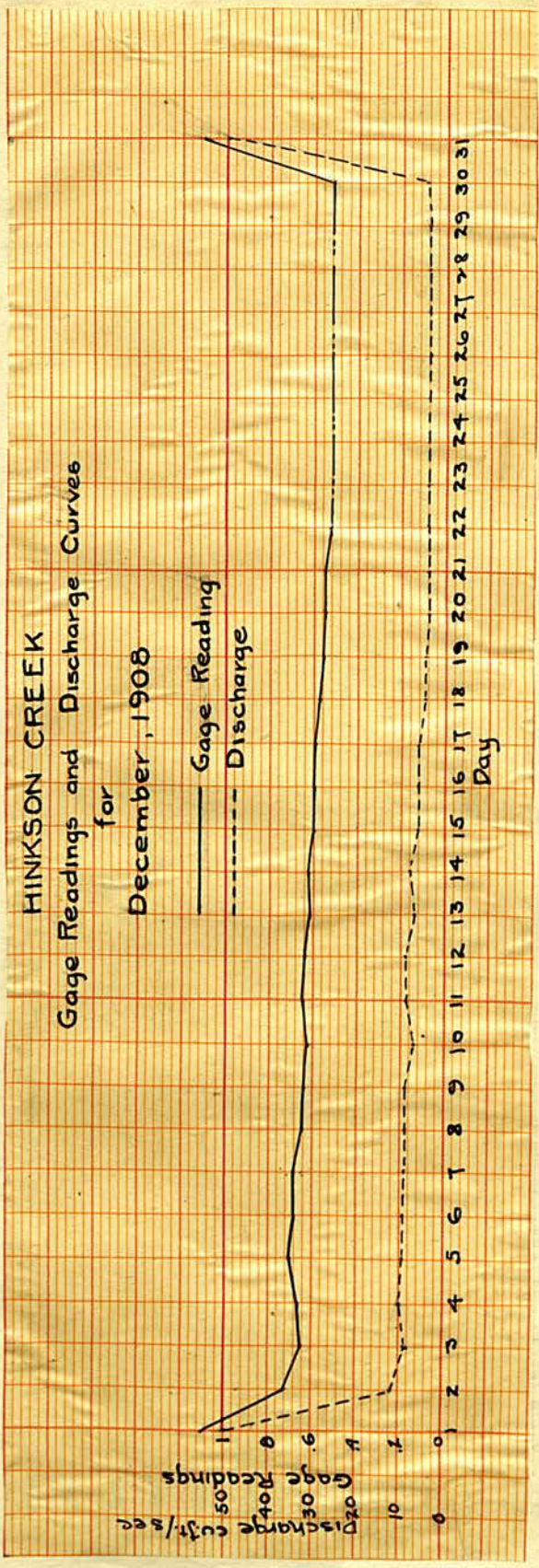
DISCHARGE CURVES FOR GRINDSTONE CREEK

October 1908 - April 1909 (inc)









HINKSON CREEK
Gage Readings and Discharge Curves

for

January 1909

— Gage Readings

- - - Discharge

100
80
60
40
20
600
80
60
40
20
500



PLATE-29-
See Table XVIII.

HINKSON CREEK
Gage Readings and Discharge Curves
for
MARCH, 1909

— Gage Readings
- - - - Discharge

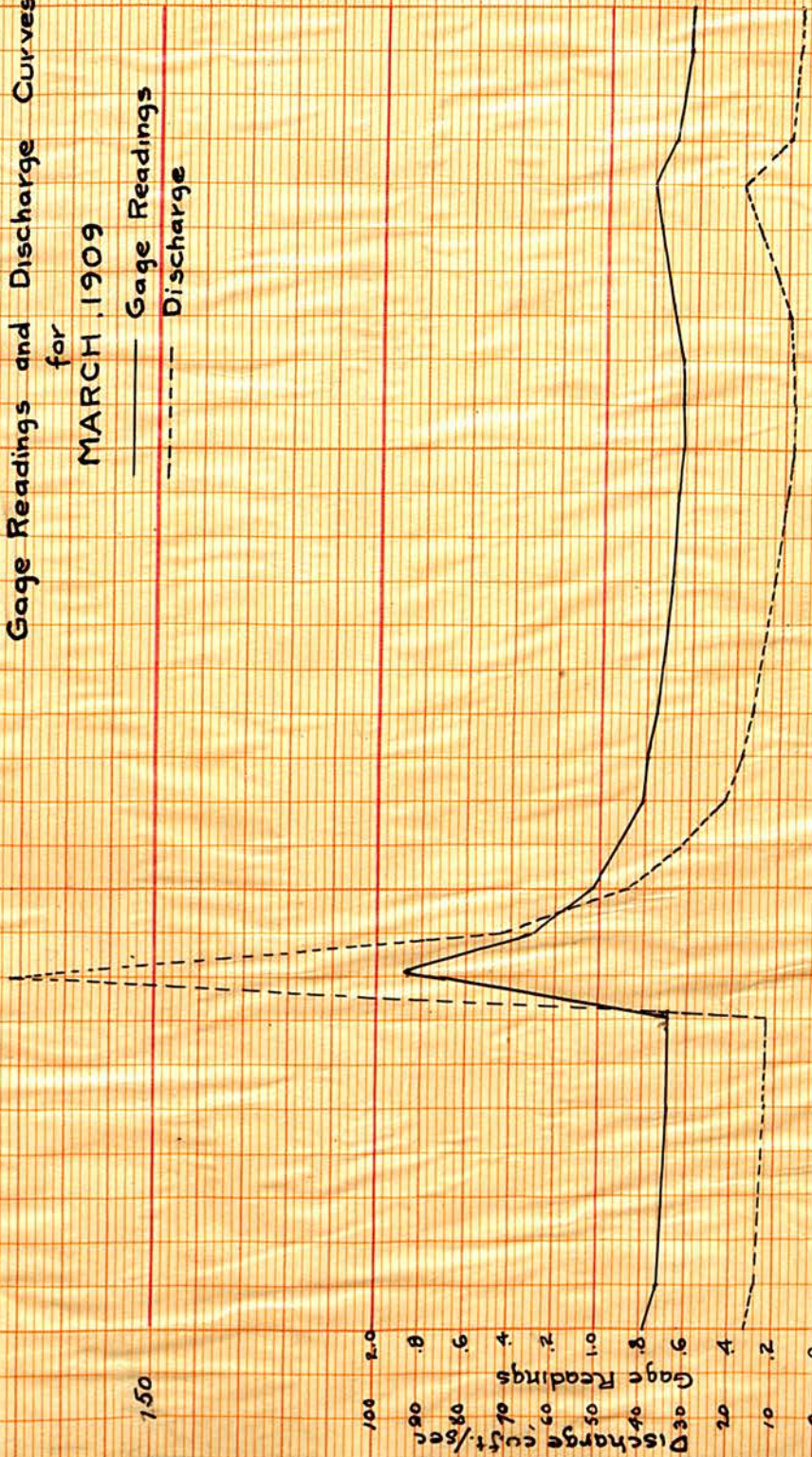
200

150

100 2.0
80 .8
60 .6
40 .4
20 .2
0

Discharge c.c./sec
Gage Readings

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day



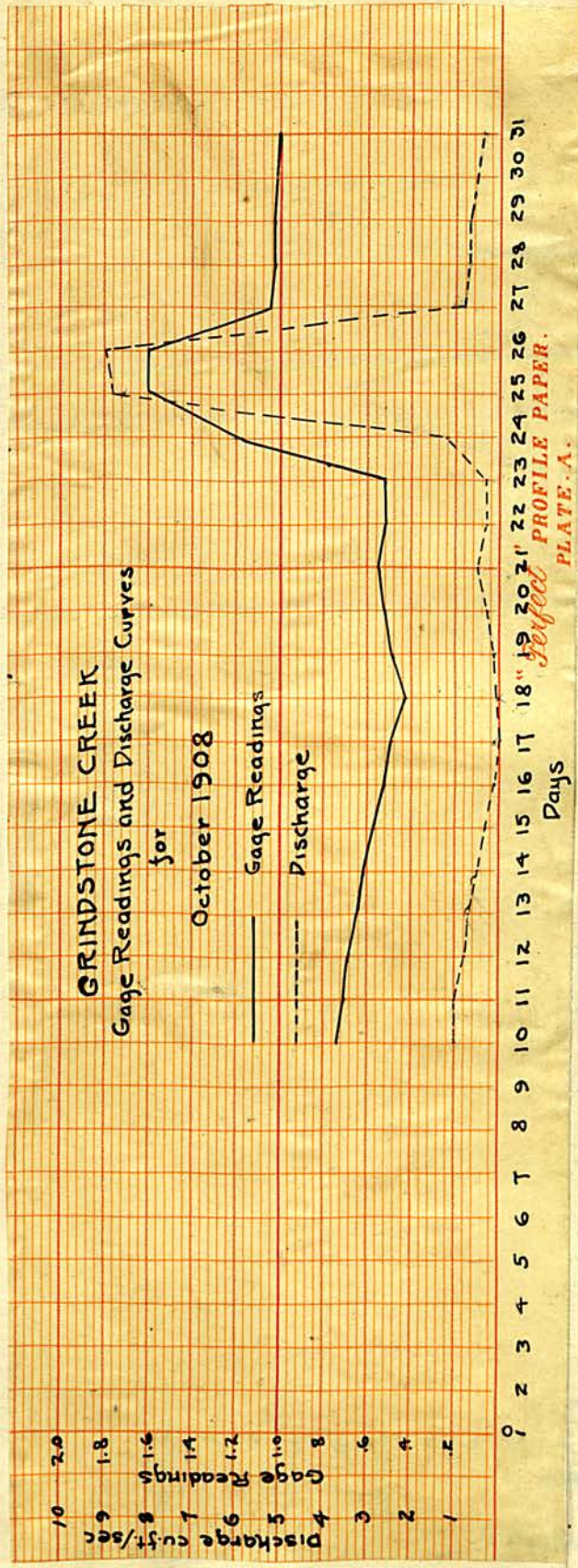
700

600

500

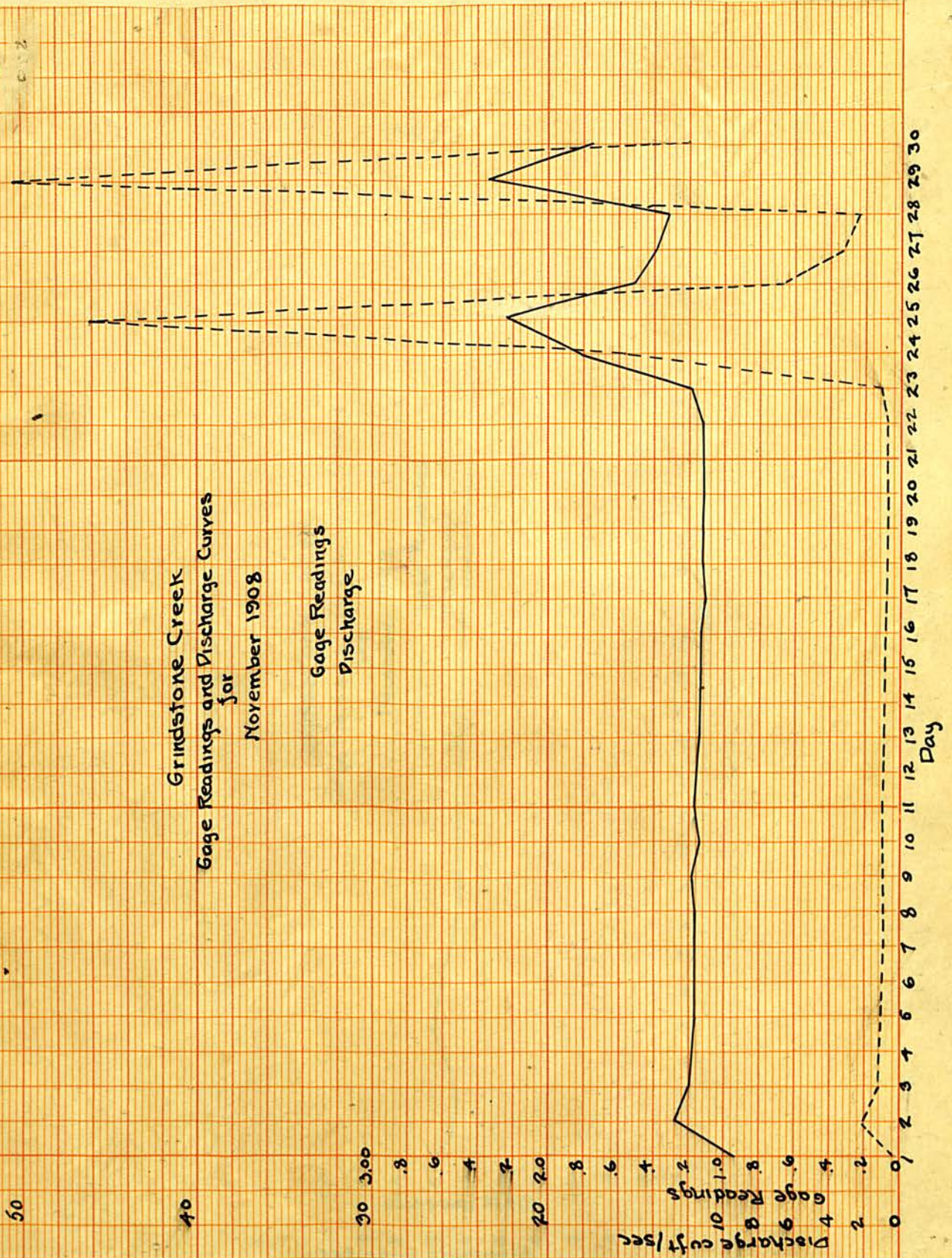
HINKSON CREEK
Gage Readings and Discharge Curves
for
April 1909
— Gage Readings
- - - - Discharge

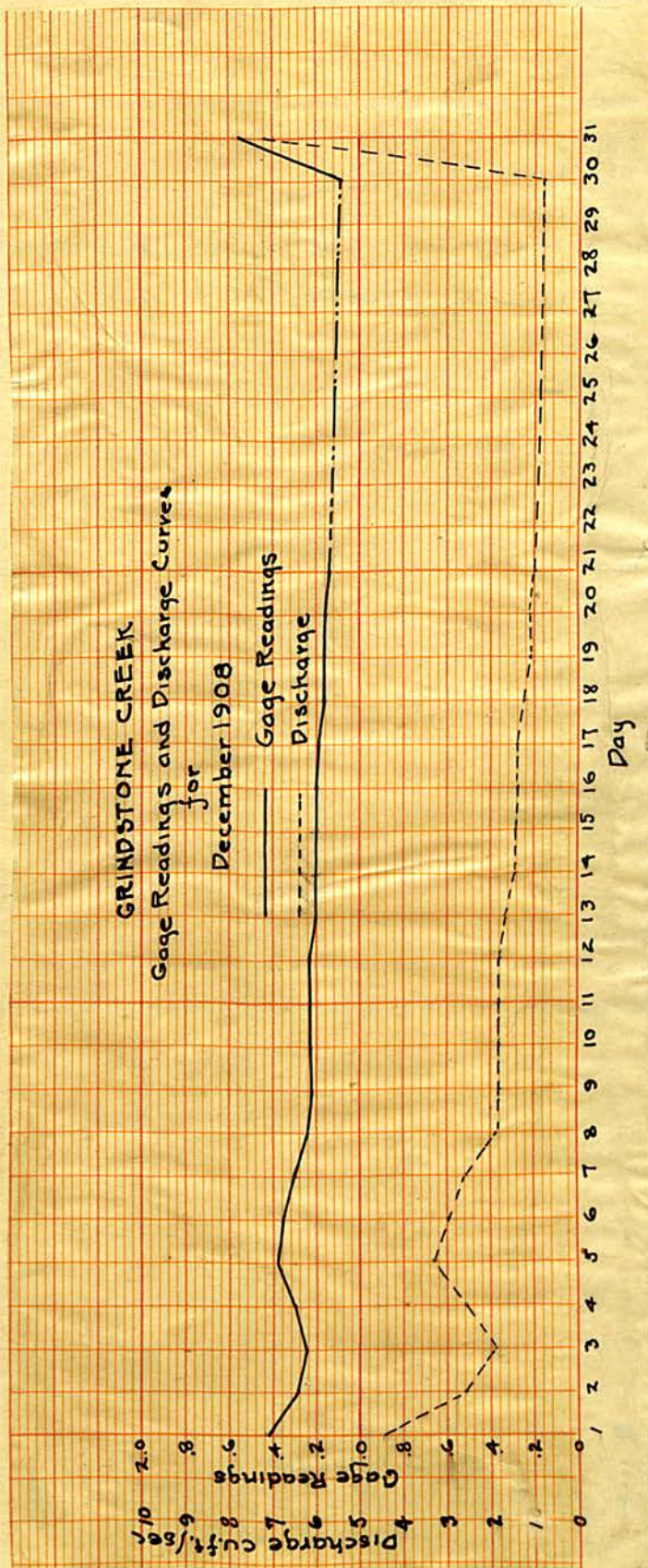




Grindstone Creek
Gage Readings and Discharge Curves
for
November 1908

Gage Readings
Discharge





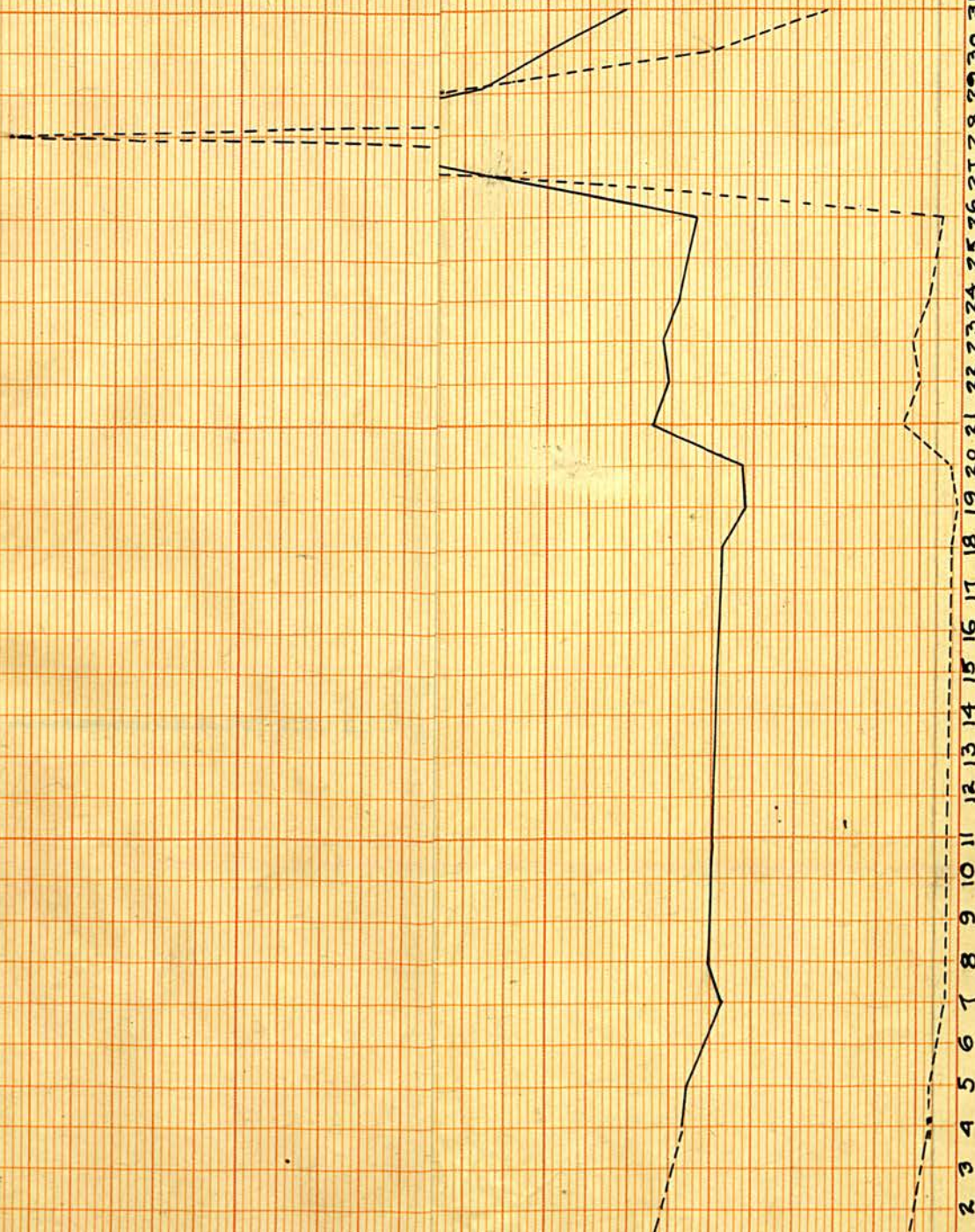
220

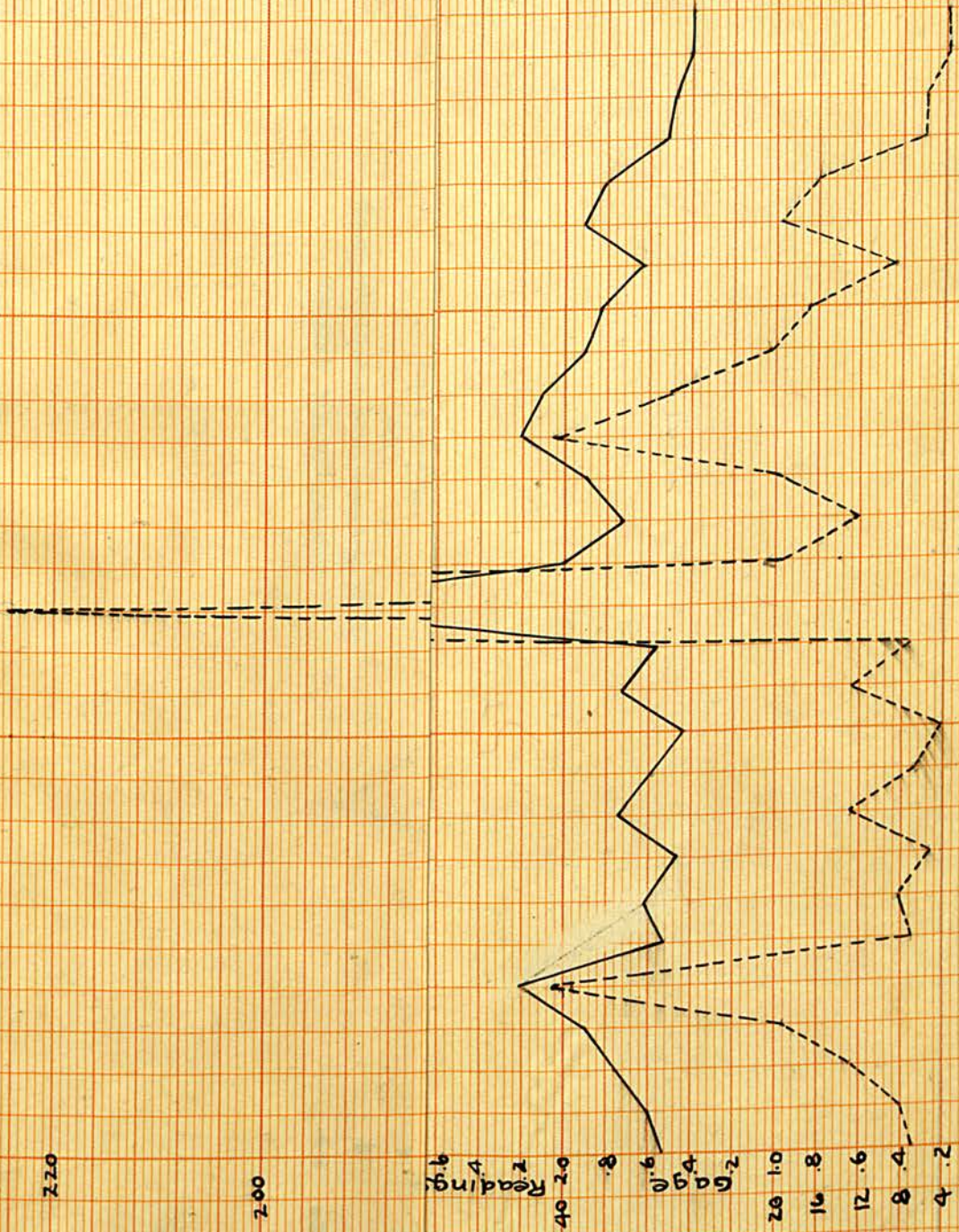
200

Discharge
40
20
0
Gage Heights
4
2
0
1.0
.8
.6
.4
.2
0

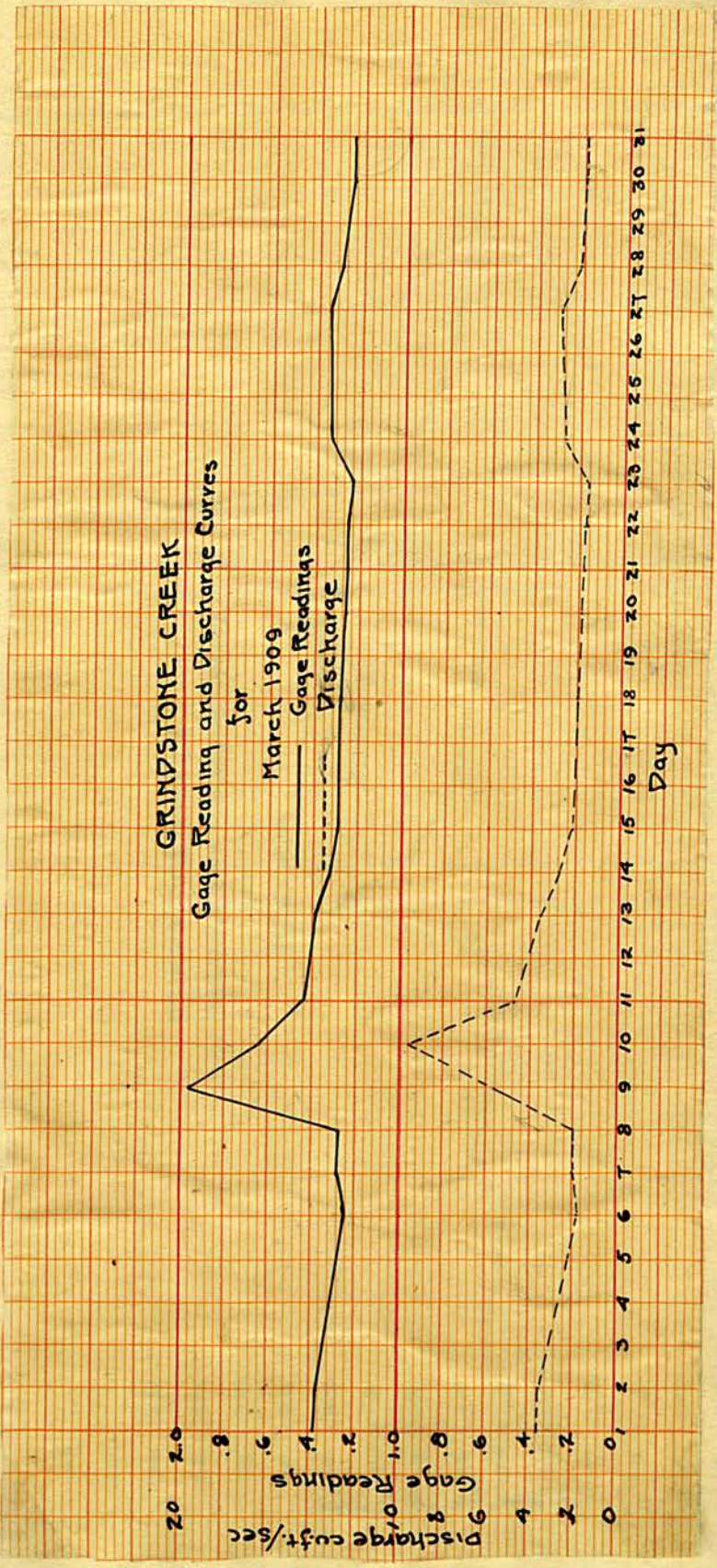
Day
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

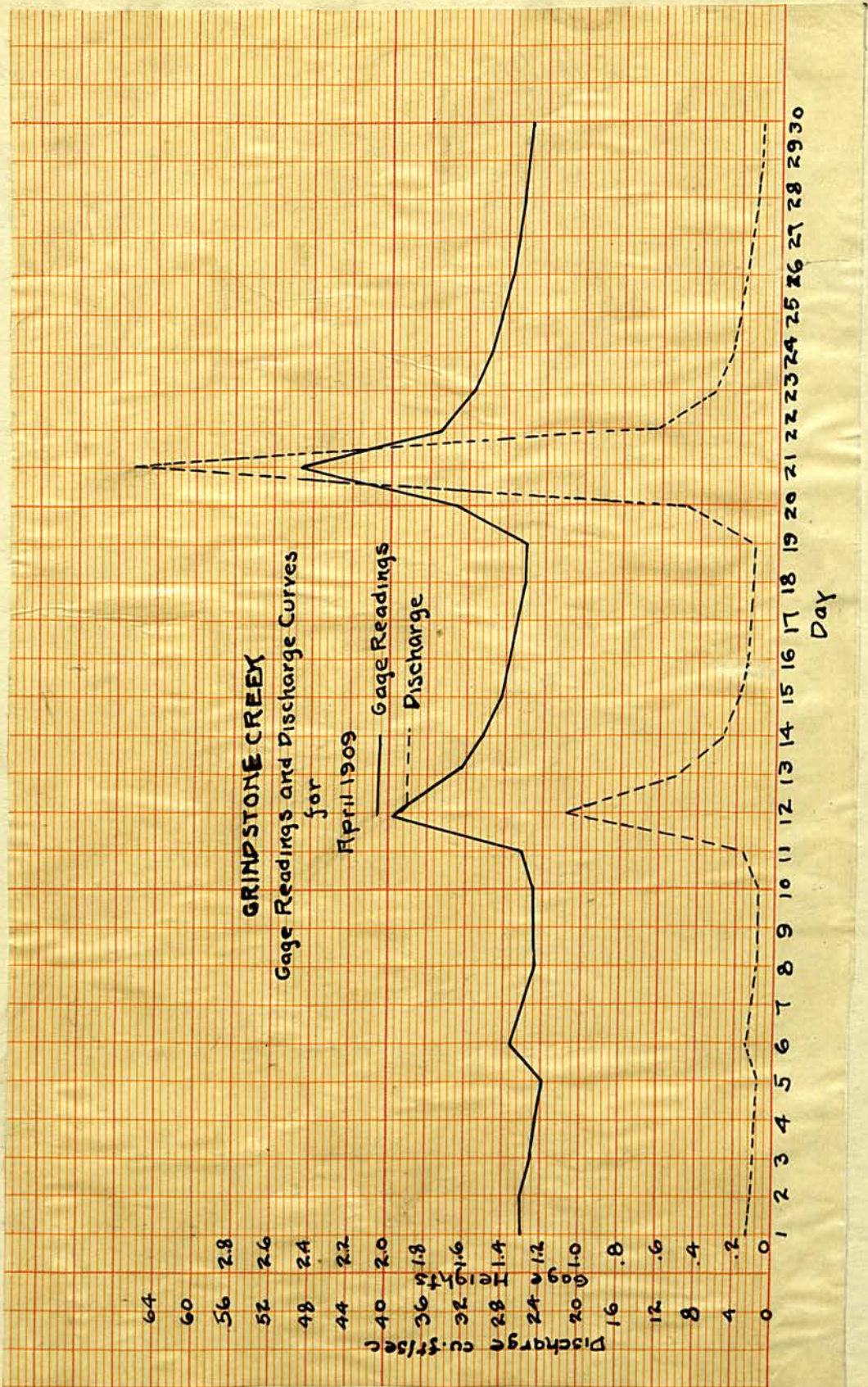
PROFILE
PLATE A.





Perfect PROFILE PAPER. Day
PLATE. A.





64
60
56 2.8
52 2.6
48 2.4
44 2.2
40 2.0
36 1.8
32 1.6
28 1.4
24 1.2
20 1.0
16 .8
12 .6
8 .4
4 .2
0

Discharge c. ft./sec.

Day
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30



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