Meteorological Statisics (Part ???). Precipitation.

METEOROLOGICAL STATISTICS (PART III)

PRECIPITATION

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(Received February 26, 1951)

1. Monthly Values of Precipitation.

The observation of precipitation in Mukaiyama Observatory commenced in March 1915. The monthly values are as given in Table 1.

Table 1.

Year \ Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Old position												
1915	—	—	59.4	80.0	165.1	252.4	21.2	165.1	186.0	220.1	16.0	23.6
16	10.0	62.3	36.5	36.2	110.0	165.6	222.2	141.3	276.0	214.7	153.7	50.8
17	71.1	29.7	169.7	54.5	56.9	185.2	46.0	95.5	272.2	320.6	54.0	4.2
18	20.6	21.9	83.3	96.0	92.4	55.9	105.9	135.3	203.0	111.5	100.0	29.0
19	70.3	126.5	39.4	57.1	59.4	62.2	43.8	119.9	135.7	171.1	71.7	96.6
20	109.6	70.2	156.0	136.4	403.9	146.3	146.1	142.2	236.2	114.6	95.7	51.0
21	42.8	67.4	107.2	90.9	164.6	107.0	116.7	151.0	411.8	254.3	38.0	51.1
22	25.3	138.6	53.4	90.2	96.0	108.5	119.3	185.3	186.7	294.3	105.5	29.2
23	39.1	106.9	56.0	110.7	159.4	279.9	163.6	18.9	371.7	207.1	131.8	42.3
24	12.7	23.9	42.4	70.9	100.2	96.3	25.4	108.0	281.6	77.3	39.6	38.7
25	14.0	26.9	78.9	50.5	68.9	120.7	215.4	342.3	315.9	59.4	107.4	173.4
26	20.4	24.7	46.1	68.6	110.0	57.0	104.4	143.0	186.7	91.4	22.4	54.5
27	17.1	13.4	107.5	207.3	111.6	61.6	126.5	144.2	169.1	79.1	42.4	26.4
28	63.6	67.7	50.1	129.6	74.4	168.2	144.1	181.4	64.1	215.2	65.1	63.2
29	36.8	19.1	32.8	142.8	236.3	85.3	32.5	70.7	223.5	162.3	120.3	72.6
30	16.7	45.5	104.5	101.9	110.5	118.6	323.9	113.1	91.2	92.0	106.4	26.1
31	68.6	57.2	46.7	131.4	60.2	186.3	145.4	66.4	128.1	125.9	53.7	43.5
32	34.0	125.5	34.7	164.8	69.5	181.0	192.8	145.6	—	—	—	—
New position												
31	—	—	—	—	—	—	—	—	144.0	127.7	50.9	47.6
32	37.1	112.9	34.1	169.4	81.7	171.3	202.6	141.8	200.9	114.4	183.5	54.1
33	35.1	13.8	85.1	68.4	71.7	55.9	97.0	176.2	76.7	166.7	59.7	37.2
34	22.9	31.4	39.0	97.2	105.3	186.4	260.7	237.4	290.5	61.7	86.7	68.7
35	38.9	27.9	85.8	85.9	65.1	147.3	116.0	185.2	224.2	181.5	57.6	53.9
36	69.2	36.2	47.6	103.4	128.4	75.3	148.2	91.1	196.2	168.5	16.6	22.8
37	34.1	120.4	96.9	83.2	147.2	57.4	115.5	107.4	233.9	73.8	76.8	100.8
38	35.1	69.4	77.5	69.0	92.4	283.6	220.3	115.8	100.0	144.9	16.4	43.8
39	42.2	37.9	68.4	171.0	54.0	174.1	74.1	169.7	88.0	222.0	40.5	17.2
40	23.6	64.6	44.4	108.2	50.3	89.4	101.6	167.7	199.3	36.7	36.1	25.4
41	39.0	8.8	57.5	86.4	126.8	184.9	373.2	103.2	244.7	23.8	59.2	36.2
42	26.4	46.7	86.4	40.8	81.4	111.4	63.5	155.9	146.1	109.3	49.0	40.6
43	30.2	38.8	26.0	28.9	85.1	86.6	20.8	89.4	158.6	227.3	10.2	23.7
44	14.8	49.5	79.8	203.7	74.1	88.8	236.8	135.8	491.7	219.6	83.0	50.0
45	17.1	40.4	64.5	53.0	136.9	201.5	342.4	72.4	176.0	307.2	143.9	96.6
46	16.2	36.5	75.6	50.1	58.5	87.9	214.0	36.5	93.9	169.4	85.1	91.1
47	63.5	49.8	53.1	75.3	150.6	276.7	215.6	75.3	395.8	82.0	9.0	61.9
48	41.1	9.8	29.0	84.8	87.4	123.7	196.2	293.9	428.2	125.5	89.0	91.7

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2. Comparison of Precipitation at Old and New Stations.

From September 1931 to August 1932 the precipitation is observed at the new and old stations. Table 2 gives the results. As the duration of precipitation is not the same at two stations, one continuous precipitation was taken for comparison as "the unit precipitation". Precipitation was observed once every day at 10^h a. m. If, therefore, measurable precipitation (more than 0.1 mm) was observed in consecutive days, it is defined to be continuous precipitation disregarding it is strictly continous or not.

Table 2.

New Station			Old Station		Difference
Date		Precipitation	Date	Precipitation	
1931	Sept. 1–6	42.9 mm	1–6	40.5 mm	+2.4
	8–9	6.3	8	5.3	+1.0
	11	2.0	11	1.9	+0.1
	14	4.3	14	4.0	+0.3
	16–19	61.3	16–19	52.9	+8.4
	26–27	26.3	26–27	22.7	+3.6
	29	0.9	29	0.8	+0.1
	Oct. 3	2.4	3	2.5	−0.1
	6–7	6.3	6–7	5.7	+0.6
	9–10	13.8	9–10	14.3	−0.5
	12–13	89.4	13	87.6	+1.8
	21	0.2	21	0.3	−0.1
	25–28	15.6	25–26, 28	15.5	+0.1
	Nov. 4–6	44.8	4–7	47.5	−2.7
	10	2.4	10	2.8	−0.4
	14–15	3.2	14–15	3.1	+0.1
	28	0.1	28	0.1	0.0
	30–Dec. 1	3.3	30–Dec. 1	2.6	+0.7
	Dec. 4	3.2	4	3.0	+0.2
	8–9	1.8	8–9	2.6	−0.8
	13	1.6	13	1.2	+0.4
	15–17	6.0	16–17	5.8	+0.2
	24–25	19.7	24–25	16.7	+3.0
	27–28	12.3	27–28	11.8	+0.5
	30	0.1	—	—	+0.1
1932	Jan. 1,3–4	27.0	1–4	23.5	+3.5
	7–9	9.7	7–8, 10	9.9	−0.2
	14	0.2	14–15	0.2	0.0
	26	0.1	26–27	0.2	−0.1
	29	0.1	30	0.2	−0.1
	Feb. 2–4	57.0	2–6	61.4	−4.4
	9	0.1	—	—	+0.1
	15–16, 18	25.3	15, 17	25.6	−0.3
	20	0.6	20	0.6	0.0
	22–23, 25–27	29.9	22–27	37.9	−8.0
	March 6	0.2	6	0.2	0.0
	8	2.9	8	3.7	−0.8
	12, 14	18.3	12–14	18.8	−0.5
	16	0.2	16	0.1	+0.1
	19–20	7.7	19–21	7.4	+0.3
	22–23	0.2	—	—	+0.2
	27–29	4.6	27–29	4.5	+0.1
	April 4	0.5	4–5	0.4	+0.1
	7, 9	2.2	7–9	3.0	−0.8
	11–12	60.8	11–12	59.0	+1.8
	14–15	43.0	15	43.0	0.0
	18–19	52.0	18–19	48.1	+3.9
	24–25	1.0	24–25	1.2	−0.2
	27–30	9.9	27–28, 30	10.1	−0.2

New Station		Old Station		Difference
Date	Precipitation	Date	Precipitation	
May 5	2.3	5	2.7	−0.4
8	2.9	8	1.3	+1.6
11–12	41.1	11–12	39.5	+1.6
14–15	0.3	15	0.1	+0.2
19	1.2	19	1.4	−0.2
21–22	14.0	21–23	15.5	−1.5
25	1.3	25	1.3	0.0
31–June 1	19.1	31–June 1	19.7	−0.6
June 3	0.8	3	0.7	+0.1
5–9	52.3	5–9	51.1	+1.2
14–17	27.3	14, 16–18	27.2	+0.1
22–24, 26–28	89.7	22–28	89.3	+0.4
30–July 2	52.5	30–July 2	51.9	+0.6
July 5–16	103.0	5–16	94.3	+8.7
19–21	45.8	19–20, 22	45.7	+0.1
31–Aug. 3	3.8	31–Aug. 3	3.4	+0.4
Aug. 5–8	8.6	5–8	8.9	−0.3
15	74.7	15	81.1	−6.4
18–24	54.5	18–24	53.8	+0.7
31	2.2	—	—	+2.2
Total	1321.1		1299.1	+22.0
			Mean	+0.33

In the annual value there is only a small difference of 22 mm which is only 1.7% of the total. The maximum difference for a continuous precipitation is 8.7 for 103 mm or only 8.4%. Such a difference may be neglected for further studies.

3. Annual Variation.

The mean monthly precipitations and the recorded greatest and least values for every month are given in Table 3 and graphically represented in Fig. 1.

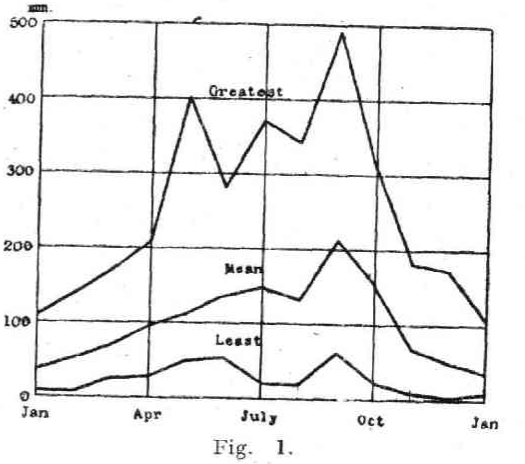

Fig. 1.

Table 3.

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean	37.1	51.4	69.4	95.4	111.8	137.4	148.6	132.9	213.8	155.1	70.8	51.5
Greatest	109.6	138.6	169.7	207.3	403.9	283.6	373.2	342.3	491.7	320.6	183.5	173.4
Year	1920	1922	1917	1927	1920	1938	1945	1925	1944	1917	1932	1925
Least	10.0	8.8	26.0	28.9	50.3	55.9	20.8	18.9	64.1	23.8	9.0	4.2
Year	1916	1941	1943	1943	1940	1918 1933	1943	1923	1928	1941	1947	1917

4. Maximum and Minimum Precipitations.

The maximum and minimum in the curve representing the secular variation of precipitation was marked, and their frequencies in every months are tabulated in Table 4.

Table 4.

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Max.	5	9	10	9	8	12	10	5	20	11	4	8
Min.	15	11	8	12	7	7	10	13	5	4	9	9

The maximum precipitation most frequently takes place in March, June, September, and December. The minimum is in winter months with only exceptions in April and August. The distribution of the maximum is approximately represented by four probability curves as shown in Fig. 2. From this result it may be seen that there are four different cause of precipitation at Sendai. The first is the continental cyclones in early spring, the second the "*Baiu*" rainy season or cyclones from southern Chinese continent in early summer, the third typhoons in early autumn and the last cannot be attributed any distinct cause. Such distinct rainy seasons cannot be seen in the curve of the mean monthly precipitation (Fig. 1), probably due to the overlapping of different types.

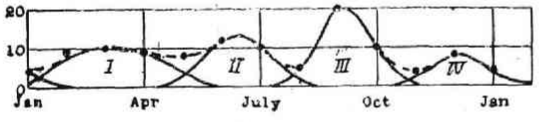

Fig. 2.

5. Secular Change in Precipitation.

Total amount of precipitation in each year is given in Table 5.

Table 5.

Year	Precipitation	Year	Precipitation	Year	Precipitation	Year	Precipitation
1915	1188.9	1924	917.0	1933	943.5	1942	957.5
1916	1469.3	1925	1573.7	1934	1487.9	1943	825.6
1917	1359.6	1926	929.2	1935	1269.3	1944	1727.2
1918	1054.8	1927	1106.2	1936	1103.5	1945	1651.9
1919	1053.7	1928	1286.7	1937	1247.4	1946	1014.8
1920	1808.2	1929	1235.0	1938	1268.2	1947	1508.6
1921	1602.8	1930	1250.4	1939	1157.3	1948	1600 3
1922	1432.3	1931	1113.4	1940	947.3		
1923	1687.4	1932	1503.8	1941	1344.0		

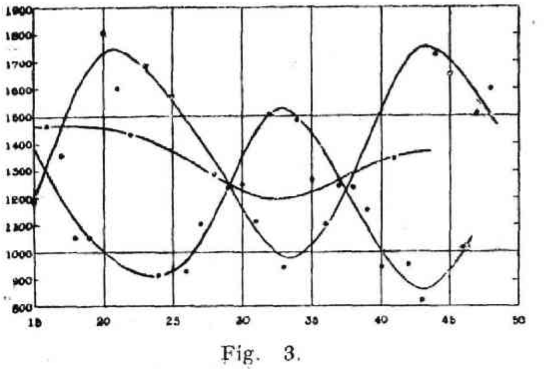

Fig. 3.

As seen in Fig. 3, which shows the result given in Table 5, though points are apparently distributed quite at random, they are nearly on one of three different sine curves. 15 of them on curve I, 17 on curve II and 9 on curve III. The same charactor is seen in the data at other stations in Japan. It is not yet clearly explained what is the cause of such a variation. There are three different states of yielding precipitation. In a certain states annual precipitation is nearly constant, not strictly constant but varies gradually. It is

mere chance that what state the atmosphere takes. If atmosphere is in a certain state, the precipitation keeps a certain level, which may be considered to be analogous to something like the energy level in radiation, represented by one of curves in Fig. 3. There are certain number of levels. And precipitation cannot continuously change its amount, but spontaneously changes its level from one to another.

6. Duration of Drought.

Table 6 gives the frequency of duration in which we have no measurable precipitation.

Table 6.

Duration \ Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1	74	75	91	69	77	64	82	92	75	62	81	92	934
2	43	43	53	47	42	37	37	28	43	46	48	41	508
3	28	25	32	37	36	31	18	23	27	28	35	35	355
4	17	15	20	22	15	15	13	11	6	19	18	12	183
5	17	10	8	12	13	12	9	4	9	11	13	10	128
6	11	7	8	6	9	8	5	10	4	6	3	5	82
7	5	12	5	9	7	2	2	7	1	5	6	4	65
8	3	2	2	1	1	—	2	3	2	2	—	3	21
9	2	1	1	4	2	2	2	3	2	3	1	1	24
10	—	1	1	2	—	—	1	—	—	2	1	3	11
11	2	1	—	—	—	—	1	1	—	—	2	2	9
12	—	1	—	—	1	1	—	—	—	1	1	1	6
13	—	1	—	—	—	—	—	1	—	1	1	—	4
14	—	—	—	—	—	—	1	—	—	—	—	—	1
15	—	—	—	—	—	—	1	—	—	2	—	—	3
16	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	—	—	—	—	1	—	—	—	—	—	1	2
Mean Duration	2.78	2.80	2.40	2.80	2.64	2.66	2.50	2.54	2.24	2.95	2.60	2.62	2.63

Let x be the duration of drought with no measurable precipitation and y its frequency, we get

$$y = Ae^{-0.4665x},$$

where A is a constant and 1380 for total year value. This equation holds when the probability of no measurable precipitation is approximately constant independent of the number of no precipitation days preceeding the day, Basing on Table 6 the expectation of the nth, no precipitation day is calculated. It is given in Table 7.

Table 7.

month \ n	1	2	3	4	5	6	7	8	9	10
Jan.	0.197	0.634	0.664	0.671	0.702	0.575	0.522	0.583	—	—
Feb.	0.208	0.613	0.639	0.671	0.706	0.722	0.731	0.368	—	—
March	0.216	0.588	0.592	0.584	0.556	0.680	0.529	0.444	—	—
April	0.211	0.670	0.664	0.602	0.607	0.647	0.727	0.438	—	—
May	0.198	0.621	0.667	0.571	0.688	0.606	0.550	0.364	—	—
June	0.175	0.630	0.661	0.569	0.634	0.538	0.429	0.667	—	—
July	0.168	0.529	0.604	0.673	0.649	0.625	0.666	0.800	—	—
Aug.	0.179	0.497	0.692	0.635	0.725	0.862	0.600	0.533	—	—
Sept.	0.170	0.554	0.548	0.471	0.750	0.500	—	—	—	—
Oct.	0.183	0.670	0.635	0.650	0.635	0.667	0.727	0.688	0.818	—
Nov.	0.212	0.614	0.628	0.568	0.609	0.536	0.800	0.500	—	—
Dec.	0.205	0.562	0.653	0.545	0.714	0.667	0.750	0.733	0.727	—
Year	0.194	0.600	0.639	0.603	0.660	0.640	0.640	0.555	0.741	0.600

7. Number of Cases with Different Amount of Precipitation in Continuous Days.

Table 8 gives the number of cases with different amount of precipitation during continuous days.

Table 8.

Precipitatation \ Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.1–0.9	77	61	67	36	31	18	37	32	22	31	70	54
1.0–1.9	24	27	21	20	15	16	13	13	7	11	22	31
2.0–2.9	14	8	13	24	14	9	9	6	8	13	18	13
3.0–3.9	13	11	15	11	13	7	8	12	4	10	5	17
4.0–4.9	12	9	10	2	9	9	6	4	6	6	7	7
0.1–4.9	140	116	121	93	82	59	73	67	47	71	122	122
5.0–5.9	5	3	6	4	5	4	6	3	7	9	11	8
6.0–6.9	7	5	8	6	5	2	8	5	4	2	9	3
7.0–7.9	2	11	4	2	8	5	3	3	2	5	6	9
8.0–8.9	3	7	5	4	4	3	5	6	2	2	3	6
9.0–9.9	6	8	8	4	5	4	3	7	2	5	1	7
5.0–9.9	23	34	31	20	27	18	25	24	17	23	30	33
10.0–19.9	23	23	26	42	36	34	19	23	23	26	25	36
20.0–29.9	5	11	24	27	28	22	4	15	18	22	14	14
10.0–29.9	28	34	50	69	64	56	23	38	41	48	39	50
30.0–39.9	2	4	12	12	17	10	16	15	18	7	10	2
>40.0	5	9	9	18	23	45	50	40	54	45	13	9
>30.0	7	13	21	30	40	55	66	55	72	52	23	11

Fig. 4 shows this graphically. Small precipitation less than 4.9 mm is more frequent in winter than in summer. Moderate one from 5.0 mm to 9.9 mm have no distinct seasonal variation, and rather strong one from 10.0 mm to 29.9 mm have two maxima in spring and in late autumn. Very strong precipitation more than 30.0 mm shows distinct maximum in late summer or early autumn.

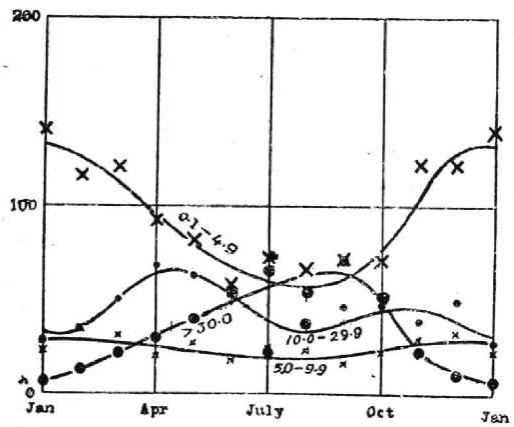

Fig. 4.

8. Frequency and the Total Amount of Precipitations with Different Individual Amount.

Table 9 gives the frequency and the total sum of precipitation with different individual amount.

Table 9 a. Frequency.

Individual Amount of Precipitation	Frequency	Individual Amount of Precipitation	Frequency	Individual Amount of Precipitation	Frequency
0.1–0.9	537	16.0–16.9	32	32.0–32.9	11
1.0–1.9	220	17.0–17.9	35	33.0–33.9	20
2.0–2.9	149	18.0–18.9	20	34.0–34.9	13
3.0–3.9	126	19.0–19.9	20	35.0–35.9	10
4.0–4.9	87	20.0–20.9	30	36.0–36.9	11
5.0–5.9	71	21.0–21.9	24	37.0–37.9	10
6.0–6.9	64	22.0–22.9	26	38.0–38.9	12
7.0–7.9	60	23.0–23.9	22	39.0–39.9	12
8.0–8.9	59	24.0–24.9	29	40.0–49.9	68
9.0–9.9	60	25.0–25.9	15	50.0–59.9	58
10.0–10.9	39	26.0–26.9	17	60.0–69.9	45
11.0–11.9	38	27.0–27.9	15	70.0–79.9	25
12.0–12.9	40	28.0–28.9	16	80.0–89.9	23
13.0–13.9	44	29.0–29.9	10	90.0–99.9	18
14.0–14.9	31	30.0–30.9	12	100.0–199.9	56
15.0–15.9	37	31.0–31.9	14	>200	11

Table 9 b. Sum of Precipitation.

Individual Amount of Precipitation	Sum of Precipitation	Individual Amount of Precipitation	Sum of Precipitation	Individual Amount of Precipitation	Sum of Precipitation
0.1–0.9	198.8	100.0–109.9	1689.4	300.0–309.9	—
1.0–1.9	300.9	110.0–119.9	916.6	310.0–319.9	—
2.0–2.9	357.7	120.0–129.9	374.3	320.0–329.9	321.0
3.0–3.9	434.3	130.0–139.9	670.6	330.0–339.9	334.3
4.0–4.9	380.3	140.0–149.9	570.4	340.0–349.9	—
5.0–5.9	393.6	150.0–159.9	1391.4	350.0–359.9	—
6.0–6.9	408.2	160.0–169.9	328.2	360.0–369.9	—
7.0–7.9	445.6	170.0–179.9	696.9	370.0–379.9	—
8.0–8.9	423.9	180.0–189.9	553.9	380.0–389.9	—
9.0–9.9	570.7	190.0–199.9	387.4	390.0–399.9	395.2
		200.0–209.9	614.2	400.0–409.9	—
0.1–9.9	3921.7	210.0–219.9	—	410.0–419.9	—
10.0–19.9	4839.8	220.0–229.9	—	420.0–429.9	—
20.0–29.9	4957.8	230.0–239.9	—	430.0–439.9	—
30.0–39.9	4305.5	240.0–249.9	245.4	440.0–449.9	—
40.0–49.9	2993.4	250.0–259.9	253.2	450.0–459.9	—
50.0–59.9	3133.6	260.0–269.9	268.5	460.0–469.9	—
60.0–69.9	2890.3	270.0–279.9	—	470.0–479.9	—
70.0–79.9	1888.1	280.0–289.9	—	480.0–489.9	482.2
80.0–89.9	1936.9	290.0–299.9	290.9	490.0–499.9	—
90.0–99.9	1711.2				

Fig. 5 shows these results. Most of precipitations falls as individual amount less than 100 mm. 90% of the total precipitation falls as individual precipitation less than 180 mm. The individual precipitation less than

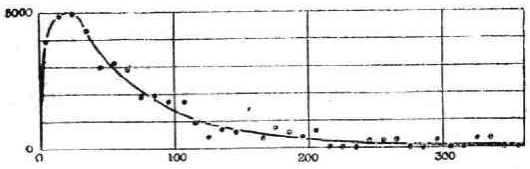

Fig. 5.

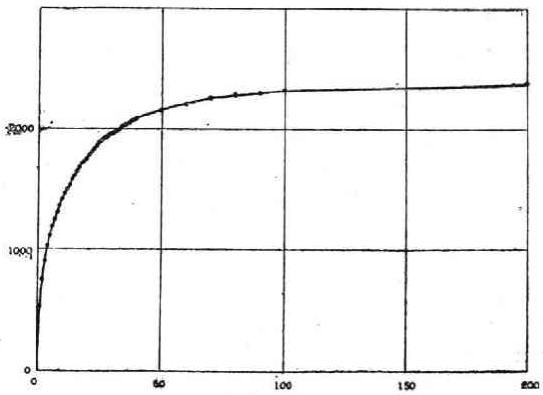

Fig. 6.

10 mm attributes to total amount only 10%, though the frequency is 59.5% of the all. Fig. 6 shows the number of precipitations less than a certain amount.

9. Duration of the Individual Precipitation.

The duration of the individual precipitation with different total amount is given in Table 10.

Table 10.

Precipitation \ Duration	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0.1–9.9	815	399	149	45	15	—	1	1	1	—	—	—	—	—	—	—	—	—
10.0–19.9	72	110	66	47	18	15	2	4	2	—	—	—	—	—	—	—	—	—
20.0–29.9	29	69	47	23	19	8	5	4	—	1	—	—	—	—	—	—	—	—
30.0–39.9	9	37	28	21	9	7	4	4	3	2	—	—	—	—	—	—	—	—
40.0–49.9	3	18	15	11	8	3	4	1	1	1	—	2	—	1	—	—	—	—
50.0–59.9	1	11	10	8	6	3	10	3	2	2	1	—	—	—	—	—	—	1
60.0–69.9	—	10	5	10	7	2	5	4	—	1	—	—	—	—	1	—	—	—
70.0–79.9	3	4	4	3	3	—	2	3	1	—	—	—	1	1	—	—	—	—
80.0–89.9	1	1	7	2	4	2	1	2	1	2	—	—	—	—	—	—	—	—
90.0–99.9	—	5	3	1	1	1	2	—	2	1	—	1	1	—	—	—	—	—
100.0–199.9	—	2	4	6	4	4	10	6	5	3	3	3	2	1	1	2	—	—
200	—	1	—	—	—	1	—	1	1	2	3	—	—	1	—	1	—	—
Sum	933	667	342	177	94	46	45	33	19	15	7	6	4	4	2	3	—	1

The expectation of precipitation in the next day first increases and then decreases. The maximum is in the 11 th day of precipitation. Table 11 gives the expectations.

Table 11.

No. of Day with Precipitation	Expectation of Precipitation in Next Day	No. of Day with Precipitation	Expectation of Precipitation in Next Day
0 (No. Precip.)	0.203	10	0.643
1	0.611	11	0.741
2	0.545	12	0.700
3	0.571	13	0.714
4	0.612	14	0.600
5	0.663	15	0.667
6	0.751	16	0.250
7	0.676	17	1.000
8	0.649	18	0.000
9	0.689	19	0.000

10. Strong Precipitations.

As precipitation is observed once every day at 10^h a. m., a single continuous precipitation is divided in two days, sometimes even in three days when the true duration is a little longer than one day. In table 12, therefore, all precipitations more than 100 mm in a single day, two consecutive days and three consecutive days with the maximum at its middle day are given as strong precipitations.

Table 12.

No.	Single day			Two days		Three days		Total	
	Date		Precip.	Date	Precip.	Date	Precip.	Date	Precip.
1	1944	Sept. 12	128.8mm	12–13	375.5mm	12–14	378.9mm	8–18	482.2mm
		13	246.7						
2	1920	May 4	132.9	3–4	148.6	3–5	178.0	1–14	395.2
				4–5	162.3				
		8	105.5	7–8	119.5	7–9	168.7		
				8–9	154.7				
3	1947	Sept.		12–13	104.6	11–13	105.0	8–16	334.3
		16	101.0	15–16	177.4				
4	1948	Sept. 17	274.0	16–17	321.0			16–17	321.0
5	1938	June		28–29	143.1			June 28–	
		July		7–8	100.7	6–8	122.9	July 8	290.9
6	1934	Aug.		28–29	124.1	28–30	134.4	Aug. 28–	
				29–30	104.7			Sept. 6	268.5
7	1945	July 18	123.0	18–19	148.0	17–19	151.5	15–25	253.2
8	1923	Sept.				13–15	102.9	1–16	245.2
9	1930	July		4–5	109.0	4–6	119.5	4–13	206.6
10	1917	Oct.		24–25	164.3	24–26	164.7	24–29	203.3
11	1941	July 22	115.4	21–22	170.4			15–22	196.9
12	1939	Oct. 26	187.2	25–26	190.5			25–26	190.5
13	1925	July		6–7	120.5	6–8	149.7	6–12	188.7
				7–8	121.3				
14	1944	Oct. 8	129.5	7–8	136.7	7–9	139.5	4–10	180.9
				8–9	132.3				
15	1917	Sept.		29–30	115.9	29–Oct. 1	116.0	Sept. 23–	
								Oct. 1	177.8
16	1928	Oct.		7–8	155.9	6–8	164.1	5–8	170.0
17	1948	Aug. 13	137.7	13–14	153.1			13–15	167.6
18	1919	Oct.				6–8	108.7	Sept. 29–	
								Oct. 9	154.8
19	1925	Aug.				12–14	103.5	9–17	152.9
20	1935	Sept.		24–25	122.4	23–25	122.7	21–25	152.7
21	1929	May 23	147.5	22–23	150.5			22–23	150.5
22	1922	Oct. 7	108.2	6–7	135.1	6–8	142.6	6–8	142.6
23	1937	Sept.		10–11	122.7	9–11	122.8	5–11	140.9
24	1922	Oct. 25	134.4	24–25	139.6	24–26	140.8	24–26	140.8
				25–26	135.6				
25	1927	April 5	122.4	4–5	124.7	4–6	132.2	1–7	138.6
				5–6	129.9				
26	1922	Aug.		24–25	101.6	23–25	112.9	23–26	135.9
27	1925	Sept.		3–4	122.6	3–5	134.0	3–6	134.3
				4–5	104.0				
28	1947	June				28–30	109.3	28–July 4	127.6
29	1943	Oct. 2	105.1	1–2	121.5	1–3	126.5	1–4	126.6
				2–3	110.1				
30	1932	Nov. 14	108.0	13–14	112.4			11–14	113.7
31	1945	June 8	103.1	7–8	104.6	7–9	105.6	6–9	107.6
				8–9	104.1				

The recorded highest value for a single day is 274.0 mm on 17th September 1948 which has also a high value of 321.0 mm in two consecutive days. The highest value in two consecutive days is 375.5 mm on 12 and 13 September 1944. The definition of individual precipitation is quite arbitrary. Sometimes two or more individuals succeeded one another with an interval of only one day between them. On the other side, one individuals continued several days have precipitation of only 0.1 mm in some days in it, and rather seems to be two or more individuals succeeded one another without interruption. The longest individual is the precipitation from 25 Dec. 1916 to 11 Jan. 1917. It can be divided at least in three minute individuals, from 25 Dec. to 31 Dec, from 1 Jan. to 4 Jan. and from 5, Jan. to 11 Jan.. And other two preceeded it with intervals of only one day.

11. Monthly Anomalies.

The monthly values are too much different from year to year. It is not suitable to take the difference from the mean to eliminate the annual variation. The percentages to the mean are taken, therefore, for comparison. Table 13 gives the results.

Table 13.

Year \ Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1915	—	—	86	84	148	184	14	124	87	142	23	46
16	27	122	53	38	99	120	150	106	129	138	216	99
17	192	58	244	57	51	135	31	72	127	207	76	8
18	56	43	120	100	83	41	72	102	95	72	141	56
19	190	246	57	60	62	45	29	90	63	110	101	188
20	295	137	225	143	393	107	98	107	110	74	135	99
21	116	131	154	95	148	78	79	114	192	164	54	99
22	68	270	77	94	86	79	80	139	87	196	149	57
23	106	208	81	116	143	204	110	14	174	133	186	82
24	34	46	61	74	90	70	17	81	132	50	56	75
25	38	52	114	53	62	88	145	258	148	38	151	336
26	55	48	66	72	99	41	70	108	87	59	32	106
27	46	26	155	217	100	45	85	108	79	51	60	51
28	172	132	72	136	67	123	97	136	30	139	92	123
29	99	37	47	150	212	62	22	53	104	105	170	141
30	45	89	151	106	99	86	218	85	43	59	150	51
31	185	112	67	138	54	136	98	50	60	81	76	85
32	100	220	49	177	73	124	136	106	94	74	259	105
33	95	27	123	72	64	41	65	133	36	108	84	72
34	62	61	56	102	94	136	175	178	136	40	122	133
35	105	54	124	90	58	107	78	139	104	117	81	124
36	187	70	69	108	116	55	100	69	92	109	23	44
37	92	235	140	87	132	42	78	80	109	48	108	196
38	95	135	112	72	83	206	148	87	47	93	23	85
39	114	74	99	179	48	127	50	128	41	142	57	33
40	64	126	64	114	45	65	68	126	93	24	51	49
41	105	17	83	91	114	134	251	77	114	15	84	71
42	71	91	125	43	73	81	43	117	68	70	69	79
43	82	76	38	30	77	63	14	67	74	146	14	46
44	40	96	115	213	66	65	159	102	230	142	117	97
45	46	81	93	56	123	147	230	54	82	198	203	188
46	44	71	109	53	53	64	144	27	44	109	120	177
47	172	97	77	79	135	202	145	57	184	53	13	120
48	111	19	42	89	79	90	132	221	200	81	126	178

Periodogram analysis of this percentage anomally gives 2.1, 4.2, 21 and 37 month periods expressed by

$$P = 100.55 - 8.4456 \sin\frac{2\pi t}{37} - 11.0027 \cos\frac{2\pi t}{37} \qquad \text{for 37 month period,}$$

$$P = -0.686 + 0.8575 \sin\frac{2\pi t}{21} + 9.772 \cos\frac{2\pi t}{21} \qquad \text{for 21 month period,}$$

and $$P = -0.0924 - 12.6136 \sin\frac{2\pi t}{4.2} - 9.8537 \cos\frac{2\pi t}{4.2} - 7.305 \sin\frac{2\pi t}{2.1} - 10.1253 \cos\frac{2\pi t}{2.1}$$

for 2.1 and 4.2 month periods.