Canadian Society of Civil Engineers.

INCORPORATED 1887.

ADVANCE PROOF - *(Subject to revision.)*

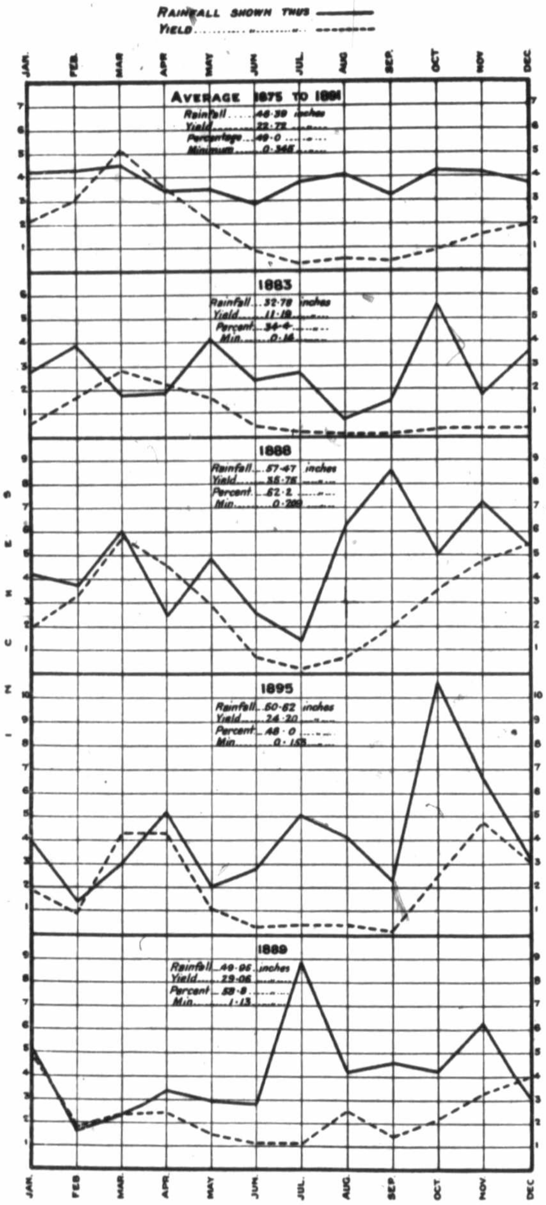
N.B.—This Society, as a body, does not hold itself responsible for the statements and opinions advanced in any of its publications.

THE FLOW OF STREAMS.

By R. S. LEA, Ma. E., M. Can. Soc. C. E.

In any undertaking which involves the utilization of surface water supplies it is of prime importance to determine the volume which may be expected to flow from a given area of watershed, and particularly the portion of that volume which may be made available for the purpose in view.

The rate of discharge of a stream for different months, seasons and years varies widely, because it is dependent on many extremely variable conditions, whose changes have often no apparent relation to each other. If a constant daily supply of water is required, only a small part of the total flow can be utilized ; the rest must run to waste. It may be practicable to increase this minimum natural flow considerably by artificial means, and so add proportionately to the supplying capacity of the watershed ; or it may be that the nature of the demand for water is compatible with occasional, temporary diminution in the supply; or it will perhaps be advantageous to plan for a minimum regular demand considerably higher than can be provided by the stream at all times, and to arrange that the deficiencies, when they occur, may be supplied from some separate source. In any case, no matter for what purpose the water may be



RAINFALL SHOWN THUS
YIELD
JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP. OCT. NOV. DEC.
AVERAGE 1875 TO 1891
Rainfall ..... 46·39 inches
Yield ..... 22·72
Percentage ... 49·0
Minimum ..... 0·346
1883
Rainfall ... 32·78 inches
Yield ..... 11·19
Percent ... 34·4
Min ..... 0·16
1888
Rainfall ... 57·47 inches
Yield ..... 35·76
Percent ... 62·2
Min ..... 0·209
1895
Rainfall ... 50·62 inches
Yield ..... 24·20
Percent ... 48·0
Min ..... 0·155
1889
Rainfall ... 49·96 inches
Yield ..... 29·06
Percent ... 58·8
Min ..... 1·13
INCHES

FIG. 1.

required, it will be advisable and often essential to obtain the most accurate attainable information upon the following points:—(1). The absolute minimum and maximum flow; (2) the minimum monthly flow; (3) the extent and frequency of periods of drought; (4) the practicability of storage, and the increase in the available constant flow which different volumes of storage will effect; (5) the relative economy of storage and supplementary steam plants in cases involving the development of power; the economy of either or both.

The best data would be from a series of gaugings of the stream, carried on for so many years as would include all probable fluctuations in the flow, and in the conditions affecting it. Next to these in value, would be a long series of gaugings of some other stream, with conditions sufficiently similar to make the records applicable to the stream in question, either directly or after making due allowance for any differences which might exist. If the gaugings have been accompanied by rainfall observations, the utility of the record will be greatly increased in districts whose rainfall is known, and in which even short periods of stream flow measurements have been made and are available.

As an aid to the study of fluctuations in stream flow, and of the influences producing them, as well as for their direct value in estimating the discharge of other streams, the writer has compiled, from various sources, a collection of rainfall and stream flow records, which are given in the tables accompanying this paper. They have been brought as nearly as possible up to date, and include streams differing considerably in extent of drainage area, geological conditions, rainfall and climate. They have been selected principally from the New England and Eastern States, not only because the measurements of streams have there been kept more accurately and for a greater length of time than elsewhere in this continent, but because the records are of more or less direct utility in many parts of Canada. A few of the main facts which they convey are exhibited graphically by diagrams.

Rainfall.

The ultimate source of the water flowing in a stream is the rainfall upon its tributary drainage area. Hence, the total discharge will be related more or less directly to the total rainfall. But this relation is not necessarily uniform for different watersheds, nor does it hold for a period as short as a single year, for example, even in the same watershed. This becomes evident from an examination of the tables and diagrams, particularly Fig. 1 and Plate 2. In the latter the tendency towards a constant value is not shown by the ratio of the ordinate of the yield curve to those of the curve of rainfall, but rather by the difference between these ordinates, which is represented by the evaporation curve. In fact, most of the rain which falls upon a watershed has to encounter so many capriciously varying influences that it is exceedingly difficult to form any idea of the stream flow from knowing merely the average or annual rainfall. And as the rate of discharge rather than its total amount is of importance, average rainfall records are of little value except in making broad comparisons between different watersheds.

Consideration of the causes producing rainfall belongs to the sphere of the metereologist. Many continuous records, covering long periods of years, have been taken with more or less accuracy in many parts of the world. The yearly amounts show many and wide variations from the mean, which conform to no known law. The general tendency seems to be towards alternating cycles of high and low rainfall, which are occasionally interrupted by the records of single years. Something of this is shown in Plate 1, in which the changes in the annual rainfall at New York and Philadelphia, during quite a long period, are represented graphically. At New York, for example, the twelve years from 1838 to 1850 form, with one or two exceptions, a low precipitation period, followed by twenty years of very high rainfall, succeeded in turn by a dry period. Similar phenomena are shown by the Philadelphia record, and, to a lesser extent, by Plate 2 and some of the tables.

The facts presented illustrate the danger of basing conclusions upon short series of measurements, either of rainfall or stream flow. They also show upon what uncertain grounds are made such statements as that the rainfall of a district is increasing or decreasing because of some local change in conditions, such as the clearing of forests or the reclaiming of swamp lands. It is probably true, as stated years ago, by Sir Robert Rawlinson, that climatic movements are, broadly speaking, on such an extended scale as to be generally beyond any influence which man can bring to bear.

The examples above referred to are, of course, very limited in number and in range of local and meteorological conditions. With regard to this point, however, reference may be made to a paper on "Fluctuations of Rainfall," by Alex. R. Binnie, M. Inst. C. E., read before the Institution of Civil Engineers in 1892.* In that paper the author analyses, in great detail, a large number of long continued rainfall observations made in all parts of the world, and deduces, as to fluctuation, certain general laws which seem to apply anywhere and under any conditions. Two problems with which he

* "Proc. Inst. C. E." Vol. CIX., pp. 89-172.

deals are (1) What is the least number of years of continuous record, whose mean will not be materially changed by a continuation of the observations for a greater length of time? (2) What is the probable accuracy of the mean of any lesser number of years of observation?

Briefly stated, his conclusions are that for records of from five to thirty-five years, the error may be expected to vary from about fifteen percent to two percent, and that little more accuracy can be expected from prolonging the period of observations.

A very able discussion of this subject by Geo. W. Rafter, M. Am. Soc. C.E., is published in the 1896 Report of the State Engineer of New York.

EVAPORATION.

Of the rain or snow which falls during a year upon a watershed, a large portion is quickly returned to the atmosphere, leaving the remainder to find its way more or less directly to the streams. The yearly amounts of the latter for the twenty-seven years of the Sudbury Record, together with the rainfall and percentages, are given in the following table:—

Year.	1875	1876	1877	1878	1879	1880	1881
Rainfall..	49.49	49.56	44.02	57.93	41.42	38.18	44.17
Yield..	20.42	23.91	25.49	30.49	18.78	12.18	20.57
Percentage..	44.90	48.20	57.90	52.60	45.30	31.90	46.60

Year.	1882	1883	1884	1885	1886	1887	1888
Rainfall..	39.40	32.78	47.14	43.54	46.06	42.70	57.47
Yield..	18.10	11.19	23.78	18.92	22.83	24.23	35.75
Percentage..	45.90	34.10	50.50	43.40	49.50	56.70	62.20

Year.	1889	1890	1891	1892	1893	1894	1895
Rainfall..	49.95	53.00	49.52	41.83	48.23	39.74	50.62
Yield..	29.06	26.99	27.61	16.46	27.77	16.18	24.20
Percentage..	58.20	50.90	55.80	39.30	45.20	40.70	47.80

Year.	1896	1897	1898	1899	1900	1901	Mean
Rainfall..	43.70	46.19	55.88	37.21	50.65	56.11	46.39
Yield..	21.45	20.82	30.46	20.44	22.72	28.76	22.72
Percentage..	49.10	45.10	54.60	55.00	44.80	51.30	48.40

This shows that the ratio of yield to rainfall varied during the twenty-seven years from 31.9 to 62.2, with an average of 48.4. But to state the yield as a fraction of the rainfall implies a relation which does not exist. The influences which cause a portion of the rainfall to return to the atmosphere without reaching the streams recur regularly with the seasons, and their intensity depends largely upon conditions which are approximately constant from year to year. Hence this quantity is subject to much less variation than either the rainfall or the percentage. It will be, therefore, more logical to consider the stream flow not as a fraction of the rainfall, but as the difference between the rainfall and the losses referred to, which are, in this connection, usually indicated under the general term of evaporation. It includes true evaporation in the meteorological sense, as well as that portion of the precipitation which is taken up during the growing period by trees and vegetation. The combined effects on the rate of flow are shown graphically, by months, in Plate 5, and by monthly averages in figures 1 and 2.

EVAPORATION FROM WATER SURFACES.

To determine the laws which govern the rate of evaporation from exposed water surfaces under natural conditions, a very extensive series of experiments was made by Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., and described by him in a paper read before the American Society of Civil Engineers in 1886. His experiments show that evaporation from a water surface is subject to a definite law, which he expresses by the following formula :—

$$E = \frac{(V - v)\left(1 + \frac{W}{2}\right)}{60}$$

E = Evaporation in inches of depths per hour.

V = Maximum force of vapor corresponding to the temperature of the water.

v = The force of vapor present in the year.

W = The velocity of the wind in miles per hour.

Since the rate of evaporation from water depends upon the prevailing temperature and the rate of motion of the air, it tends to average very nearly the same from year to year.

This is shown by a table (No. 5), giving the measurements of the quantities by months, from 1875 to 1889, published with a paper by Mr. Fitz Gerald, on "Rainfall and Stream Flow," read before the American Society of Civil Engineers in 1892. The mean values by months are as follows :—

Month.	Jan.	Feb.	Mar.	Ap'l.	May.	June.	
Evaporation in inches.. ..	0.96	1.05	1.70	2.97	4.46	5.54	
Month.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Evaporation in inches.. ..	5.98	5.50	4.12	3.16	2.25	1.51	39.20

The table also shows that the monthly amounts for individual years do not vary very widely from these means.

During the summer months evaporation is greatly in excess of the ordinary rainfall, so that the loss from the surfaces of large reservoirs and lakes may often be considerable. The average wind conditions for any particular exposure of surface being practically constant, the changes in the annual evaporation from water will be chiefly affected by the average temperature. This, in comparison with the other elements involved, is subject only to slight variation from year to year.

A temperature record taken at St. Petersburg, from 1743 to 1875, gives an annual minimum of 34.1°, a maximum of 42.4° and an average of 38.6°. Similar records at Paris, from 1725 to 1890, give a mean of 51.4 and a maximum of 57.6°. At Albany, N. Y., from 1826 to 1856, the maximum was 51.0°, the minimum 44.32° and the average 48.41.°

The maximum evaporation from water, observed by Mr. Fitz Gerald, was .64 inches in a single day. The effect of different depths of water seemed to be confined to that due to difference in the surface temperature. During the winter months evaporation was, of course, largely from snow or ice, the average daily loss from which averaged .02 and .04 inches per day respectively.

Evaporation from Land Surfaces.

True evaporation will proceed from land as from water, when the surface is wet, and, also, to a certain extent from a damp subsoil. The amount will, therefore, vary greatly during the summer months with the quantity, distribution, and intensity of the rainfall. Only heavy rains at this season will cause much run-off from the surface. The area from which direct evaporation can take place is greatly increased by the leaves and foliage of trees and plants. The ratio of evaporation from different surfaces, relative to that from a water surface, is given by Fernow as follows :—Water 1.00, sod 1.92, cereals 1.73, forest 1.51, mixed 1.44, bare soil 0.60. In general the more rain and the greater the number of rainy days, the greater will be the evaporation. This will be modified to some extent by the fact that great heat and rainy weather do not usually occur simultaneously. The land conditions in winter weather, with snow covered ground, approximate those of water surfaces, and evaporation proceeds at a low but fairly constant rate.

The other important factor in decreasing the total yield of a watershed is the demand for water, during the growing period, by trees and vegetation. Several series of experiments have been undertaken to determine the amount consumed in this way, the most reliable of which are those made by Risler, in Switzerland. He concludes that growing crops require approximately the following quantities per day.

Meadow grass	0.134 to 0.267 inches.
Oats	0.140 to 0.193 "
Indian corn	0.110 to 0.157 "
Clover	0.14 "
Wheat	0.106 to 0.110 "
Rye	0.091 "
Potatoes	0.038 to 0.055 "
Vineyards	0.031 to 0.035 "
Oak trees	0.038 to 0.035 "
Fir trees	0.020 to 0.043 "

The following table from Bulletin No. 7, Foresty Division, U.S. Department of Agriculture, gives the consumption of water during the growing season by various trees :—

Ash	9.18 inches.
Birch	8.18 "
Beech	8.13 "
Elm	7.32 "
Maple	6.24 "
English oak	6.15 "
Norway spruce	1.25 "
Scotch pine	1.08 "
Fir (balsam)	0.83 "
Austrian pine	0.63 "
Mixed forest	3.80 "

These figures indicate that grain crops will consume, annually, from ten to fifteen inches of water; grass, from twelve to eighteen or more; hardwood forests, from six to nine, and spruce and pine only an inch or two. The total loss from a watershed by evaporation proper or by the requirements of vegetation, is affected, to some extent, by the slope of the surface and by the ability of the upper soil to absorb and hold water which would otherwise sink downward beyond the influence of either. But whether it is a year of high rainfall or low rainfall the forces causing evaporation are always in active operation, and the trees and vegetation demand with unfailing regularity the water necessary for their life and growth. Only what is left after these combined requirements are satisfied, contributes to the annual yield of the stream.

In a report to the State Geologist of New Jersey, in 1894, Mr. C. C. Vermeule, C. E., describes a method of estimating the average evaporation from large areas. Taking the records of the Sudbury, Croton and Passaic Rivers, and grouping the years in classes corresponding closely in the amount of rainfall, he obtains a relation between annual precipitation and annual rainfall which he expresses in this formula :— $E = a + b R$, where E is the annual evaporation in inches, a and b constants and R the annual rainfall. For the districts referred to a is taken as 15.5 and b .16. Assuming that the capacity of the atmosphere to absorb moisture is about doubled for each twenty degrees of increase in temperature, he extends the application of this formula to other districts by introducing the factor $[1 + (T - 49.7)\ .05]$. Here 49.7 is the mean annual temperature in degrees, of the district in which the original formula applies, and T that of any other district in which it has a higher or lower value. The formula will then be:—

$$E = (15.5 + .16R)\ [1 \div (T - 49.7)\ .05].$$

Expressing the relation in this way implies that differences in the proportion of rainfall discharged on the average by streams are almost entirely due to differences in annual temperatures.

The *rate* at which that portion of the rainfall which escapes evaporative influences, can reach the streams, depends upon underground storage, natural surface storage, surface slope, forest growth, and, in cold countries, the effects of frost and snow.

The most desirable characteristic of a watershed, so far as minimum yield is concerned, is a large capacity for ground storage.

This will be greatest, of course, for sandy and gravelly soils and for porous rock. Pure compact clay, hard pan, and rocks of the nature of the granites, traps, slates, etc., may be considered as almost impervious. Many rock formations are, however, covered with a layer of shattered and disintegrated rock which may carry large quantities of water.

The water year may be conveniently divided into three parts : first, a period, beginning late in the fall or in early winter, with full ground water. The greater part of the precipitation of this period will reach the streams by flowing over the surface. This portion of the yield is depended on to refill artificial storage reservoirs. During the earlier months of this period the water may be all retained upon the ground as ice or snow, leaving the stream flow to be maintained by the ground water. During severe winters in cold climates this may be the season of minimum flow. Second, a growing period, when the greater part or all of the rainfall will be consumed by evaporation and when the ordinary flow of the streams, for three or four months, may be made up entirely of the stored ground water, which reaches them in the form of springs and seepage. Third, a replenishing period during which the rainfall largely goes to refilling the depleted ground storage, and has, in consequence, only a slight effect upon the stream flow.

Lakes and ponds upon a watershed may help considerably to maintain the flow during the early part of the summer and may increase somewhat the minimum flow during years of high rainfall. Steep and impervious surface slopes produce "flashy" streams, subject to heavy freshets of short duration, and to extremely small flows in times of drought. Cultivation will, in some soils, increase the dry weather flow by rendering the surface more open and permeable, and thereby increasing the ground water.

The effect of forest growth is a subject upon which decidedly different opinions are held by those who have made a study of such matters. The chief point of difference seems to be as to whether the cutting down of forests decreases the total stream flow. The common view is that it does, and the statement is frequently made that such and such a stream, which used formerly to be capable of driving mills has, since the clearing of the land, shrunk to little more than a brook.

It is claimed by those who hold a contrary opinion that the shrinkage in flow is only apparent, and that, because the freshets are more frequent and severe than formerly, the ordinary and minimum flow appear and are less than they used to be, while the total flow is as great as ever. Whether this is so or not, it does seem probable that the effect of large areas of forest upon a watershed will be in the direction of regulation of stream flow. The inequalities of the surface, the loose absorbent upper soil, the roots of trees, etc., all tend to retain the precipitation for a greater length of time, whether in the form of rain or snow, and so to diminish the frequency of small freshets, the intensity of large ones, and to give greater opportunity for percolation and increase of ground water. This last effect must be of considerable benefit during the growing and replenishing periods.

It is, of course, true that the ground surface of forests is wet for a greater length of time than that of clearances, with a consequently greater opportunity for evaporation. On the other hand, the lower temperature under the trees, and particularly the shelter from wind which they afford, will permit evaporation to proceed at only a moderate rate. This is particularly true of the wasting away of snow in the later winter months. In addition to this there is to be considered the small requirements of water by trees as compared with grass and crops.

The area of a watershed has an important bearing upon stream flow, inasmuch as the greater it is the less likelihood is there of the simultaneous prevalence over its whole extent of extreme conditions. The effect is to produce a higher minimum, more regular ordinary flow, and, particularly, to reduce the intensity of floods ; since not only are violent rain storms usually confined to a limited area, but freshet flows from the smaller basins included in the watersheds are not likely to pass simultaneously down the main stream.

Maximum, Minimum and Ordinary Flow.

The absolute maximum flow is of little importance except as it affects the design of the development works. It is often impossible to ascertain the maximum amount by actual measurement, as it only lasts for a short time and is accompanied by continually changing surface slope. In cold climates the severest freshets occur in the spring when heavy rains are accompanied by melting snow. No idea of their intensity can be obtained from the tables, as the quantities given are the average rates by months. The same thing is true of the flow in the minimum flow months, but to a very much less extent, as is illustrated by the following table of the discharge of the Connnecticut River at Holyoke, Mass., during the year 1896 :

Month.	Discharge in cubic feet per second. Maximum.	Minimum.	Minimum for 6 working days.	Mean.
January..	47,350	5,800	6,221	10,882
February..	20,750	4,800	6,130	9,096
March..	112,050	8,550	9,470	27,216
April..	89,200	17,750	19,193	42,363
May..	18,300	4,850	5,450	9,684
June..	8,850	2,550	3,878	5,357
July..	6,050	1,750	2,429	3,684
August..	4,650	1,300	2,479	2,965
September..	8,450	2,100	2,843	4,768
October..	22,100	3,500	4,400	10,971
November..	30,450	7,900	8,779	14,115
December..	17,900	3,400	4,036	7,624

The real minimum flows are more correctly represented by the figures for six working days, as the daily flow is considerably influenced by the control of the discharge used for power. For small watersheds of two or three square miles area, the minimum flow may, in very dry times, amount to practically nothing, and the maximum to as much as 140 to 150 cubic feet per second.

The following table gives the maximum and minimum flows for various watersheds, in cubic feet, per second per square mile :—

Drainage Area less than 200 Square Miles.

Stream.	Drainage Area in Sq. Miles.	Flood Flow.	Minimum Flow.
Sudbury, Mass.	78	44.2	.036
Pequest, N. J..	83	9.6	0.170
Tohickon, Pa..	102	55.3	0.001
Neshaminy, Pa..	139	41.4	0.009
Perkiornen, Pa...	152	34.9	0.050
Ramapo, N. J.	160	66.1	0.140
Paulins Kill, N. J.	175	26.0	0.130

Drainage Area 200 — 2,000 Square Miles.

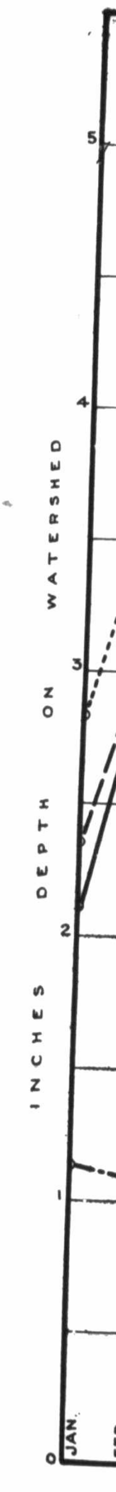
Stream.	Drainage Area in Sq. Miles.	Flood Flow.	Minimum Flow.
Charles, Mass..	215	....	0.20
Croton, N. Y..	339	74.9	0.15
Concord, Mass..	361	12.3	0.17
Housatonic, Conn..	790	....	0.17
Passaic, N. J.	797	24.2	0.19
Raritan, N. J..	879	68.0	0.14
Schuylkill, Pa...	1,800	....	0.17

Drainage Area over 2,000 Square Miles.

Stream.	Drainage Area in Sq. Miles.	Flood Flow.	Minimum Flow.
Merrimac, Mass..	4,599	20.9	0.31
Potomac, Md...	4,640	22.2	0.078
Delaware, N. J..	6,790	37.5	0.17
James, Va..	6,800	....	0.19
Connecticut, Conn..	10,234	20.3	0.31
Ohio, Pa..	19,900	....	0.11

Ordinary Flow.

The flows by months given in the tables, being affected by freshets of short duration, do not give a correct idea of what should be called the ordinary flow of a stream. Neither do the average monthly flows, as represented in figure 2, since even for the dry months the average is considerably raised by occasional months of abnormally high flow. For this reason it is customary, in estimating



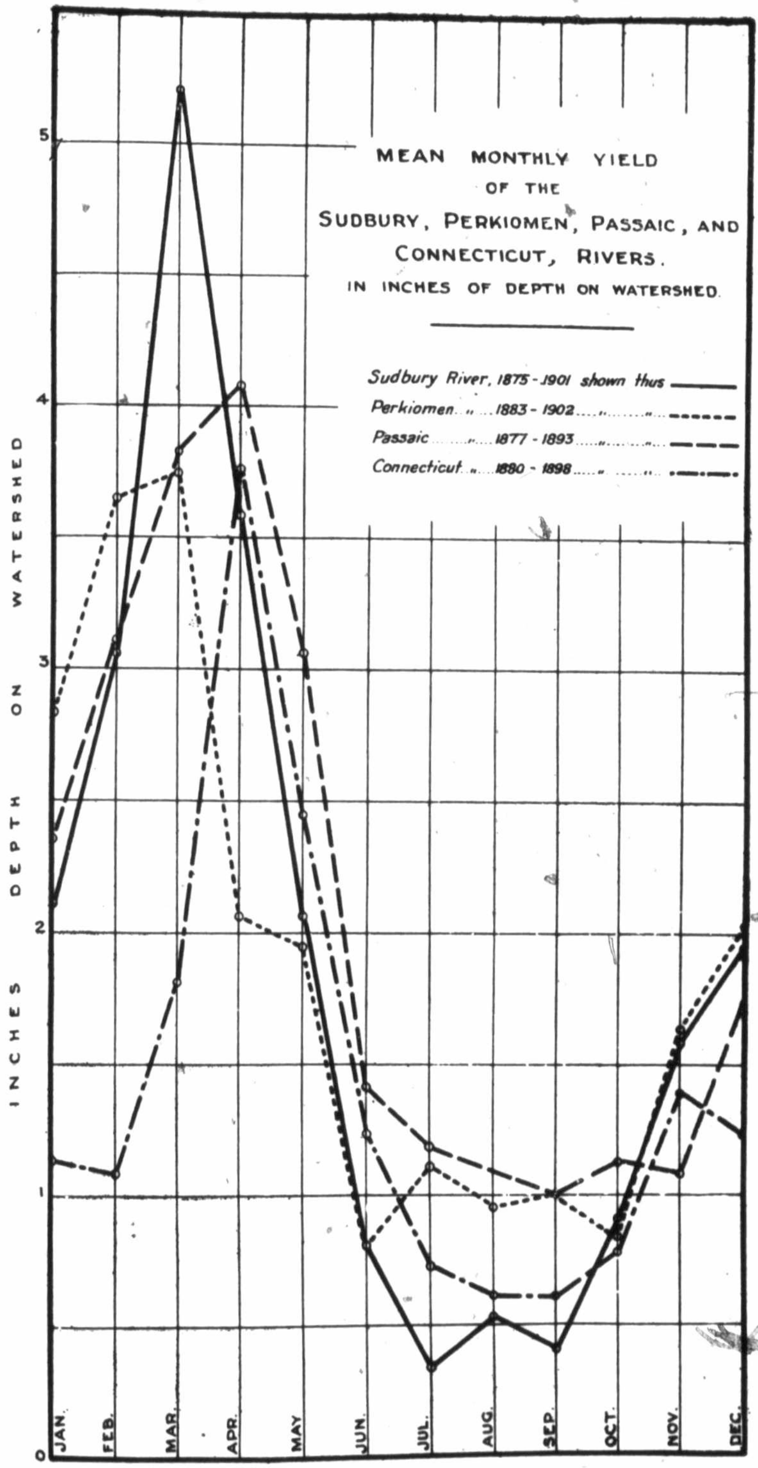

MEAN MONTHLY YIELD
OF THE
SUDBURY, PERKIOMEN, PASSAIC, AND
CONNECTICUT, RIVERS.
IN INCHES OF DEPTH ON WATERSHED.
Sudbury River, 1875-1901 shown thus
Perkiomen „ 1883-1902 „ „
Passaic „ 1877-1893 „ „
Connecticut „ 1880-1898 „ „
INCHES DEPTH ON WATERSHED
0
1
2
3
4
5
JAN.
FEB.
MAR.
APR.
MAY
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.

Fig. 2.

the available water power of streams, to arrange the months of each year, not as they occur, but in order of dryness, and use the means of the quantities as then arranged. Mr. FitzGerald considers that a fair idea of the ordinary flow may be obtained by taking the months above the annual average at the average rate, and adding to these the observed flow of the months below the average, excluding the minimum month, and dividing the sum by the whole year. In this way he estimates the ordinary flow from the Sudbury from 1875-1890 at about 1.1 cubic feet per second per square mile, or 706,000 gallons per day.

Rankine in his "Civil Engineering" gives the following rule:—

Arrange the days of the year in order of their flow. Divide this list into a middle half and an upper and lower quarter. For the upper quarter use the average of the middle half; the mean of the whole list thus taken is to be considered the ordinary discharge of the stream exclusive of flood waters.

Numerous examples of the action of the various influences above referred to, will be found by a study of those tables which include both rainfall and stream flow records, and, also, from figures 1 and 2 and Plates 2 and 5.

Figure 1 shows diagramatically the average rainfall and flow of the Sudbury River by months, from 1875 to 1901. It also shows the same records for a year of maximum (1888) and a year of minimum rainfall (1883). At the bottom of the figure are represented two years, 1889 and 1895, of nearly equal rainfall, but differing greatly in the average, ordinary and minimum yield. The slight effect upon the stream flow of the summer rains and, in dry years, of the autumn rains, is well illustrated.

Plate 5 shows the yield by months of the same river in thousands of gallons per day per square mile and in cubic feet per second, from 1875 to 1901.

Plate 2 shows the average and yearly rainfall, evaporation, and yield for the same period.

Figure 2 represents the average variation in the monthly flow of the Sudbury, Perkiomen, Passaic and Connecticut rivers.

Following is a short description of the watersheds of the rivers whose records are given in tables 1 to 15:—

Genesee River, (Table 1.)

in which

Area of watershed at point of gauging, 1070 square miles.
Mean annual temperature, 43°.

It rises in northern Pennsylvannia and flows through the northern part of the State of New York into Lake Ontario. The surface is rolling and somewhat mountainous, with deep valleys and high hills. In the river valley are many superficial accumulations of gravel and sand overlying deposits of laminated clays. Almost the entire watershed has been cleared of forests and is devoted either to farming or grazing.

Muskingum River (Table 2.)

Area of watershed, 5,828 square miles.
Mean temperature, about 49° F.

It issues from the flat areas of Central Ohio, where there is very little timber, and flows into the Ohio River. A considerable portion of the drainage area is described by the State geologists as boulder clay, which is of an impervious character, so that springs are rare. By the middle of July many of the streams dry up, and remain so till late in the fall.

Connecticut River (Table 3.)

Area of watershed, 8,660 square miles.
Mean temperature, 44.5° F.

It rises in Canada, near the boundary line, and has its head waters in the White Mountain districts of northern New Hampshire and Vermont. The watershed is more or less rugged throughout. It flows in a southerly direction, forming the greater part of the boundary between Vermont and New Hampshire, then across the States of Massachusets and Connecticut into Long Island Sound.

The watershed is long and narrow with about forty-seven percent improved land, and the remainder fallow or covered with timber in various stages of growth. There are no large lakes to affect the flow.

Merrimac River (Table 4.)

Area of watershed, 4,553 square miles.
Mean temperature, 44.6° F.

This stream receives the drainage from a considerable portion of the White Mountain area in New Hampshire. Its flow is regulated by a number of large lakes near the head waters, the outlets of several of which are controlled by dams. The fall is considerable and developments of water power have taken place to a greater extent than on any other river in the United States. About forty percent of the drainage area is covered with forests.

Kennebec River (Table 5.)

Area of watershed, 4,410 square miles.
Mean temperature.

The basin drained by this river is about one hundred and fifty miles long by from fifty to eighty miles wide, and extends from the Canadian boundary line to the Atlantic ocean. It runs out of Moosehead Lake, to which 1,250 square miles of its watershed are tributary. The northern part of the basin is broken by offsets from the White Mountains, and nearly the whole of the upper area is covered with forest. The surface materials are, in the north, sandy and gravelly. Towards the south there is a greater proportion of loam and clay. There are a great number of falls on the river which give power to sawmills, pulp mills, and cotton mills. There is a dam at the outlet of Moosehead Lake, but the storage has only been imperfectly developed, and is not controlled in a manner favourable to water power interests, inasmuch as the greater part is used during May and June for driving logs. Arrangements are being made between an association of manufacturers, called the Kennebec Water Power Company, and the Kennebec Log Driving Company, whereby the stream can be regulated to their mutual satisfaction.

Upper Hudson River (Table 7.)

Area of temperature, 5,400 square miles.
Annua ltemperature, 41.8° F.

Its extreme head waters are in the northern part of New York State, and flow from the southern slopes of some of the highest of the Adirondack peaks. It is a wild, uninhabited region of mountains, forests and lakes. Its western branches drain a country almost as wild, and the greater part of the whole drainage area is covered with forests.

Sudbury River, (Table 8.)

Area of watershed, 78.2 square miles.
Mean temperature, 48° F.

This river is situated in the extreme eastern end of Massachusets, about fifteen miles west of Boston, and is one of the sources of water supply for that city. Mr. F. P. Stearns, C. E., in a paper published in the 22nd Annual Report of the Massachusetts State Board of Health, says: "The watershed contains many hills with steep slopes, some of which are used for pasturage, and others are covered with a small growth of wood. The valleys, as a rule, are not steep, and there are extensive areas of swampy land, generally covered with a growth of brush and trees. The hills are, for the most part, of rather impervious clayey material, containing boulders, while the flat land is sandy, and, in some cases, gravelly."

The measurements of yield for this stream have been made with unusual care and accuracy, and have already proved of great value in questions relating to water supplies and water power. The fluctuations in the average monthly yields are illustrated in Plate 5, and the quantities shown, give correctly the yield of the watershed, but do not, in the very dry months, truly represent the actual flow of the stream. The flow is controlled by large artificial reservoirs. The effect of these, so far as their storage volume is concerned, has been allowed for and does not affect the records ; but the evaporation from the increased water surfaces has not been taken into account. From 1875 to 1878 these surfaces formed 1.9 percent of the whole drainage area. This proportion was increased in 1879 to 3 percent, in 1885 to 3.4 percent, in 1894 to 3.9 percent, and to 6.5 percent in 1898.

During the dry months the draft is usually altogether from the reservoirs, and as the percentage of water surface increased the measured depletion of the storage began to approximate the draft ; and for two months in 1899 and one month in 1900 it was actually greater, showing that the loss by evaporation from the water surface was greater than the contribution from the land, causing a net loss for those months to the watershed as a whole. This will explain the lowering of the yield curve of Plate 5 during the years 1899 and 1900.

Using Mr. FitzGerald's table of evaporation from water surfaces, the yield of a square mile of land surface can be calculated from the records, and a table of calculated yields, from 1875 to 1890, is given in his paper on "Stream Flow." These quantities are shown on the diagram (Plate 5), for the dry months, by the short horizontal dotted lines. For the high flow months they are sometimes a little less and sometimes a little greater than the observed flows, but differ only by a relatively small proportionate amount.

Cochituate River (Table 9.)

Area of watershed, 18.87 square miles.
Mean temperature, 48° F.

The watershed of this stream adjoins that of the Sudbury, but its surface conditions are entirely dissimilar. The slopes are flat and sandy. The surface is mostly modified drift, while that of the

Sudbury is largely composed of unmodified drift. The flow is also controlled by artificial storage.

Perkiomen, Neshaminy and Tohickon Creeks (Tables 10, 11 and 12.)

Drainage areas :

Perkiomen..	152	square miles.
Neshaminy..	139.3	" "
Tohickon..	102.2	" "

Mean temperature :

Perkiomen		52° F.
Neshaminy	139.3	52° F.
Tohickon	102.2	51° F.

The following description of the watersheds of these streams is condensed from a paper read before the Engineers' Club ot Philadelphia, by John E. Codman, C. E., in 1897 :—

The watersheds of the three streams are contiguous to each other, and the whole area is within the geological formation known as the New Red Sandstone. The streams have a rapid fall from source to outlet and have made for themselves moderately deep valleys, the beds of which are filled with large boulders.

The Perkiomen falls, from its source to the gauging station, about eight hundred feet in twenty-four miles ; the Neshaminy, about six hundred feet in twenty-seven miles, and the Tohickon six hundred feet in twenty-eight miles.

The surface is mostly farm land under a high degree of cultivation. The original forest growth has been almost entirely cut away, and the little remaining timber is found generally on the banks of the creeks. The proportion of cultivated land, woodland, etc., is as follows: Woodland, about 20 percent; cultivated land, about 77.5 percent; roads, 2 percent and flats about 0.5 percent. The exposure of the surface soil in summer to the sun bakes and hardens it, the ground water lowers, the springs dry up and the streams are reduced to rivulets flowing among the boulders.

The Perkiomen is a tributary of the Schuylkill, and the Neshaminy and Tohickon of the Delaware.

The measurements of these streams have, since 1887, been under the charge of Mr. John E. Codman, C. E., of the Philadelphia Water Bureau, who very kindly furnished the writer with the remainder of the records from 1897 almost up to the end of 1892.

Croton River (Table 13.)

Area of watershed, 339 square miles.
Mean temperature, 48° F.

This river is the source of the water supply of New York. The country embraced in its watershed is hilly and the rock is gneissic.

It is overlaid with drift earths and gravel to some extent. The valleys are rather flat-bottomed, and the upper portions of the East Branch are bordered by narrow swamps. About thirty percent is covered with timber or brush, the remainder being tillable or pasture land. There are some forty natural lakes and mill-ponds, aggregating about 1.3 percent of the whole area.

Passaic River (Table 14.)

Area of watershed, 822 square miles.
Mean temperature, 48° F.

The watershed of this stream lies in the northeastern part of the State of New Jersey. About three-fifths of the whole area is situated in the Archean Highlands, and the rest, at a much lower elevation, on the eastern red sandstone plain. About fifty-eight percent is covered with forest. There are many deposits of sand and gravel, and broad areas of flat meadows often inundated by floods. A detailed description of the various parts of its drainage area is given in Mr. Vermeule's report on "Water Supply" to the State Geologist of New Jersey, referred to above.

Artificial Storage.

So far, only the flow of the stream in its natural condition has been considered, and the diagrams and records given in the tables show how exceedingly small this may be at certain seasons of the year. And yet, for all purposes which require a constant supply, this is all that can be utilized. Hence it follows that next to the proper determination of the available natural flow in interest is the possibility and economic practicability of artificially increasing it. This is especially the case in connection with supplies for domestic use. The water supplied by the relatively small streams is usually more desirable for this purpose than that of the larger ones, on account of its smaller liability to pollution. A conveniently located stream whose summer flow is quite inadequate may often be readily made available by the construction of storage reservoirs, at a cost much less than would be required to bring water from a larger but more distant source. It is often possible, without undue expenditure, to thus increase the capacity of a watershed by six or eight times its natural value, and to make small watersheds available which would otherwise have no value whatever.

Development on any such scale as this would, of course, be out of the question in the case of water for power, for economical as well as practical reasons. It is, however, often possible to increase the available flow to a smaller but nevertheless important degree, particularly when the watersheds contain large lakes with outlets favorable for the construction of dams. The two main elements in water power are height of fall and volume, and any increase is of about as much value in one as in the other. An increase in the dry weather flow—which may be a measure of the capacity—of 100 or 150 percent, would not be a matter of small importance. Storage possibilities of even a limited extent may considerably increase the value of a water power which is to be supplemented by steam. The capacity of two watersheds of similar area, rainfall, etc., may, according to this standard, have considerable difference in value. There is an efficiency of watersheds and streams, as well as of turbine wheels. Many examples of this, and of the value of storage. are furnished by the large water powers of some of the New England and Eastern States. An example of what may occasionally be effected in this way is presented by the Presumpscot River, in Maine. It is the outlet of Sebago Lake, which lies about 17 miles north-west of Portland. The area of this lake is 50 square miles, and its drainage area 470 square miles, i.e. the water surface is a little less than 10 percent of the whole watershed. The flow is regulated by a dam at the outlet, and in no month in the 15 years from 1887 to 1901 has the flow fallen below seven-eighths of a cubic foot per second per square mile. For three-quarters of the entire period it has not varied more than 25 percent either way from an average of 1¾ cubic feet per second per square mile, and in an especially favorable year the entire range of flow has not been more than 5 percent either way from the mean of that year. The records of flow are very complete, and have been taken with great care. The available fall for power on the river is about 225 feet. Assuming an efficiency of 75 percent for the turbines, this small watershed, with an area of about 22 miles square, can furnish a constant net H.P. of 7,500, and 15,000 H.P. on the average.

It is, however, in connection with domestic supplies that the possibilities of storage are of greatest interest. The questions which arise in problems of this kind are : (1). For a constant daily draft of so many gallons or cubic feet per day, what volume of storage will be required for a given watershed? (2). In comparing two watersheds, what constant drafts can be depended upon for various storage capacities? The answers to all such questions can be obtained at once for streams like the Sudbury, from Plate 4. This diagram was plotted from a table accompanying Mr. FitzGerald's paper on "Stream Flow," and is similar in nearly every respect to a diagram published in the same paper. The data necessary in the preparation of such a diagram are stream flow records covering a long period of years, such as those of the Sudbury, Croton, and others given by the tables. The following graphical method of obtaining them is described in an abstract of a paper by W. Rippl, published in the minutes of the Institute of Civil Engineers, vol. 71, page 270.

The method is as follows:—In the first column of a table are entered the monthly yields of the stream from the beginning to the end of the period; in the second, the monthly drafts; in the third, the difference between the quantities in columns 1 and 2, which will be plus or minus, according as the yield is greater or less than the demand; in the fourth, the cumulative sums of the quantities in column 3. A curve is plotted with the months as abscissas and the quantities in column 4 as ordinates. An illustration of this mass curve, as it is called, is given by Plate 7. It is for a daily draft of 500,000 gallons per square mile from the Sudbury watershed during the years 1876 to 1883. Ascending portions of the curve indicate periods of surplus yield, and descending portions periods when there is a deficiency requiring drafts upon storage. At the crests and hollows the supply and demand are equal. If a horizontal line, as CD, is drawn from any crest, the vertical distance between it and the curve, as GH, indicates the total deficiency during the period from C to G, and, therefore, the total draft upon the storage. From A to C the reservoirs are full and running over. A maximum ordinate like GH gives the storage capacity required to cover the whole period. It occurs here in January, 1881. With this capacity, the portions of the ordinates included in the horizontal shading indicate the amounts which would be in the reservoirs from time to time during periods of draft upon them. The length of such lines as AB and CD represent respectively the periods during which the reservoirs are overflowing and those during which they are drawn down below high water level. Representing the variations in the different quantities graphically has considerable advantage over dealing with columns of figures.

Another method described and used by Mr. Freeman in his very valuable report on the Water Supply of New York, is more convenient than the one just explained. An illustration of its use is given in Plate 6. Here the mass curve is plotted from the aggregate yield by months without deducting any draft. The slope of the curve at any point therefore represents the rate of yield at the corresponding time. Lines drawn at inclinations corresponding to various rates of draft are shown in the lower part of the diagram. Choosing any given rate, say, 500,000 gallons per day, if the corresponding lines are drawn forwards at the summits until they meet the curve, the vertical distances between them and the curve will represent the extent of the draft upon the storage necessary to supply that demand. The periods of low water, the quantity wasted, and the maximum storage required can thus be readily obtained. The upper figure in Plate 3 represents, on a small scale, the mass curve, according to this method, for the 27 years of the Sudbury record. It shows the decided difference in the average rate of flow of the stream for different cycles of years. By drawing lines, which do not cut the curve, tangent to any two summits, the maximum rate which can be maintained for that period, as well as the necessary storage capacity, can be obtained at once. The critical periods can easily be selected and dealt with on a larger scale, as in Plate 6. An advantage of this method is that the same mass curve serves for all rates of draft, while with the previous one a different curve must be drawn for each different rate.

The lower figure in Plate 3 is obtained from such a diagram as that given in Plate 6 or Plate 7. It represents more clearly the fluctuations in the quantities stored in a reservoir corresponding to a draft of 500,000 gallons per day. The horizontal line corresponding to the zero of the vertical scales represents the overflow from the reservoir, the shaded portions, the extent of the depletion during the different years. The difference in the supplying capacity in different years in here strikingly shown. The shaded portions in Plate 5, representing waste, storage and refill, are obtained from the above diagrams.

Proceeding in some such way as described, and correcting the yield for the effect of various percentages of water surfaces, the results given in such a diagram as Plate 4 may be obtained.

Plates 3, 5, 6 and 7 have been plotted by the writer from the Sudbury records, chiefly as illustrating the methods referred to; and, therefore, relate only to the proportion of water surface actually existing on that watershed. In Plate 4, however, the storage required for different daily drafts, is given for a square mile of watershed containing from 0 to 25 percent of water surface.

CONCLUSION.

In undertaking the preparation of this paper, the writer had primarily in view the collection, in a form convenient for reference, of the best data available on the subject of Stream Flow. The appended tables have been largely made up of records scattered through various volumes of the Geological Survey of the United States, and from reports of city and state engineers.

In several cases it has been possible to complete imperfect data by unpublished records, kindly furnished by the observers themselves. Appended to this paper will be found a reference list of sources, from which each table has been compiled.

In connection with the subject, the writer may properly refer to the necessity for a series of careful measurements of streams in this country. Canada's water resources constitute a very important part of her natural possessions, as has been ably pointed out by Mr. T. C. Keefer in his presidental address to the Royal Society of Canada in 1899. The region north of the St. Lawrence and the Great Lakes, with its numerous lakes and rivers of rapid fall, presents immense possibilities for water power development. The importance of this is greatly enhanced by the fact that those potential sources of power are backed and surrounded by vast forest areas, capable of supplying almost illimitable supplies of wood for lumber and pulp mills.

In dealing with the development of power, the great advantage of definite information regarding the yield of streams must be admitted; and it is evident that the only reliable data are those obtained from long continued measurements of the flow from typical drainage areas.

Canada has entered upon a period of intensified development, and if necessity for such data is not very urgent at the present time, it may be so before many years. Unless these gaugings are undertaken now, they will not be available then.

The writer is aware, through experience, of the difficulty of making such observations by individual effort. The work appears to him essentially part of the duty of either the Federal or Provincial Governments. In the United States this work has been carried on for several years by the Hydrography Division of the Geological Survey, under the direction of Dr. F. H. Newell. The governments of some states, notably New York, have also undertaken such measurements on their own account.

So far as the writer knows, no records of this kind have been systematically taken for any considerable length of time in any part of Canada. If only a few carefully-selected streams were measured, the records would almost immediately begin to be of value in connection with those taken elsewhere. Of course, this value would increase as the period of observations extended.

In concluding, I wish to acknowldge my obligation to Dr. F. H. Newell, of Washington, D.C., for information as to the methods of carrying on the field work of his department; to Messrs. C. C. Vermeule, John R. Freeman and Charles W. Sherman for their wilingness to permit the use of data published by them, or in their possession; to Mr. John E. Codman, who furnished me with the records of the three Pennsylvania streams up to within two or three months ago; and particularly to Mr. Geo. W. Rafter, of Rochester, N.Y., who very generously forwarded to me his original manuscripts of records yet to be published in the Reports of the Geological Survey of the United States.

TABLE No. 1.

RAINFALL AND YIELD IN INCHES OF DEPTH OF GENESEE RIVER WATERSHED ABOVE MOUNT MORRIS, FROM 1890 TO 1898.

[Area 1070 Square Miles.]

Month	1890 Rainfall	1890 Rainfall Collect'd	1891 Rainfall	1891 Rainfall Collect'd	1892 Rainfall	1892 Rainfall Collect'd	1893 Rainfall	1893 Rainfall Collect'd	1894 Rainfall	1894 Rainfall Collect'd	1895 Rainfall	1895 Rainfall Collect'd	1896 Rainfall	1896 Rainfall Collect'd	1897 Rainfall	1897 Rainfall Collect'd	1898 Rainfall	1898 Rainfall Collect'd	Mean Rainfall
December	3.33	1.00*	2 61	0.97	3.80	1.04	1.23	..	3.39	2.34	2.47	0.61	3.80	1.32	1.41	0.79	2.94	0.95	2 78
January	4.36	1.70*	4 12	2.62	3.82	0.78	2.68		3.91	1.40	3.26	0.66	2.29	0.47	2.92	0.78	3.66	1 95	3.45
February	3.63	2.53*	4.67	3.40	3.71	1.66	4.49	..	2.93	0.86	1.22	0.22	3.56	0.91	1.56	0.79	1.75	1 85	3.06
March	2.72	2 40*	3.70	2.87	1 73	1.94	2.85	..	1.62	3.31	1.72	1.94	4 00	3 00	3.61	2.65	4.19	2.75	2.90
April	2.82	2 17	1.52	1.39	1.04	2.21	3.65	..	7.22	3.39	2.10	2 01	1 62	3.38	2.77	1.31	2.71	1 65	2.83
May	6 15	3.16	1.60	0.63	5 74	1.41	5.75	..	8.64	4.43	2.43	0.19	2 57	0.17	3 41	0.99	3.41	1.25	4.41
June	4.12	1.85	4.01	0.44	6.67	1.41	2.11	..	2.51	1.10	4 57	0.13	3.52	0.39	3.99	0.44	4.73	0.80	4.02
July	3.18	0.38	4 52	0.37	4 18	2.06	2.27	..	3.70	0.14	2.57	0.11	4.90	0.24	5.66	0.46	2.30	0.45	3 70
August	3.22	0.28	4 25	0.25	4.45	1.43	5.17	..	1.74	0.22	3 99	0.12	1.86	0.20	2.27	0.44	7.12	0 80	3.78
September	6.59	1.35	1.72	0.46	1 62	0.24	3.74	0.33	6 97	0.93	1.96	0.10	5.22	0.16	2.23	0.18	1.44	0.50	3.50
October	4.52	2.27	2.49	0.24	2.19	0.33	2.95	0.38	3.50	0.44	1.30	0.11	4.08	1.74	0.79	0.18	5.12	0.78	2.99
November	2.90	2.13	2.91	0.41	2.74	0.57	2.41	0.54	1 66	0 82	3.41	0.47	3.26	0.82	3.77	0.37	3.13	1.40	2.91
Totals ..	47 54	21.22	38.12	14.05	41.69	15.42	39 30	13 35	47 79	19 38	31.00	6.67	40 68	12.80	34.39	9 38	42.50	15 13	40.33
Evaporation = (Rainfall-Yield)	..	26 32	..	24 07	..	26 27	..	25 95	..	28.41	..	24 33	..	27.88	..	25.01	..	27.37	..

Mean Yield 14.16 inches.

* Approximate.

Mean Yield (1888 to 1875) 13.01 inches.

TABLE No. 2.

RAINFALL AND YIELD IN INCHES OF DEPTH ON THE WATERSHED OF THE MUSKINGUM RIVER.

[Area—5,828 Square Miles]

Month	1888		1889		1890		1891		1892		1893		1894		1895		1896		Mean Rainfall
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	
Dec.	1.94	0.18	1.50	0.84	3.01	1.48	2.45	0.91	2.62	1.03	1.62	0.24	2.59	1.54	3.01	0.36	4.45	0.40	2.58
Jan.	3.96	1.24	3.63	1.89	4.52	3.53	2.52	2.40	2.40	0.74	3.01	0.37	2.11	1.00	3.99	1.67	1.85	0.95	3.11
Feb.	1.91	1.12	1.55	1.42	5.84	3.73	4.43	4.56	2.76	2.40	6.38	4.70	2.95	2.19	0.89	0.12	2.49	..	3.24
Mar	4.05	1.38	1.71	0.71	4.38	4.23	3.19	2.52	3.10	1.26	2.31	2.55	2.20	1.41	1.87	1.20	3.52	..	2.92
Apr.	1.75	0.80	2.23	0.88	3.41	2.00	1.74	1.58	2.24	1.38	5.94	2.22	2.45	0.75	1.76	0.59	3.77	..	2.81
May	3.55	0.45	2.90	0.28	6.61	3.10	2.39	0.45	7.27	2.25	5.78	4.05	4.63	0.74	1.52	0.10	2.86	..	4.17
June	2.66	0.29	4.79	0.47	5.27	1.64	7.56	0.91	7.05	2.30	3.08	0.78	2.12	0.42	2.87	0.17	6.51	..	4.66
July	5.81	0.81	5.35	0.55	3.06	0.51	3.92	0.51	5.44	0.75	2.92	0.28	1.77	0.13	2.52	0.21	8.69	..	4.39
Aug	5.84	0.67	1.98	0.22	5.35	0.49	2.08	0.35	4.05	0.60	2.31	0.16	0.67	0.11	3.75	0.11	2.50	..	3.17
Sept.	3.28	0.61	4.17	0.14	6.86	2.28	1.08	0.17	2.33	0.28	1.56	0.14	4.12	0.15	2.39	0.13	5.44	..	3.47
Oct.	3.25	0.77	2.35	0.14	6.20	2.01	1.25	0.26	0.80	0.20	5.51	0.46	2.19	0.10	1.38	0.08	0.84	..	2.64
Nov.	4.61	2.01	3.72	0.68	2.46	1.84	4.75	0.94	1.68	0.19	1.94	0.25	2.71	0.16	3.89	0.16	2.13	..	3.10
Totals	42.61	10.33	35.88	8.22	56.97	26.84	37.36	15.56	41.74	13.38	42.36	16.20	30.51	8.70	29.84	4.90	45.05	..	40.26
Evaporation	..	32.28	..	27.66	..	30.13	..	21.80	..	28.36	..	26.16	..	21.81	..	24.94	..	..	..

Mean Yield (1888 to 1875) 13.01 inches.

1.24	0.73	0 61	0.61	0.78	1 40	1.23	1.40

TABLE No. 3. ESTIMATED MONTHLY DISCHARGE IN CUBIC FEET PER SECOND PER SQUARE MILE OF CONNECTICUT RIVER AT HOLYOKE, MASS.

[Drainage Area—8,660 Square Miles.]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Means.
1880	1.11	1.71	1.77	2.39	1.33	0.48	0.42	0.82	0.20	0.26	0.70	0.35	0.96
1881	0.29	0.62	1.59	2.49	3.11	0.72	0.46	0.45	0.34	0.37	1.33	1.83	1.13
1882	0.82	1.01	2.25	2.10	2.33	2.03	0.63	0.32	0.91	0.53	0.39	0.32	1.14
1883	0.29	0.45	0.61	3.81	3.26	1.23	0.64	0.35	0.22	0.39	0.59	0.40	0.94
1884	0.71	2.19	2.54	4.65	3.10	1.03	0.52	0.33	0.33	0.48	0.97	1.26	1.51
1885	1.77	0.82	0.55	4.89	1.90	0.83	0.75	0.71	0.64	0.92	2.41	1.31	1.46
1886	1.83	1.85	1.11	4.30	1.48	0.85	0.34	0.30	0.28	0.50	1.70	1.20	1.31
1887	1.36	1.57	0.94	4.99	3.59	1.46	1.27	1.38	0.62	0.52	0.78	1.37	1.65
1888	0.98	0.99	1.38	4.34	5.52	1.22	0.50	0.54	1.50	2.08	2.69	2.27	2.00
1889	1.93	0.84	1.61	3.03	1.60	1.51	1.03	0.84	0.70	1.32	2.19	2.46	1.59
1890	1.81	1.71	2.28	3.42	3.62	1.54	0.57	0.69	1.66	1.82	1.59	0.65	1.78
1891	1.64	1.96	3.36	4.75	1.75	0.86	0.59	0.61	0.45	0.35	0.57	1.28	1.51
1892	2.22	0.83	0.98	2.61	2.48	2.65	1.47	0.83	0.57	0.56	1.84	0.76	1.48
1893	0.41	0.60	1.35	3.53	3.81	0.87	0.40	0.53	0.66	0.65	0.63	0.86	1.09
1894	0.72	0.54	2.57	2.42	1.26	1.00	0.44	0.27	0.31	0.53	0.87	0.70	0.97
1895	0.55	0.35	0.72	5.23	1.43	0.75	0.35	0.38	0.32	0.47	1.97	1.83	1.10
1896	1.26	1.05	3.14	4.89	1.12	0.62	0.42	0.34	0.55	1.27	1.63	0.88	1.43
1897	0.58	0.67	1.67	4.10	2.60	2.58	2.71	1.25	0.50	0.42	1.72	2.51	1.78
1898	1.19	1.00	4.09	3.77	2.19	1.31	0.45	0.57	0.63	1.40	1.82	1.12	1.63
Means	1.13	1.09	1.82	3.77	2.45	1.24	0.73	0.61	0.61	0.78	1.40	1.23	1.40

Table No. 4. FLOW OF MERRIMAC RIVER AT LAWRENCE, Mass.

In Cubic Feet per Second per Square Mile.

[Area of Watershed 4553 Square Miles].

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Means.
1887	1.718	2.903	1.850	4.873	3.034	1.890	1.466	1.811	0.922	0.685	0.970	1.348	1.944
1888	1.409	1.862	2.256	5.470	4.595	1.238	0.552	0.581	1.567	2.716	2.971	3.277	2.373
1889	2.700	1.377	2.424	2.447	1.455	1.184	0.793	1.138	0.768	1.254	1.972	2.883	1.725
1890	1.528	1.696	3.441	3.787	3.138	1.731	0.694	0.748	1.844	2.705	1.948	1.444	2.059
1891	2.921	2.965	5.187	4.726	1.614	0.998	0.636	0.540	0.559	0.469	0.542	0.903	1.831
1892	1.872	0.908	1.610	1.790	2.248	0.839	1.045	1.056	0.866	0.469	1.426	0.863	1.291
1893	0.648	1.097	2.355	3.418	4.284	0.967	0.525	0.567	0.611	0.794	0.739	1.171	1.434
1894	0.664	0.939	3.157	2.435	1.536	1.325	0.500	0.372	0.402	0.495	0.779	0.666	1.106
1895	0.634	0.508	1.286	4.358	1.369	0.667	0.567	0.479	0.367	0.881	2.099	2.065	1.273
1896	1.438	2.001	4.624	4.005	0.975	0.773	0.449	0.443	0.686	1.139	1.463	0.957	1.574
1897	0.749	1.004	2.322	3.868	2.222	2.791	2.372	1.114	0.606	0.485	1.280	2.279	1.760
1898	1.624	1.712	4.088	3.345	2.415	1.420	0.584	0.834	0.639	1.412	2.172	1.928	1.848
1899	1.726	1.072	2.624	5.807	2.093	0.655	0.545	0.458	0.438	0.393	0.613	0.614	1.417
1900	0.738	3.620	3.568	4.063	2.204	0.869	0.399	0.412	0.332	0.553	1.285	1.490	1.628
Means	1.455	1.690	2.914	3.885	2.370	1.233	0.795	0.759	0.758	1.032	1.443	1.563	1.662

TABLE. No. 5.

KENNEBEC RIVER AT WATERVILLE, ME.

[Drainage Area—4,410 Square Miles.]

Discharge in Cubic Feet per Second per Square Mile.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Means
1893	0.60	0.53	0.95	2.64	6.92	3.47	1.31	0.51	0.46	0.53	0.51	0.36	1.65
1894	0.37	0.40	0.91	3.33	2.17	1.17	1.30	0.67	0.62	0.85	0.85	0.44	1.12
1895	0.46	0.41	0.45	5.43	2.17	1.46	0.80	0.61	0.40	0.28	1.27	1.37	1.27
1896	0.98	0.64	2.98	6.21	3.87	1.25	1.21	0.71	0.77	0.83	2.07	0.62	1.84
1897	0.82	0.84	0.86	5.75	6.11	2.95	2.98	1.65	1.08	0.60	1.29	1.21	2.18
1898	0.73	0.77	2.56	6.76	5.70	2.26	0.89	0.71	0.59	0.92	1.17	0.59	1.97
1899	0.53	0.54	0.73	5.31	4.81	2.00	1.14	0.73	0.43	0.28	0.46	0.51	1.46
Means	0.64	0.59	1.35	5.06	4.54	2.08	1.38	0.80	0.62	0.61	1.09	0.73	1.64

TABL

Y'r.	Jan.
1875	0.159
1876	0.995
1877	1.019
1878	2.800
1879	1.083
1880	1.733
1881	0.642
1882	1.920
1883	0.518
1884	1.540
1885	1.910
1886	2.260
1887	4.006
1888	1.629
1889	4.305
1890	1.941
1891	4.669
1892	2.893
1893	0.671
1894	1.072
1895	1.600
1896	1.677
1897	1.307
1898	2.535
1899	3.53
1900	1.23
1901	0.675
M'ns.	1.862

TABLE No. 6.

YIELD OF THE SUDBURY RIVER WATERSHED.

In Cubic Feet per Second per Square Mile, from 1875 to 1901.

[Area 782 Square Miles.]

Y'r.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Means
1875	0.159	2.315	2.482	4.718	1.838	1.346	0.497	0.612	0.321	1.000	2.015	0.903	1.504
1876	0.995	2.116	6.862	5.094	1.761	0.343	0.283	0.627	0.285	0.361	1.683	0.702	1.756
1877	1.019	1.469	7.448	3.703	2.153	0.924	0.312	0.187	0.092	0.977	2.193	1.995	1.878
1878	2.800	3.814	5.426	2.516	2.158	0.782	0.199	0.736	0.249	0.799	2.619	4.916	2.246
1879	1.083	2.647	3.605	4.821	1.723	0.640	0.243	0.611	0.218	0.109	0.318	0.716	1.383
1880	1.733	2.765	2.126	1.808	0.796	0.271	0.273	0.184	0.124	0.157	0.318	0.271	0.895
1881	0.642	2.392	6.195	2.392	1.493	2.070	0.428	0.229	0.305	0.287	0.611	1.199	1.515
1882	1.920	3.718	4.392	1.342	1.998	0.818	0.133	0.086	0.474	0.463	0.324	0.487	1.334
1883	0.518	1.598	2.492	2.088	1.450	0.464	0.178	0.122	0.141	0.288	0.317	0.299	0.824
1884	1.540	4.397	5.857	4.415	1.594	0.644	0.346	0.397	0.068	0.129	0.271	1.431	1.747
1885	1.910	2.095	2.433	2.808	2.067	0.659	0.096	0.372	0.187	0.519	1.822	1.816	1.393
1886	2.260	7.428	3.185	3.013	1.114	0.314	0.179	0.146	0.182	0.225	1.041	1.578	1.682
1887	4.006	4.377	4.437	4.053	1.561	0.640	0.178	0.331	0.172	0.294	0.570	0.995	1.785
1888	1.629	3.011	5.009	4.093	2.526	0.652	0.182	0.587	1.786	3.093	4.267	4.708	2.626
1889	4.305	1.850	2.071	2.182	1.361	1.011	0.980	2.216	1.274	1.903	3.003	3.467	2.140
1890	1.941	2.366	5.636	2.900	2.114	0.878	0.166	0.204	0.708	3.515	1.879	1.541	1.989
1891	4.669	5.393	6.891	3.709	0.901	0.639	0.231	0.2[illegible]2	0.314	0.325	0.472	0.842	2.034
1892	2.893	1.459	3.025	1.348	1.947	0.662	0.331	0.433	0.355	0.195	1.079	0.750	1.209
1893	0.671	2.386	5.021	3.288	4.461	0.680	0.244	0.280	0.167	0.343	0.493	1.232	1.604
1894	1.072	1.533	3.463	2.538	1.299	0.648	0.249	0.324	0.231	0.579	1.293	1.108	1.192
1895	1.600	0.837	3.728	3.892	0.984	0.269	0.357	0.354	0.138	2.134	4.296	2.757	1.782
1896	1.677	4.140	5.933	2.312	0.557	0.617	0.147	0.088	0.600	0.916	1.020	1.017	1.576
1897	1.307	1.651	3.968	2.344	1.416	1.488	1.018	0.914	0.282	0.145	1.407	2.451	1.533
1898	2.535	4.676	4.029	2.830	1.927	0.880	0.357	1.712	0.571	1.795	3.073	2.783	2.248
1899	3.53	2.14	6.52	3.91	0.791	0.101	0.029	0.054	0.146	0.178	0.471	0.341	1.504
1900	1.23	5.89	5.67	2.09	2.03	0.489	0.028	0.053	0.101	0.288	1.027	1.695	1.672
1901	0.675	0.456	4.27	6.51	4.58	1.166	0.474	0.656	0.472	0.637	0.735	4.180	2.074
M'ns.	1.862	2.919	4.518	3.207	1.798	0.742	0.300	0.465	0.368	0.800	1.428	1.706	1.676

TABLE NO. 7.

RAINFALL AND YIELD IN INCHES OF DEPTH OF THE HUDSON RIVER ABOVE MECHANICVILLE, N.Y.

[Area of Watershed, 4500 Square Miles.]

Month	1891		1892		1893		1894		1895		1896		1897		1898		1899		1900		1901		Mean	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd
Dec.	3.01	0.83	4.41	2.27	2.11	1.03	5.75	1.85	3.01	1.12	4.18	2.79	1.84	1.77	4.59	3.67	4.17	1.40	4.82	1.86	3.21	1.36	3.74	1.81
Jan.	4.82	2.12	5.99	4.83	2.16	0.82	3.48	1.73	2.96	0.99	2.25	1.74	2.93	1.03	5.46	1.97	3.40	1.71	3.92	1.50	2.28	0.79	3.60	1.75
Feb.	4.91	2.70	3.15	2.22	4.43	1.09	2.87	1.12	1.58	0.82	6.36	1.12	1.99	0.90	3.29	1.56	2.38	1.22	3.93	2.88	1.34	0.67	3.29	1.48
Mar.	3.70	4.55	3.59	2.80	1.97	2.11	2.26	3.78	2.14	1.08	5.56	3.49	4.88	3.13	2.09	5.18	4.79	2.47	5.07	1.98	3.25	2.00	3.57	2.96
Apr	2.46	4.97	1.62	5.35	3.52	4.44	1.81	2.76	3.11	5.91	1.19	6.20	3.72	4.73	3.28	3.40	1.64	5.86	1.01	5.60	3.45	7.03	2.44	5.11
May.	1.79	1.42	6.19	5.03	5.64	5.71	5.20	1.94	2.99	1.76	2.63	1.18	4.41	3.04	4.09	2.83	3.10	2.49	2.38	2.30	4.94	2.99	3.94	2.79
June.	3.42	0.79	5.38	3.08	3.20	1.19	4.40	1.76	2.61	0.70	2.87	1.18	4.97	2.94	3.78	1.30	2.10	0.65	3.12	1.01	4.75	1.93	3.69	1.50
July.	6.06	0.60	4.90	2.38	3.34	0.65	2.89	0.81	3.13	0.66	4.80	0.72	7.36	2.74	3.28	0.64	3.77	0.62	4.11	0.60	5.25	0.91	4.44	1.03
Aug.	4.01	0.68	8.84	1.41	6.83	1.28	1.44	0.63	4.63	1.00	2.58	0.63	3.47	2.11	6.46	1.30	1.53	0.36	4.88	0.69	5.09	1.18	4.52	0.80
Sept.	1.96	0.51	3.41	1.10	3.90	1.70	4.00	0.47	3.42	0.65	4.93	0.71	2.25	0.68	3.67	0.96	3.37	0.51	2.92	0.47	3.72	1.00	3.41	0.88
Oct.	2.90	0.38	2.16	0.72	1.96	0.99	5.10	0.94	2.14	0.69	2.85	1.05	1.70	0.65	4.89	2.02	2.95	0.67	2.30	0.54	2.69	1.08	2.88	1.71
Nov.	3.92	1.01	4.23	1.89	3.12	0.90	2.77	1.58	4.95	2.08	5.01	2.82	6.99	2.47	3.63	2.29	2.59	1.58	6.95	1.24	2.61	0.92	4.25	1.02
Total	42.96	20.56	53.87	33.08	42.18	21.91	41.97	19.37	36.67	17.46	45.21	23.63	46.51	26.19	48.51	27.12	35.79	19.54	45.41	20.67	42.58	21.86	43.77	22.84
Evaporation.	..	22.40	..	20.79	..	20.27	..	22.60	..	19.21	..	21.58	..	20.32	..	21.39	..	16.25	..	24.74	..	20.72	..	20.93

Table No. 8. RAINFALL and YIELD in INCHES of DEPTH of SUDBURY RIVER WATERSHED (Area = 78.2 SQUARE MILES) from 1875 to 1901.

	January		February		March		April		May		June	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd
1875	2.42	0 184	3.15	2.411	3.74	2.862	3.23	5.263	3.56	2.119	6.24	1.501
1876	1.83	1.147	4.21	2 282	7.43	7.911	4.20	5.683	2.76	2 031	2.04	0.383
1877	3 22	1.174	0.74	1.529	8.36	8.586	3.43	4.132	3.70	2 482	2.43	1 031
1878	5.63	3.228	5.97	3.972	4.69	6 256	5.79	2.807	0.96	2.487	3.88	0.873
1879	2.48	1.249	3.56	2.756	5.14	4.156	4.72	5.379	1.58	1.987	3.79	0.713
1880	3.57	2 000	3.98	2.982	3.31	2.451	3.11	2.017	1.84	0 917	2.14	0.303
1881	5.56	0.740	4.65	2.491	5.73	7.142	2.00	2.669	3.51	1.721	5.39	2.309
1882	5.95	2.213	4.55	3.872	2.65	5.064	1.82	1.497	5.07	2 304	1.66	0.913
1883	2.81	0.597	3 87	1.664	1.78	2.873	1.84	2.330	4.19	1.673	2 40	0.518
1884	5.09	1.775	6.54	4.742	4.72	6.752	4.41	4.925	3.47	1.838	3.44	0.719
1885	4.71	2.203	3.87	2.182	1.07	2.805	3 60	3.133	3.48	2 383	2.87	0.735
1886	6.36	2.606	6.28	7 734	3.61	3.672	2.22	3.361	3.00	1.285	1.47	0 350
1887	5.20	4,619	4.78	4.558	4.90	5.116	4.27	4.522	1.16	1.799	2.65	0.714
1888	4.15	1.878	3.68	3.255	6.02	5.775	2.43	4.566	4.82	2.912	2.54	0.728
1889	5.37	4.963	1.65	1.926	2.37	2.388	3.41	2.434	2.95	1.569	2.80	1.128
1890	2 53	2.237	3.51	2 463	7 73	6.498	2.64	3.236	5.21	2.437	2.03	0 980
1891	7.02	5 383	5.23	5.616	6.48	7.944	3.91	4 138	2.01	1.039	3.77	0.714
1892	5.85	3.335	3.14	1.574	4.06	3.488	0.83	1.504	5.58	2.245	2.76	0.739
1893	2 92	0.773	8 20	2.485	3.67	5.789	3 60	3.668	6.61	5.143	2.38	0.759
1894	4.09	1.236	3.91	1.596	1.43	3.992	3.42	2.832	4.24	1.498	1.15	0.723
1895	4.06	1.844	1.39	0.871	2.98	4.299	5.25	4.341	2.02	1.134	2.77	0.801
1896	2.39	1.933	7.18	4.466	5.24	6.841	1.57	2.579	2.57	0 641	3.22	0.689
1897	4.00	1.507	2 91	1.718	3.66	4.575	2.82	2.615	4.37	1.632	4 46	1.661
1898	6.83	2.922	4.49	4 869	2.40	4 645	4.66	3 158	3.22	2.222	2.48	0.915
1899	4.18	4.082	4.91	2.225	7.01	7.501	1.90	4 351	1.45	0.911	2 51	0.114
1900	4.96	1.417	9.14	6 123	6 35	6.518	2.58	2.330	4 32	2.341	2.99	0.545
1901	1.82	0.779	1.52	0.483	6 57	4.920	8.60	7.268	7.23	5.270	1.38	1.300
Means	4.259	2.149	4.334	3.068	4.56	5.216	3.42	3.583	3.51	2.075	2.88	0.828

	July		August		September		October		November		December		Total Rainfall	Total Yield	Evaporation
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd			
1875	3.57	0.573	5.53	0.706	3.43	0.358	4 85	1.152	4.83	2.248	0.94	1.041	45.49	20.418	25.072
1876	9 13	0.326	1.72	0 723	4 62	0 318	2 24	0 417	5.76	1 878	3.62	0.809	49.56	23 908	25.652
1877	2.95	0.360	3.68	0.216	0.32	0.103	8.52	1.127	5.80	2.447	0.87	2.300	44.02	25.487	18.533
1878	2.97	0.229	6 94	0.848	1.29	0 277	6.42	0.921	7.02	2 922	6.37	5.667	57.93	30.487	27.443
1879	3.93	0.281	6.51	0 705	1.88	0.243	0 81	0.126	2.68	0.355	4 34	0.825	41.42	18.775	22.545
1880	6 27	0.315	4.01	0.212	1.60	0.138	3.74	0.181	1 78	0 354	2 83	0 312	38.18	12 182	25 998
1881	2.35	0 493	1.36	0.264	2 62	0 340	2.95	0.331	4.09	0 682	3.96	1.383	44.17	20.565	23.605
1882	1.77	0.154	1.67	0 099	8.74	0.529	2 07	0 534	1.15	0 362	2.30	0.561	39 40	18 102	21.298
1883	2.68	0.206	0.73	0 140	1.52	0.157	5.60	0.331	1.81	0 354	3.55	0 345	32.78	11.188	21 592
1884	3.67	0.399	4.65	0 458	0 85	0.076	2.48	0.148	2.65	0.302	5.17	1.650	47.14	23.784	23 356
1885	1.43	0.111	7.18	0.429	1.43	0 209	5.09	0.599	6 09	2.033	2.72	2.094	43.54	18.916	24.624
1886	3.27	0.206	4.10	0.168	2.90	0.203	3 24	0.260	4 64	1.161	4.97	1.819	46.06	22 825	23.235
1887	3.76	0.204	5.28	0.382	1.32	0.191	2.83	0.339	2.67	0 636	3.88	1.147	42.70	24.227	18 473
1888	1.41	0.209	6.22	0.677	8.59	1.994	4 99	3 566	7.22	4 761	5.40	5.428	57.47	35 749	21.727
1889	8.94	1.130	4.18	2 554	4.60	1.422	4.25	2.194	6 29	3.351	3 14	3.997	49.95	29.056	20.894
1890	2.46	0.191	3.87	0 235	6.00	0.790	10.51	4.053	1.20	2.097	5.31	1.776	53 00	26.993	26.007
1891	3 39	0 266	4.73	0.290	2.38	0.350	3.83	0.375	3 09	0 526	3.68	0.971	49.52	27.612	21.908
1892	4.23	0.382	4.44	0.500	2.84	0.396	1.17	0.224	5.80	1.204	1.13	0.865	41.83	16.456	25 374
1893	2.57	0.282	5 41	0 322	1.74	0.187	4.07	0.395	2 20	0 550	4.86	1.421	48 23	21 774	26.456
1894	3 26	0.287	2.03	0.373	2 63	0 258	5.34	0.668	3.43	1 442	4.81	1.277	39.74	16.182	23.558
1895	5.04	0.411	4.15	0.409	2 30	0 153	10.68	2.460	6 63	4.794	3.35	3.179	50.62	24.196	26.424
1896	2 51	0.170	2 40	0.102	7.72	0.669	3.76	1.055	3.02	1.137	2 12	1.171	43 70	21.453	22.247
1897	5 44	1.174	3.51	1.053	2.94	0.315	0.47	0 168	6.40	1.570	5.21	2.827	46.19	20.815	25.375
1898	4.09	0.411	8 17	1.974	2.62	0.637	6.71	2.069	6.93	3 429	3.28	3.208	55.88	30.459	25.421
1899	3 22	0.035	1.43	-0.063	3.95	0.162	2.69	0.206	2.18	0.525	1.78	0.392	37.21	20.441	16.769
1900	2 42	-0.032	2.26	-0.060	3.36	0.112	3.83	0 331	5.70	1.144	2.74	1.955	50 65	22.724	27.926
1901	5.71	0.546	4.57	0.757	3.30	0.527	2.82	0.735	2.90	0.819	9.69	4.820	56.11	28.755	27 355
Means	3.79	0.345	4.10	0.536	3 24	0 412	4.30	0.925	4 22	1.596	3.78	1.972	46.39	22.724	23.666

Table No. 9. RAINFALL AND YIELD IN INCHES OF DEPTH OF LAKE COCHITUATE WATERSHED, FROM 1863 TO 1897.

[Area 18.87 Square Miles].

Year.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Totals.		Evaporation
	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	Rainfall	Yield	
1863	4.10	1.91	4.38	3.12	3.57	3.71	11.34	4.41	2.66	1.44	1.98	0.66	14.12	2.94	5.61	1.54	3.39	0.99	4.56	1.31	8.54	2.64	5.05	2.19	69.30	26.87	42.43
1864	3.37	2.41	0.98	1 56	8.44	4.09	4.02	2.65	2.84	1.61	0.58	0.49	1.06	0.41	3.56	0.67	1.52	0.49	6.50	1.42	5.45	1.24	4.28	1.17	42.60	18.22	24.38
1865	4.99	2.06	4.45	1.76	5.48	4.66	2.18	2.71	8.25	4.75	0.91	0.33	3.10	0.46	3.36	0.48	1.66	0.44	6.99	0.69	4.78	1.02	3.31	1.13	49.46	20.49	28.97
1866	1.44	0 74	5.80	2.84	3.92	1.78	1.94	1.62	6.46	1.29	4.80	1.09	13.35	1.26	3.98	0.64	8.36	1.32	3.43	0.94	4.52	0.97	4.22	1.55	62.32	16.03	46.29
1867	2.76	1.10	5.40	5.24	5.65	3.47	2.43	2.86	6 46	2.18	2.95	0.66	5.36	0.56	12.36	2.10	1.08	0.31	7.27	1.05	2.63	1.11	1.90	1.12	56.25	21.77	34.48
1868	3.70	1.23	1.18	1.12	2.51	3.85	5.61	3.49	8.12	6.18	2.95	1.60	2.16	0.46	7.38	1.15	7.69	1.82	1.19	0.95	6.77	1.99	0.45	1.17	49.71	24 99	24.72
1869	3.71	1.82	7 07	1.87	7.52	3.33	2.57	2.48	7.59	2.17	3.68	1.05	2.63	0.75	2.34	0.59	8.49	1.11	9.50	2.33	3.26	1.30	5.98	3.16	64.34	21 96	42.38
1870	7.85	4.73	4.68	3.95	6.04	3.37	8.81	6.86	3.14	1.66	4.05	0.97	3.10	0.53	2.03	0.40	0.64	0.64	7.96	0.96	4.40	0.80	3.19	0.78	55.89	25.66	30.23
1871	1.31	1.03	2.30	2.28	5 02	2.53	2.29	1.58	5.66	2.00	5.96	0.87	2.20	0.43	3.56	0.70	1.46	0.28	5.38	0.61	7.01	1.23	3.24	1.18	45.39	14.74	30.65
1872	1.86	1.10	1.37	0.89	3.06	1.35	1.74	2.96	3.24	1.10	4.27	1.48	5.55	0.14	9.76	1.32	6.29	1.70	3.69	1.70	4.22	1.99	3.42	1.20	48.47	16.94	31.53
1873	4.24	3.10	2.43	1.58	3.98	3.90	2.69	6.08	3.24	2.66	0.38	0.45	4.08	0.61	7.17	1.43	2.62	0.79	6.11	2.02	4.54	1.86	3.95	2.69	45.43	27 17	18.26
1874	2.96	3.12	2 90	2.20	1.19	1.84	6.36	3.18	3.40	2.79	4.79	1.96	3.16	0.95	4.83	0.92	1.55	0.53	1.04	0.52	2.05	0.57	1.70	0.51	35.93	19.09	16.84
1875	2.42	0.15	3.15	2.93	3.74	2.66	3.23	3.17	3.56	1.39	6.24	1.50	3.57	0.25	5.53	0.61	3.43	0.58	4.85	1.12	4.83	1.98	0.94	1.22	45.49	17 65	27.84
1876	1 83	1.08	4 21	1.77	7.43	5.20	3.24	4.21	2.80	1 43	1.60	0.51	9.49	0.85	2.19	0.28	3.98	0.58	2.00	0.36	6.59	1.85	3.13	1.00	48 49	19.12	29.37
1877	3.19	1.20	0.53	1.37	7.79	6.81	3.24	3.24	3.73	2.04	2.64	0.92	2.77	0.64	3.35	0.66	0.46	0.40	8.14	1.21	6.94	2.69	1.02	1.97	43.80	23.06	20.74
1878	5.77	3.25	5.93	3.97	4.20	5.40	5.63	2.86	0.83	1.66	1.33	0.76	3.47	0.47	6.94	0.84	1.12	0.29	5.15	0.73	6.09	2.07	5.12	4.04	53.58	26.34	27.24
1879	2.00	1.29	3.05	2.32	3.90	3.30	4 69	4.48	1.20	1.40	4.14	0.77	3.38	0.33	6.43	0.95	1.74	0.61	0.90	0.60	2.98	0.72	3.60	1.04	38.01	17.81	20.20
1880	3.07	1.47	5.05	2.24	2.83	1.79	2.94	1.57	1.98	0.44	1.25	0.06	7.00	0.33	3.81	0.23	1.69	0.24	2.95	0.28	1.70	0.66	2.56	0.59	35.83	9.90	25.93
1881	5.56	1.19	4.43	2.23	4.79	5.66	1.71	1.79	3.18	1.26	4.83	1.31	2.78	1.16	1.13	0 09	2.13	0.23	2.87	0.18	3.85	0.84	3.83	1.40	41.09	16 34	24.75
1882	5.93	1.84	3.96	3.00	2.76	3.67	1.89	0.93	4.73	1.55	1.87	0 62	3.49	0.06	1.14	0.07	9.20	0.97	2.22	0.84	0.93	0.58	2.17	0.92	40.29	15.05	25.24
1883	2.88	0.84	3.59	1.59	1.76	2.04	2.27	1.66	3.95	1.26	1.81	0.07	2.88	0 02	0.39	0.07	1.31	0.44	5.16	0.44	2.06	0.40	3.14	0.94	31.20	9.76	21.44
1884	4.39	1.84	6.04	2.86	4.50	4.67	3.80	4 00	2.92	1.39	3 88	0.67	4.42	0.26	4.49	0.61	0.90	0.13	2.59	0.34	2.33	0.62	5.31	1.82	45.57	19.21	26.36
1885	5.25	1.90	3.98	2.00	1.09	2.21	3.71	2.36	3.46	1.61	2.96	0.43	1.73	0.00	7.01	0.33	1.63	0 25	5.26	0.79	5.26	2.05	2.32	1.64	43.66	15.57	28.09
1886	6.53	2.28	6.86	7.93	3.46	3.51	2 00	2.52	2.97	1.09	1.21	0.18	3.30	0.25	3.75	0.14	3.20	0.30	3.16	0.42	4.76	1 20	5.77	2.10	46.97	21.92	25 05
1887	5.29	4.06	5.34	4.34	5.10	4 70	4.45	3.36	1.02	1.35	2.58	0.82	3.77	0.72	3.70	1.33	1.28	0.64	2.49	0.49	2.76	0.70	3.80	0.96	41.58	23.47	18.11
1888	4.13	1.13	3.55	2.77	5.60	4.76	2.51	3.45	4.63	2.37	2.07	0.53	1.67	0.47	6.32	0.94	8.81	2.31	4.95	2.57	7.03	4.21	5 66	5.46	56.93	30.97	25.96
1889	5 46	4.50	1.56	1.85	2.28	2.08	3.19	2.17	3.64	1.20	3.17	1.18	9.10	1.63	4.57	3.43	4.92	1.79	3.85	1.91	5.79	2.95	2.70	3.26	50.23	27.95	22.28
1890	2.34	1.92	3.21	2.04	7.35	5.87	2.51	2.23	5.31	1.85	1.78	1.41	2 31	0.33	3.34	0.46	6.47	1.40	10.11	3.40	1.24	1.49	5.26	2.11	51.23	24.51	26.72
1891	6.67	6.26	5.02	6.62	5.49	8.03	3.62	4.31	1.67	0.88	3.78	0.77	2.99	0.50	4.91	0.72	2.12	0.76	4.14	0.79	2.84	0.83	3.17	1.26	46.42	31.73	14.69
1892	4.78	8 03	2.80	1.54	4.12	3.02	0.78	0.90	5.46	2.03	3.23	0.49	3.47	0.33	3.79	0.56	2.87	0.60	1.42	0.57	5.14	1.09	1.18	0.84	39.04	15.02	24 02
1893	2.61	0.64	7.26	2.55	3.13	4 12	3.21	2.42	5.45	1.83	2.75	0.75	2.40	0.38	5.86	0.77	1.76	0.42	3.74	1.08	2.08	0.83	5.03	1.48	45.28	17.27	28.01
1894	3.95	1.21	3.89	1.67	1.16	2.55	3.27	2.15	3.70	0.91	1.61	0.45	3.61	0.38	2.57	0.41	2.27	0.46	5.14	0.66	3.53	0.92	4.38	1.14	39.08	12.91	26.17
1895	3.93	1.58	1.70	0.75	3.11	3.50	5.03	3.35	2 03	0.97	3.12	0.40	4.71	0.55	3.96	0.50	2.77	0.69	9.57	1.97	6.32	3.51	2.71	2.40	48.96	20.17	28.79
1896	2.43	1.72	6.70	3.69	5.20	5.52	1.60	2.01	2.27	0.62	3.04	0.71	2.22	0.38	2.43	0.47	8.21	1.03	3.53	1.28	3.00	1.40	2.15	1.31	42.78	20.14	22.64
1897	4.23	1.64	2.86	1.65	3.60	3.22	2.78	1.85	4.25	1.39	4.28	1.19	4.80	0.75	3.26	0.63	2.56	0.46	0.89	0.43	6.47	1.68	4.81	2.16	44.79	17.05	27.74
Means	3.91	2.01	3.90	2.632	4.31	3.776	3.52	2.911	3.88	1.764	2.98	0.803	4.26	0.558	4.48	0.771	3.42	0.743	4.53	1.056	4.36	1.486	3.44	1.773	47.01	20.195	26 815

TABLE No. 10.

RAINFALL AND YIELD IN INCHES OF DEPTH, PERKIOMEN CREEK, PA., FROM 1883 TO 1902.

[Area of Watershed 152 Square Miles].

Year.	October.		November.		December.		January.		February.		March.		April.		May.		June.		July.		August		September.		Totals.		Evaporation.
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Yield	
1883-1884	5.27	1.42	1.93	0.91	4.00	1.04	5.14	5.40	5.04	9.73	5 04	5.29	2.63	2.37	3.40	1.36	4.65	1.26	7.44	2.16	3 44	0.65	0.59	0.31	48.57	31.90	16.67
1884-1885	3.69	0.37	3.26	0.91	6.08	3.77	3.76	3.27	4.41	2 16	1.32	2.52	2.41	2.75	2.49	0.82	1.48	0.28	2.18	0.17	6 17	1.23	0.87	0.16	38.12	18.41	19.71
1885-1886	4.74	0.43	3.88	1.79	3.18	2.45	4.21	3.03	5.08	5 64	3.96	2 56	3.00	3.42	6.60	2.64	5.26	1.89	5.06	1.11	1.44	0.35	1.37	0.23	47.78	25.54	22.24
1886-1887	2.35	0.26	5.28	1.53	3.76	1.43	4.55	4.00	5.64	4.23	2.99	3.03	2.84	1.25	1.85	0.72	5 87	0.76	8.63	2.07	2.76	1.43	3.64	0.62	50.16	21.33	28.83
1887-1888	1.45	0.43	1.61	0.40	6.65	2.13	5 01	3.66	4.08	4.41	5.15	5.10	3 43	3.45	3.16	0.92	1.62	0 39	2.77	0.25	8.03	1.53	7.35	3 68	50.31	26.35	23 96
1888-1889	3.41	1.26	3.42	2.46	4.37	2.88	3.86	3.27	1.99	1.47	3.17	3 01	5 05	2.07	4.55	1.58	7.16	2.65	12.23	4 89	3.99	2.48	7.00	2.80	60.20	30 82	29.38
1889-1890	4.78	2 34	8.66	6.67	1.70	1.27	2.81	2.05	4.37	3.58	6.56	5.58	2.79	2.51	6.43	3.15	2.40	0.94	5.19	1.09	6 75	1.08	3.71	1.30	56.15	31.56	24 59
1890-1891	5.48	2.35	1.12	0.87	2.71	1.14	6.30	5.29	3 84	4.18	6.07	4.29	1 98	1.80	1.99	0.65	3.02	0 36	7.73	0.85	7.57	2.04	2 63	1.53	50.44	25.35	25.09
1891-1892	3.53	0.56	1.99	0.60	4.73	2.89	5.56	4.79	1.25	1.17	4 99	4.05	1 79	1.16	5 32	1.83	3.18	0.89	5.19	0.73	2.69	0.76	2.21	0.33	42.43	19.76	22.67
1892-1893	0.48	0.20	6.64	2.13	1.88	1.22	2.38	1.45	5.53	4.04	2.90	4.93	4.11	2.30	5 36	3.27	3.75	0.56	2.00	0.30	6.45	0 96	3.14	0.60	44.62	21.96	22.65
1893-1894	2 82	0.89	4.22	1.84	2.75	1.90	1.78	0.70	4.22	2.42	1.45	2.38	2.54	1.71	11 63	6 66	3.61	1.13	2.93	0.58	2.23	0.34	6.36	1.67	46.54	22.22	24.32
1894-1895	6.24	1.66	2.80	1.85	4 81	2.83	4.30	3.06	1.58	1.25	2.96	3.91	6.12	3 48	3.45	0.98	3.56	0.43	3.96	0.61	3 36	0.28	0.93	0.18	44.07	20.52	23.55
1895-1896	3.46	0.23	1.86	0.34	3.13	0.91	0.91	0.59	5.97	3 50	4.43	3.83	1.85	0.97	3.70	0.46	4.53	0.48	9.31	2.01	1.21	0.34	5 18	0 65	45.54	14 31	31.23
1896-1897	4 72	1.48	4 72	2.06	0.65	0 81	2.05	1.18	2.90	2.93	2.38	1 83	3.30	1.64	8 72	3.98	3.17	0.93	7.79	1.56	2.73	0.59	1.62	0.29	44.75	19.28	25.47
1897-1898	2.06	0.22	6.38	1.75	4.37	2.76	4.04	2.56	3.18	3 33	2.56	1.56	3 86	1.68	6 22	3.83	0.96	0.42	2.85	0.33	6.16	0.63	2 22	0.22	44.86	19.29	25.57
1898-1899	5.12	0.59	6.60	3.08	3.64	3.25	3.48	3.57	4 44	4.51	5.83	6.59	2.00	1.80	3.41	0.76	3.90	0.54	5.76	0.79	4.46	1.13	7.46	2.44	56.10	29.06	27.01
1899-1900	1 29	0.56	2.61	1.02	1.72	0.94	2.62	2.24	5 04	5.07	2.88	2.49	1.96	1.31	2.98	0.89	3.01	0.34	4.97	0.96	3.74	0.41	1.80	0.24	34.62	16.47	18 15
1900-1901	2.16	0.29	2.25	0.37	2.53	0.64	2.38	1 05	0.69	0.30	5.34	3 34	5.18	2 48	4.90	1.79	2.36	0.87	5.13	0.34	8.70	1.39	3.27	0.63	44.89	13.49	31.40
1901-1902	1.86	0.61	2.31	0 53	7.17	4.22	3.60	2.68	5.11	5.39	3.98	5.05	3.47	2.21	2.20	0.75	5.64	0.53	3.33	0.55	4.06	0.52	7.54	1.21	50.27	24.25	26.02
Means ..	3.42	0.85	3.77	1.64	3.68	2.03	3.62	2 83	3.91	3.65	3.89	3.75	3.17	2.12	4.64	1.95	3.64	0.82	5.50	1.12	4.52	0.96	3.63	1.01	47.39	22.73	24.66

TABLE No. 11.

RAINFALL AND YIELD IN INCHES OF DEPTH OF NESHAMINY CREEK, PA., FROM 1883 TO 1902.

[Area of Watershed 139.3 Square Miles.]

Year.	October.		November.		December.		January.		February.		March.		April.		May.		June.		July.		August.		September.		Totals.		Evaporation.
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	
1883-1884	3.80	0.48	1.43	0.35	3.06	0.85	5.58	6.77	6.27	10.45	5.20	5.55	2.42	1.64	3.24	0.35	5.24	0.82	4.89	0.52	3.58	0.51	0.31	0.06	45.02	28.35	16.67
1884-1885	3.05	0.06	3.69	0.33	5.70	4.56	3.76	3.50	4.93	5.18	1.04	1.84	2.26	2.21	2.44	0.56	1.68	0.08	2.19	0.04	6.38	0.96	1.16	0.03	38.28	19.35	18.93
1885-1886	5.56	0.17	4.50	1.53	2.88	1.73	5.11	5.21	6.18	6.55	3.72	2.30	2.93	3.57	5.79	2.09	5.67	0.91	5.40	0.81	1.60	0.15	0.91	0.05	50.25	25.07	25.18
1886-1887	2.77	0.06	3.92	0.55	3.30	2.34	4.63	4.22	5.05	3.94	3.58	3.25	3.17	1.46	2.15	0.71	7.27	1.67	8.15	1.96	3.84	0.81	4.06	0.41	51.89	21.38	30.51
1887-1888	1.90	0.36	1.63	0.26	6.13	2.88	4.47	4.60	3.98	5.49	5.15	4.89	3.88	2.79	2.87	0.52	2.34	0.22	3.71	0.15	5.78	0.64	6.93	2.63	48.78	25.43	23.35
1888-1889	3.76	1.05	3.49	2.34	3.72	3.16	3.61	2.92	1.90	0.90	3.37	2.90	4.83	2.07	4.89	1.49	5.25	1.16	12.42	5.47	4.75	3.37	8.56	3.51	60.55	30.34	30.21
1889-1890	5.09	2.55	8.53	6.31	1.88	1.88	2.88	1.60	4.28	3.00	5.36	5.09	2.46	1.77	5.20	1.51	4.51	0.99	4.47	0.63	5.30	0.53	2.99	0.39	52.95	26.25	26.70
1890-1891	6.18	2.16	1.06	0.78	2.86	1.37	6.28	5.78	4.61	4.47	4.91	4.32	1.90	1.48	2.92	0.32	3.46	0.24	5.71	0.34	6.73	1.95	2.54	1.27	49.16	24.48	24.68
1891-1892	3.66	0.55	1.88	0.56	4.19	3.02	5.09	5.14	1.07	0.97	4.13	3.56	2 24	1.03	5.83	1.29	3.38	0.58	4.83	0.53	3.37	0.20	2.59	0.11	42.26	17.54	24.72
1892-1893	0.40	0.04	7.14	1.79	1.69	1.15	3.13	2.00	5.68	4.89	2.66	4.66	4.97	2.88	4.03	2.94	3.20	0.45	1.60	0.13	7.41	1.12	3.36	0.57	45.27	22.61	22.66
1893-1894	3.30	0.59	4.41	2.58	2.78	2.61	1.71	0.79	4.05	2.68	1.61	2.67	3.04	2.00	13.49	7.41	2.55	1 05	3.72	0.43	2.68	0.34	8.18	2.27	51.52	25.42	26.10
1894-1895	5.25	1.48	3.02	2.37	4.14	2.31	4.68	3.46	1.12	1.77	3.17	4.26	5.32	3 34	2.54	0.70	4.30	0.52	3.74	0.88	3.37	0.67	0.74	0.05	41.39	21.76	19.63
1895-1896	3.26	0.08	2.21	0.11	1 85	0.40	1.31	0.59	7.79	4.73	5.09	4.37	1.63	1.07	2.85	0.38	4.70	0.41	5.12	1.04	0.98	0.20	5.88	0.96	42.67	14.34	28.33
1896-1897	2.64	0.93	4.13	1.52	0.85	0.76	2.04	1.29	3.20	2.53	2.21	1.73	3.36	1.53	7.62	2.76	5.21	2.46	9.10	2.96	3.39	1.08	1.33	0.22	45.08	19.77	25.31
1897-1898	2.50	0.16	5.23	1.17	4.84	3.26	3.96	3.10	3.55	3.51	3.04	1.51	3.87	1.69	6.43	3.80	0.91	0.44	3.46	0.19	7.97	1.06	1.88	0.10	47.64	19.99	27.65
1898-1899	4.86	0.22	6.05	3.01	3.59	3.46	3.90	3.41	6.20	4.12	6.58	7.41	1 39	1.07	1.43	0.44	1.62	0.13	3.49	0.19	4.30	1.44	6.97	0.64	50.38	25.54	24.84
1899-1900	1.75	0.28	2.19	1.04	2.52	0.74	3.52	2.71	4.44	5.12	2.98	3.13	2.47	1.22	7.05	2.31	6.66	0.83	4.13	0.38	2.68	0.19	2.65	0.09	43.04	18.04	25.00
1900-1901	2.54	0.15	2.34	0.40	2.47	0.75	2.41	1.15	0.96	0.34	5.08	3.48	5.07	3.48	5.59	2.10	2.52	0.89	6.95	1.48	7.43	2.74	4 05	1.57	47.41	18.53	28.88
1901-1902	1.25	0.33	2.58	0.64	7.47	4.54	3.24	2.35	6 56	6.56	4.45	5.30	3.40	2.14	1.79	0.41	5.51	0.50	3.80	0.61	4.30	0.90	5.38	1.12	49.73	25.40	24.33
Means	3.34	0.62	3.65	1.45	3.47	2.20	3.75	3.19	4.31	4.06	3.86	3.80	3.19	2.02	4.64	1.69	4.00	0.76	5.10	0.99	4.52	0.99	3.71	0.84	47.54	22 61	24.93

Table No. 12

RAINFALL AND YIELD IN INCHES OF DEPTH OF TOHICKON CREEK, PA., FROM 1883 TO 1902.

[Area of Watershed 102.2 Square Miles].

Year.	October.		November.		December.		January.		February.		March.		April.		May.		June.		July.		August.		September.		Totals.		Evaporation
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	
1883-1884	4.40	0.88	1.64	0.57	4.04	0.97	5.32	7.34	5.45	10.41	5.19	6.02	2.52	1.89	3.54	0.64	6.48	3.43	7.05	2.82	3.99	0.28	0.46	0.07	50.08	35.32	14.76
1884-1885	4.00	0.12	3.51	1.16	6.26	3.94	4 35	4.48	4.83	3.57	1.57	2.98	2.69	3.98	2.16	0.50	0.84	0.08	2.30	0.23	8.17	1.23	0.53	0.04	41.21	22.31	18.90
1885-1886	4.80	0.33	4.67	2.57	3.06	1.77	4.15	4.36	6.01	9.19	4.76	4.28	3.42	4.76	7.14	3.43	4.53	1.40	5.48	0.77	1.09	0.10	1.30	0.03	50.41	32.99	17.42
1886-1887	2.59	0.05	5.16	1.96	3.83	2,38	4.24	5.04	5.47	5.25	3.06	3.83	2.41	1.01	2.59	0.93	5.77	1.21	8.13	1.63	5.29	1.96	3.36	0.40	51.90	25.65	26.25
1887-1888	1.93	0.25	1.42	0.26	6.53	3.20	5.31	6.38	4.34	6.72	5.23	6.27	4.08	4.28	3.03	0.52	1.69	0.15	3.20	0.06	8.07	1.78	8.32	5.49	53.15	35.36	17.79
1888-1889	4.06	1.54	3.66	3.11	4.35	3.48	4.43	4.38	2.37	1.52	3.67	3.86	4.90	2.88	5.41	1.70	6.94	2.29	12.33	6.41	4.63	3.75	7.91	3.40	64.66	38.32	26.34
1889-1890	4.57	2.33	8.86	7.97	1.99	1.92	2.82	2.06	4.73	3.78	6.77	6.37	2.48	1.79	6.30	3.09	3.93	0.75	5.81	0.87	5.75	0.92	2.98	1.22	56.99	33.07	23.92
1890-1891	6.21	3.54	1.01	0.69	2.75	1.51	6.15	6.15	4 58	5.68	4.79	5.03	1.97	1.58	2.83	0.28	3.38	0.17	7.49	0.90	8.90	3.92	1.37	0.94	51.43	30.39	21.04
1891-1892	3.81	0.46	1.98	0.63	5.09	4.28	5.49	6.53	1.22	1.19	4.13	4.87	1.95	0 84	5.55	2.05	3.20	0.70	4.26	0.51	3.76	0.31	2.91	0.19	43.34	22.56	20.78
1892-1893	0.64	0.09	7.10	3.19	1.58	1.67	2.96	2.21	5.88	6 64	2.46	4.53	4.96	3.22	4.98	3.78	4.05	0.44	2.10	0.10	8.67	1.56	3.20	0.83	48.58	28.26	20.32
1893-1894	3.73	0.60	4.38	2.63	3.17	3.10	1.82	0.80	3.96	3.80	1.65	3.09	2.91	2.28	13.53	8.58	2.63	0.53	2.28	0.19	2.04	0.12	9.44	3.34	51.54	29.06	22.48
1894-1895	5.18	2.10	3.01	2.67	4.60	3.57	4.19	3.96	0.96	1.70	3.11	5.37	5.50	4.65	2.99	0.66	4.49	0.27	3.53	0.81	4.43	0.38	0.67	0.05	42.66	26.19	16.47
1895-1896	3.85	0.09	2 11	0.14	2.51	0.67	1.18	0.54	7.90	4.58	5.44	5.48	1.48	0.73	3.18	0.30	4.07	0.18	8.06	2.54	1.63	0.19	5.83	1.12	47.24	16.56	30.68
1896 1897	2.67	1.06	4.08	2.34	0.94	0.81	2.21	1.80	3.11	2.93	2.46	2.19	3.20	1.55	8.90	4.65	5.10	1.71	8.47	2.68	3.75	0.73	1.92	0.12	46.81	22.57	24.24
1897-1898	1.83	0 08	5.03	1.78	4.64	4.08	4 19	3.70	3.38	4.05	2.84	1.83	3.73	2.50	7.62	5.04	0.76	0.19	4.06	0.07	6.05	0.74	2.03	0.08	46.16	24.14	22.02
1898-1899	5.41	0.61	6 56	4.50	3.50	4.23	3.68	4.72	4.76	5.56	6.60	9.00	2.19	1.57	2.23	0.25	2.74	0.08	3.28	0.08	5.05	1.02	6.71	2.26	52.71	33.88	18.83
1899-1900	1.39	0.19	2.55	1.02	2.34	1.28	3.53	2.48	5.75	5.09	2.95	2.79	2.08	1.27	2.85	0.89	2.31	0.34	5.86	0.69	2.56	0.19	2.06	0.09	36.23	16.32	19.91
1900-1901	2.66	0.15	2.38	0.38	2.54	0.69	2.54	1.63	0.90	0.09	4.72	5.19	5.36	4.05	5.14	2.27	1.53	0.63	2.92	0.05	7.49	1.39	2.89	0.44	41.07	16.96	24.11
1901-1902	1.64	0.19	1.95	0.29	7.86	7.02	3.08	2.48	5.22	6.33	4.07	7.10	3.59	2.22	1.63	0.33	5.24	0.15	4.64	0.60	2.69	0.16	7.53	2.42	49.14	29.29	19.85
Means.	3.44	0.76	3.74	1.99	3.77	2.66	3.77	3.74	4.25	4.64	3.97	4.74	3.23	2.48	4.82	2.10	3.67	0.77	5.33	1.16	4.95	1.10	3.76	1.19	48.70	27.33	21.37

Table No. 13.

RAINFALL AND YIELD IN INCHES OF DEPTH OF CROTON WATERSHED.

[Area 338.8 Square Miles, 1.73°/$_\circ$ to 3.56°/$_\circ$ Water Surface]

Month	1868		1869		1870		1871		1872		1873		1874		1875		1876		1877	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd
Dec. ..	3.75	2.12	2.35	1.39	5.96	2.86	1.49	0.53	2.59	2 01	3.68	1.24	4.13	3.00	1.78	0.87	1.56	1.56	2.35	0.33
Jan. ..	2.90	1.75	3 79	1.99	4.51	3.54	3.80	0.52	1.44	1.83	5.66	3.83	6.96	8.32	2 74	0.48	1.42	1.27	2.86	0.75
Feb. ..	1.38	0.71	3.64	1.88	6.40	3.85	3.81	1.98	1.22	1.07	3.09	1.48	2.78	2.53	3.47	3.85	4.91	3.31	0.94	1.37
March ..	2.55	3.97	5.48	4.95	3.80	3.16	4.27	3.13	2 59	1.54	3.08	3.62	1.57	2.97	4.99	2.90	6.33	6.37	8.11	6.52
April ..	3 87	3.39	2 11	3.01	5.45	4 00	3 01	1.75	3 04	2.76	3.77	6.45	6.31	3 22	3.04	5.11	4.43	5.62	2.47	2.62
May ..	8.79	5.31	4.52	2.53	2.30	1.60	3.45	1.81	3.69	1.10	2.91	1.90	1.99	2.82	1 08	1.60	3 99	1.76	0.76	0.77
June ..	4.53	2.93	3 59	1.16	2.06	0.72	5 73	1.24	4.00	1 04	0.71	04.3	3 57	0.78	3.02	0.46	2.52	0.57	5.16	0 52
July ..	2.13	0.98	2.26	0.54	3.43	0.43	5.07	0.62	4.34	0.52	2.21	0.44	5.98	1 25	3 10	0.32	3.42	0.25	5.26	0.21
August .	6.98	1.84	1.92	0.31	5.10	0.41	5.24	0.75	5.99	1.45	5.73	0 67	2.75	0.74	10 33	5.08	1 20	0.25	2.75	0 23
Sept. ..	9.33	4.88	3.20	0.18	2.85	0 15	1.44	0.54	3.69	1.06	3.73	0.45	3.56	0.32	2.11	0.75	5.21	0.34	1.36	0 23
October .	0.87	2.65	9.46	2.37	4.73	0.25	6 18	1 78	2.15	0.96	5.13	1.26	2.40	0.72	3.61	0.72	1.50	0 33	9.15	1.08
Nov. ..	4 65	3.53	2.43	1.84	2.51	0.56	4.35	3.33	4 91	2.36	3.72	1.49	2.72	0.56	4.61	1.94	3.40	0.68	7.95	4.18
Totals ..	51.73	34 06	44.75	22.15	49.10	21.53	47 82	17.98	39.65	17.70	43.42	23.26	44.72	27.23	43.88	24.08	39 89	22.31	49.12	18.81
Evaporation	..	17.67	..	22.60	..	27.57	..	29.84	..	21.95	..	20.16	..	17.49	..	19.80	..	17.58	..	30.31

Month	1878		1879		1880		1881		1882		1883		1884		1885		1886		1887		1888		1889	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd
Dec. ..	1.46	1.73	7 62	7.13	4.44	1.46	2.59	0.38	6.18	2.00	2 49	1.02	3.65	0.61	6.39	3.63	3.08	2.16	3.87	1.34	5.58	2.21	5.93	4 90
Jan. ..	4.71	2.59	2.79	1.23	3.43	2.45	4.85	0.79	4.68	2.59	3.40	1.00	4.87	2.13	5.41	3.89	5 42	3 19	5.77	2.87	5 31	3.72	5.05	4.08
Feb. ..	4.06	3 45	3.14	2.46	3.40	2.77	5.25	4.59	5.72	4.31	5.38	3.10	5.52	5.10	4.44	2.27	4 92	4.41	6 29	4.64	5.02	4.37	2.25	2 11
March ..	3.04	3.46	4.57	3.82	3.90	2.76	6.54	6.12	3 99	4.65	1.78	2.62	3.99	4.61	1.26	1 82	3 91	2 24	3.72	3.39	5.81	4.38	1.76	1.87
April ..	3.05	1.51	4 76	4.56	3.57	1.92	1.27	1.69	1.42	1.24	3.42	2 44	2.88	2 71	2.27	2.33	3 84	4.25	3.09	3 04	2 57	4.60	4.45	2.35
May ..	4.67	1.45	2.29	1.61	1 04	0.83	4.03	1.22	5.92	2.06	2.56	1.19	3.90	1.69	2.09	1.42	4 28	1.91	0.31	1.16	6.04	2.46	2.96	1.55
June ..	4.18	1.37	5 27	0.79	1 40	0.28	4 67	1.50	2.74	1.49	4.52	0.59	2 52	0.52	1.17	0.35	3.28	0.70	6.79	1 06	2.24	1 24	3.87	1.27
July ..	4.05	0.65	5.87	0.66	5.86	0.26	2.48	0.38	3.13	0.47	4.89	0.35	6.31	0.77	5 01	0.19	5.31	0 46	11.23	2.42	2.41	0.40	9.77	1.43
August .	3.06	0.55	6.95	1.18	4.16	0.14	2.46	0.07	3 16	0.10	2.69	0.15	6.89	1.05	6.71	0.34	3.09	0.37	6.73	3.23	6.60	0.99	3.73	3 79
Sept. ..	7.83	2.18	3.32	1.01	2.42	0.20	0.78	0.05	14 63	3.35	2.61	0.05	0 85	0 52	1.10	0.13	2.29	0.13	1.70	0.80	10 00	3.11	6.42	2.06
October .	4.10	0 86	0.69	0 36	2.83	0.16	2.95	0.42	2 86	2.02	6.24	0.49	2.92	0.34	5.17	0.44	2 14	0.16	3.56	0.94	4 69	2.29	3.87	1.70
Nov. ..	4.79	1 97	2.95	0.51	2.32	0.48	5.23	0.50	1.61	0.84	1.56	0.74	4 24	1.01	5.96	2 35	5.39	0.94	2.52	0.86	4.07	2.83	8.54	4.94
Totals ..	49.00	21.77	50.22	25.32	38 77	13.71	43.10	17.71	56.04	25.12	41.54	13.74	48 54	21 06	46.98	19.16	46.95	20 92	55 58	25.75	60 34	32 60	58.60	32 05
Evaporation	..	27.23	..	24.90	..	25.06	..	25 39	..	30.92	..	27.80	..	27 48	..	27.82	..	26.03	..	29 83	..	27.74	..	26.55

Month	1887		1888		1889		1890		1891		1892		1893		1894		1895		1896		1897		1898		1899		Means	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd		
Dec. ..	3.87	1.34	5.58	2.21	5.93	4 90	3.03	4.24	3.86	1.55	5.36	1 56	1.04	1 44	5.10	3.73	4.19	2 37	4.49	1 22	1 98	1.33	4 98	2.62	3.04	3.42	3.75	..
Jan. ..	5.77	2.87	5 31	3.72	5.05	4.08	2.54	2.05	9 06	6 48	6.18	4.82	3 61	1.46	3 22	1 54	4.70	3 08	1.14	2.02	3.49	1.95	4.98	3.44	3 85	3 64	4.20	..
Feb. ..	6 29	4.64	5 02	4.37	2.25	2 11	4.38	2 94	5.71	5.40	1.14	1 53	7 43	3 27	4 60	1.88	1.86	0 96	7.27	4.19	2.67	2.87	4 51	4.53	5.43	2.72	4.13	..
March ..	3.72	3.39	5.81	4.38	1.76	1.87	6.09	4 44	3.42	4.40	3.61	2 18	4 25	6 56	1.77	4.65	2 12	3 40	7 71	7 20	3.40	3 41	2 90	3.00	6.63	7.01	4 03	..
April ..	3.09	3 04	2 57	4.60	4.45	2.35	3.43	3.00	3.02	2 57	1.08	1 31	3 13	3 16	2.83	2 16	4 57	3 78	1.20	2 83	3.01	2 38	3.67	1.98	1.75	3 68	3.18	..
May ..	0.31	1.16	6.04	2.46	2.96	1.55	5.84	2.43	1 59	0 82	5.56	1 47	7 88	5 52	5.72	1.69	2.11	1.19	3.03	0.55	6.02	2.70	7.77	4 51	1.96	0.91	3.78	..
June ..	6.79	1 06	2.24	1 24	3.87	1.27	3.97	1.37	2 13	0.57	3.54	1 07	2 38	0.88	1.56	1.32	2 35	0 33	3 89	0 85	3.10	1 29	1.41	1.62	5 62	0 41	3 36	..
July ..	11.23	2.42	2.41	0.40	9.77	1.43	5 07	0 67	4 08	0.25	5.71	0.56	2 88	0 32	2.68	0.25	4 73	0 47	4.52	0 66	12 49	2 63	4.24	0.44	5.93	0 94	4 87	..
August .	6.73	3 23	6.60	0.99	3.73	3 79	4.27	0 47	5.05	0.32	6.12	0 97	7.13	0 64	3 71	0.25	4 11	0.25	3.84	0.52	5 20	3 01	11.52	2.77	0.64	0.22	4.87	..
Sept. ..	1.70	0.80	10 00	3 11	6.42	2.06	6.78	2 01	1.97	0 27	2 25	0.47	2 56	0 47	6 70	0 61	1 32	0.22	5.39	0 61	1 82	0 81	2.24	0 73	7.19	0.77	4 02	..
October .	3.56	0 94	4 69	2.29	3.87	1.70	6 73	3.14	2.32	0.23	0.93	0 22	5 39	1.21	5 72	0.53	3 64	0 32	2.31	0.82	1.25	0 52	4 83	0.97	1.27	0.48	3.80	..
Nov. ..	2.52	0 86	4.07	2.83	8.54	4.94	1.09	1.87	3.49	0.61	7.12	1.63	3.13	1 83	4.63	3.27	4 58	0 73	3.57	1.70	5.69	1 40	6 29	2.29	1.91	0.71	4 12	..
Totals ..	55 58	25.75	60 34	32 60	58.60	32 05	53.22	28.63	45 70	23 47	48 60	17.78	50 81	26 76	48 24	21 88	40.28	17.10	48.36	23 17	50 10	24 30	59.34	28 90	45.22	24.91	48.11	22.97
Evaporation	..	29 83	..	27.74	..	26.55	..	24.59	.	22.23	..	30.82	..	24 05	..	26 36	..	23.18	..	25.19	..	25.80	..	30.44	..	20.31	..	25.14

TABLE NO. 14.

RAINFALL AND YIELD IN INCHES OF DEPTH, PASSAIC RIVER, FROM 1877 TO 1893.

[Area of Watershed 822 Square Miles].

Month.	1877		1878		1879		1880		1881		1882	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd
December	..	..	1.01	2.53	5.69	6.83	5.04	2.42	2.70	0.68	4.59	1.65
January	3.81	0.92	5.35	2.67	2.87	0.82	2.40	3.55	4.08	1.14	5.63	2.20
February	1.48	2.30	3.82	3.75	2.21	1.83	2.72	2.64	4.57	3.59	4.31	6.90
March	6.30	6.02	3.35	1.67	3.75	4.12	4.12	2.55	5.10	6.77	3.23	4.35
April	3.00	3.06	1.50	3.84	4.61	4.37	2.89	2.09	1.04	1.68	2.05	1.23
May	0.97	0.98	4.59	1.43	2.51	1.71	0.61	1.04	2.78	0.89	6.45	3.04
June	4.37	0.63	3.03	1.77	4.17	0.97	1.44	0.32	5.42	1.89	6.43	1.90
July	4.87	0.44	5.00	0.80	5.10	0.45	7.69	0.42	1.85	0.39	3.32	0.94
August	6.11	0.60	5.99	1.62	8.18	1.60	4.87	0.50*	0.90	0.27	2.43	0.26
September	1.98	0.36	2.46	0.52	2.77	0.93	2.18	0.48*	1.06	0.26	10.74	3.86
October	7.25	2.98	3.17	0.49	0.29	0.24	1.70	0.22	3.08	0.25	2.06	1.68
November	6.93	5.34	3.48	1.75	2.00	0.26	2.32	0.74	3.12	0.57	1.59	0.57
Totals ..	47.07	23.63	42.75	22.84	44.16	24.13	37.98	16.97	35.70	18.38	49.83	28.58
Evaporat'n	..	23.44	..	19.91	..	20.03		21.01	..	17.32	..	21.25

Month.	1883		1884		1885		1886		1887		1888	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd
December	1.88	1.14	3.36	0.75	5.52	3.36	3.20	3.25	3.57	1.15	5.72	2.32
January	3.75	0.91	5.16	2.83	4.18	4.15	4.83	3.54	4.45	2.84	5.77	4.61
February	4.24	3.03	4.54	6.21	4.82	2.24	4.61	5.68	5.10	4.84	4.41	3.90
March	2.03	3.16	4.75	5.01	1.27	1.96	3.68	2.64	2.87	3.63	6.68	4.97
April	3.91	2.94	2.43	2.68	1.53	3.50	3.41	5.10	2.53	2.66	3.97	6.13
May	2.92	1.67	2.92	1.85	2.55	1.68	6.10	3.38	1.93	1.10	6.09	0.69
June	4.93	0.71	4.45	0.64	1.20	0.52	2.73	1.04	6.65	2.04	2.80	0.38
July	2.96	1.04	5.21	1.33	4.08	0.42	3.81	0.52	8.82	2.29	1.98	0.36
August	2.13	0.38	5.81	0.88	7.26	0.78	2.55	0.49	4.27	1.35	7.60	1.00
September	4.13	0.35	0.61	0.32	0.66	0.26	1.36	0.31	2.01	0.38	8.06	4.19
October	5.67	1.09	3.38	0.59	4.95	0.76	2.55	0.33	2.14	0.66	4.53	2.65
November	1.35	1.30	3.39	0.99	5.53	2.73	4.92	0.92	1.75	0.59	4.09	3.00
Totals ..	39.90	17.72	46.01	24.08	43.55	22.36	43.75	27.20	46.09	23.53	61.70	34.20
Evaporat'n	..	22.18	..	21.93	..	21.19	..	16.55	..	22.56	..	27.50

Month.	1889		1890		1891		1892		1893		Means.	
	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd	Rainfall	Rainfall Collect'd
December	4.33	4.51	2.14	4.40	4.17	1.98	4.73	2.04	1.47	1.18	3.48	2.36
January	6.04	5.75	2.69	2.01	7.52	5.92	5.38	5.34	3.87	3.86	4.57	3.12
February	2.41	2.28	4.59	3.24	4.55	5.41	1.35	1.55	6.35	5.65	3.89	3.83
March	3.22	2.19	6.03	3.30	4.24	5.30	4.19	2.66	3.43	6.95	4.01	4.08
April	6.34	3.41	2.58	2.99	2.30	2.49	1.69	1.43	4.59	4.88	2.96	3.06
May	2.85	2.85	4.39	2.74	2.80	0.94	4.92	1.42	5.15	4.88	3.57	1.92
June	3.43	1.65	4.55	1.78	1.86	0.44	4.68	1.20	3.60	2.32	3.69	1.18
July	14.49	2.31	6.14	1.47	5.16	0.31	3.27	0.52	2.25	0.71	5.06	0.84
August	4.49	4.14	4.96	1.04	5.72	0.83	4.39	0.53	7.26	1.05	5.00	1.02
September	10.06	3.90	3.73	1.52	2.25	0.64	2.17	0.40	2.92	0.58	3.48	1.13
October	3.06	2.15	5.20	2.49	2.50	0.31	0.72	0.25	4.59	1.25	3.34	1.08
November	10.16	6.29	0.75	1.37	2.96	0.63	6.84	1.38	3.65	1.30	3.81	1.75
Totals ..	70.88	42.23	47.75	28.35	46.03	25.20	44.33	18.72	49.13	34.61	46.86	25.45
Evaporat'n	..	28.65	..	19.40	..	20.83	..	25.61	..	14.52	..	21.41

*From Croton Records.

[illegible]

TABLE No. 15.

YIELD IN MILLION GALLONS PER DAY PER SQUARE MILE OF SUDBURY RIVER WATERSHED.

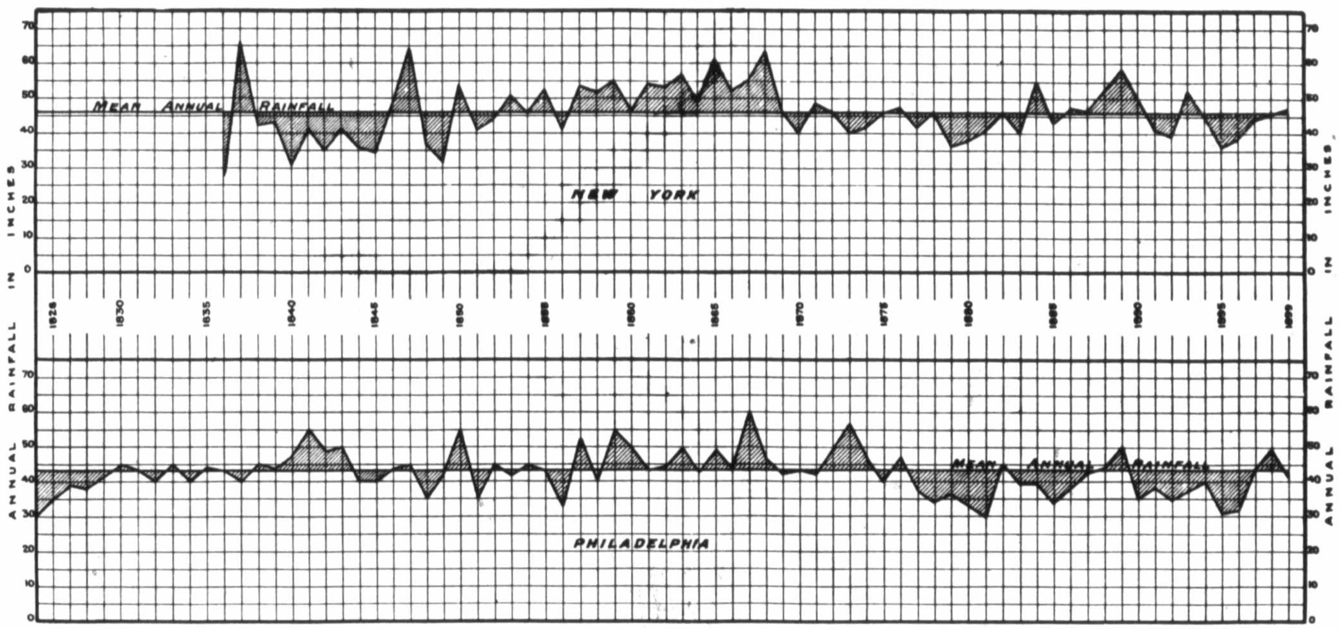
[Area 78.2 Square Miles] from 1875 to 1901.

M'nth	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888
Jan.	0.103	0.693	0.658	1.810	0.700	1.120	0.415	1.241	0.335	0.995	1.235	1.461	2.589	1.053
Feb.	1.496	1.368	0.949	2.465	1.711	1.787	1.546	2.403	1.033	2.842	1.354	4.801	2.829	1.950
Mar.	1.604	4.435	4.814	3.507	2.330	1.374	4 004	2.839	1.611	3.785	1.572	2.059	2.868	3.238
April	3.049	3.292	2 394	1.626	3.116	1,169	1.546	0.867	1.350	2.853	1 815	1.947	2 620	2.645
May	1.188	1.138	1.391	1.394	1.114	0.514	0.965	1 292	0.937	1.030	1.336	0.720	1.009	1.632
June	0.870	0 222	0.597	0.506	0.413	0.175	1 338	0.529	0.300	0.416	0.426	0.203	0.413	0.421
July	0.321	0.183	0.202	0.128	0.157	0.176	0.276	0.086	0.115	0.224	0.062	0.116	0.115	0.117
Aug.	0.396	0.405	0.121	0.476	0 395	0.119	0.148	0.055	0.079	0.257	0.240	0 094	0.214	0.379
Sept.	0 207	0.184	0.060	0.161	0.141	0.080	0 197	0.307	0.091	0.044	0.121	0.117	0.111	1.155
Oct.	0.646	0.234	0 631	0 516	0.071	0.102	0.186	0.299	0.186	0.083	0.336	0.146	0.190	1.999
Nov.	1.302	1.088	1.418	1.693	0 206	0.205	0 395	0.209	0.205	0 175	1.177	0.673	0.369	2 758
Dec.	0.584	0.453	1 290	3.177	0 463	0.175	0.775	0.315	0 194	0.925	1.174	1.020	0 643	3.043
Average for year	0.972	1.135	1.214	1.452	0.894	0.578	0 979	0.862	0.533	1.129	0.901	1.087	1.154	1.697
Average for driest 6 months	0.574	0 384	0.502	0.532	0.230	0.143	0 330	0.211	0.145	0.200	0 391	0.223	0.234	0.953

M'nth	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	Means
Jan.	2.782	1.254	3.018	1.870	0.434	0.693	1.034	1.084	0.845	1.638	2.288	0.794	0.437	1.205
Feb.	1.196	1.529	3.486	0.943	1.542	0.991	0 541	2.676	1.067	3.022	1.381	3.800	0.300	1.889
Mar.	1.338	3.643	4.453	1.955	3.245	2.238	2 410	3 835	2.565	2.604	4.205	3.654	2.755	2.923
April	1.410	1.875	2.397	0.871	2.125	1.640	2.515	1.494	1.515	1.829	2.521	1.350	4.204	2.075
May	0 880	1.366	0.583	1.259	2.883	0.840	0 636	0.360	0.915	1 246	0.511	1.312	2.954	1.163
June	0 653	0.568	0.413	0.428	0.440	0.419	0 174	0.399	0.962	0 530	0.066	0 316	0.753	0.480
July	0.634	0.107	0.149	0.214	0.158	0 161	0.231	0.095	0.658	0.231	0.019	-0 018	0.306	0.194
Aug.	1.432	0.132	0.163	0.280	0.181	0.209	0.229	0.057	0.591	1.107	-0.035	-0.034	0.424	0.301
Sept.	0.823	0.457	0.203	0.229	0 108	0.150	0 089	0.388	0.182	0.369	0.094	0.065	0 305	0 238
Oct.	1 230	2.272	0.210	0.126	0.222	0.374	1.379	0.592	0.094	1.160	0.115	0.186	0.412	0 518
Nov.	1.941	1.215	0 305	0.697	0 319	0.836	2.777	0.659	0.909	1.986	0 304	0.663	0.474	0.924
Dec.	2.241	0 996	0.544	0.485	0.796	0.716	1.782	0.657	1.584	1.799	0 220	1.096	2 695	1 105
Average for year	1.383	1.285	1.315	0 781	1.037	0.770	1.152	1.019	0 991	1.450	0.973	1 082	1 342	1.081
Average for driest 6 months	0 944	0.747	0.239	0.327	0.237	0 356	0.460	0.314	0.564	0.777	0.093	0.194	0.445	0.444

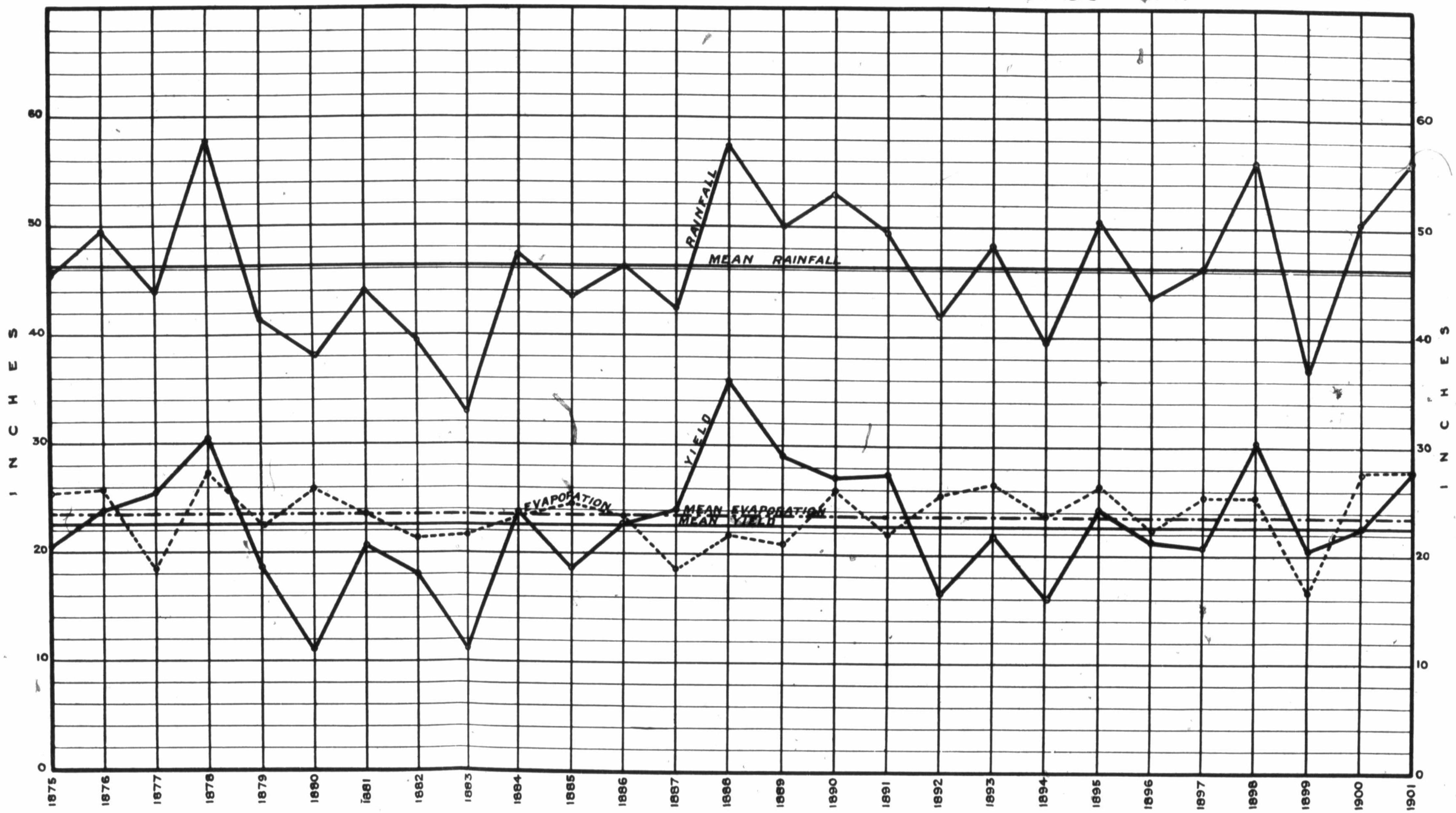
TRANSACTIONS CAN. SOC. C. E.
VOL. XVII, PLATE 1.

SECULAR CHANGE IN ANNUAL RAINFALL.



SUDBURY RIVER WATERSHED

DIAGRAM SHOWING MEAN AND YEARLY RAINFALL EVAPORATION AND YIELD FROM 1875 TO 1901.



MASS CURVE SHOWING ACCUMULATED YIELDS BY MONTHS OF SUDBURY RIVER WATERSHED FROM 1875 TO 1901.

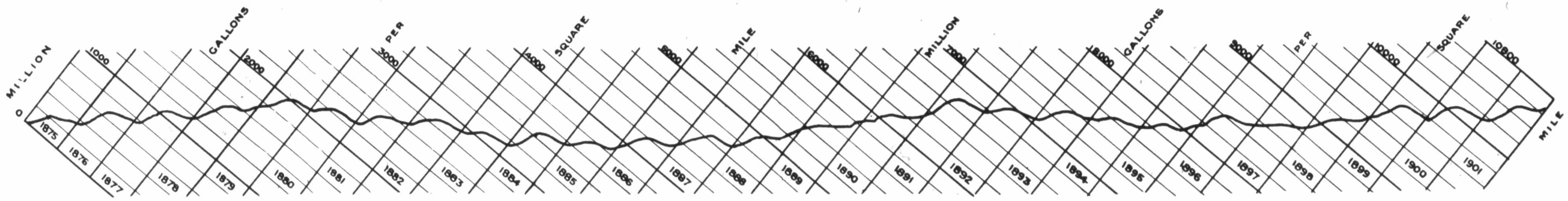
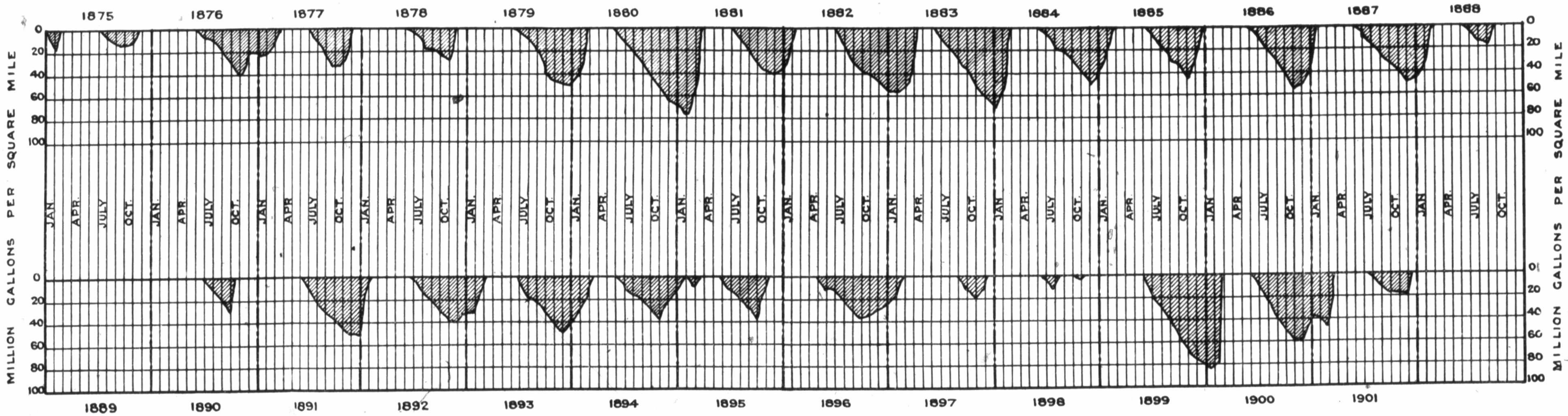
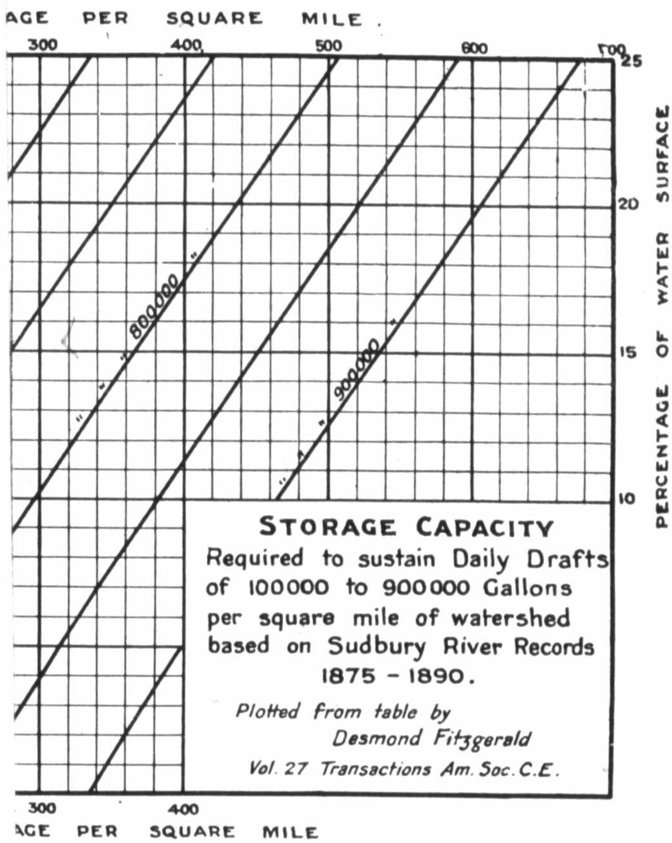


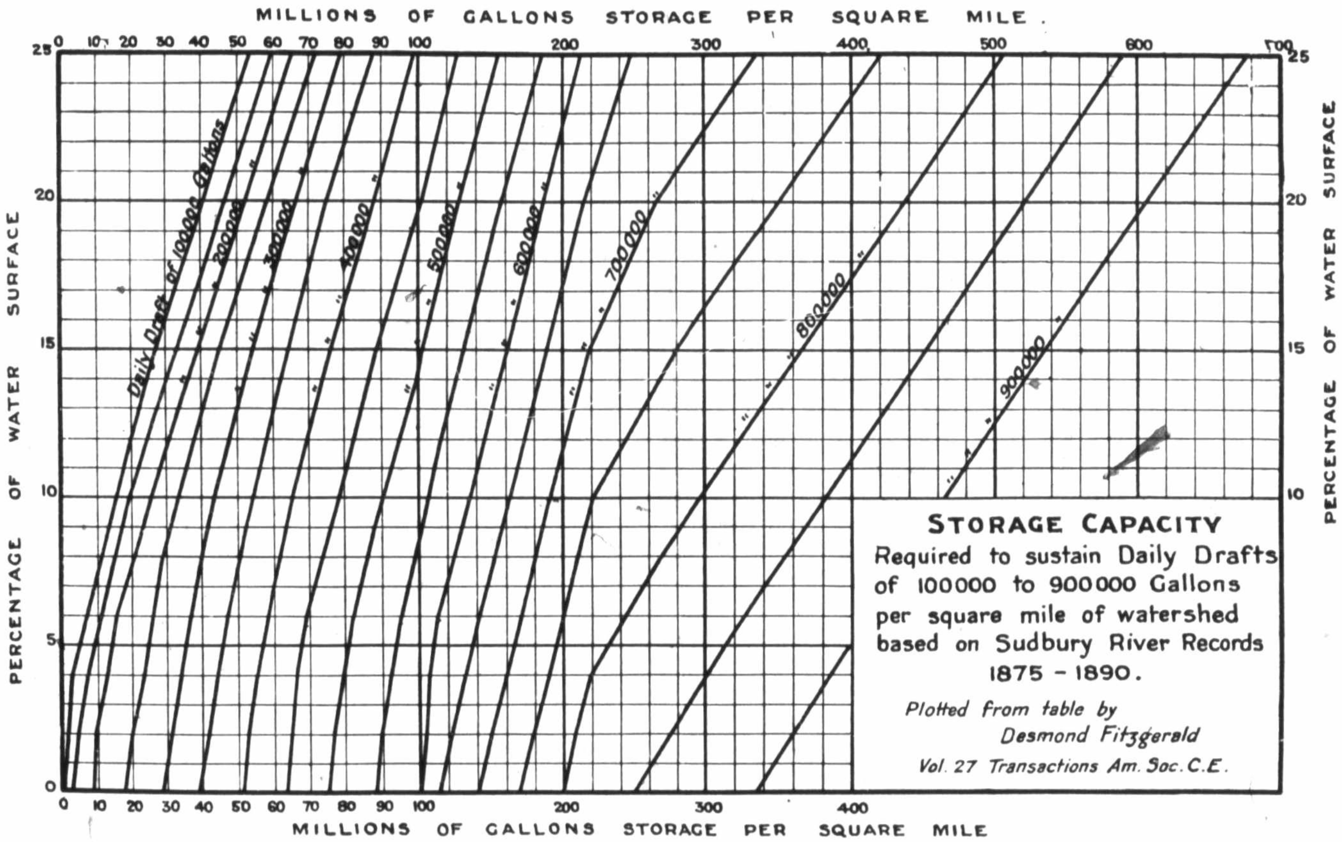
DIAGRAM SHOWING THE FLUCTUATIONS OF A RESERVOIR CAUSED BY A DAILY DRAFT OF 500000 GALLONS PER DAY PER SQUARE MILE OF WATERSHED.





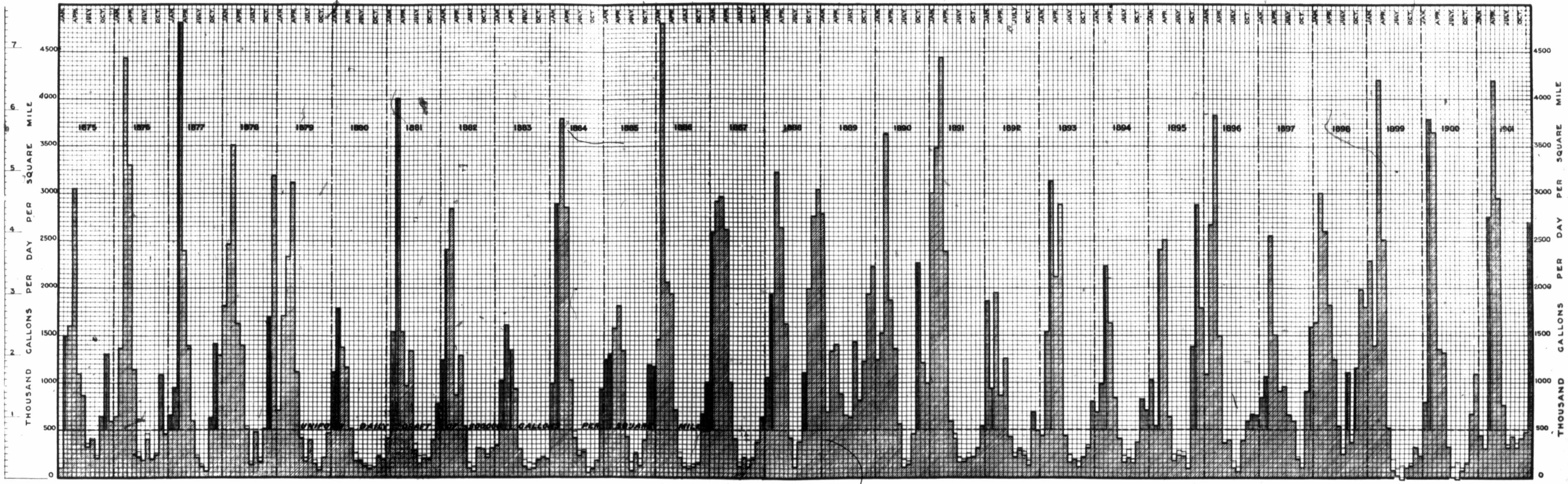
STORAGE CAPACITY
Required to sustain Daily Drafts of 100000 to 900000 Gallons per square mile of watershed based on Sudbury River Records 1875 - 1890.

Plotted from table by Desmond Fitzgerald Vol. 27 Transactions Am. Soc. C.E.


MILLIONS OF GALLONS STORAGE PER SQUARE MILE.
PERCENTAGE OF WATER SURFACE
Daily Drafts of 100000 Gallons
200000
300000
400000
500000
600000
700000
800000
900000
STORAGE CAPACITY
Required to sustain Daily Drafts of 100000 to 900000 Gallons per square mile of watershed based on Sudbury River Records 1875 - 1890.
Plotted from table by Desmond Fitzgerald
Vol. 27 Transactions Am. Soc. C.E.

TRANSACTIONS CAN. SOC. C. E.
VOL. XVII PLATE 5

AVERAGE DAILY YIELD OF SUDBURY WATERSHED
IN EACH MONTH FROM 1875 TO 1901



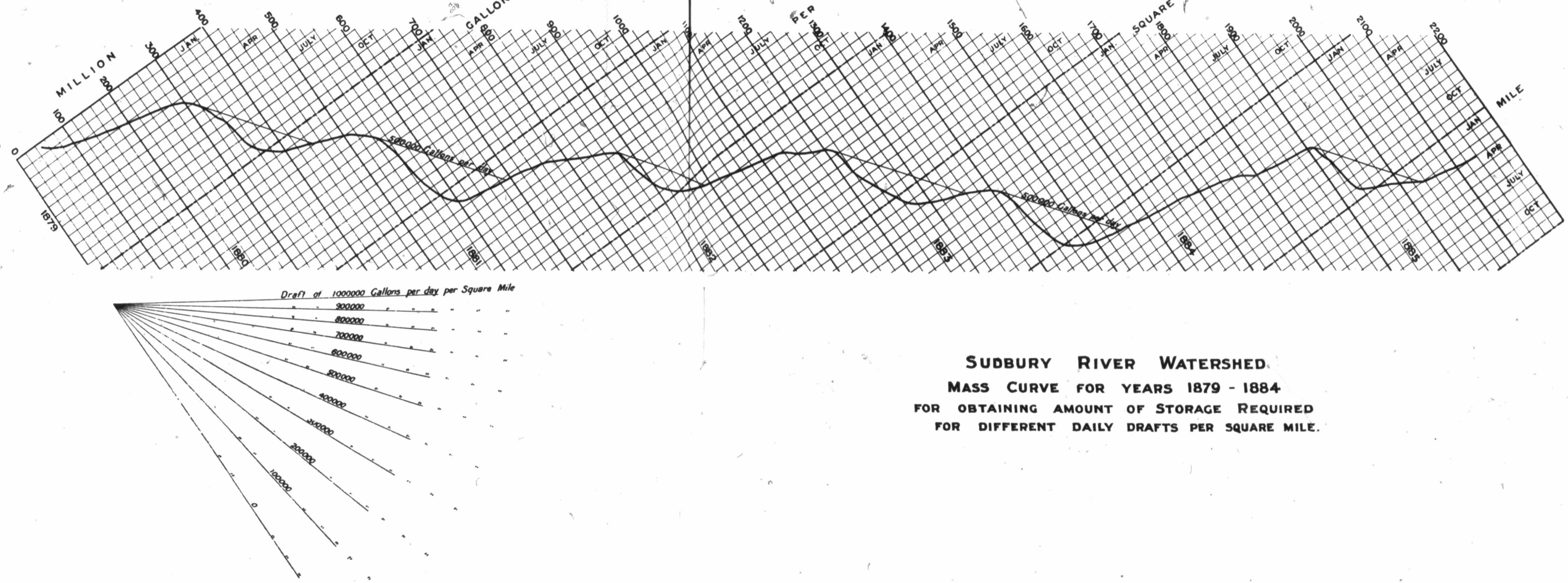
For a uniform daily draft of 500000 gallons per square mile – { Entire shaded portion represents Natural Flow.
Unshaded portion below 500,000 gallon line indicates Draft from Storage.
Vertical shading indicates Refill.
Diagonal shading above 500,000 gallon line indicates Waste.

Yield in driest months of one square mile of Land Surface is indicated by short dotted line thus

JULY

97

TRANSACTION CAN. SOC. C. E
VOL. XVII PLATE 6



SUDBURY RIVER WATERSHED

MASS CURVE FOR YEARS 1879 - 1884

FOR OBTAINING AMOUNT OF STORAGE REQUIRED FOR DIFFERENT DAILY DRAFTS PER SQUARE MILE.

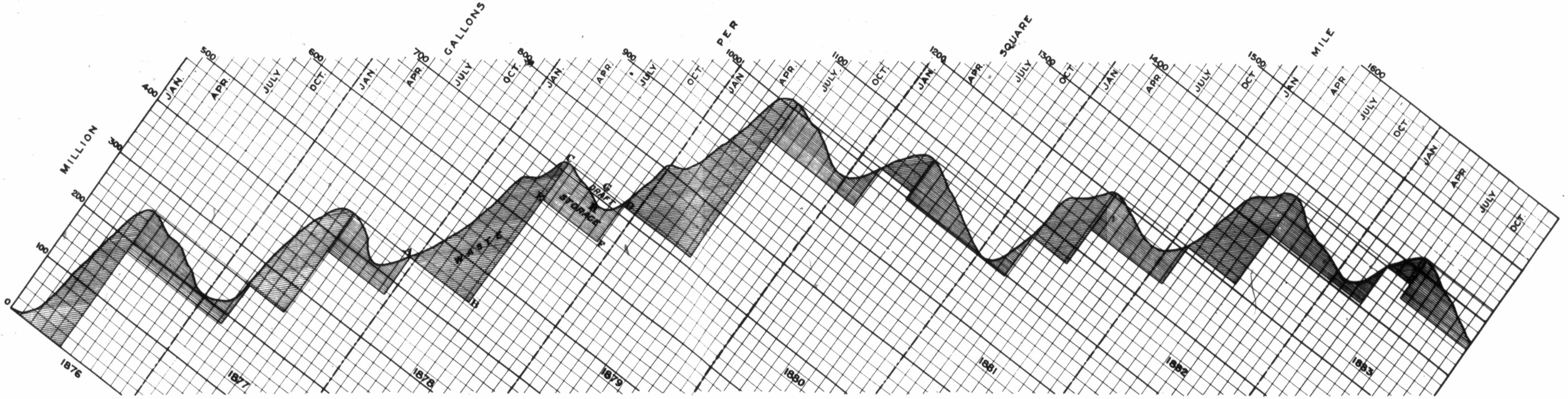
JULY

97

TRANSACTIONS CAN. SOC. C. E
VOL. XVII PLATE 7

SUDBURY RIVER WATERSHED.

MASS CURVE [RIPPL] FOR DAILY DRAFT OF 500000 GALLONS PER SQUARE MILE OF WATERSHED SHOWING STORAGE REQUIRED PER SQUARE MILE FROM 1876 TO 1883



NOTE.

Ordinates in {Horizontal Shading represent Quantity Stored in Reservoir.
{Diagonal Shading represent Quantity Wasted