

# SUMMARY OF WEATHER CONDITIONS OVER 11 YEARS (1928-38) IN THE SUGAR BELT OF NATAL AND ZULULAND

By B. E. BEATER.

This report is given as an extension of the paper issued by the writer in 1935 on the climate of the sugar belt.

The Chairman at that Congress in 1936 remarked that records such as these were of great potential value to the Industry and of inestimable value in the future in the study of the general conditions that we cannot yet foresee. It is to be regretted, however, that records approximately similar to those taken at the Experiment Station cannot be obtained from one or two other centres of the sugar belt. The Experiment Station is situated in a central position along the sugar belt, and at an altitude of 300 feet above sea level, and may for the present be taken to represent fairly well the total weather conditions experienced along the coast. It is generally admitted, however, that the climate along the Zululand coast is warmer than that of Natal. Such contentions could be justified experimentally with simple temperature and humidity records at any centre where enterprise of this nature is considered worthwhile.

## Rainfall.

Rainfall is one of the most important factors in an Industry such as this where irrigation remains only a remote possibility for the majority of planters. It will be noticed from Table I. that the

average rainfall throughout the sugar belt over 15 years is 41.87 ins. ranging from 60.84 ins. in 1925 to 30.15 ins. in 1931.

While this total rainfall does not compare very favourably with the total annual rainfall of other sugar-growing countries, a more important factor to be considered is the seasonal distribution of the fall. Upon the seasonal distribution of rainfall so much depends. An examination of Table II. shows that, with only occasional exceptions, the rainfall over the planting season here is on an average as regular as may be expected. Rains occurring between April and September, however, are very irregular and cannot be relied upon. Over this long period of six months, the absence of sufficient rain normally becomes very evident in the dry appearance of crops.

During 1926, 1927, 1928, 1931, 1933 and to some extent 1937 these out-of-season rains were very scarce, being in the majority of cases between 7 and 8 ins. only. At Sitebe Halt in Zululand only 3.08 ins. was recorded for the six months April to September, 1933.

March is the month of heaviest rainfall, while in August the fall is at its lowest. Heavy precipitation however may occur at any time of the year, for example the floods in June, 1935.

Fig. 1.

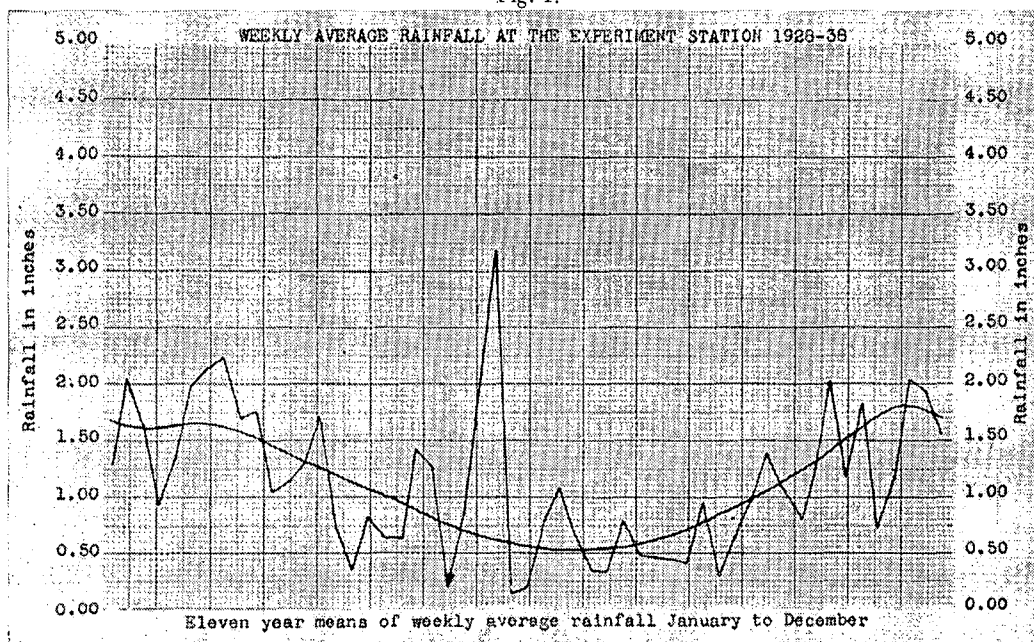


Fig. 1. Smooth curve is 4th order polynomial. Regression equation  $Y=a+bt+ct^2+dt^3+et^4$  (where  $t$ =difference from mean period 7) is derived from corresponding eleven-year four-weekly means.

A glance at the diagram above will make evident this fact. The smooth regression line illustrates the tendency of the rainfall throughout the year, the peak periods being in February and December, the rainfall falling steadily to August and rising more sharply to December.

The heaviest rainfall for twenty-four hours was 14.23 ins. at Eteza on 10th March, 1925. During that month Eteza recorded no less than 50.85 ins. a record which may very well remain unchallenged. In contrast to such abnormally wet periods it may be observed that during the two months of May and June, 1937, only 0.20 ins. was recorded at Chaka's Kraal, 0.29 ins. at Kearsney, and 0.29 ins. at Esperanza over May and June, 1931. These low falls are hardly of any value to crops and it may be said that the sugarcane here is expected to, and actually does, stand up to periods of over two months with no rain. Since 1924 there have been twenty-four monthly returns from planters which record no precipitation, and a very large number recording less than 0.10 ins. Despite this continual menace of drought the Industry flourishes, indicating the perseverance and practical ability of sugar cane planters in overcoming the greatest of limiting factors in agriculture—a deficient rainfall.

#### Temperature.

The mean screen temperature over the past eleven years at Mount Edgecombe was 68.3°, ranging from 69.2° in 1932 to 66.8° in 1935. The highest mean variation was 12.4°, namely from February the warmest month to July the coolest. The highest monthly variation for any one year, 16.2°, was in 1931.

The highest mean temperature on record for any month was 77.0° in February, 1931, and the lowest 60.3° in July, 1934, showing a range of 16.7° of mean monthly temperature. The mean temperatures at Mount Edgecombe, Verulam, Stanger, Eshowe, Nkwaleni and Empangeni (covering a frontage of 100 miles of the North Coast) are given for the years 1931-36 inclusive.

The mean temperatures for Verulam, Stanger, Eshowe, Nkwaleni and Empangeni are averaged from the records of the Department of Irrigation, Meteorological Office.

These records show a maximum variation of 18.5° from February to July at Empangeni and 18.4° at Verulam. The mean screen temperature, 68.6°, is somewhat similar to that of the Experiment Station over the past eleven years, namely 68.3°. The cool climate of Eshowe is representative of a large area of the Industry, such as may be found at Kearsney, Sinembe, Braemar and Powerscourt, altitudes of roughly 1,500 feet above sea level.

The absolute maximum temperature on record at Nkwaleni for any of these stations was 113.5° during November, 1928. The absolute minimum temperature was 35.0° also at Nkwaleni during August, 1928 and July, 1929. This shows a range in shade temperature of 78.5°.

The mean grass minimum temperature over four years was 55.3°, with an absolute minimum of 36.5° during June, 1936. The instruments at the Experiment Station are on a hillside 300 feet above sea level and valley temperatures below freezing point may be found to occur frequently.

The mean solar maximum temperature for three years was 127.3°, with an absolute maximum of 160.0° during February, 1936. Solar radiation thermometers differ frequently and it is desirable to standardise the instruments before using. Higher absolute maximum temperatures are observed to occur on hazy days than on clear days, due no doubt to the reflection of heat rays from the cloud layer.

Records of the earth's temperature have now been taken since 1935. The depths measured are 1 foot, 2 feet, and 4 feet. All these thermometers follow somewhat closely the mean air temperature, though of course there is the time lag, proportional to the depth. Changes in air temperature are noticeable at a depth of 1 foot in clay loam within half a day. At two feet the change becomes noticeable after a day, while two days are required to produce an effect on the four foot thermometer. The lowest monthly average temperature over four years at four feet was 66.8° in August and 1 foot, 63.2° in July. From June to October the temperature of the earth ranges from 65° to 70° and it may be stated that irrigation of sugar cane to promote growth is not profitable between the months of May and October. While the water may serve to keep the cane healthy under dry conditions it cannot be expected to stimulate growth profitably as the temperature of the earth is too low.

#### Atmospheric Conditions.

The mean true atmospheric pressure over eleven years was 29.77 ins. at 300 feet altitude, ranging from the mean of 29.64 ins. in January to 29.91 ins. in July. The unbroken rise from January to June is most rapid during autumn, and the unbroken fall from August to January is most rapid during the spring. There is actually however scarcely any significant variation in the mean true atmospheric pressure over June, July and August.

The absolute maximum was attained during July, 1937, with the abnormally high reading of 30.45 ins. On that occasion there was an exceptionally sharp

and rapid rise of one inch within three days. The absolute minimum of 29.12 ins. was attained during February, 1933, showing a possible range of 1.33 ins.

It is regularly observed that the barometer falls with the prevailing N.N.E. by E.N.E. winds and rises sharply with the prevailing S.S.W. by S.W. winds. No exception to this rule has yet been observed. Occasionally the barometer will dip slightly with S. winds, and S.S.E. by S.W. breezes.

A very full summary of the prevailing winds was given by the writer in 1936 at this Congress. It was there shown that September, October, and February are the windiest months, while June is the calmest. Winds attaining strong gale force (50 m.p.h.) are very uncommon.

The average sunshine over the past eleven years was 2,403.0 hours, or 54.8 per cent of daylight, ranging from 2,287.7 hours in 1936 to 2,513.2 hours in 1931, a variation of 225.5 hours, or 22 full days of summer sunshine.

The least sunshine occurs in November with only 163.0 hours or 40.1 per cent of the available hours of daylight. The sunniest months are May and June with 224.9 hours (70.9 per cent of daylight) and 218.8 hours (71.3 per cent of daylight) respectively.

The range of sunshine from the sunniest to the cloudiest month was 61.7 hours. In 1936 the writer drew attention to the possible relation existing between sunshine and sucrose content of the cane. From 1928-37 (excepting 1934 in which year invasions of locusts caused an abnormal drop in sucrose) a correlation co-efficient of  $r=0.7181$  is

obtained, which of course demonstrates the significance of the relationship.

The per cent of sky covered by clouds at 8.30 a.m. was highest in November with 63%, and lowest in June and July with 27% and 26% respectively.

Evaporation which is a function of wind and temperature is at its lowest in June, and at its maximum in January. The average total evaporation from the water surface of the evaporimeter over the three years was 45.33 ins., which is slightly in excess of the mean annual rainfall for those three years, 38.85 ins.

The relative humidity of the atmosphere over eleven years averaged 73.6% of saturation at 8.30 a.m. and 63.0% at 1 p.m. Saturation is at its highest at 8.30 a.m. in March and April with 78.4% and 78.7% respectively, and lowest in June with 69.8% of saturation. At 1 p.m. it is at its highest from November to March roughly 67% and lowest in June with 55.2%. June is thus the least humid month and is at the same time the least windy month. The climate during the month of June is almost ideal from the point of view of human habitation. In February the climate is at its worst for those who wish to escape a warm humid sub-tropical atmosphere.

In general, however, the climate along the sugar belt may be described as mildly warm. Out-of-season hot or cold spells are experienced on occasion only cold snaps during summer though are perhaps less infrequent, and a fall of 10° in mean temperature from one day to another may sometimes be expected in summer, such sudden variations very aptly illustrating the old saying "as changeable as the weather."

South African Sugar Association,  
Experiment Station,  
Mount Edgecombe,  
March, 1939.

TABLE I.\*  
A COMPARISON OF RAINFALL RETURNS IN INCHES FROM 29 DIFFERENT CENTRES  
THROUGHOUT THE SUGAR BELT OF NATAL AND ZULULAND, 1924-38.

	1924.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.	1936.	1937.	1938.	Average
Umzumbi .. .. .	26.37	40.54	34.99	37.31	25.18	56.28	34.95	40.31	42.04	36.35	37.50	43.66	—	—	—	37.96
Esperanza .. .. .	30.09	43.81	28.34	43.11	27.58	57.47	42.10	36.13	38.36	32.81	46.13	43.70	44.74	36.14	41.41	39.46
Park Rynie.. .. .	32.32	46.38	27.70	44.64	36.94	58.84	39.25	38.94	44.14	37.71	46.53	47.89	52.85	46.10	43.22	42.89
Renishaw .. .. .	30.66	40.54	28.13	43.54	36.08	58.24	37.22	31.86	41.56	34.43	42.17	42.69	46.10	44.40	36.13	39.59
Illovo .. .. .	28.92	47.41	27.70	32.94	27.85	49.22	38.12	31.54	36.89	26.94	41.00	39.03	51.65	30.79	43.09	36.87
Umbogintwini .. .. .	36.13	50.18	31.73	34.65	33.41	47.88	42.10	32.42	39.67	36.43	45.59	52.87	53.09	34.78	41.94	40.86
Durban, Point .. .. .	40.89	53.16	31.48	47.62	36.54	59.97	38.92	43.68	49.45	34.42	47.45	60.93	56.85	45.84	41.89	45.94
Durban, Berea .. .. .	34.82	44.93	26.16	37.52	34.62	46.87	38.93	31.51	44.74	31.61	42.28	58.08	46.71	36.09	41.23	47.74
Mt. Edgecombe (29° 40' Lat.) ..	30.11	44.75	25.89	40.63	30.88	47.04	34.52	32.98	43.51	30.94	40.03	57.41	49.60	36.65	43.13	39.20
La Mercy .. .. .	33.07	48.84	25.68	35.56	27.04	53.37	36.40	29.26	56.65	31.16	37.64	56.27	45.65	35.17	45.36	39.80
Tongaat .. .. .	39.36	52.61	27.92	35.74	30.87	50.55	34.26	29.88	48.79	26.59	38.44	47.54	50.87	35.61	40.85	39.32
Sinembe .. .. .	37.93	55.93	27.52	35.45	32.42	49.78	37.02	30.36	52.71	38.64	49.99	41.48	56.80	35.17	42.07	41.55
Umlhali .. .. .	41.84	51.32	30.28	34.72	29.31	50.38	40.07	29.09	49.85	35.13	41.20	53.61	56.57	40.29	56.88	42.71
Chakas Kraal .. .. .	32.38	45.33	26.99	31.89	29.88	42.78	33.06	22.25	43.05	30.14	35.09	43.38	46.74	32.87	38.40	35.62
Riet Valley.. .. .	37.81	60.09	29.50	38.13	34.88	50.07	35.65	25.38	54.64	37.98	47.70	44.33	65.99	35.28	41.96	42.63
Tinley Manor .. .. .	39.50	55.46	30.33	32.13	33.61	51.36	33.22	30.97	47.44	35.44	41.20	50.97	56.83	38.38	46.35	41.55
Kearsney .. .. .	44.72	63.32	37.79	45.25	33.55	49.20	43.36	26.31	55.49	37.45	53.57	38.42	64.34	39.73	44.30	45.12
Darnall .. .. .	37.66	60.71	33.13	41.69	25.60	42.38	40.63	24.31	52.27	29.22	48.24	40.23	52.09	39.75	43.74	40.77
Sitebe Halt.. .. .	38.60	63.18	32.42	39.10	25.66	42.05	40.41	24.40	51.27	28.10	53.33	42.57	50.10	34.50	—	40.41
Amatikulu .. .. .	30.98	60.64	40.88	33.21	30.98	42.23	40.80	21.09	47.16	29.86	47.66	43.41	47.86	35.38	37.24	39.35
Gingindhlovu (29° 00' Lat.) ..	35.41	72.17	36.25	36.64	35.08	42.42	47.72	24.60	53.85	33.08	50.91	53.16	52.68	39.62	40.10	43.58
Eshowe .. .. .	51.70	91.81	43.53	48.33	37.99	49.97	44.26	30.36	65.05	46.88	71.85	46.18	66.61	47.56	46.40	52.56
Mtunzini .. .. .	53.87	79.15	44.23	40.93	39.01	52.57	48.99	32.92	61.97	40.03	59.28	53.02	55.62	43.57	44.23	52.96
Felixton .. .. .	55.37	88.23	40.48	49.30	42.20	59.39	44.57	38.03	69.08	31.43	58.82	50.16	58.71	51.96	38.62	51.75
Empangeni.. .. .	44.28	70.45	33.13	37.81	32.14	48.95	33.80	31.98	55.34	29.55	48.72	38.18	49.48	47.87	33.49	42.35
Kulu Halt (28° 40' Lat.) ..	43.21	79.83	40.03	34.77	29.65	51.94	37.44	25.96	66.55	30.15	48.26	35.03	48.39	56.80	36.95	44.33
Mposa .. .. .	37.46	75.42	35.56	32.12	28.91	45.80	37.83	24.29	59.33	25.43	46.45	29.59	46.81	51.80	33.08	40.66
Eteza .. .. .	42.46	93.88	32.90	34.33	27.71	41.27	36.86	31.27	59.48	29.85	44.05	25.73	42.21	49.95	35.98	41.86
Umfolozu (28° 25' Lat.) ..	29.91	84.44	22.55	26.82	24.90	34.53	27.99	22.38	51.19	25.04	37.34	21.44	34.98	39.45	36.33	34.68
Averages.. .. .	37.86	60.84	32.18	38.13	31.74	49.41	38.64	30.15	51.09	32.85	46.50	44.86	51.85	40.77	41.27	41.87

\* Many of the monthly returns used in preparing this table were taken from the pages of the South African Sugar Journal.

67

TABLE II.  
 AVERAGE RAINFALL BY MONTHS, IN INCHES FROM 17 CENTRES  
 THROUGHOUT THE SUGAR BELT OVER 15 YEARS, 1924-38.

	January	February	March	April	May	June	July	August	September	October	November	December
1924 ..	4.39	4.45	2.62	2.19	1.38	1.00	0.38	1.46	4.21	2.96	6.77	6.36
1925 ..	5.41	5.92	24.83	2.12	3.55	0.41	2.32	0.35	5.20	3.82	3.18	2.23
1926 ..	2.12	3.89	6.40	0.81	0.68	2.50	0.40	0.54	2.63	4.62	3.66	3.80
1927 ..	3.32	4.99	11.95	0.57	1.77	0.32	1.52	1.74	1.38	3.39	2.03	5.13
1928 ..	5.62	4.62	2.72	2.19	1.99	0.40	0.51	1.39	1.72	2.92	2.82	3.90
1929 ..	5.84	3.14	10.87	1.98	1.20	5.36	2.75	1.63	4.55	4.74	4.04	2.04
1930 ..	8.16	2.04	2.91	1.96	0.99	1.68	1.61	3.15	4.21	2.99	4.68	4.77
1931 ..	3.88	2.30	4.39	2.16	0.64	0.66	2.77	0.37	1.88	2.14	2.44	4.94
1932 ..	4.78	13.81	5.70	6.40	5.30	0.82	0.25	0.72	1.70	4.19	3.74	4.91
1933 ..	3.81	2.87	3.30	1.86	0.97	0.41	1.48	0.68	1.38	2.36	6.36	6.51
1934 ..	7.41	5.27	4.63	5.03	2.96	1.76	3.05	2.61	0.91	1.79	3.30	7.16
1935 ..	4.44	4.06	4.32	1.68	6.24	12.82	1.06	3.24	0.80	2.19	1.64	3.00
1936 ..	6.58	8.82	6.03	1.00	7.70	1.01	1.08	0.38	2.47	3.89	11.24	1.66
1937 ..	3.90	7.07	2.71	3.33	0.19	1.85	1.30	1.68	1.06	2.55	3.83	10.69
1938 ..	5.00	7.69	0.90	3.46	1.28	2.73	3.88	1.68	0.76	5.01	3.47	5.88
<b>Averages</b>	4.98	5.40	6.29	2.45	2.46	2.24	1.62	1.44	2.33	3.31	4.21	4.86

TABLE III.

**SUMMARY OF MEAN DRY BULB SCREEN TEMPERATURES OVER SIX YEARS (1931-36)  
FOR VARIOUS NORTH COAST CENTRES.**

Locality.	January	February	March	April	May	June	July	August	September	October	November	December	Means
Mount Edgecombe .. ..	73.4	74.0	72.6	70.1	66.1	62.6	61.7	63.6	65.7	68.4	70.3	72.6	68.4
Verulam .. .. .	75.9	76.6	74.8	70.0	64.5	58.7	58.2	62.4	67.6	70.8	73.2	75.5	69.0
Stanger .. .. .	75.9	76.4	75.1	72.4	68.3	63.8	64.0	66.4	69.2	71.6	73.9	76.3	71.1
Eshowe .. .. .	70.3	70.9	69.3	67.3	63.0	57.9	57.4	60.5	63.7	66.0	67.7	69.6	65.3
Nkwaleni .. .. .	74.8	74.9	72.8	69.0	63.5	57.8	59.7	62.2	65.6	69.3	71.5	73.9	67.9
Empangeni .. .. .	75.6	77.3	75.2	72.0	66.1	60.3	58.8	64.1	67.7	70.7	72.8	74.8	69.6
<b>Means .. .. .</b>	<b>74.3</b>	<b>75.0</b>	<b>73.3</b>	<b>70.1</b>	<b>65.3</b>	<b>60.2</b>	<b>60.0</b>	<b>63.2</b>	<b>66.6</b>	<b>69.5</b>	<b>71.6</b>	<b>73.8</b>	<b>68.6</b>



TABLE V.  
SUMMARY OF WEATHER CONDITIONS OVER ELEVEN YEARS (1928-1938)  
AT THE EXPERIMENT STATION.

	January	February	March	April	May	June	July	August	September	October	November	December
Rainfall in inches . . . . .	4.34	4.73	3.95	2.46	2.47	2.75	1.88	1.39	1.79	2.80	3.88	4.55
Number of rain days . . . . .	14.5	12.9	11.0	8.8	5.2	4.5	4.9	5.4	7.77	13.2	13.9	14.3
Highest fall in inches . . . . .	2.56	3.87	2.18	2.25	4.64	10.41	3.24	2.11	2.06	1.34	2.60	2.83
Date . . . . .	14th, '35	21st, '32	7th, '30	4th, '34	23rd, '36	12th, '35	9th, '29	5th, '30	15th, '29	9th, '36	10th, '36	6th, '34
Total from January 1st, in inches . . . . .	4.34	9.07	13.02	15.48	17.95	20.70	22.58	23.97	25.76	28.56	32.44	36.99
Per cent. of normal . . . . .	103.3	104.6	95.7	95.1	99.3	106.5	109.8	110.2	105.2	100.2	99.7	99.8
Per cent. relative humidity at 8.30 a.m. . . . .	75.4	76.2	78.4	78.7	73.9	69.8	70.5	72.8	70.6	71.6	72.1	72.7
" " " at 1. 0 p.m. † . . . . .	67.3	67.0	67.3	64.9	60.2	55.2	56.5	59.8	60.9	64.1	67.1	66.2
Average daily evaporation in inches—												
Atmometer* . . . . .	0.49	0.44	0.41	0.36	0.41	0.40	0.45	0.52	0.47	0.46	0.47	0.44
Water surface † . . . . .	0.18	0.16	0.15	0.11	0.09	0.07	0.08	0.09	0.12	0.13	0.15	0.17
Hours of sunshine . . . . .	184.3	181.8	209.1	219.4	224.9	218.8	222.1	226.0	199.6	174.5	163.2	179.3
Per cent. of daylight . . . . .	43.2	48.0	56.9	64.6	70.9	71.3	68.8	66.0	56.8	43.9	40.1	42.1
Per cent. sky covered by clouds at 8.30 a.m. . . . .	62.0	58.0	49.0	37.0	32.0	27.0	26.0	32.0	45.0	58.0	63.0	61.0
Mean true atmospheric pressure in inches												
at 295 feet . . . . .	29.64	29.66	29.69	29.76	29.82	29.90	29.91	29.90	29.80	29.75	29.70	29.65
Absolute maximum . . . . .	29.98	30.06	30.08	30.25	30.30	30.37	30.45	30.39	30.34	30.23	30.04	30.12
Absolute minimum . . . . .	29.17	29.12	29.27	29.28	29.30	29.34	29.35	29.12	29.13	29.19	29.20	29.14
Mean earth temperature at 1 foot* . . . . .	78.2	78.4	78.5	75.1	69.5	64.3	63.2	64.2	67.4	70.6	72.7	75.8
" " " 2 feet* . . . . .	80.6	78.6	79.4	76.7	72.1	67.0	65.2	65.5	68.1	70.9	72.8	75.6
" " " 4 feet* . . . . .	76.6	77.6	78.5	77.2	74.1	69.8	67.3	66.8	68.1	70.3	74.6	74.4
Mean solar maximum temperature* . . . . .	136.3	137.5	135.0	128.2	122.4	117.0	116.5	119.5	124.1	126.2	129.7	133.8
Absolute maximum . . . . .	155.0	160.0	151.5	142.0	142.0	129.0	134.0	140.0	147.0	154.0	149.5	153.0
Mean grass minimum temperature* . . . . .	58.6	60.6	61.5	57.5	51.2	48.1	46.0	47.8	51.2	55.6	57.1	59.4
Absolute minimum . . . . .	44.0	52.0	46.5	46.0	37.5	36.5	37.0	38.5	38.0	37.0	42.0	45.5
Mean screen maximum temperature . . . . .	80.6	81.2	80.2	78.0	75.5	72.5	71.5	72.4	74.3	75.9	77.6	80.0
Absolute maximum . . . . .	104.0	95.0	99.5	92.0	94.0	88.0	92.0	98.0	101.0	102.5	96.5	100.5
Absolute minimum . . . . .	67.0	65.5	65.0	66.5	60.0	58.0	60.0	58.0	59.0	61.0	61.0	66.0
Mean screen minimum temperature . . . . .	66.5	66.7	65.1	61.6	56.6	52.7	51.7	53.3	56.3	60.3	62.8	65.4
Absolute maximum . . . . .	75.5	76.0	75.0	72.0	69.5	62.5	61.5	67.0	67.0	71.5	73.0	73.5
Absolute minimum . . . . .	56.0	57.0	54.0	50.0	44.0	42.5	41.0	43.5	42.0	47.0	50.0	54.0
Mean screen temperature . . . . .	73.6	74.0	72.7	69.7	66.1	62.6	61.6	62.8	65.3	68.1	70.2	72.7

\* Records commenced in 1935.

† Records commenced in 1936.

‡ Records commenced in 1929.