THE DISTRIBUTION OF TEMPERATURE IN THE SUGAR BELT OF NATAL AND ZULULAND

By B. E. BEATER.

Records at Mount Edgecombe.

The mean annual screen temperature (mean maximum + mean minimum ÷ 2) at Mount Edgecombe was 68.7°F. over twenty-one years, ranging from 74.6° in February to 61.8° in July. The mean summer temperature (November to April) was 72.8°, and the mean winter, 64.9°. The highest mean annual temperature was 70.0° in 1940 and 1941, and the lowest, 66.9° in 1935.

The highest mean temperature on record for any month was 77.0° for February, 1931, and the lowest, 59.7° for July, 1947, a range in monthly means of 17.3°.

The absolute maximum recorded for any single day at Mount Edgecombe was 113.5°, on December 30th, 1941, and the lowest 41.0°, on July 17th, 1947.

In the past twenty-one years, temperatures have reached and exceeded 100° on fourteen occasions, these occurring during the months of January, April, August, September, October and December.

The mean grass minimum temperature over thirteen years was 55.4°, with an absolute minimum of 32.5°, on July 20th, 21st and 22nd, 1943.

The mean solar maximum temperature (black bulb) over eight years was 127.1°, with an absolute maximum of 167.0°, on December 30th, 1941.

The temperature of the earth at one foot over fourteen years was 71.9°, ranging from a mean of 79.6° for February, to a mean of 62.9° for July.

At two feet, the temperature over fourteen years was 73.0°, ranging from 79.8° for February to 65.1° for July.

At four feet, the mean fourteen years' figure was 73.1°, ranging from 78.7° for February and March to 67.1° for August, showing the effect of time lag over the shallower thermometers.

The mean earth temperature at two feet over the winter months May to October was 66.8°, while for the summer months November to April it was 77.0°

Records throughout Sugar Belt.*

There is a very noticeable increase in temperature from south to north, the temperature along the immediate sea coast rising 3° from one extremity of the sugar belt to the other.

Zones of higher temperatures predominate inland from the coastal hills and plains, and tend to predominate round and about the course of the main north coast road and railway.

Further inland, due to the rising country, temperatures decrease, reaching a minimum high on the inland plateau, as at Hill Crest, outside the sugar belt, where the mean summer temperature is below the mean annual temperature at Durban, and the mean annual temperature, 63.8°, very considerably below the mean for the coast.

Temperatures at elevations above sea-level tend to be more equable throughout the year than temperatures at recording stations nearer sea-level. This is illustrated in some measure by the mean summer and winter temperatures at the Durban Bluff (220 feet) and the Durban Airport (20 feet). The difference between summer and winter temperatures at the higher elevation is 6.8°, and at the lower 8.8°. Temperatures along the coastal region, i.e. just inland from the coast, tend to become less equable throughout the year from south to north.

The differences in summer and winter temperatures increase from the sea coast to the larger inland valleys and flats, in which latter situations very hot summers are followed by cold winters. This is most noticeable at Mkuzi, which has a mean annual temperature of 72.7°, by far the highest in the sugar belt, and where the difference in summer and winter temperatures is no less than 10.5°.

Mkuzi is the only recording station in the sugar belt where the mean temperature for any month of the year reached and exceeded 80°, namely, a mean temperature for January over six years of 80.7°.

On the other hand, surprisingly enough, the lowest mean monthly temperature, over a period of not less than six years, was recorded further north, at the former Magut Cotton Experiment Station, which is a short distance south of the Pongola River. Here the mean June temperature reached the low level of 59.9°.

The winters at the northern extremity of the sugar belt are no less unfavourable for vegetative growth than the central north coast areas. The mean winter temperature at Mkuzi, Pongola and Magut is 66.4°, which is only 0.8° higher than the equivalent mean at Mount Edgecombe, Verulam and Stanger. On the contrary, corresponding differences during the summer months are 2.8° in favour of the more northern areas.

The mean annual temperature at Eshowe is the lowest recorded in the sugar belt, 67.5°, though only 0.5° lower than at Port Shepstone on the southern

* Figures averaged from Reports, Division of Meteorology Pretoria.

extremity of the sugar belt. At Eshowe the mean summer temperature is 71.1°, and the mean winter temperature 63.9°. At Port Shepstone the corresponding temperatures are 72.0° and 64.0°; while 100 road miles further south, at Port St. John's, with its mean annual temperature of 67.9°, the summer and winter temperatures are 70.8° and 64.9°.

The mean temperature, and the mean summer and winter temperatures, show a regular and orderly increase from Port Shepstone along the coastal regions to Mkuzi, where the mean summer temperature has increased by 6.0° and the mean winter by 3.5°, with an increase in mean annual temperature of 4.7°.

Along the sugar belt, the hottest month is February, 75.8°, January taking second place with 75.4°. The coolest month is July, 62.0°, with June 62.6°. The mean summer temperature for the entire sugar belt is 73.9°, the mean winter 65.5°.

In the large inland valleys, on the other hand, the hottest month is January, and the coolest month June, the temperature gradient being steeper than for the other localities. Nearer the coast this temperature gradient tends to "flatten out."

The mean annual temperature of all stations from Pongola to Stanger, excluding Eshowe on the plateau, is 70.8°. For all stations south of Stanger the mean is 68.7°, 2.1° lower.

The highest mean annual temperature for any station was 73.4° at Mkuzi in 1947, and the lowest 65.8° at Eshowe in 1935.

The highest mean monthly temperature for any single year was 83.5° for January, 1944, at Mkuzi, and the lowest 56.9° for July, 1942, at Eshowe, thus constituting an absolute range of 26.6° in the mean monthly temperature.

The years 1935, 1936, 1939 and 1943 were cool years throughout the sugar belt. It is of passing interest to note that these were, in general, years of higher rainfall. Further, 1941, with its record high mean temperature of 70.5°, had the lowest mean annual rainfall on the records, namely, only 26.18 inches.

Experiment Station,
South African Sugar Association,
Mount Edgecombe.
March, 1949.

TABLE 2.—**TEMPERATURE RECORDING STATIONS IN THE SUGAR BELT.**

Station.	S. Lat.	E. Long.	Height above sea-level.	Distance from sea.	General terrain represented.
Port Shepstone (182/794A)	30° 45′	30° 27′	50 feet	Nil	Sea coast dunes.
Umbogintwini (211/661)	29° 58′	30° 56′	240 feet	1 mile	Depressions in sea coast hills.
Durban Bluff (241/82A)	29° 52′	31° 03′	220 feet	Nil	Sea coast dunes.
Durban Airport (241/49)	29° 51′	31° 03′	20 feet	½ mile	Sea coast plains.
Mount Edgecombe (241/72) ...	29° 40′	31° 04′	340 feet	4 miles	Low coastal hills.
Verulam (241/68)	29° 37′	31° 04′	400 feet	6 miles	Semi-inland hills.
Stanger (271/500)	29°19′	31° 17′	400 feet	7 miles	Semi-inland hills.
Eshowe (303/833)	28° 53′	31° 27′	1,740 feet	17 miles	Inland plateau.
Empangeni (304/736)...	28° 46′	31° 55′	450 feet	10 miles	Low inland hills.
Nkwaleni (304/43)	28° 42′	31° 33′	580 feet	19 miles	Large inland valleys.
Cape St. Lucia (339/720)	28° 31′	32° 24′	360 feet	Nil	Sea coast dunes.
Mkuzi (375/37)	27° 37′	32° 02′	450 feet	35 miles	Large inland valleys.
Magut (374/275)	27° 33′	31° 37′	1,080 feet	82 miles	Inland hills and plains.
Pongola (410/203)	27° 23′	31° 38′	900 feet	85 miles	Large inland valleys.

TABLE 3.—**GEOGRAPHICAL DISTRIBUTION OF MEAN TEMPERATURES WITHIN THE SUGAR BELT.**

	Mean temperature, Nov.-April. °F.	Mean temperature, May-October. °F.	Difference. °F.	Mean annual temperature °F.
Inland plateau (Eshowe)	71.1	63.9	7.2	67.5
Sea coast (Port Shepstone, Durban Bluff, Cape St. Lucia)	72.9	65.3	7.6	69.1
Coastal regions (Umbogintwini, Durban Airport, Mount Edgecombe, Verulam, Stanger, Empangeni)	73.6	65.4	8.2	69.5
Inland valleys (Nkwaleni, Mkuzi, Pongola)	76.0	66.6	9.4	71.2

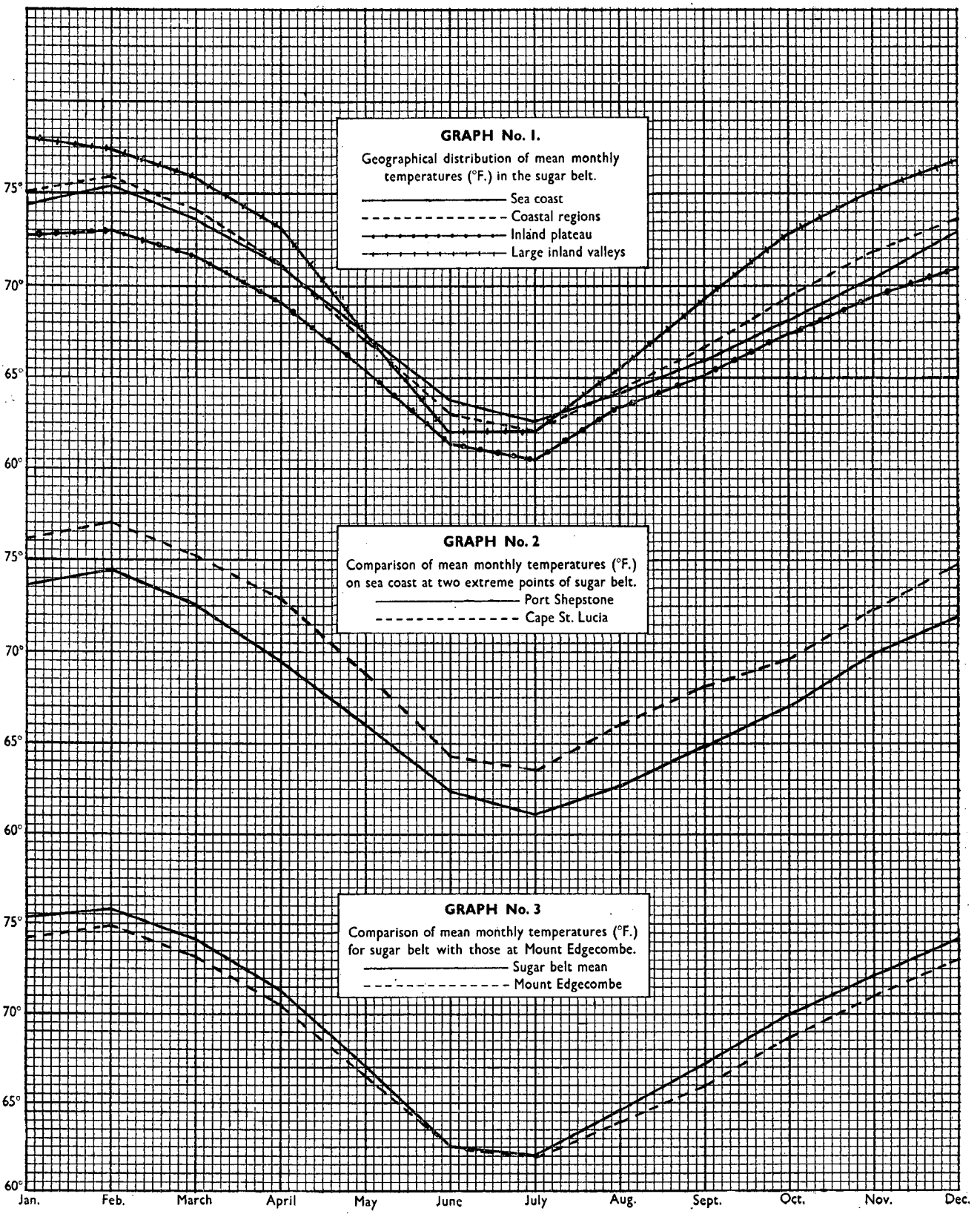

GRAPH No. 1.
Geographical distribution of mean monthly temperatures (°F.) in the sugar belt.
Sea coast
Coastal regions
Inland plateau
Large inland valleys
GRAPH No. 2
Comparison of mean monthly temperatures (°F.) on sea coast at two extreme points of sugar belt.
Port Shepstone
Cape St. Lucia
GRAPH No. 3
Comparison of mean monthly temperatures (°F.) for sugar belt with those at Mount Edgecombe.
Sugar belt mean
Mount Edgecombe
75°
70°
65°
60°
Jan.
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

TABLE 1.—**MONTHLY MEANS OF RECORDED METEOROLOGICAL DATA AT THE EXPERIMENT STATION, MOUNT EDGECOMBE.**

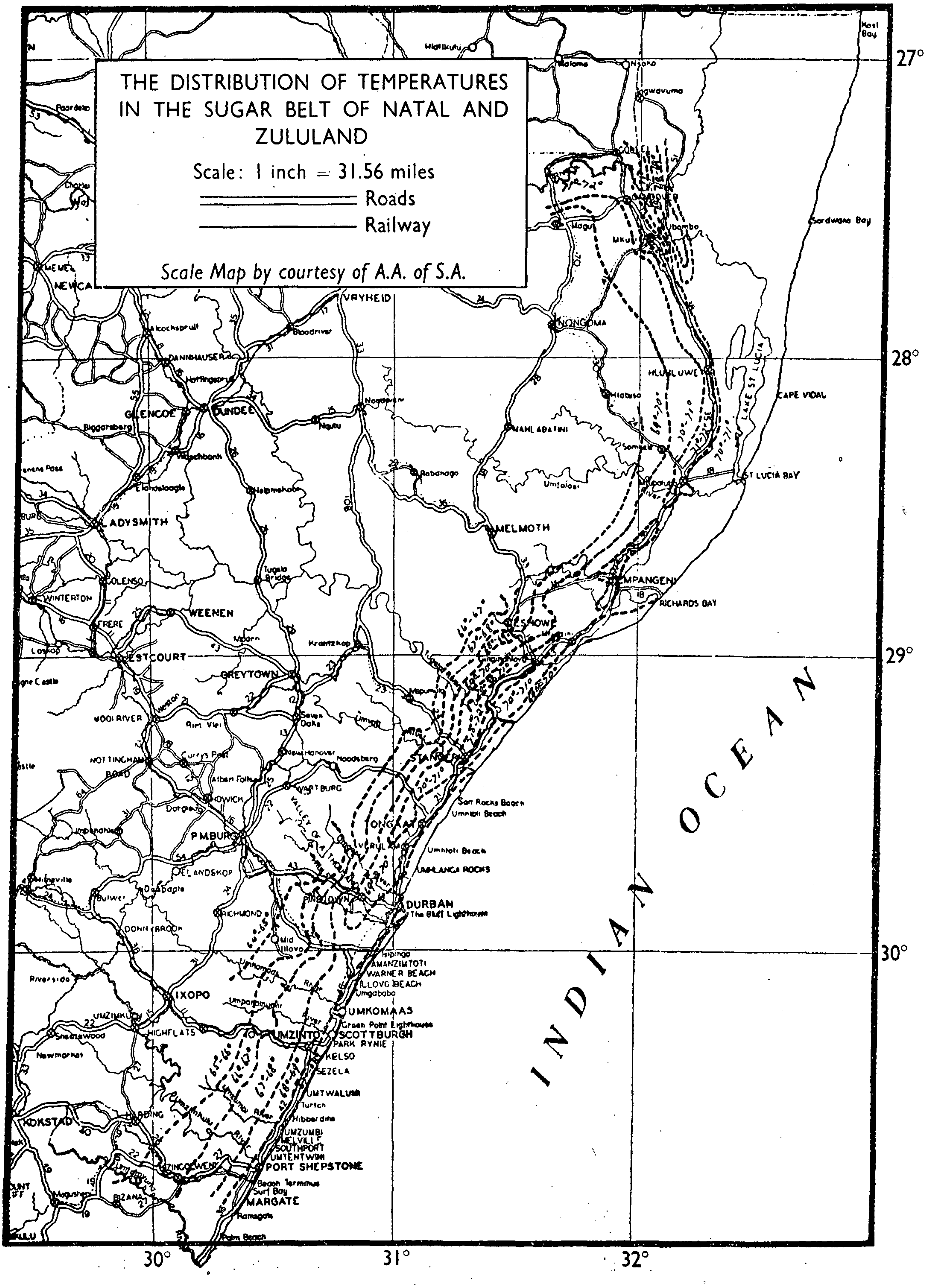
	No. of years.	Period.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Means.
Rainfall in inches	23	1926/48	3.82	4.74	5.15	2.59	2.25	1.90	1.32	1.19	1.95	3.27	4.22	4.13	**36.53**
Number of rain days	23	1926/48	13.7	12.1	12.2	8.4	5.4	4.4	4.4	5.2	8.1	14.2	14.0	14.3	**9.7**
Daily rate of fall, inches	23	1926/48	0.123	0.168	0.166	0.086	0.073	0.063	0.043	0.038	0.065	0.105	0.141	0.133	**0.100**
Highest single fall, inches...	23	1926/48	2.56	3.87	4.29	4.30	5.77	10.41	3.24	2.11	2.06	2.76	2.60	2.83	**10.41**
Date	23	1926/48	14/35	21/32	16/27	22/43	5/40	12/35	9/29	5/30	15/29	9/48	10/36	6/34	12/6/35
Total from January 1st	23	1926/48	3.82	8.56	13.71	16.30	18.55	20.45	21.77	22.96	24.91	28.18	32.40	36.53	**36.53**
Evaporation from water surface, ins.	13	1936/48	5.70	4.78	4.39	3.37	2.72	2.28	2.46	2.91	3.61	4.11	4.79	5.45	**46.57**
Daily rate, inches	13	1936/48	0.184	0.169	0.142	0.112	0.088	0.076	0.079	0.094	0.120	0.133	0.160	0.176	**0.128**
Excess daily rate over rainfall... ...	—	—	0.061	0.001	—0.024	0.026	0.015	0.013	0.036	0.056	0.055	0.028	0.019	0.043	**0.028**
Per cent. relative humidity, 8.30 a.m.	21	1928/48	74.7	76.8	78.7	78.2	73.2	68.6	68.9	71.9	70.3	71.8	71.6	71.5	**73.0**
Per cent. relative humidity, 1 p.m....	20	1929/48	66.2	67.5	68.2	66.0	59.8	54.8	54.5	58.6	60.4	65.1	66.3	65.8	**62.8**
Hours of sunshine	21	1928/48	189.1	184.4	198.6	211.5	224.0	213.9	220.7	220.7	192.5	171.6	167.1	182.0	**2376.2**
Per cent. available daylight	21	1928/48	44.3	48.7	54.1	62.3	70.6	69.7	68.4	64.5	54.8	43.1	41.1	42.7	**54.2**
Per cent. of sky covered by cloud at 8.30 a.m.	21	1928/48	60.8	55.9	50.1	38.9	31.5	26.5	27.3	33.9	47.7	59.6	63.0	60.4	**46.3**
Mean true barometer at 340 ft. in ins.	21	1928/48	29.64	29.66	29.70	29.75	29.81	29.89	29.91	29.89	29.81	29.75	29.69	29.65	**29.76**
Absolute maximum	21	1928/48	29.98	30.06	30.14	30.25	30.30	30.37	30.45	30.39	30.34	30.30	30.14	30.12	**30.45**
Absolute minimum	21	1928/48	29.08	29.12	29.27	29.21	29.21	29.30	29.35	29.12	29.13	29.19	29.20	29.14	**29.08**
Mean earth temperature (°F.) at 1 ft.	14	1935/48	79.0	79.6	78.3	75.1	69.8	64.4	62.9	65.0	68.0	70.9	73.5	76.6	**71.9**
Mean earth temperature (°F.) at 2 ft.	14	1935/48	79.6	79.8	79.2	76.6	72.2	67.3	65.1	66.1	68.6	71.1	73.5	76.4	**73.0**
Mean earth temperature (°F.) at 4 ft.	14	1935/48	77.3	78.7	78.7	77.1	74.0	69.9	67.2	67.1	68.6	70.5	73.3	75.0	**73.1**
Mean solar maximum temp. (°F.) ...	8	1935/42	137.6	137.7	132.0	126.7	121.8	116.5	117.0	119.5	123.6	127.4	130.4	135.2	**127.1**
Absolute maximum	8	1935/42	160.0	160.0	154.0	149.0	142.0	133.0	134.0	140.0	147.0	154.0	149.5	167.0	**167.0**
Mean grass minimum temp. (°F.) ...	13	1935/47	61.6	62.6	62.0	58.2	51.7	47.2	45.4	48.8	52.1	57.0	58.9	59.8	**55.4**
Absolute minimum	13	1935/47	44.0	51.0	46.5	42.0	37.5	35.0	32.5	35.0	37.0	37.0	42.0	45.5	**32.5**
Mean screen maximum temp. (°F.)...	21	1928/48	81.2	81.8	80.2	78.3	75.9	72.7	72.1	73.3	74.5	76.1	78.1	80.3	**77.0**
Absolute maximum	21	1928/48	104.0	95.0	99.5	101.0	94.0	90.0	92.0	100.0	106.5	102.5	96.5	113.5	**113.5**
Absolute minimum	21	1928/48	66.0	65.5	65.0	64.0	57.0	57.0	56.5	55.0	58.5	61.0	58.5	66.0	**55.0**
Mean screen minimum temp. (°F.) ...	21	1928/48	67.0	67.4	65.7	62.0	56.9	52.6	51.7	53.9	57.0	60.8	63.3	65.6	**60.3**
Absolute maximum	21	1928/48	75.5	77.0	75.0	72.0	69.5	58.0	68.5	67.0	68.0	71.5	73.0	75.5	**77.0**
Absolute minimum	21	1928/48	56.0	57.0	54.0	49.0	44.0	42.5	41.0	41.5	42.0	47.0	50.0	53.5	**41.0**
Mean screen temperature (°F.)... ...	21	1928/48	74.1	74.6	73.0	70.1	66.5	62.7	61.9	63.6	65.8	68.4	70.7	73.0	**68.7**

TABLE 4.—**MEAN MONTHLY TEMPERATURES (°F.) FROM 14 RECORDING STATIONS IN THE SUGAR BELT.**

Locality.	Recorder.	No. of years.	Period.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Port Shepstone	Lightkeeper	17	1931/47	73.6	74.4	72.6	69.5	66.0	62.4	61.2	62.7	64.8	67.0	69.8	71.8	**68.0**
Umbogintwini	African Explosives ...	17	1931/47	74.0	74.8	73.4	70.5	66.5	62.9	61.9	63.8	65.8	68.2	70.5	72.4	**68.7**
Durban Bluff	Lightkeeper	7	1933/39	73.5	74.5	73.1	70.8	67.5	64.5	63.1	64.0	64.7	67.8	69.1	71.8	**68.7**
Durban Airport	Met. Office...	8	1940/47	75.4	75.6	74.1	71.0	66.2	62.3	61.3	63.5	66.2	68.6	71.4	73.5	**69.1**
Mt. Edgecombe	Experiment Station .	17	1931/47	74.3	74.9	73.2	70.5	66.5	62.6	61.9	63.9	66.0	68.6	70.9	72.9	**68.9**
Verulam... ...	Gaoler	7	1931/37	74.5	75.1	73.9	70.3	66.6	61.8	60.7	63.2	66.0	68.8	71.6	73.0	**68.8**
Stanger	C. C. Foss, Esq. ...	15	1931/45	75.2	77.0	75.1	72.4	69.0	65.2	64.4	66.7	68.1	71.1	72.5	74.6	**70.9**
Eshowe	Government Forester	17	1931/47	72.7	73.0	71.6	69.2	65.4	61.4	60.5	63.4	65.1	67.4	69.4	70.9	**67.5**
Empangeni ...	Government Forester	16	1931/46	76.3	77.2	75.6	72.6	68.3	63.4	62.7	65.2	67.6	71.0	73.2	75.1	**70.7**
Nkwaleni... ...	Government School...	8	1931/38	75.7	75.6	74.3	71.6	66.7	62.2	61.9	64.7	66.9	71.6	72.4	74.4	**69.8**
Cape St. Lucia	Lightkeeper	17	1931/47	76.1	77.0	75.2	72.9	68.8	64.3	63.5	66.0	68.1	69.6	72.3	74.7	**70.7**
Mkuzi	I. Lamb, Esq.	6	1942/47	80.7	79.3	76.8	74.7	68.9	62.4	62.1	66.0	71.2	74.2	77.8	78.6	**72.7**
Magut	Cotton Experiment Station	9	1931/39	77.0	76.4	74.6	71.2	65.9	59.9	60.5	64.6	68.4	72.5	74.1	75.8	**70.1**
Pongola	Supt. Settlement ...	8	1940/47	77.5	77.2	75.9	72.9	66.6	61.5	62.6	65.8	69.9	72.4	75.1	77.2	**71.2**
Means			... ...	75.4	75.8	74.2	71.4	67.0	62.6	62.0	64.6	67.1	69.9	72.2	74.1	**69.7**

TABLE 5.—**MEAN ANNUAL TEMPERATURES (°F.) FROM 14 RECORDING STATIONS IN THE SUGAR BELT.**

Locality.	1931.	1932.	1933.	1934.	1935.	1936.	1937.	1938.	1939.	1940.	1941.	1942.	1943.	1944.	1945.	1946.	1947.	Means.
Port Shepstone*...	67.8	68.2	67.9	68.6	66.6	67.1	68.0	67.6	67.6	68.9	69.0	68.3	67.1	68.4	67.8	68.6	68.2	**68.0**
Umbogintwini*	69.0	69.0	68.9	69.2	66.9	67.5	68.7	68.7	67.9	69.6	69.8	68.9	67.9	69.0	68.8	69.6	69.0	**68.7**
Durban Bluff	—	—	68.8	69.0	67.6	68.3	69.0	69.1	69.1	—	—	—	—	—	—	—	—	**68.7**
Durban Airport	—	—	—	—	—	—	—	—	—	69.3	69.6	69.2	68.3	69.3	68.5	69.5	69.0	**69.1**
Mount Edgecombe*	68.8	69.1	68.9	68.9	66.9	67.9	68.8	68.7	68.1	70.0	70.0	69.4	68.2	69.5	68.9	69.5	68.9	**68.9**
Verulam	69.6	69.7	69.4	69.7	67.2	67.7	68.4	—	—	—	—	—	—	—	—	—	—	**68.8**
Stanger*	71.9	71.4	71.4	71.5	69.1	70.2	71.1	70.9	69.9	71.5	72.0	71.3	70.0	71.3	70.7	71.3	70.7	**70.9**
Eshowe*	68.2	68.2	68.6	68.2	65.8	66.4	67.2	67.8	66.6	68.3	68.6	67.4	66.3	67.8	67.6	67.4	67.2	**67.5**
Empangeni*	70.5	71.7	71.2	70.8	69.8	69.1	70.1	70.7	69.4	71.1	72.7	71.1	70.4	71.2	70.4	70.6	70.1	**70.7**
Nkwaleni	70.0	69.7	71.0	70.3	68.6	69.5	69.6	69.8	—	—	—	—	—	—	—	—	—	**69.8**
Cape St. Lucia*	71.5	71.5	71.1	71.6	69.8	69.9	71.0	70.3	70.6	71.0	71.5	70.5	68.9	70.7	70.5	71.0	70.7	**70.7**
Mkuzi	—	—	—	—	—	—	—	—	—	—	—	72.7	71.5	73.0	72.7	73.1	73.4	**72.7**
Magut	71.5	70.5	69.3	69.9	70.2	70.0	69.9	70.5	68.8	—	—	—	—	—	—	—	—	**70.1**
Pongola	—	—	—	—	—	—	—	—	—	71.0	71.7	70.6	69.8	71.2	71.6	71.9	71.9	**71.2**
Total mean	69.9	69.9	69.7	69.8	68.0	68.5	69.3	69.4	68.7	70.1	70.5	69.9	68.8	70.1	69.8	70.1	69.8	**69.7**
*** Mean 7 stations... ... ...**	69.7	69.9	69.7	69.8	67.8	68.3	69.3	69.2	68.6	70.1	70.5	69.6	68.4	69.7	69.2	69.7	69.3	**69.3**



THE DISTRIBUTION OF TEMPERATURES IN THE SUGAR BELT OF NATAL AND ZULULAND

Scale: 1 inch = 31.56 miles

Roads

Railway

Scale Map by courtesy of A.A. of S.A.

The PRESIDENT reminded the meeting that knowledge of climatic conditions was essential to the proper understanding of cane growth and that a considerable amount of data was published in the Annual Summary of Laboratory Reports. Mr. Beater had made many useful contributions to knowledge of climatic conditions in the sugar belt, and this paper dealt with a subject which had not been covered very fully previously.

Dr. DODDS said that the paper filled a definite vacancy in our records, for although he had published rainfall records from the different districts for many years, warmth and freedom from frost was just as important for sugarcane growth as was moisture. The paper now published had required a great deal of work in its compilation.

Mr. RAULT wished to know to what extent sucrose per cent. cane figures could be correlated with the records of climatic conditions. At Esperanza, for instance, cane had a very high sucrose content, and he wondered if this could be associated with temperatures, or might it be due to high altitude ?

Mr. BEATER replied that he had not as yet attempted to correlate temperature with sucrose percentages, but, in a general way, he would expect a high temperature to induce more rapid growth of cane and thus, if anything, tend to lower the sucrose content. He thought this point raised could be followed up in the future.