

of cloudless skies, of which 26 were in September, 24 in October, and 23 in both June and July, and only 4 in March.

The largest fall of rain for the month in the year was 7·29 inches, in March, of which 2·50 inches fell on the 20th and 1·33 inch on the 10th. The next largest fall for the month was 6·60 inches, in December, of which 2·53 inches fell on the 26th, 1·97 inch on the 25th, and 1·18 inch on the 15th. No rain fell from April 9th till November 3rd, making a period of 207 consecutive days without rain. The total fall of rain for the year was 28·66 inches, being 2·42 inches above the average of 37 years, viz., 1861 to 1897. The number of days on which rain fell was 59, being 3 more than the average.

## RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT TIBERIAS IN THE YEAR 1898.

By JAMES GLAISHER, F.R.S.

THE numbers in column 1 of this table show the highest reading of the barometer in each month; the highest appear in the winter, and the lowest in the summer months; the maximum for the year was 31·214 inches, in January, and the next in order 31·103 inches, in December.

In column 2 the lowest reading in each month is shown; the minimum for the year was 30·126 inches, in March, and the next in order 30·192 inches, in August.

The range of readings in the year was 1·088 inch, being 0·153 inch greater than the range at Jerusalem; both the maximum and minimum readings of the barometer at Tiberias occurred in the morning observations.

The numbers in the 3rd column show the extreme range of readings in each month; the smallest was 0·309 inch, in June, and the next in order 0·350 inch, in August; the largest was 0·800 inch, in January, and the next in order 0·686 inch, in December.

The numbers in columns 4 and 5 show the mean monthly reading of the barometer at 8 a.m. and 4 p.m., and those in column 6 the lower reading at 4 p.m. than at 8 p.m.; the smallest difference between these two readings was 0·051 inch, in March, and the next in order 0·062 inch, in February; the largest was 0·163 inch, in October, and the next in order 0·098 inch, in July. In England, in January, the readings at 8 a.m. and 4 p.m. are practically the same; in all other months the reading at 4 p.m. is lower than at 8 a.m.; the greatest difference is 0·025 inch, in June. The mean for the year at Tiberias was 0·082 inch, being about four times greater than in England.

The numbers in the 7th column show the mean monthly pressure of the atmosphere; the highest was 30·896 inches, in January, and the next in order 30·784 inches, in December; the lowest was 30·360 inches,

## MONTHLY METEOROLOGICAL TABLE.

Deduced from observations taken at Tiberias, by Mr. LAWIN, at about 652 feet below the level of the Mediterranean, and 30 feet above the level of the Sea of Galilee, open on all sides.  
Latitude, 32° 48' N.; Longitude, 35° 34' E.

Months.	Pressure of atmosphere—corrected to 32° Fahrenheit.							Temperature of the air.							8 a.m.							4 p.m.							Rain.					
	Highest.	Lowest.	Range.	Mean at 8 a.m.	Mean at 4 p.m.	Lower reading at 4 p.m. than at 8 a.m.	Mean at 8 a.m. and 4 p.m.	Highest.	Lowest.	Range.	Mean of all highest.	Mean of all lowest.	Mean daily range.	Inferred Mean.	Mean reading.			Vapour.				Degree of humidity.	Weight of a cubic foot of air.	Mean reading.			Vapour.				Degree of humidity.	Weight of a cubic foot of air.	Number of days on which rain fell.	Amount collected.
															Dry bulb.	Wet bulb.	Dew point.	Elastic force of.	Weight in a cubic foot of air.	Additional weight required for saturation.	Dry bulb.			Wet bulb.	Dew point.	Elastic force of.	Weight in a cubic foot of air.	Additional weight required for saturation.	Dry bulb.	Wet bulb.				
1898.	in.	in.	in.	in.	in.	in.	in.	°	°	°	°	°	°	°	°	°	in.	grs.	grs.	°	grs.	°	°	°	in.	grs.	grs.	°	grs.	°	°	°	sum.	sum.
January ...	31·214	30·414	0·800	30·939	30·854	0·085	30·896	69·0	—	—	59·1	—	—	53·5	52·4	46·9	41·3	·261	2·9	1·5	67	560	55·6	50·7	46·1	·313	3·5	1·4	70	554	6	2·24		
February ...	30·967	30·456	0·511	30·753	30·691	0·062	30·722	82·0	—	—	68·5	—	—	59·6	59·5	52·0	45·4	·304	3·4	2·2	59	548	63·2	55·2	48·4	·340	3·7	2·7	59	543	7	3·22		
March ...	30·779	30·126	0·653	30·589	30·528	0·061	30·563	89·0	—	—	70·6	—	—	62·5	63·1	56·9	51·7	·388	4·3	2·2	66	541	67·0	59·5	53·6	·410	4·6	2·8	62	536	8	2·46		
April ...	30·843	30·355	0·488	30·667	30·577	0·090	30·622	99·0	—	—	83·7	—	—	73·1	73·1	63·0	55·5	·442	4·8	4·0	54	532	78·3	64·5	55·0	·438	4·6	5·8	45	525	0	0·00		
May ...	30·725	30·325	0·400	30·581	30·488	0·093	30·534	99·0	—	—	88·5	—	—	78·2	77·5	67·6	60·7	·532	5·7	4·4	56	525	84·5	67·5	56·3	·450	4·8	7·8	39	518	0	0·00		
June ...	30·617	30·308	0·309	30·508	30·411	0·097	30·460	109·0	—	—	95·7	—	—	85·6	84·5	74·0	67·1	·666	7·0	5·5	53	517	92·1	73·8	62·5	·519	5·9	9·8	37	509	0	0·00		
July ...	30·600	30·197	0·403	30·409	30·311	0·098	30·360	104·0	—	—	99·1	—	—	87·8	87·2	78·5	72·9	·811	8·5	5·2	62	512	93·6	78·0	68·6	·697	7·3	9·2	44	505	0	0·00		
August ...	30·542	30·192	0·350	30·427	30·360	0·067	30·393	102·0	—	—	97·9	—	—	87·8	86·5	78·0	69·2	·715	7·5	5·9	57	513	91·6	75·5	65·6	·624	6·6	8·9	42	509	0	0·00		
September ...	30·735	30·298	0·437	30·539	30·448	0·091	30·494	109·0	—	—	95·4	—	—	84·4	84·6	74·4	67·7	·672	7·2	5·4	58	517	91·3	74·3	63·9	·589	6·2	9·2	40	509	0	0·00		
October ...	30·767	30·316	0·451	30·630	30·527	0·103	30·578	102·0	—	—	95·6	—	—	85·1	84·9	71·7	63·2	·580	6·1	6·6	48	519	89·0	73·3	63·5	·581	6·1	8·3	42	513	0	0·00		
November ...	31·009	30·523	0·486	30·726	30·654	0·072	30·690	98·0	—	—	80·5	—	—	74·8	73·8	67·7	63·4	·582	6·3	2·7	70	531	75·4	68·5	63·6	·588	6·4	3·2	66	529	8	2·80		
December ...	31·103	30·417	0·686	30·822	30·747	0·075	30·784	80·0	—	—	68·7	—	—	61·6	60·9	56·6	52·9	·401	4·5	1·5	75	547	65·1	57·6	51·5	·380	4·2	2·7	61	542	8	4·28		
Means ...	30·825	30·327	0·498	30·632	30·550	0·082	30·591	95·2	—	—	83·7	—	—	74·5	74·0	63·8	59·2	·529	5·7	3·9	60	530	78·9	66·5	58·2	·496	5·8	6·0	51	524	sum. 37	sum. 15·00		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32		

in July, and the next in order 30·393 inches, in August. The mean for the year was 30·591 inches.

The highest temperature of the air in each month is shown in column 8. The first day in the year the temperature reached 90° was on April 3rd, and there were 7 other days in April on which the temperature reached or exceeded 90°; in May, on 14 days; in June, on 22 days; in July, August, and September it reached or exceeded 90° on every day; in October, on 21 days; and in November, on 6 days; thus the temperature reached or exceeded 90° on 163 days during the year. At Jerusalem the temperature did not reach 90° till June 1st, and there were only 12 days in the year on which the temperature was as high as 90°. At Tiberias the temperature was 101° on June 12th, and reached or exceeded 100° on 10 other days in this month; in July, on 11 days; in August, on 6 days; in September, on 1 day; and in October, on 7 days; thus on 36 days in the year the temperature reached or exceeded 100°. The highest temperature in the year at Tiberias was 109°, on both June 18th and September 10th; at Jerusalem it was 98°·5, on June 19th.

The minimum readings of the thermometer were not trustworthy, and consequently columns 9, 10, 12, and 13 are blank. On p. 73 of the *Quarterly Statement* for January, 1899, the difference between the mean temperature of the air in every month at 8 a.m., and the simple mean of the maximum and minimum temperature (used as mean temperature), was found from seven years observations—1890–1896—as follows:—

In January to the mean of observations at 8 a.m. add	1°1
February	” ” ” 0°1
March	” ” subtract 0°6
April	” ” (no correction).
May	” ” add 0°7
June	” ” ” 1°1
July	” ” ” 0°6
August	” ” ” 1°3
September	” ” subtract 0°2
October	” ” add 0°2
November	” ” ” 1°0
December	” ” ” 0°7

By the application of these numbers to those in column 15 the numbers in column 14 have been found, showing the approximate mean temperature of each month.

In column 11 the mean of all the high day temperatures in each month is shown. The lowest was 59°·1, in January, being 12°·5 higher than that at Jerusalem, the next in order were 68°·5, in February, and 68°·7, in December; the highest was 99°·1, in July, and the next in order were 97°·9, in August, and 95°·7, in June. At Jerusalem the lowest were 46°·6 in January, 54°·1 in February, and 55°·7 in December; the highest were 84°·7 in July, 84°·6 in June, and 83°·7 in August.

The mean temperature of the air in each month is shown in column 14.

The lowest was  $53^{\circ}5$ , in January, the next in order were  $59^{\circ}6$ , in February, and  $61^{\circ}6$ , in December; the highest was  $87^{\circ}8$ , in both July and August, and the next in order were  $85^{\circ}6$ , in June, and  $85^{\circ}1$ , in October. At Jerusalem the lowest temperatures were  $41^{\circ}1$  in January,  $47^{\circ}9$  in February, and  $49^{\circ}6$  in December; the highest were  $74^{\circ}6$  in July,  $74^{\circ}0$  in June and October, and  $73^{\circ}3$  in August. At Tiberias the mean temperature increased month by month to the maximum in both July and August, decreased in September, increased in October, then decreased again to the end of the year. At Jerusalem the mean temperature increased month by month to the maximum in July, then decreased in August and September, increased in October, and then decreased again to the end of the year. At Tiberias the yearly value was  $74^{\circ}5$ ; at Jerusalem it was  $62^{\circ}4$ .

The numbers in the 15th and 16th columns are the mean readings of a dry and wet-bulb thermometer, taken daily at 8 a.m. The mean for the year of column 15 was  $74^{\circ}0$ , being  $0^{\circ}5$  less than the inferred mean of column 14. In the year 1890 the dry-bulb was  $1^{\circ}1$  lower than that of the maximum and minimum thermometers; in 1891 it was  $1^{\circ}5$  lower; in 1892,  $0^{\circ}4$  higher; in 1893,  $0^{\circ}7$  lower; in 1894,  $0^{\circ}5$  lower; and in 1895,  $0^{\circ}1$  lower; the mean of the six differences is  $0^{\circ}6$ ; and therefore the mean temperature of the year may be approximately determined by a single reading of the thermometer taken daily at 8 a.m.

The numbers in the 17th column are the temperature of the dew-point, or that temperature at which the air would be saturated by the quantity of vapour mixed with it; the smallest difference between these numbers and those in column 15 was  $8^{\circ}0$  in December, and the largest  $21^{\circ}7$  in October.

The numbers in column 18 show the elastic force of vapour, or the length of a column of mercury in inches corresponding to the pressure of vapour; the smallest was 0.261 inch, in January; and the largest 0.811 inch, in July.

In column 19 the weight in grains of the water in a cubic foot of air is shown; it was as small as 2.9 grains in January, and as large as 8.5 grains in July.

In column 20 the additional quantity of vapour required to saturate a cubic foot of air is shown; it was as small as 1.5 grains in both January and December, and as large as 6.6 grains in October.

The numbers in column 21 show the degree of humidity of the air, saturation being represented by 100; the largest number is 75 in December, and the smallest 48 in October.

The numbers in column 22 show the weight in grains of a cubic foot of air, under the mean atmospheric pressure, temperature, and humidity of the air; the largest number was in January, decreasing to the smallest in July, then increasing again to the end of the year.

In columns 23 and 24 are the mean readings of a dry and wet-bulb thermometer taken daily at 4 p.m. By comparing the numbers in column 15 with those in column 23, the increase of temperature from

8 a.m. to 4 p.m. is shown; in November the increase was only  $1^{\circ}6$ , and in June it was as much as  $7^{\circ}6$ .

In column 25 the temperature of the dew-point at 4 p.m. is shown. By comparing these numbers with those in column 17, it will be seen that the temperature of the dew-point in the months of January, February, March, October, and November was higher than at 8 a.m., and lower than at 8 a.m. in all other months. The numbers in this column are smaller than those in column 23 by  $9^{\circ}5$  in January, increasing to  $29^{\circ}5$  in June, then decreasing to  $11^{\circ}8$  in November; these differences between the temperature of the air and that of the dew-point are very much larger than those at 8 a.m., being in several months more than twice as large.

On several days during the months of April, May, June, July, September, and October at 4 p.m., the reading of the dry-bulb thermometer exceeded that of the wet by  $20^{\circ}$  or more, and the temperature of the dew-point was from  $32^{\circ}2$  to  $54^{\circ}3$  lower than the temperature of the air, as shown by the table on the following page.

In column 26 the elastic force of vapour is shown, and by comparing the values with those in the same month at 8 a.m., we find that it was smaller at 4 p.m. in the months of April, May, June, July, August, September, and December, and larger than at 8 a.m. in the remaining months.

In column 27 the amount of water in a cubic foot of air at 4 p.m. is shown; the amount was less than at 8 a.m. in the months from April to September, and in December, of the same value in October, and larger than at 8 a.m. in the remaining months.

In column 28 the amount of water required to saturate a cubic foot of air was as large as 9.8 grains in June, and as small as 1.4 grain in January.

In column 29 the degree of humidity is shown; the driest months are from April to October, the value for these months varying from 37 in June to 45 in April.

In column 30 the weight of a cubic foot of air is shown; the smallest was 505 grains in July, and the largest 554 grains in January.

In column 31 are given the number of days of rain in each month; the greatest number was 8 in each of the months of March, November, and December. The total number in the year was 37. At Jerusalem rain fell on 59 days.

In column 32 the monthly fall of rain is given. The heaviest fall of rain on one day in the months from January to March was 1.16 inch, on February 13th, and the next in order were 0.77 inch, on January 25th, and 0.75 inch, on January 15th. No rain fell from March 19th till October 12th, making a period of 206 consecutive days without rain. The fall of rain on December 13th was 1.45 inch, and on the 14th 1.55 inch fell. The heaviest monthly fall in the year was 4.28 inches, in December, and the next in order 3.22 inches, in February. The total fall for the year was 15 inches. At Jerusalem the total fall for the year was 28.66 inches.

Month and Day.	Reading of		Temperature of the Dew-Point.	Temperature of the Dew-Point below Dry.
	Dry.	Wet.		
April 3 .. ..	91·0	71·0	58·6	32·4
4 .. ..	93·0	73·0	60·8	32·2
20 .. ..	91·0	66·0	50·5	40·5
21 .. ..	93·0	73·0	60·8	32·2
May 5 .. ..	85·0	65·0	51·9	33·1
6 .. ..	85·0	64·0	50·2	34·8
7 .. ..	85·0	65·0	51·9	33·1
10 .. ..	91·0	68·0	53·7	37·3
16 .. ..	92·0	66·0	49·9	42·1
17 .. ..	91·0	67·0	52·1	38·9
22 .. ..	94·0	68·0	52·4	41·6
29 .. ..	91·0	68·0	53·7	37·3
31 .. ..	93·0	70·0	56·0	37·0
June 1 .. ..	91·0	70·0	57·5	33·5
10 .. ..	97·0	75·0	62·1	34·9
11 .. ..	96·0	74·0	61·0	35·0
12 .. ..	100·0	77·0	63·9	36·1
13 .. ..	103·0	74·0	57·8	45·2
18 .. ..	105·0	80·0	66·2	38·8
21 .. ..	97·0	75·0	62·1	34·9
28 .. ..	99·0	77·0	64·3	34·7
29 .. ..	102·0	79·0	66·1	35·9
30 .. ..	99·0	77·0	64·3	34·7
July 9 .. ..	99·0	78·0	65·9	33·1
10 .. ..	100·0	79·0	67·0	33·0
Sept. 10 .. ..	94·0	73·0	60·3	33·7
11 .. ..	105·0	71·0	50·7	54·3
21 .. ..	93·0	72·0	59·2	33·8
23 .. ..	93·0	72·0	59·2	33·8
Oct. 19 .. ..	90·0	70·0	57·5	32·5
21 .. ..	92·0	71·0	58·1	33·9
22 .. ..	95·0	70·0	55·0	40·0
23 .. ..	95·0	74·0	61·4	33·6
24 .. ..	97·0	73·0	58·8	38·2
25 .. ..	95·0	70·0	55·0	40·0
26 .. ..	94·0	72·0	58·7	35·3
27 .. ..	96·0	71·0	56·2	39·8
28 .. ..	97·0	73·0	58·8	38·2
31 .. ..	94·0	72·0	58·7	35·3