III. *Observation of the Summer Solstice, 1812, at the Royal Observatory.* *By* John Pond, *Esq. Astronomer Royal, F. R. S.*

Read November 12, 1812.

As it is intended that a minute description of the mural circle lately erected at the Royal Observatory, when completely finished, shall be laid before the Royal Society, I think it unnecessary to accompany this communication with any other remarks on its construction, than such as are absolutely necessary to render the annexed observations intelligible; being only anxious to take an early opportunity of transmitting the result of the observations of the sun, made at the last summer solstice. For, notwithstanding the instrument was at that time in a very unfinished and imperfect state, I have reason to think, that the observations made with it were much more exact than could have been made with any other instrument hitherto constructed: the uncertainty of the result, as far as the instrument itself is concerned, does not, I believe, exceed a small fraction of a second; but I think it necessary to offer a few remarks on the elements of the computation, by which the result is obtained.

The distance of the sun from the pole at the moment of the solstice, may either be considered as a simple arc, or as composed of two others, namely, the distance of the sun from the zenith, and the distance of the zenith from the pole. From the construction of instruments which take their point of departure from the position of a plumb-line or level, it is a general

method to measure these two arcs separately; that is to say, the zenith distance of the sun is considered as the immediate object of investigation, and the remaining arc, or as it is usually termed, the co-latitude of the place, (the knowledge of which is presumed) is added to complete the polar distance. But in whatever way we consider the subject, it is evident that the sole object of the practical astronomer is to obtain by some mechanical means the measure of this total arc.

The mural circle at Greenwich has neither level nor plumb-line, nor do I conceive that the least advantage could be derived from the application of either: its principle enables the observer to determine this total arc without any intermediate or zenith point, hence the co-latitude, the knowledge of which is so essential from the construction of other instruments, is in this case rather a question of curiosity than of absolute necessity.

I find it, however, convenient (for reasons which I hope to have an opportunity of stating more at large in a future Paper) to assume an intermediate point, which I call the zenith point, without being at all anxious to know whether it is really so or not; because I find myself possessed of the means of determining the position of this *imaginary* point of departure, on the instrument, to within the tenth of a second, a degree of precision, which I apprehend no level or plumb-line can ever be expected to equal.

From this point of departure, I measure the distance of the sun to the southward, and of the pole to the northward, and the sum of these two measures is evidently the north polar distance of the sun, which in every method is the ultimate object to be attained.

I have, as an example, annexed a computation of the same

solstice obtained by direct measurement, from the pole, without the aid of the intermediate point above mentioned; and it will be seen that the results do not in this case differ above a quarter of a second from each other.

There is indeed no other difference between these two methods but that, in the former case, the part of the arc Z P is obtained rather more accurately, by a great number of observations both before and after the solstice, than could be done in the short interval of time in which the solstice itself is observed.

By sixty observations of γ draconis, of which only three differ so much as $1''$ from the mean, it appears that the zenith point which I have assumed is $2'$, $18'',64$, south of the mean position of γ draconis for the beginning of the year 1812, which is the same quantity that is found by the observations with the zenith sector, 1811.

Mr. TROUGHTON is now occupied in making a zenith sector upon a new and very simple principle, with which I have no doubt that this distance may be determined with a much greater degree of precision.

Astronomers will immediately perceive that this arc, however accurately it may be mechanically determined, must inevitably be subject to whatever uncertainty still exists upon the question of astronomical refractions; the instrument not having been erected long enough to remove this uncertainty, I have for the present employed Dr. BRADLEY's refractions, such as they have been used for many years in this Observatory. Such alterations in this part of the calculation may easily be made in future, as the advanced state of the science may require.

1812	Bar.	Ther. in.	Ther out.	Ref.		Observations as given by the Instrument.	Position of the Zero Point, or Equation, to be applied to obtain the apparent N. P. D.	Equation to reduce the observed N. P. D to Zenith distance, or Position of Zenith Point on the Circle.	Semi-diameter of ⊙ 1″ greater than in the Nautical Almanack.	Reduction to the Solstice.	Solstitial Zenith. Distance with Parallax.	N. P. D. deduced by direct measurement from Polaris.
June				′ ″								
12	29,94	64	70	0,30,3	⊙ UL	66,33,33,0	12,95	38,31,34,10	15,47,2	0,17,15,4	28, 1, 1,0	66,32,21,4
14	29,76	63	71	0,29,4	⊙ UL	66,26,48,5	12,95	34,10	15,47,2	10,32,4	0,58,6	18,9
18	29,77	58	62	0,29,6	⊙ UL	66,18,20.2	12,95	34,10	15,46,8	2, 2,6	0,59,9	20,2
19	29,31	59	61	0,29 7	⊙ LL	66,48,44,6	10,04	38,31,31,20	15,46,8	0,57,0	0,59,3	19,9
20	29,28	57	60½	0,29,2	⊙ UL	66,16,31,4	10,04	31,20	15,46,8	0,16,3	0,59,9	20,5
23	29,78	56	61	0,30,4	⊙ LL	66,48,43,5	23,59	38,31,44,74	15,46,6	0,42,7	0,59,7	21,3
24	29,88	58	62	0,29,8	⊙ UL	66,18,11,3	23,59	44,74	15,46,6	1,41,1	1, 1,9	23,3
25	29,86	58	65	0,30,4	⊙ LL	66,51, 5,5	23,59	44,74	15,46,6	3, 4,2	1, 0,4	21,8
27	29,81	56	58	0,29,7	⊙ UL	66,23,33,5	23,59	44,74	15,46,6	7, 4,4	1, 0,7	22,0
28	29,78	54	54	0,30,7	⊙ LL	66,57,41,5	23,59	44,74	15,46,6	9,41,4	0,59,5	20,8
29	30,05	58	64	0,30,1	⊙ UL	66,29,11,4	23,59	44,74	15,46,6	12,43,0	1, 0,2	21,7
30	29,90	58	63	0,30,7	⊙ LL	67, 4, 9,5	23,59	44,74	15,46,6	16, 8,9	1, 0,1	21,4

Mean of 12 Observations	28, 1, 0,10	66,32,21,10
Nutation—8″, 4 Parallax 4″,0	— 12,40	— 12,40
	28, 0,47,70	
Z. P. determined by 30 observations of Polaris above, and 30 below	38,31,21,15	
Z. P + ⊙ Z or N. P. D.	66,32, 8,85	66,32, 8,70
Solsticial Declination	23,27,51,15	23,27,51,30
Correction for ⊙'s Latitude	+, 0,95	+, 0,95
Mean Obliquity at Summer Solstice	23,27,52,10	23,27,52,25

Subsequent observations gave the arc Z. P. rather greater than here assumed; but as I attribute this to a change in the refraction arising from a colder temperature, I take the arc as it was measured at the Summer Solstice.

This result may at any future time be rendered more accurate, if it should be found that the arc Z. P. has not been rightly determined; and in this consists the great advantage of the intermediate point Z., that the arc P. Z. may be determined more and more accurately, almost without limit, the only unalterable error resting on the determination of ⊙ Z.