Meteorological Observations Made in Chiengmai. 1910-1914.

by

Dr. A. F. G. Kerr.

Meteorological records of the temperature, humidity and rainfall were kept more or less regularly in Chiengmai from March 1909 till August 1915, but, for the purposes of this paper, the five completed years from January 1st. 1910 to December 31st. 1914 are chiefly dealt with. Observations on the direction and force of the wind were made for three years, 1912 to 1914, and these are also included.

There have been several intervals when I was away on tour or leave and could not personally keep up the observations, but usually when on tour my wife has kept the records and when on leave in 1913 Mr. R. B. H. Gibbins very kindly took charge of the observations, so the figures are complete enough, as far as temperature is concerned, to give a good idea of the average climate of Chiengmai.

The temperatures were taken with thermometers examined and certified by the National Physical Laboratory at Richmond. Till July 12th. 1912 the thermometers were exposed in a wooden screen after the pattern of Stevenson's screen, thereafter in a grass hut built on the lines of the British Association model.

The tables for temperature and rainfall have been drafted to allow of ready comparison with those for Bangkok published by Dr. Campbell Highet in this Journal (Vol. IX, Pt. 2, 1921).

Temperature.

On comparing the Bangkok and Chiengmai tables it will be seen that the chief difference between the two places is the more marked extremes of heat and cold in Chiengmai. This is due mainly to the inland situation of Chiengmai, in fact Chiengmai has much more a continental climate than Bangkok. The latitude of Chiengmai, about 5° North of Bangkok, and its altitude, 1000 feet (300 metres), have also some influence on its temperature. The mean annual temperature of Chiengmai, 80.1° F. (26.8° C), is, however, only 2.5° F (1.4° C) less than that of Bangkok.

The differences are most marked in the cold and hot seasons, while during the rains there is very little to choose, as far as temperature goes, between Chiengmai and Bangkok. These differences are well shown by the mean daily range of temperature which keeps well over 30° F (16.7° C) from January till the end of April in Chiengmai; in Bangkok the range is 25.4° F (14.1° C) in January, dropping to 20.1° F (11.1° C) in April. In July, August and September the daily range in Chiengmai is only two or three degrees Fahrenheit more than in Bangkok.

The cool season in Chiengmai usually lasts from the middle of November till the middle of March. During this period the mean temperature keeps below 76° F. (24.4° C) and the nights are not only cool but often unpleasantly cold. The middle of the day is usually hot. The lowest temperature recorded was 41.3° F (5.2° C) on February 8th 1911.

In the hot season, from about the middle of March till the onset of the rains in May, the temperature towards mid-day is hotter than in Bangkok at the same season and the atmosphere is probably much drier but the nights are several degrees cooler. The highest temperature recorded was 109.8° F (43.2° C) in April 1913.

The temperature in the sun was taken with a black-bulb thermometer for some sixteen months, till, in fact, the thermometer was broken when it was not replaced. The highest temperature recorded was 152° F (66.7° C) in April 1909 and again in May of the same year.

Rainfall.

In Chiengmai rain may fall in any month of the year but when it does do so outside the limits of the rainy season it usually falls in showers only, though occasionally two or three days continuous rain are experienced in the dry season. The most notable falls of rain in the dry season during the period under consideration were in 1910 when rain fell every day from the 8th. to the 11th. of March, the total fall for the six days being 3.910 inches (99.4, millimetres) and again in the following April when in four days from the 13th. to the 16th., 5.700 inches (132.1 millimetres) fell.

The rains commence in earnest about the middle of May. The earliest and latest dates for the commencement of the rains in the five years were the 8th. and the 17th. of May.

It is not so easy to fix the end of the rains as there is often a fairly long dry interval before they finally cease. It may however be put down as about the middle of November. The outside dates for the cessation of rains during the five years were the 4th. and the 26th. of November.

The mean annual rainfall for the five years was 42.629 inches (1082.7 millimetres). This is probably lower than the mean would be if the rain were measured over a longer period. The actual fall for each of the five years was as follows:—

1910	49.550 inches	(1258.6 millimetres).
1911	38.180 inches	(969.7 millimetres).
1912	51.195 inches	(1300.3 millimetres).
1913	33.245 inches	(844.4 millimetres).
1914	49.970 inches	(1269.3 millimetres).

In not one of these years did the rainfall come up to the average of the previous nine years, 51.285 inches (1302.7 millimetres. The figures for these years were very kindly supplied to me by the Borneo Company. In the whole period of 14 years the year of greatest rainfall was 1908 with 64.49 inches (1638.0 millimetres) while 1913 with 33.245 inches (844.4 millimetres) had the least. Combining the two sets of figures the mean annual rainfall for the 14 years, 1901-1914, is 48.194 inches (1224.1 millimetres); more than seven inches less than the mean annual rainfall of Bangkok for the 17 years 1902-1918, 55.843 inches (1418.3 millimetres).

The average number of days on which rain fell, that is 0.01 inches or more, in a year is 111 as compared with 136.6 in Bangkok.

The largest rainfall recorded in any one day was 2.790 inches (70.9 millimetres) on the 15th. August 1914, the whole amount falling in about five hours.

Humidity.

The humidity of Chiengmai is probably less than that of Bangkok. It will be noted how low the percentage of humidity drops

at midday in the dry season while still remaining fairly high in the early morning. The very high percentages in the mornings of the cold season are associated with heavy dews and mists.

Dew and Mist.

A heavy dew falls every night throughout the cold season. This dew usually begins about the middle of November and lasts till the beginning of March, from then on till the commencement of the rains there is no dew.

A morning mist, sometimes very thick, is of frequent occurrence in the cold season, it usually clears up by 9 or 9.30 A. M.

Haze.

There is a good deal of haze during the hot season. It is most marked when there are long spells without rain. From the middle of March on to the break of the rains Doi Sutep is seldom visible from Chiengmai, though its foot is only three or four miles distant, while by 4 P. M. the sun is a dull red disc which can be gazed at without discomfort. Probably most of this haze is due to smoke from forest fires. All the dry deciduous forests, which predominate in the vicinity of Chiengmai, are burnt over at least once every hot season, these fires producing a great quanity of smoke which diffuses through the atmosphere.

Winds.

The winds of Chiengmai are chiefly local winds which depend more on local conditions than on the Monsoon. In speaking of thesr winds surface winds are referred to and not currents in the upper aie.

The topography of Chiengmai gives the clue to the prevailing winds and may be briefly sketched. Chengmai Plain runs roughly North and South for a distance of al out one hundred miles; its breadth from East to West is much less, averaging probably under 25 miles. The whole of the plain is surrounded by fairly high mountains.

Chiengmai lies close to the western border of the plain and in its northern third, almost at the foot of Doi Sutep, a mountain which rises to a height of 4500 feet (1350 metres) above the plain.

To the Southwest lies a very large mountain mass, at a distance of between 30 and 40 miles, containing the highest peak in Siam, Doi Angka, usually called on maps Intanon.

Theoretically, in a locality with such features, during sunny weather the heated air over the plain would rise and its place be taken by cool air coming down from the mountains all round. These winds from the mountains should not be felt till after mid-day, when the sun had well heated up the plain, and would be expected to increase in strength till the evening when they should begin to abate and cease altogether during the night. When staying, during the hot season, at the Hue Chāngkian Sanatorium the wind coming down the valley of the mountain is a very regular feature, it commences rather late in the afternoon and dies down usually between 8 and 9 P. M.

As Chiengmai lies near the western side of the plain and has high mountains to the Southwest the prevailing winds should be West and Southwest, most marked in the afternoon and dying down after sunset; while the mornings should be calm or with light winds blowing towards the mountain.

On referring to the tables it will be seen that the observed facts fit in fairly closely with the theory. At 7 A. M. 61% of the observations in the rainy season and 71% in the cool and hot seasons were calms while at 2 P. M. for the same seasons the percentages of calms were only 19 and 13 respectively By 9 P. M. the percentage of calms had risen again considerably, being 58 for the rains and 49 for the rest of the year. No doubt if observations had been taken an hour or so later than 9 P. M. the percentage of calms would have been considerably higher. At 2 P. M. in the rains 57% of the winds are from the quarter South to West and for the rest of the year, at the same time of day, 51% are from the same quarter. In calculating the percentage of winds for each quarter the winds from each of the cardinal points are counted twice. For instance in the East to South quarter the East and South as well as all intermediate winds are counted, in the South to West quarter the South winds are counted again and so on round the compass.

It is not common to find a wind blowing steadily from the same point throughout the day. During the three years on only seven days was the wind blowing from the same point at all three observations.

The winds in Chiengmai are usually light, 4 or below 4 on the Beaufort scale; 47% of all the observations are recorded as calms, 46% as light or very light winds, that is 4 or less on the Beaufort scale, and only 7% as fresh or strong, 5 or more on the Beaufort scale. About half of these strong winds occur in the three months June, October and November, that is after the beginning of the rains and again near their end.

In the hot season gusty irregular winds are common and often take the form of small whirlwinds.

If observation were made on the top of one of the higher mountains much more constant and stronger winds would be found. The trees on exposed ridges at high altitudes show this by being stunted and permanently bent away from the prevailing strong southwesterly winds.

The Climate of Doi Sutep.

The summit of Doi Sutep is 4500 feet (1350 metres) above the level of Chiengmai and is, naturally, very considerably cooler.

The first meteorological observations taken on the top of Doi Sutep to be published were those of Dr. C. C. Hosseus who made temperature records there for 4 days in the first half of December 1904. These observations, together with others made by Dr. Hosseus elsewhere in Siam, were the subject of a paper by Dr. Gerbing, "Das Klima von Siam und die Ergebnisse der von Dr. Hosseus angestellten meteorologischen Beobachtungen" published in Petermann's Geographische Mitteilung, 1909, No. 6. Dr. Hosseus gives an extract relating to Doi Sutep from this paper in his book, Durch König Tschulalongkorns Reich. The following is a summary of this extract.

Temperatures were taken simultaneously in Chiengmai and on the top of Doi Sutep from 2 P.M. on December 10th. till 7 A.M. on December 14th. When these temperatures are tabulated it is seen the mean decrease in temperature between Chiengmai and the

top of Doi Sutep for the four days is at 7 A.M. 2.45° C (4.4° F), at 2 P.M. 13.3° C (23.9° F) and at 9 P.M. 6.2° C (11.2° F). This gives a mean fall for each 100 metres altitude of 0.533° C, which accords with the value for decrease of temperature with height found in mountains elsewhere, namely 0.56° C for every 100 metres (about 1° F to 300 feet). The difference in temperature at night is not so great owing to the heavy cold air collecting in the valley.

Taking it for granted that December is the coolest month in Chiengmai and April the hottest it may be assumed that the mean temperature on the top of Doi Sutep for December will be 12.2° C (54° F) and for April 22.3° C (72.1° F). May, which falls in the rains when the decrease of temperature with height is less, will have the same mean temperature as April.

Combining all the results it may be predicted that the Winter months on the top of Doi Sutep will have a temperature resembling that of our Spring months, though night frosts are hardly to be expected. The hottest months, April and May, on the other hand will have a mean temperature which we rarely reach in the Summer months.

Since the above paper was written a good many temperature records have been made on the top of Doi Sutep and these bear out, in the main, the predictions of Dr. Gerbing. It may be mentioned here that night frosts are not unknown in N. Siam, and at lower altitudes than the top of Doi Sutep. I myself experienced a frost one night in a small valley on the Baw Sali plateau in January 1904, the altitude being about 3000 feet. I believe these frosts occur in valleys at fairly high altitudes and sufficiently enclosed to act as pockets for cold air. Such a valley, however, is not to be found on Doi Sutep, whose slopes are steep, so night frosts there are improbable.

Our present knowledge of the temperature conditions on the top of Doi Sutep is almost entirely due to Dr. McKean, who, with the help of other members of the Mission Staff, has kept regular records of the temperature at Chawmchêng Sanitorium during the hot season. This sanitorium is within 100 feet of the actual summit, that is with regard to altitude. The thermometers were exposed under the shade of trees, no doubt temperatures so obtained tend to be more even, that is the minimal temperatures higher and the

maximal lower, than those of thermometers exposed in a screen, but such differences will not be large.

These records are spread over several years, from 1914 to 1922, and cover the latter half of March, all of April and most of May. The observations for January were taken by myself. In comparing Doi Sutep temperatures with those of Chiengmai mean temperatures have had to be used as most of the Doi Sutep records were made at a time when no records were being made in Chiengmai.

The following is a summary of the observations on Doi Sutep, month by month, as far as the records go.

January

In January 1915 temperatures were recorded on five days, from the 1st. to the 5th. A maximum thermometer was not used but the temperatures were taken between 2 and 3 P. M., about the time for the daily maximum to occur. The highest temperature recorded in the five days was 64.5° F (18.1° C) and the lowest minimum was 48.1° F (9.0° C). In Chiengmai for the same five days the highest maximum was 86. 3° F (30. 2° C) and the lowest minimum 53. 8° F (12. 1° C).

March

There are records for 42 days in March, all in the last half of the month.

Mean Temperature	69. 5° E (20. 8° C)
Mean of Maxima	76. 0° F (24. 4° C)
Mean of Minima	63. 0° F (17. 2° C)
Highest Maximum	83. 0° F (28. 3° C)
Lowest Minimum	52. 0° F (11. 1° C)
Greatest Daily Range	18. 0° F (10. 0° C)
Least Daily Range	2. 0° F (1. 1° C)

The mean temperature of Chiengmai for the last half of March is 82. 2° F (27. 9° C), the mean of the maxima 101. 4° F (38. 5° C) and the mean of the minima 62. 8° F (17. 1° C).

It will be noticed that the mean of the minima in Chiengmai is actually lower than that on Doi Sutep. Besides the difference in the method of exposure of the thermometers, already alluded to, it must be remembered that these means are not calculated from the same series of years. It is quite possible that either the Chiengmai

Marches were exceptionally cool or the Doi Sutep ones exceptionally hot; either case might make a difference of 4° or 5° F in the mean of the minima, which is all that is to be expected between the two places.

April

The observations in April cover 72 days, spread well over the whole month. In 1921 there are records for 21 continuous days and in 1922 for 29 days.

Mean Temperature	71. 0° F (21. 7° C)
Mean of Maxima	77. 5° F (25. 3° C)
Mean of Minima	64. 5° F (18. 1° C)
Highest Maximum	83. 0° F (28. 3° C)
Lowest Minimum	59. 0° F (15. 0° C)
Greatest Daily Range	19. 0° F (10. 6° C)
Least Daily Range	6. 0° F (3. 3° C)

The mean temperature on the top of Doi Sutep is thus 14.3° F (8.0° C) lower than the mean temperature of Chiengmai for the same month while the mean of the maxima is 24.9° F. (13.8° C) and the mean of the minima 3.6° F (2.0° C) lower than the respective means in Chiengmai.

In April 1914 temperatures were recorded both on the top of Doi Sutep and in Chiengmai for three days, from the 12th. to the 14th., with the following results.

	Chieng-		Doi	
Mean Temperature	mai	84.5° F (29.2° C),	Sutep	68.2° F (20.1° C)
Mean of Maxima	„	100.5° F (38.1° C),	„	75.0° F (23.9° C)
Mean of Minima	„	68.5° F (20.3° C),	„	61.3° F (16.3° C)
Highest Maximum	„	101.2° F (38 4° C),	„	75.0° F (23.9° C)
Lowest Minimum	„	67.6° F (19.8° C),	„	59.0° F (15.0° C)

On April 11th. 1915 the minimum temperature was taken in both places, that for Chiengmai was 69.5° F (20.8° C) and for the top of Doi Sutep 60.0° F (15.6° C).

May.

The temperature records for May are not so complete as those for April. Temperatures were taken for 26 consecutive days, from the 1st. to the 26th., in 1919, but only the means are available:

in 1922 temperatures were taken on four days in the first week of the month.

Mean Temperature	69.1° F (20.7° C)
Mean of Maxima	73.9° F (23.3° C)
Mean of Minima	64.3° F (18.0° C)

In Chiengmai for May the mean temperature is 85.8° F (29.8° C) the mean of the maxima 98.7° F (37.1° C) and the mean of the minima 73.0° F (22.8° C).

There is no note in the May records as to the amount of rain or mist but it is probable that there were a good many cloudy or wet days which were accountable for lowering the mean of the maxima temperatures.

No records are available for the rest of the year. It is probable that the maximal temperatures are considerably lowered during the rains while the minimal may be slightly higher. In the rains the top of Doi Sutep is very frequently enveloped with clouds, even when fine weather is being experienced in Chiengmai; it has however fine intervals when it is clear of clouds.

I. Mean and Extreme Shade Temperatures in Chiengmai for a period of 5 years (1910-1914).

	Mean		Mean of Maxima		Mean of Minima		Mean Daily Range		Greatest Daily Range		Least Daily Range		Highest Maximum			Lowest Minimum		
	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	Year	F.	C.	Year	F.	C.
January ..	71.8	22.1	88.7	31.5	55.3	13.0	33.6	18.7	49.0	27.2	20.9	11.6	1910	96.0	35.6	1914	42.5	5.8
February ..	75.1	23.9	93.2	34.0	55.7	13.2	36.8	20.5	49.1	27.3	21.5	12.0	1910	100.5	38.1	1911	41.3	5.2
March ..	80.1	26.8	99.4	37.4	61.7	16.5	37.9	21.1	48.0	26.8	13.5	7.5	1913	106.5	41.4	1913	51.5	10.8
April ..	85.3	29.6	102.4	39.1	68.1	20.1	33.2	18.5	44.0	24.5	13.5	7.5	1913	109.8	43.2	1913	60.0	15.6
May ..	85.8	29.8	98.7	37.1	73.0	22.8	25.7	14.3	37.5	20.9	8.1	4.5	1913	108.5	42.5	1910	67.0	19.4
June ..	84.4	29.1	94.8	34.8	74.1	23.4	20.7	11.5	27.5	15.3	5.1	2.8	1913	102.0	38.9	1914	68.7	20.4
July ..	83.0	28.3	91.9	33.3	73.9	23.3	18.3	10.2	27.6	15.3	5.4	3.0	1912	100.2	37.9	1910	69.8	21.0
August ..	82.0	27.8	90.5	32.5	73.5	23.1	17.0	9.5	27.2	15.1	1.3	0.7	1910	99.9	37.7	1911	69.3	20.8
September ..	82.2	27.9	91.2	32.9	73.1	22.9	18.0	10.0	24.8	13.8	8.5	4.8	1910	98.2	36.8	1910	69.1	20.7
October ..	80.9	27.2	90.6	32.5	71.2	21.8	19.4	10.8	28.2	15.7	7.9	4.4	1910	97.2	36.2	1912	64.4	18.0
November ..	76.9	24.9	88.0	31.1	66.0	18.9	22.1	12.3	33.6	18.7	5.3	3.0	1911	95.3	35.2	1910	56.8	13.7
December ..	73.4	23.0	86.9	30.5	59.7	15.4	27.0	15.0	36.4	20.2	10.5	5.8	1911	96.4	35.8	1910	49.4	9.6

Mean Shade Temperature for the five years 80.1° F. (26.8° C).

Mean Daily Range 25.8° F (14.3° C).

II. Rainfall and Humidity in Chiengmai for 5 years (1910-1914)

	Mean Rainfall		Average Number of days on which rain fell	Greatest rainfall in 24 hours			Mean Relative Humidity in percentages		
	Inches	Millimetres		Year	Inches	Millimetres	7 A. M.	2 P. M.	9 P. M.
January ..	0.773	19.6	2	1912	1.390	35.3	95	46	88
February ..	0.006	0.2	0	1910	0.030	0.8	92	36	78
March ..	0.924	23.5	2	1910	1.180	29.9	84	31	61
April ..	1.506	38.3	4	1914	0.850	21.6	81	31	63
May ..	5.201	132.1	13	1911	2.150	53.8	86	47	80
June ..	5.857	148.8	16	1911	2.610	66.2	89	56	84
July ..	4.611	117.1	19	1912	2.025	51.4	88	59	88
August ..	7.792	197.9	20	1914	2.790	70.9	92	64	90
September ..	8.665	220.0	18	1912	2.725	69.2	93	65	93
October ..	3.924	99.7	10	1913	2.190	55.6	94	58	90
November ..	3.242	82.3	6	1910	2.000	50.8	97	55	90
December ..	0.127	3.2	1	1913	0.430	11.0	96	49	90

Mean Annual Rainfall for the five years 42.629 inches (1082.7 millimetres)

III Wind Observations Chiengmai 1912-1914

May to November (inclusive)

	7 A.M.	2. P.M.	9 P.M.
Calm	180	49	154
Variable	1	1	1
N	17	3	4
NE	17	24	12
E	10	12	3
SE	7	32	12
S	10	23	5
SW	32	91	57
W	4	2	8
NW	15	16	10

December to April (inclusive)

	7 A.M.	2 P.M.	9 P.M.
Calm	141	21	77
Variable	3	4	0
N	5	4	1
NE	6	13	5
E	5	9	7
SE	3	33	11
S	1	17	6
SW	13	46	31
W	7	12	14
NW	15	8	5

IV Percentages of Winds from each of the Four Quarters

May to November

	7 A. M.	2 P.M.	9 A.M.
Calm	61	19	58
N to E	39	19	17
E to S	24	33	18
S to W	41	57	63
W to N	32	10	20

December to April

	7 A.M.	2 P.M.	9 P.M.
Calm	71	13	49
N to E	28	18	16
E to S	16	40	30
S to W	36	51	63
W to N	47	16	25