OUR ASTRONOMICAL COLUMN

THE DOUBLE STAR Σ 2120.—In the notes to the last catalogue of measures of double stars of the late Rev. W. R. Dawes, he remarks with reference to Σ 2120, or, as it has been frequently called, Herculis 210 (Bode): "This object discovered by Struve is undoubtedly a binary system—the position varying in a retrograde sense, and the distance diminishing." Notwithstanding this positive opinion as to physical connection of the components by so high an authority in this department of practical astronomy, an examination of the path of the companion up to the latest published measures of the Baron Dembowski towards the end of 1870, or, it should be stated, through a period of observation fifteen years longer than that upon which the above opinion was expressed, does not support the presumed binary character of the object, but on the contrary, when the apparent fixity of the principal star is considered, shows pretty decidedly that the variation of angle and distance must be owing to proper motion of the smaller one. In fact we may represent the measures, from Struve's earliest in 1829, to Dembowski's in 1870, by the following expressions :—

$$d \sin P = -1''{\cdot}6806 - 0''{\cdot}12044\ (t - 1850{\cdot}0)$$
$$d \cos P = +1{\cdot}7259 - 0{\cdot}10250\ (t - 1850{\cdot}0)$$

which formulæ imply a secular proper motion of the small star amounting to 14″·75 in the direction 226°·0; they may doubtless be somewhat improved by complete discussion of all the measures, and perhaps some one of the astronomical readers of NATURE may be able to say how measures in the present year are represented.

D'Agelet, Bessel, and Struve have meridionally observed this star.

THE "MIRK-MONDAY" ECLIPSE, 1652, APRIL 7-8.—The following elements of this long-remembered eclipse are founded upon the same system of calculation which furnished so satisfactory an agreement between computation and observation in the eclipse of 1715, lately detailed in NATURE :—

Conjunction in R.A. April 7, at 23h. 4m. 33s. G.M.T.

R.A.	17	42	14
Moon's hourly motion in R.A.		33	0
Sun's ,, ,, ...		2	18
Moon's declination	8	24	17 N.
Sun's ,, ...	7	31	40 N.
Moon's hourly motion in Decl.		17	5 N.
Sun's ,, ,, ...		0	56 N.
Moon's horizontal parallax		60	16
Sun's ,, ...			9
Moon's true semidiameter		16	25
Sun's ,, ...		15	57

The sidereal time at mean noon April 8 was 1h. 9m. 20s., and the equation of time 1m. 38s. subtractive from mean time. The middle of general eclipse April 7, at 22h. 21m. 30s.

Hence the following points upon the central line in its track over the north of Ireland and Scotland :—

Long. 8° 25′ W.,	Lat. 50° 21′ N.	Long. 4° 8′ W.,	Lat. 55° 3′ N.
,, 7 50	51 0	,, 2 47	,, 56 28
,, 6 3	53 0	,, 1 20	,, 57 54
,, 5 26	53 42		

At Carrickfergus, where Dr. Wyberd observed the eclipse as described in the "Philosophical Transactions," totality began at 22h. 8m. 34s. according to the above elements, and continued only forty-four seconds. At Edinburgh it commenced at 22h. 22m. 55s., the duration being 2m. 47s. with the sun at an altitude of 39°; and at Arbroath at 22h. 26m. 23s. with the same duration, these being local mean times. Probably there may be other accounts of this eclipse in existence than those commonly quoted when "Mirk Monanday" is referred to.

DIAMETERS OF THE PLANETS.—We give the following values of the apparent diameters of planets reduced to the mean distance of the earth from the sun and of their true diameters in English miles, as being perhaps as reliable as any that can be assigned from existing data. They are founded in every case upon the measures which from observational circumstances appear to deserve the greatest weight, and in the reduction to true values the solar parallax is taken 8″·875, and Clarke's diameter of the earth's equator is adopted. It would of course be idle to attempt to offer final numbers, where the difficulties attending observations and the differences between the results of the most experienced and favourably-circumstanced observers are so considerable.

	″	Miles.	
Mercury	6·35	2,850	
Venus	16·95	7,550	
Mars	9·305	4,150	
Jupiter, Equat.	197·47	88,200	Compression $\frac{1}{15{\cdot}54}$
,, Polar	184·76	82,500	
Saturn, Equat.	166·82	74,500	Compression $\frac{1}{9{\cdot}10}$
,, Polar	148·50	66,300	
Uranus	68·57	30,600	
Neptune	67·26	30,050	

In fixing upon the apparent diameters of the bright planets it has been desired to adopt values which shall represent the actual arc values that are presented by the true diameters at the earth's mean distance. Many observations would assign larger values, but undoubtedly less trustworthy for computing real dimensions. As is well known, preference in such case is to be given to double-image over wire-micrometer measures, yet even if we confine ourselves to the former mode of observation we by no means secure great consistency of results.

SOLAR HEAT AND SUN-SPOTS

THAT the rainfall of certain parts of the earth tends to vary periodically with the sun-spots has been shown with considerable probability by Messrs. Meldrum and Lockyer, and Prof. Köppen * has detected a similar tendency in the temperature of the atmosphere, most distinctly shown (as might have been anticipated) at stations in the tropical zone.† These discoveries indicate that there is at least some ground for the truth of Sir W. Herschel's surmise, that the heat emitted by the sun undergoes a periodical increase and decrease, concurrently with the varying disturbance of the solar atmosphere, as evidenced by the number of spots and prominences on his surface. But except Mr. Joseph Baxendell, who has published two papers on the subject in the fourth volume of the Transactions of the Literary and Philosophical Society of Manchester (new series), I am not aware that anyone has attempted to investigate the more direct evidence afforded by observations of the black-bulb thermometer.

Mr. Baxendell's work was based on the observations of the Radcliffe Observatory at Oxford, and a series made at Eccles by Mr. Mackereth; the two series extending over the years 1859-66. He did not attempt to institute a direct comparison of the recorded radiation temperatures with the number of the sun's spots, a proceeding which would probably have failed to lead to any definite result in English latitudes and in so cloudy a climate; but took as the first term of his comparison the ratio existing between the excess of the maximum radiation over the maximum air-temperature in the shade, and that of the mean air-temperature over that of the wet bulb, or the dew point deduced therefrom. His conclusion was to the effect that the sun's heat undergoes a distinct periodical variation, coinciding with and directly as that of the spots.

* Zeitschrift der Oesterr. Gesellschaft für Meteorologie. Vol. viii. Nos. 16 and 17.

† It is to be noticed as a remarkable fact that Prof. Köppen finds the epochs of maximum and minimum temperature to correspond (not as might be expected from the results of the present investigation with the maxima and minima of sun-spots respectively), but approximately with the opposite phases; the *maximum* of temperature (in the tropics) preceding the *minimum* of the sun-spots by 0·9 of a year, and the minimum of the former the maximum of the latter by 0·1 year.

It is evident that India offers far greater advantages for investigating the variations of the solar heat than any European country can do, and as observations of the black-bulb thermometer *in vacuo* have now been registered at several stations during the last six or seven years, I have lately examined a portion of these, to see if they afford any direct evidence of a periodical graduated variation in the intensity of the radiation. The result is to me very striking, and if not absolutely conclusive as to the direct variation of the sun's heat with the number of the spots and prominences, certainly, as far as it goes, strongly confirms Mr. Baxendell's conclusions, drawn from indirect evidence.

It is unfortunate that owing to the fragility of the instruments employed and the necessity of exposing them freely, they are very frequently broken; and, as a consequence, the longest series of observations made with one and the same instrument extends over only five years. This is at Silchar in Eastern Bengal. The place is situated in lat. 25°, therefore beyond the tropic; and the climate being very damp and more cloudy than most parts of Bengal, it is not, perhaps, so favourably circumstanced for the present purpose as some other stations.

The means of the maximum sun-temperatures registered on clear days (that is, on days when the proportion of clear sky estimated at 10 A.M. and 4 P.M. did not average less than three-fifths) are given in the following table. The months of the S.W. monsoon are omitted, since in some cases they do not furnish a single clear day according to the above definition, and as a rule such days are too rare to contribute much evidence of value. I give for each month the number of clear days that have contributed to the mean.

TABLE I.—*Average maximum temperature of solar radiation on clear days at Silchar.*

	Days.	1870	Days.	1871	Days.	1872	Days.	1873	Days.	1874
January . .	24	124·8	25	127·1	27	122	21	121	19	121
February .	19	130·4	20	130·9	20	125·8	19	128·2	8	128·2
March . .	15	137·2	19	135·7	23	133·8	17	132·4	10	134·3
April . . .	12	142·6	17	139·1	13	140·5	12	134·5	5	139·8
May . . .	10	144·7	15	142·8	14	143·8	5	140·6	6	146·5
October . .	16	140·7	19	136·7	9	141·3	7	140	5	146·4
November .	23	132·2	27	126·3	15	131·7	20	127·7	10	143·1
December .	29	124·7	25	121·3	18	121·5	23	121·2	14	136·7
Year . .	148	134·6	167	132·5	139	132·5	124	130·7	77	137

Did this table stand alone, the evidence of any periodical variation would be very doubtful. But we shall presently see that the irregularities that it exhibits are all but completely neutralised by the registers of other stations. It is easy to suggest their explanation, grounded on the fact to which all the registers testify, that the highest sun-temperatures occur, not on days registered as cloudless, but on those on which there is a considerable proportion of cloud, and frequently rain. Such days were numerous in 1874; while in 1871 (the year of sun-spot maximum) days without visible cloud predominated. Leaving the discussion of this question, however, as unnecessary in this place, I will give the combined results of Silchar and eight other Observatories variously situated, some in, and others beyond the tropical zone. These are:—

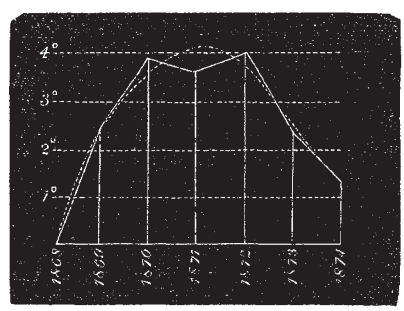
Port Blair, in the Andamans	lat.	11°	41′ N.
Cuttack, in Orissa	,,	20	29 ,,
Chittagong, on the Arakan coast ...	,,	21	39 ,,
Jessore, on the Gangetic delta ...	,,	23	9 ,,
Dacca, also on the delta	,,	23	43 ,,
Hazaribagh,* elev. 2,000 ft. in Western Bengal	,,	24	0 ,,
Berhampore,* on the Gangetic delta ...	,,	24	6 ,,
Roorkee, elev. 900 ft. in the N.W. Prov.	,,	29	52 ,,

Since the radiation-thermometers originally in use at most of these stations have been broken and replaced by other instruments, and since these thermometers (furnished by the best London makers) sometimes differ to the extent of many degrees when placed under the same conditions of exposure, it would be only misleading to compare together the registers of different years recorded with different instruments at the same station. In order to avoid this source of error, and at the same time to bring in evidence as much as possible of the registers, I have taken for each station separately the difference (rise or fall indicated respectively by + and −) of each pair of homonymous months in consecutive years, omitting all cases in which the instrument has been changed in the interval; and then the mean of all the differences thus obtained for the same pair of months. The results are given in the following table, additional columns being added to show how many stations have contributed to the mean of each pair of months. As in Table I., the mean temperatures compared are those of clear days only; but with the exception of Port Blair, I have admitted as clear days those only on which at least four-fifths of the sky on an average was estimated as unclouded at 10 A.M. and 4 P.M. In the case of Port Blair it was necessary to admit days with only one half of unclouded sky.*

TABLE II.—*Annual variation of mean maximum readings of black-bulb thermometers on clear days.*

	Station.	1868 1869	Station.	1869 1870	Station.	1870 1871	Station.	1871 1872	Station.	1872 1873	Station.	1873 1874
January .	2	− 0·9	3	+ 0·5	4	+ 0·4	6	− 3·7	4	+ 0·4	8	− 5·3
February .	2	+ 1·9	3	− 1·5	4	+ 0·6	6	− 3·6	4	+ 2·1	8	− 3·6
March . .	2	+ 3·8	3	+ 1·2	4	+ 2·6	6	− 2·4	5	− 0·7	8	− 1·7
April . . .	2	+ 7·1	3	+ 1·5	7	− 0·5	5	+ 0·7	6	− 2·6	8	− 0·2
May . . .	1	+ 14·2	3	+ 0·9	7	− 1·9	4	+ 2·6	7	− 0·7	8	− 2·5
October . .	2	− 4·3	3	+ 8·2	6	− 1·5	4	+ 4·0	8	− 4·7	8	+ 2·7
November .	3	− 2·7	4	+ 0·4	6	− 0·6	4	+ 3·5	8	− 3·6	8	+ 0·8
December .	3	− 1·0	4	+ 1·8	6	− 1·3	4	+ 2·2	8	− 2·9	8	+ 0·9
Year . .		+ 2·3		+ 1·6		− 0·3		+ 0·4		− 1·6		− 1·1

If these differences be plotted as the increments of a series of ordinates, and the curve thus marked out be corrected for its small irregularities *liberâ manu*, its resemblance in general character to the sun-spot curve will be distinctly apparent. (See figure.)



I have been unable to ascertain (here in Calcutta) the number of spots observed during the last few years; but this datum can readily be supplied at home.

Calcutta, May 28 HENRY F. BLANFORD

LECTURES AT THE ZOOLOGICAL GARDENS†

VIII.

Mr. Sclater on the Pheasants.

IN that Birds possess a high temperature of the blood, they agree more with the mammalian than with other vertebrated animals; the balance of anatomical evidence

* The registers of these two stations taken alone give a curve nearly approximating to the resultant of all the stations, but it is of doubtful validity owing to the thermometers having been twice renewed at both stations.

* I have ascertained by direct comparison that any difference thus introduced is inappreciable, the results being treated comparatively, and not for absolute values.

† Continued from p. 139.