*Kokstad. —Country* in grand condition. Rivers all full. The terrific hailstorm of the 7th did an immense amount of damage to gardens and fruit trees, simply knocked off all the fruit and flattened out the gardens. One farmer puts his loss in oats alone at 60,000 bundles. Six hundred panes of glasswere broken in the village. Fowls and ducks were also killed by the hailstones.

*Mount Ayliff. —The* rain of the 14th came just in time to allow the natives to plough. In a large part of this district mealies can be sown up to Christmas with a fail prospect. The outlook however is not good.

*Durban. —*Rainfallon 18 days. The total fall (396 in.) being below the average for 25 years by 0.92 in.

*Ayrshire Mine (Rhodesia). —The* natives in the district report failure of crops. The vegetable farm near here is suffering severely from drought.

*Mount Darwin (Rhodesia). —Hot,* dry weather commencement of month. The rain on the 19th, 20th and 21st just in time to *save* mealie crop in the neighbour­hood.

**REPORT OF THE METEOROLOGICAL OBSERVATIONS TAKEN AT   
KENILWORTH, KIMBERLEY, DURING THE YEAR 1902.**

*To the Secretary of the Meteorological Commission.*

SIR, —In accordance with your request I have prepared, and give below, a return of the more important meteorological observations conducted by me during the year 1902, for publication in the Annual Report of the Meteorological Commission.

The matter included in the report is divided into two parts, namely, (1) Daily Observations arranged in monthly tables, and (2) Appendices giving hourly and monthly summaries.

In the Observations, Col. 1 gives the daily readings of the Standard Barometer, reduced to 32°, at viii. The Standard Barometer is by Negretti and Zambra, No. 1,921, with a Kew verification. In this fine instrument the cistern is fixed, while the scale—which terminates in a fine zero point of ivory—is caused to slide up and down the frame by means of a rack and pinion. The inside diameter of the tube is about 01 inch. Monthly and Annual Pressure values, derived from the indications of the Standard, are given for three different hours *(i.e., at* viii., xiv., and xx.) in Appendix 2.

Column 2 of the Observations gives the mean pressure of the day derived from the hourly values measured on the Photo-barograms, beginning with midnight and ending at xxiii. The Barograph is a very good one of the usual pattern, by Negretti and Zambra. The rays from a paraffin lamp are reflected from a concave spherical mirror through a condenser, passing across the Torricellian vacuum, between the jaws of a long, vertical, narrow slit, whence a compound camera objective brings them to a focus upon a sheet of bromide paper wrapped round a rotating drum. By means of a piece of mechanism attached to the clock a shutter cuts off the light for a few minutes every two hours, forming upon the barogram a series of equidistant narrow white lines as time indicators. Temperature compensation is effected by the agency of a delicate system of zinc and glass rods so arranged as to cause the base­line of reference photographed upon the barograms to rise and fall according to the temperatures. The charts are changed every second day about xxiii., and developed and measured every one or two weeks. The hourly ordinates are measured with a metal templet to the nearest .005 inch, and are converted into approximately true pressures in inches after comparison with the regular control observations, taken three times daily, of the Standard Barometer. Ultimately, therefore, the results may be regarded *as* very nearly the same as those from hourly observations with the Standard would be. In case of any temporary failure of the photographic record, the pressures may be interpolated either from the indications of the Standard Barometer in from a Recording Aneroid by Ross, according as the failure was or was not anticipated. This supplementary aid was not required during 1902.

Appendix 1 gives the hourly mean pressures, month by month, for the year, and also the greatest and least of the mean daily pressures; the extremes of pressure appearing in Appendix 3.

The mean pressure for the year, 26.122 inches, is exceptionally small. The

total range is very nearly three-quarters of an inch.

All the barometers are mounted in an outside room of raw brick, whose walls are nearly a foot thick. It contains no window, but is well-ventilated. The diurnal range of temperature in this room is about 5°.

Columns 3 and 4 of the Observations give the respective Minimum and Maxi­mum Shade Temperatures of the day. The thermometers from which they are derived are of the standard pattern by Negretti and Zambra, and Kew verified. They are: -

Standard Maximum, No. 81, 229, mounted 5 ft. 2 in. above the ground. Index-error = -0°.1 at 32°.

Standard Minimum, No. 81,580, mounted 4 ft.9 in. above the ground. No index-error.

Standard Minimum, No. 81,592, mounted 4 ft.4 in. above the ground. No index-error.

Up to December 31st, 1902, the zero point of the Standard Maximum was not appreciably displaced.

These thermometers are mounted in a large, handsome, single-louvred wooden screen, of 8 x 8 x 8 feet, about two feet from the louvres, and so arranged, consistently with firmness and security, as to be as nearly as possible floating in free air. A board behind and below them serves to cut off possible radiation from the ground.

The lowest Shade Temperature registered was 25°.2, June 13th, following an exceptional spell of low maxima. In this spell the temperature remained below 50° for three consecutive days. This is probably a unique experience for Kimberley. There are isolated instances of maxima below 50°—one indeed below 40°—but not a previous record of three together. [See the Tables of Maximum and Minimum Temperatures at Kimberley, 1880 to 1897, at the end of this Report.] The highest temperature registered was 99°.9 December 13th. The lowest mean daily temperature, from hourly observations, was 37°.3 on June 13th; the highest was 84°.9 on December 13th. On three occasions, each in June, the mean daily temperature was less than 40°; on ten occasions, each in December, the mean daily temperature exceeded 80°. The temperature fell below freezing six times in June, four times in July, and four times in August.

Comparison observations are taken with Kew-verified Maximum and Minimum Thermometers in a Stevenson Screen (not of the latest pattern as adopted by the Royal Meteorological Society). The mean daily range of temperature in this Screen is about 1°.5 greater than it is in the Large Screen ; but there are days when the range is 5° or 6° greater. The monthly averages of Maximum and Minimum, *i.e.,*  (M + m), are very nearly the same in either Screen. The extreme range of temperature during the year in the Stevenson Screen was from 24°.2 to 100°.2.

The readings of Maximum and Minimum Temperature are taken at xxiii., and an additional reading of Minimum at viii., for the Minimum Shade Temperature of the night hours only. This last is for the purposes of comparison with the Minimum on grass. A list of such differences as have occurred during the year between the Minimum Shade Temperature for the whole day of 24 hours (xxiii. — xxiii.), and that for the night hours only, is given in Table 1. It will be useful whenever the daily values of m—m are required.

In Appendix 4 will be found the mean and extreme readings of in, M, M—m, *.,*  (M + m), and Ma. for the Large Screen.

Column 5 of the Observations gives the Mean Dry Bulb Temperature of the day, and Column 6 the Mean Wet Bulb, derived from the 24 hourly readings beginning at midnight and ending at xxiii. About two-thirds of these are from eye- observations of a Standard (including nearly all between viii. and midnight, and occasional ones between midnight and vii.); the others are obtained from the readings of two sets, of twelve each, of Negretti and Zambra’s patent Reversing Thermometers, with long, slender, cylindrical bulbs, one set mounted for Dry Bulb Observations, the other for Wet. These Thermometers are in the Large Screen; the clock regulating the apparatus is in the Barometer-house, and joined to the Thermometers by a system of wires. At each hour the clock closes an electric circuit, which, drawing back the armatures of the electro-magnets above the Thermometers (one Dry and one Wet) whose turn has come to act, releases the hooks supporting them, thus allowing the Thermometers to reverse upon their axes and register the temperatures.

Each Wet Bulb is enclosed in a sewn muslin jacket, a loose tuft of which extends below the bulb, serving to collect nearly all the incrustation which would otherwise settle upon the lower end of the bulb.

The Standard readings are taken from two Kew-verified Board of Trade Thermometers with short cylindrical bulbs, by Negretti and Zambra, the Wet Bulb in this case also having the loose tuft of muslin below the bulb. And partly for the purpose of testing whether different positions in the Screen give identical temperatures, a second Dry and Wet pair, but with spherical bulbs, by Casella, is mounted upon a different aspect. Generally speaking, the temperature inside the screen is fairly uniform between four and five feet above the ground. The most important of the occasional differences observed during the year are: —

May 26. —Standard Dry Bulb read 76°.0 at xiv.; Standard Maximum, 75°.5. September 21. —Standard Dry Bulb read 77°.2 at xiv.; Standard Maximum, 77°.2.

Control Dry and Wet Observations are secured by: —

1. A small Reversing Apparatus of one pair, with spherical bulbs, which can be set to register at any assigned hour;

2. A Richard Thermograph; and

3. A Richard Hygrograph.

Each of the two last marks a continuous record upon a drum rotating once in 24 hours. Their hourly ordinates are compared with the corresponding registrations of the Reversers for every hour at which the Standards are not read, and readings are interpolated from their records when necessary.

Such interpolation was made in the Wet Bulb readings three times during the year: —

May 26, x—xiii., = 4 hours, the muslin jacket having become defective;

June 13, ii. — vi., = 5 hours; and

July 1, vi., vii., = 2 hours, when the thermometers were frozen up.

To collect the incrustation that would otherwise settle upon the spherical Wet Bulbs two strands of wick-cotton (No. 10 “knitting ") are threaded through the lowest point of each jacket and left to hang. It is quite successful.

Columns 7 and 8 of the Observations give respectively the Daily Mean Dew Points and Humidity-percentages deduced from the simultaneous readings of Dry and Wet Bulbs by the aid of the Greenwich Factors. Appendices 6, 7, 8, 9, give respectively the hourly means of Dry Bulb, Wet Bulb, Dew Point, and Humidity, for the year.

The quantity of aqueous vapour in the air was at its maximum for the day on February 28th, the Dew Point on this day averaging 64'3'8. The highest computed Dew Point for any hour was 670'4, on the same day. The Mean Dew Point for the year was 10.3 less than for the year before. On the other hand the Relative Humidity was one per cent. greater in 1902.

Column 9 of the Observations gives the Minimum Radiation Temperature during the night hours over short grass. The Spirit Thermometer used for this purpose has a spherical bulb and is mounted upon a stand provided by the makers which raises it about three inches above the ground. Comparison observations are taken with a similar instrument resting on the grass; but these are not formally entered in the Register, although they are preserved in the Note Book. Usually the thermometer touching the grass registers much the lower temperature, particularly in winter when the top growth is dead, but occasionally, on a wet night, it may be the other way about. At the end of Appendix 4 will be found the lowest temperatures on grass for each month.

The temperature of the Thermometer lying on the grass only fell below 20° km five occasions, i.e., twice in June, twice in July, and once in August; although, even as late as November, it fell below the freezing point on two occasions, and almost to freezing once or twice besides. The relatively high minimum radiation readings (luring the winter were probably due to the great haziness of the sky. Although there was little cloud (the average for May, June, July, and August being only 16%), the skies were not so clear as usual; and evidently the quantity of matter floating in the air must have been enormous.

Column 10 of the Observations gives the Maximum Temperature in the Sun registered by a Black-bulb Thermometer in *vacuo*, mounted on a tripod about five feet above the ground.

Appendix 4 contains the monthly means and extremes of Radiation Minima, together with the mean and extreme daily ranges of m, - m; the monthly means and extremes of solar maxima, together with the mean and extreme daily ranges of S-M. The mean and extreme monthly values of temperature given by an open Maximum Black Bulb over grass also appears for the first five months of the year.

Unfortunately this instrument was maliciously broken on June 13th, and because there was not a duplicate instrument available, the record was brought to an end.

Earth Temperatures under bare sand have been observed at five different depths from one inch to six feet. The Temperatures at one inch are obtained from the readings of registering Maximum and Minimum Thermometers pushed into long horizontal copper pipes sunk beneath the surface, the axes of which are one inch deep. The results seem to be fairly trustworthy, albeit the Minimum Thermometer gives some trouble and requires careful watching. The Temperatures of deeper levels are obtained by Symons's method from slow-action Thermometers hung by chains hi vertical iron pipes.

There was not a reading of the one-inch Earth Minimum on April 21st, because the spirit column of the Thermometer had broken into bubbles. And both Maxi-mum and Minimum readings seem to have been overlooked on February 10th, so that the readings on the 11th are for the two days in one.

Four sets of readings of Earth Temperature are made daily, viz.: —

At VIII. 1 foot, 2 feet;

’’ XIV. 1 foot, 2 feet;

’’ XX. 1 foot, 2 feet, 4 feet, 6 feet;

’’ XXIII. 1 inch, maximum and minimum.

Columns 11-16 of the Observations give daily readings of Earth Temperature at one inch (Maximum and Minimum), at one and two feet read at xiv., at four end six feet read at xx. Monthly and Annual means appear in Appendix 5.

The following are the observed ranges of Earth Temperature during 1902: —

At 1 inch, from 28°.8 to 147°.1;

’’ 1 foot, ’’ 45.0 to 91.0;

’’ 2 feet, ’’ 52.1 to 84.0;

’’ 4 feet, ’’ 58.6 to 77.3;

’’ 6 feet, ’’ 61.1 to 74.9.

Column 17 of the Observations contains the daily amounts of Sunshine, in minutes, taken from the records of a Jordan Twin Hemi-cvlinder Photographic Recorder; and Column 18 contains the corresponding quantities taken from the records of a Campbell-Stokes Burning Recorder with a crown-glass bail. Both Sun-. shine Recorders are mounted together, about 40 feet above the ground, upon a bracket attached to the Anemometer Post. Their records have been interfered with to some extent in the hours of sunrise by growing trees. A temporary improvement was effected by an extensive pollarding of the trees in the middle of April.

Monthly summaries of Sunshine appear in Appendices 10 and 11. The percentages in the columns following the monthly totals show the monthly ratios of the duration of Sunshine recorded to the total amount that would be recorded on a per. feet instrument if no cloud or haze ever obscured the sky.

The Campbell-Stokes record was broken September 19-28, and again December 2r record. in consequence of the supply of cards having run out. For the purpose of making up the monthly totals, the missing values were interpolated from the Jordan Column 19 of the Observations gives the average amount of Cloud, expressed in percentages of the visible hemisphere, from observations made at viii., xi., xiv., xvii., xx., and xxiii.; the summary appearing in Appendix 10. Hourly observations of Cloud, both by eve and instrument, are much to be desired.

The routine observations of Evaporation have been continued as usual. Three instruments were in regular use: -

1. A Piche Evaporator of the usual form. It is assumed that the evaporation is equal from equal areas all over the exposed part of the paper disc above and below. The tube is graduated on the glass to equal volumes, and the factor required to reduce the scale readings to depths in inches has been computed equal to .004147. This instrument is suspended in the Large Screen.

2. An iron tub about 14 inches diameter and 18 inches deep, coated with white bath enamel inside and out, was in use until the middle of June when it was burst by the frost. It was replaced on June 28 by a much stronger galvanised iron tub of similar dimensions. The first tub was cylindrical in outline; the second. upon the advice of Mr. Gardner Williams, was made to taper slightly with the idea of offering a better resistance to the pressure of congelation. It has a tap at the bottom for the purpose of adjusting the water-surface quickly and accurately to zero. It stands alone in a single-louvred screen, whose dimensions are 46 inches long, by 34 inches wide, by 6 feet high over all. The amount of evaporation is read off twice daily at viii. and xx., from a lever which, actuated by a float, travels over a graduated dial, and magnifies the fall in level ten times.

3. A circular steel tank, rather over 46 inches diameter, and 29 inches deep, coated inside and out with bath enamel, and placed in the centre of a cemented brick cistern of about seven feet square. The walls of the cistern rise some eight inches higher than the rim of the tank. The outer cistern is kept supplied with water up to a level about equal to that of the evaporating surface of the tank, but there is no communication from one to the other. An iron pipe opens under the centre of the evaporating surface in the tank, passes through the side of the tank--to which it is secured by water-tight check nuts—onward through the wall of the cistern, and thence underground to a vertical cylindrical vessel set under the floor of the Barometer room. A large hollow copper ball floating in the cylinder carries a vertical wooden rod which is attached to one end of a light brass lever balanced upon knife edges. A pen at the other end of the lever writes a magnified record of the fluctuations in the level of the water on a long drum rotated by clockwork. Thus the records are of both evaporation and rainfall, the pen rising for the one and falling for the other. The drum and clockwork comprise the beautiful Auxanometer of the Cambridge Instrument Company; the lever, by the same makers, being especially adapted for evaporation experiments, and so arranged upon its supports that the pen presses with nearly constant force, whatever its altitude, upon the drum.

Daily amounts of Evaporation from the Tank are given in Column 20 of the Observations; the monthly summaries of hourly rates in Appendix 12. Appendix 13 gives the monthly summaries of Evaporation from the other gauges, together with the highest and lowest values observed on any day.

Appendix 14 gives the monthly totals of Rainfall in hourly values, and also the hourly frequency for the year. These values are got partly from the Raingauge, and partly from the records of the Auxanometer corrected as closely as circumstances allow to the catch of the Gauge. The hourly totals must therefore be regarded as approximate ratios. A recording Raingauge is in course of construction and should be in use before the close of 1903. I hope to be able to give a full description of it in my next report.

Column 21 of the Observations gives the daily quantities of Rainfall collected in an eight-inch M.O. Gauge whose rim is three feet above the surface of the ground. It is read at viii. and xx., the latter hour being here considered the end of a rain-day of 24 hours. The quantity .000 appearing here and there, signifies rain of too small a quantity to admit of measurement—*i.e*., something less than .005 inch.

The "Comparative Table of Rainfall" in Appendix 15, contains complete returns from the Premier, Bultfontein (two), Du Toit's Pan, De Beers, and Kimberley Mines, and also from Kenilworth. The country gauges have not yet been restarted. The Mine Gauges are "Snowdon" five-inch, and are read at VIII. The returns received from them (luring 1902 were mostly very good. The Premier results are certainly better since the removal of the flagstaff spoken of last year.

The Kenilworth return in Appendix 15 is made up as follows: -

Night Rain front XX. to VIII.:

Day Rain from VIII. to XX.;

Total Rain for days ending at XX.;

Maximum fall for days ending at XX.:

A. The number of days open which .005 inch, or more, rain fell;

B. The number of days upon which any rain fell, including falls of .000 inch.

The Kenilworth Rainfall (luring 1902 was consistently greater titan at the other rainfall stations. The greatest difference appeared in September, and was largely due to the heavy rainfall of September 16th and 17th. This fall, at Kenilworth, for the 24 hours ending VIII. September 17th was 4.52 inches, and is the largest fall in 24 hours on record.

We had the rare phenomenon of an "ink " rain on June 24th. Nearly all the rain during the winter was exceptionally dirty, probably in consequence of the great quantity of foreign matter in the air, but the fall in question was so black as to excite general comment. Concerning this rain, the report of the Government Analyst is as follows: —

6th August, 1902.

**EXAMINATION OF RAIN WATER**.

Report on the examination of three samples of Black Rain water " from Kimberley, submitted by the Civil Commissioner, under cover of his letters, Nos. 5/506-02 D (undated) and No. 5/520-02 D, dated the 24th July respectively.

The samples of water forwarded by Mr. Sutton from the Rev. P. King, Malay Camp, and Mrs. Leslie Laing were received on July 21st and 28th respectively. In both cases a light floculent sediment was obtained from the bottom of the bottles, the water above being somewhat murky. On shaking, the distribution of sediment through the liquid imparted to this a blackish colour.

On microscopic examination the sediments proved to be almost entirely of organic origin. Various plant tissues, hairs and cellcomplexes, frogspawn, and both living and dead animalculae were distinguishable in the ease of the sample obtained from Mrs. Laing. In that from the Rev. P. King, which was lighter in colour and also less in quantity, the organic matter was finer and more decomposed. A very little sand was present, showing none of the characters of volcanic dust.

Probably the peculiar character of the rain was clue either to a waterspout sucking up dirty water from a vlei, or to one of the whirlwinds so common in South Africa taking up into the upper atmosphere organic matter from the dried-up surface of a vlei or marsh which was subsequently carried down by the rain. The sample of water from the "Malay Camp" was similar in every respect to the sample from the Rev. King.

(Sgd.) J. LEWIS, M.A.,

Analyst.

The last column of the observations gives the velocity of the wind in miles per day. It is derived from the records of a Kew-pattern Robinson Anemometer whose cups are 42 feet above the ground. The recording part of this instrument was designed and made for me by Mr. W. Henderson, formerly of the De Beers Company, and is so arranged that a pen rises from zero to its highest point once for each two and a half miles of wind, writing its record upon a Richard drum. Monthly -summaries are given in Appendix 16.

The pen of the Robinson Anemometer went wrong from I. to VIII., March 10.

The missing velocity-values were interpolated, probably not very accurately from a pressure instrument.

Wind Directions and Pressures are recorded by an Osier Anemograph. For want of a duplicate anemometer occasional hours of record are lost now and then.

The greatest hourly velocity of the wind recorded during 1902 was 271 miles between XXIII. and midnight on September 11, the wind reaching a maximum pressure for the year of 8 lbs. on the square foot on the same day.

Appendix 17 contains the approximate hourly distribution of electrical phenomena for the year from eve and ear observations. The amounts given between VI. and midnight cannot be far short of completeness, but from midnight to VI. it has not always been possible to set a regular watch.

The various clocks have been kept to time by means of an Oliver's Mean-time Sundial whose indications have been reduced to the meridian of 22° E. The approximate position of the observatory is: -

Long. 24° 27' E

Lat. 28° 42' S.

Altitude, about 3,950 feet.

The arrangements for preventing any break in the records remain the same. Mrs. Sutton watches the instruments and takes necessary control observations during my absence. Mr. H. Neal maintains an acquaintance with the routine so as to take charge when required. I am responsible for all the computing and clerical work.

I have to offer very grateful thanks to Professor Cleveland Abbe, Hofrath D; Julius Hann, Dr. H. R. Mill, Mr. E. Nerill. and Sir Charles Todd, for gifts of most valuable literature during 1902.

J. R. SUTTON, M.A., F.R. Met. S.

**ERRATUM IN THE KENILWORTH REPORT FOR 1900.**

On p.69 for rainfall between XXIII. And midnight during November, substitute .007inch instead of .307 inch.

TABLE 1. – List of occasions upon which the Minimum Shade Temperature of the 24 hours ending at XXIII differed from the Minimum Shade Temperature of the 9 hours ending at VIII.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1902. | Min. in Shade | | 1902. | Min. in Shade | |
| XXIII. | Night hours only  VIII. | XXIII. | Night hours only  VIII. |
| February 21… … | 61.3 | 63.9 | Aug. 12… … | 45.8 | 55.0 |
| March 2… … | 58.4 | 59.4 | ’’ 23… … | 41.2 | 42.1 |
| ’’ 12… … | 61.1 | 66.9 | ’’ 25… … | 40.3 | 44.9 |
| ’’ 22… … | 54.2 | 56.0 | Sept. 12… … | 43.8 | 50.8 |
| ’’ 31… … | 59.6 | 63.0 | ’’ 30… … | 52.9 | 55.0 |
| April 7… … | 58.5 | 58.6 | Oct. 21… … | 59.0 | 63.9 |
| ’’ 13… … | 54.8 | 57.0 | ’’ 25… … | 49.8 | 52.6 |
| ’’ 22… … | 48.8 | 48.9 | ’’ 28… … | 51.4 | 53.6 |
| June 24… … | 43.0 | 45.0 | Nov. 13… … | 54.8 | 58.4 |
| July 4… … | 38.0 | 39.2 | Dec. 14… … | 61.0 | 68.1 |
| ’’ 24… … | 42.5 | 48.8 | ’’ 19… … | 54.1 | 63.0 |
| ’’ 26… … | 34.0 | 40.7 | ’’ 31… … | 66.9 | 67.0 |
| ’’ 29… … | 39.5 | 45.8 |  |  |  |