*On the Horary Oscillations of the Barometer near Edinburgh,
deduced from 4410 Observations ; with an Inquiry into the
Law of Geographical Distribution of the Phenomenon. By
JAMES D. FORBES, Esq. F.R.S.E.*

(Read 4th April 1831.)

1. **T**HE science of Meteorology must be ranked, at the present moment, among the most rising branches of natural knowledge. The transition from the hasty generalization which always marks the embryo state of science, to the application of sober inductive analysis, is one so important, and so truly interesting, as to repay amply the philosophical abstinence which it imposes. No more important lesson, indeed, can be learned, than from the very examples of crude speculation, which, for centuries, the progress of this subject has afforded among the multitudes whose scientific acquirements are limited to the art of consulting a weather-glass, or registering a thermometer, little imagining that the very science they affect to cultivate, ranks among its phenomena the interwoven effects of remote and recondite causes,—a science which, to use the words of Mr HERSCHEL, is “ one of the most complicated and difficult, but, at the same time, interesting subjects of physical research : one, however, which has of late begun to be studied with a diligence which promises the speedy disclosure of relations and laws, of which, at present, we can form but a very imperfect notion.”

2. One of the most important features of recent improvement in the mode of studying the group of facts which meteorology

presents to us, is the analytical method of discussing observations, extracting, as it were, from the data which nature presents to us, laws which shall best represent them, instead of framing clumsy hypotheses, to which it became a secondary object, to apply the facts. No better example of the method can be given, than HUMBOLDT's masterly essay on Isothermal Lines ; and the same distinguished traveller was the first who threw into anything like lucid order, the class of phenomena which it is the object of this paper to discuss,—the Horary Oscillations of the Barometer.

3. These atmospheric tides were first discovered in a decisive manner at Surinam, in 1722, by a Dutch philosopher, whose name has not descended to us ; and the history of their subsequent development is too well known to require even an abstract in this place. It has been reserved for the nineteenth century to ascertain almost every thing connected with them besides their bare existence, and even that was not established in the temperate zone previous to the observations of RAMOND, little more than twenty years since. But it was reserved for HUMBOLDT, after much practical labour in the first years of the century, to draw up the admirable analysis of the subject which appeared in the third volume of the "*Relation Historique*," published in 1825. From that time a new impulse was given to the labours of observers ; and during the last five years many important registers have thrown light upon the modification which the barometric oscillation undergoes in different latitudes, and at various heights above the sea. The subject had always appeared to me one of singular interest, and accidental circumstances first induced me to prosecute it experimentally, during some months' stay at Rome in the spring of 1827. The period was very short, but as I frequently made from twelve to fifteen observations in a day, I was enabled, very satisfactorily, to trace the variation from hour to hour, and to ascertain the periods of maximum and minimum, though too brief to determine the amount accurately, which came

out, in all probability considerably too small *. On my return to Scotland in autumn of the same year, I resolved to institute immediately a series of observations in Latitude 56° , a more northerly station than any at which observations have, as far as I know, yet been made for this purpose, excepting those of Captain Sir EDWARD PARRY. These I have pursued almost without intermission, up to the close of 1830 ; and when it is recollected how rare observations, sufficiently long continued, have been in the higher latitudes, and especially how trivial have been the donations of Great Britain to this branch of meteorology, I hope that, with all the defects inseparable from the efforts of a solitary observer, the results of this inquiry, placed in the form of Tables at the end of this paper, and the deductions from which I am now about to give in words, may not be unacceptable to the Society.

4. These observations, amounting in all to 4410 in number, comprised between the years 1827 and 1830, were made at Colinton House, four miles south-west of Edinburgh, in Latitude $55^{\circ} 55' 20''$ N., and Longitude $12^{\text{m}} 57^{\text{s}}.5$ west of Greenwich, deduced trigonometrically from the Calton Hill Observatory, and at 410.5 feet above the mean level of the sea, determined by accurate levelling. Four months observations, however, at the commencement of 1828, were made in Edinburgh, but reduced to the same level of 410.5 feet, in order to prevent their affecting the mean absolute height. Five observations were made daily of the barometer and attached thermometer, from 8 to $8\frac{1}{2}$ A. M., at 10 A. M., about 4 P. M., and at 8 and 10 P. M. ; in order to detect the morning and evening maximum, and afternoon minimum. The same instrument has not been used throughout these observations. For the greater part of the last two years, however, I have used a barometer in which I put great confidence, the mercury having been boiled in the tube by my-

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* A full account of these observations was published in the *Edinburgh Journal of Science* for January and April 1828.

self with every precaution, and with every part of which I am thoroughly acquainted. It is of the mountain construction, has an adjustable level, and attached thermometer, and requires no correction for capillarity. Though the other barometers were not so unexceptionable, they were both furnished with attached thermometers, and one was on the mountain construction; indeed the nature of the deductions which I have to make being entirely confined to *differences*, without regard to absolute height, the nicety of the instrument is of little importance, considering the great number of observations required to be combined, in order to obtain any trust-worthy result. Any constant cause, rendering the height of the mercurial column at one hour of the day different from that at another, independent of the atmospheric tide, must be sedulously guarded against; but there is nothing worth mentioning which can produce this effect, except change of temperature. The attached thermometer must therefore be considered a *sine qua non*. The corrections on this account are applied to the monthly means; and the table I have employed is that of Professor SCHUMACHER: it may safely be affirmed, that, with rare exceptions, the tables commonly employed in this country are more or less erroneous, and some very strikingly so. The whole of the observations are thus reduced to 32° FAHR. I may also add, what is by no means unimportant, that with hardly any exceptions (amounting to not above a few dozens in all), the whole of these 4410 observations were made personally by myself.

5. In the numerical reduction of the observations, I experienced a very harassing difficulty. The omissions at particular hours, which could not fail to occur occasionally, in the attempt of an individual to register the barometer five times a-day for so long a period, where they happened during extreme states of pressure, would, it is easy to see, materially affect the monthly means; and although the reduction was continued in the hope that the combination of a sufficient number of months would destroy the irregularity, it became obvious, that any attempt to

draw more delicate conclusions, such as the influence of the seasons, would be vain ; and, finally, I was led to distrust the accuracy of even the general result. Under this impression, I resolved to repeat the whole reductions upon a plan which I had previously employed with success, and which has fully answered my expectations. As the great object was to avoid the inequality of absolute height, which might vary indefinitely on different days, and preserve only the differences corresponding to different hours, I selected one time of day at which the barometer was most regularly observed, and, under the columns corresponding to the other hours, inserted the differences as they were + or — of the barometer and attached thermometer, from the heights at the standard hour inserted in the first column, and the means for each month of the principal column and the subsidiary ones being taken, the corrections (total or partial respectively) for temperature were applied, from which mean results a new set of absolute heights might be deduced. By far the greater deviations from the mean, on the account above alluded to, were thus avoided, and though particular omissions no doubt affected the partial means, the errors were greatly smaller in amount. As this simple artifice is not, I believe, generally adopted, and as it seems greatly preferable to the employment of interpolation which must frequently be guessed at, and always open a door to the practice of admitting hypothetical numbers on the same footing with observed ones, I think it worth while to give a practical example of the mode I pursued, and the forms of my Tables. The normal hour employed was 10 P. M., at which time the observations appear to have been been most regularly made ; and it is surprising how few observations I was obliged to discard for want of this standard of comparison. I have selected the Tables for June 1828, in which 18 observations out of 150 were wanting, the first reduction of which, by the method of simple means, gives the oscillation from 10 A. M. to 4 P. M. in the wrong direction, which is again restored by the application of the second method I employed, shewn on the opposite page.

JUNE 1828,—132 OBS.

Day.	8-8½ A. M.		10 A. M.		4 ± P. M.		8 P. M.		10 P. M.	
	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.
	Inches.		Inches.		Inches.		Inches.		Inches.	
1	27.394	67°			29.454	70°	29.440	65°	29.394	67°
2	29.200	67	29.224	68	29.290	63			29.374	64
3	29.400	64	29.400	65	29.216	65	29.162	65	29.096	65
4	29.058	67	29.020	70			28.810		28.844	64
5	28.956		28.986	67			29.084	64	29.114	63
6	29.168	64	29.180	64	29.326	64	29.384	62	29.428	62
7	29.628	60	29.620	65	29.658	64	29.676	64	29.700	62
8*	29.764	63	29.768	64	29.784	66	29.808	62	29.830	64
9	29.830	65	29.818	66			29.780	65	29.794	64
10	29.810	67	29.814	68			29.750	62	29.728	64
11	29.780	67	29.774	68	29.770	64	29.762	62	29.794	64
12	29.818	66	29.832	68	29.834	66			29.870	64
13	29.856	67	29.828	66	29.864	65	29.884	65	29.894	63
14	29.950	67	29.956	65	29.948	62			29.946	57
15	29.898	60	29.894	60	29.820	60	29.800	60	29.798	59
16	29.710	60	29.700	61	29.642	63	29.562	62	29.612	62
17	29.484	60			29.330	60	29.296	59	29.280	61
18	29.222	61	29.286	65					29.300	62
19	29.340	64	29.352	65	29.384	65	29.404	64	29.434	63
20	29.478	66	29.470	67	29.450	65	29.430	64	29.444	63
21	29.428	65	29.428	67					29.378	64
22			29.484	68	29.530	68	29.582	66	29.606	66
23	29.732	64	29.750	64	29.784	65	29.796	65	29.818	64
24	29.886	68	29.888	70	29.870	70	29.894	68	29.900	67
25			29.834	71	29.800	68	29.802	67	29.808	67
26	29.872	70	29.876	70	29.872	69	29.856	68	29.850	67
27	29.850	70	29.850	70	29.800	71	29.794	68	29.794	66
28							29.750	68	29.750	66
29	29.730	66	29.734	66	29.704	66	29.716	64	29.728	64
30	29.700	64	29.698	66	29.616	68	29.592	62	29.590	64
Sum, ...	798.942	1689	799.464	1794	681.746	1507	739.814	1541	887.896	1912
Mean, ...	29.5904	65.0	29.6098	66.5	29.6411	65.5	29.5926	64.2	29.5965	63.7
Cistern } Level, } Temp....	+ .0033		+ .0039		+ .0048		+ .0034		+ .0035	
	— .0974		— .1018		— .0990		— .0951		— .0937	
	29.4963		29.5119		29.5469		29.5009		29.5063	

The barometer employed at this time not being on the syphon construction, required a correction for the capacity of the cistern. The dashes in the columns of the following Table indicate a difference from the standard number equal to zero.

JUNE 1828,—132 OBS.

Day.	10 P. M.		8 — 8½ A. M.				10 A. M.				4 + P. M.				8 P. M.			
	Barom.	Ther.	Barometer.		Ther.		Barometer.		Ther.		Barometer.		Ther.		Barometer.		Ther.	
	Inches.	°	+	—	+	—	+	—	+	—	+	—	+	—	+	—	+	—
1	29.394	67									.060		3		.046			2
2	29.374	64		.174	3			.150	4			.084		1				
3	29.096	65	.304			1	.304				.120				.066			
4	28.844	64	.214		3		.176		6							.034		
5	29.114	63		.158				.128	4							.030	1	
6	29.428	62		.260	2			.248	2			.102	2			.044		
7	29.700	62		.072		2		.080	3			.042	2			.024	2	
8	29.830	64		.066		1		.062				.046	2			.022		2
9	29.794	64	.036		1		.024		2							.014	1	
10	29.728	64	.082		3		.086		4						.022			2
11	29.794	64		.014	3			.020	4			.024				.032		2
12	29.870	64		.052	2			.038	4			.036	2					
13	29.894	63		.038	4			.066	3			.030	2			.010	2	
14	29.946	57	.004		10		.010		8		.002		5					
15	29.798	59	.100		1		.096		1		.022		1		.002		1	
16	29.612	62	.098			2	.038			1	.030		1			.050		
17	29.280	61	.204			1					.050			1	.016			2
18	29.300	62		.078		1		.014	3									
19	29.434	63		.094	1			.082	2			.050	2			.030	1	
20	29.444	63	.034		3		.026		4		.006		2			.014	1	
21	29.378	64	.050		1		.050		3									
22	29.606	66						.122	2			.076	2			.024		
23	29.818	64		.086				.068				.034	1			.022	1	
24	29.900	67		.014	1			.012	3			.030	3			.006	1	
25	29.808	67					.026		4			.008	1			.006		
26	29.850	67	.022		3		.026		3		.022		2		.006		1	
27	29.794	66	.056		4		.056		4		.006		5				2	
28	29.750	66															2	
29	29.728	64	.002		2		.006		2			.024	2			.012		
30	29.590	64	.110				.108		2		.026		4		.002			2
Sum, ...	887.896	1912	+ .210		+ 39		— .008		+ 76		— .242		+ 42		— .214		+ 4	
Mean, ...	29.5965	63.7	+ .0078		+ 1.5		— .0002		+ 2.8		— .0105		+ 1.8		— .0086		+ 1.6	
Cistern } Level, } Temp....	+ .0035		+ .0002				.0000				— .0003				— .0002			
	— .0937		— .0044				— .0082				— .0053				— .0047			
	29.5063		+ .0036				— .0084				— .0161				— .0135			
			29.5099		65.2		29.4979		60.9		29.4902		65.5		29.4928		65.3	

The general results of the monthly means fully justified my expectations. The extent of the deviations on both sides, from the mean oscillation given by the monthly results, was greatly diminished, and likewise the number of times which the oscillation came out *negative*, or in the wrong direction.

6. By consulting Tables I, II, III, and IV, at the end of this Memoir, the partial means of each month during which observations were made will be found for the years 1827, 1828, 1829, and 1830. As there cannot be a doubt that the seasons produce a very sensible effect on the amount of the oscillation, I prefer deducing the general result from the mean of the different seasons, which are contained in the four following Tables, the absolute numbers being *restored* from the data of the previous ones. The following are the general means, the spring period being understood to include March, April, May; summer, June, July, August; autumn, September, October, November; and winter, December, January, February.

SEASONS.	Number of Obs.	8 A. M.	10 A. M.	4 P. M.	8 P. M.	10 P. M.
Spring,	1159	29.3651	29.3589	29.3438	29.3618	29.3640
Summer,	977	29.3896	29.3820	29.3715	29.3812	29.3866
Autumn,	1107	29.4378	29.4422	29.4286	29.4360	29.4312
Winter,	1167	29.4386	29.4447	29.4416	29.4447	29.4425
Sum,	4410	117.6311	117.6278	117.5855	117.6237	117.6243
Mean,		29.4078	29.4070	29.3964	29.4059	29.4061

It thence appears that the principal oscillation from the first morning observation to the afternoon one, amounts to — .0114 inch; that from the afternoon to the second evening one, to + .0097: the ratio is 1 : 1.18, which is considerably less than the best observations give for the south of Europe. In the north we have no data of comparison, since, as far as I know, no register capable of affording satisfactory results for the evening maximum has

ever been kept in any part of Britain*. In the comparisons I am about to institute with the observations made in other parts of the world, I shall adopt the oscillation between 10 and 4, or — .0106 inch, since this agrees nearly with the usual hours of observation, as it has rarely happened that meteorologists have taken the trouble to observe the barometer at two periods near one another. The amount just named exceeds somewhat the oscillation observed by SOMMER at Königsberg, in Latitude $54^{\circ} 42'$, which has hitherto been referred to as the solitary result from northern Europe†. We shall afterwards see that the amount I have assigned agrees much more closely with the strict analogy of other observations in more southern latitudes. Besides, the hour at which the afternoon minimum was observed by SOMMER was much too early in all probability, being part of the time at 2 P. M., and the remainder at 3 P. M. The hour in temperate climates is probably later than is generally assigned: nor does it add much to our confidence in the results, that BESSEL informs us, that “notwithstanding the minuteness of the amount, it is recognised in each *annual* mean‡,” when in my tables it is eliminated in 28 out of 38 *monthly* means, notwithstanding its extreme minuteness in winter. In London, where the amount is more than twice as great as here, and the observations are made only twice a-day, but with such regularity as to avoid the necessity of any artifice for correcting omissions, I find the oscillation detected in 46 monthly means out of 48 §; and at Paris, in every one of 132 months ||, the amount there being nearly three times that at Edinburgh.

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* I do not except Mr DANIELL's Observations for reasons assigned below, §. 9.

† HUMBOLDT, *Relation Historique*, 4to edition, tom. iii. p. 306.

‡ *Astronomische Nachrichten*, 1823, No. 26.

§ *Philosophical Transactions* for 1827, &c.

|| See M. BOUVARD's Memoir in the *Memoires de l'Institut* for 1824.

7. The influence of the seasons upon the horary oscillation is an important inquiry ; and considerable uncertainty prevails in the best observations. With regard to the *hour*, we find the duration both of the morning and evening oscillation is greater in spring and summer than in autumn and winter ; 8 or half-past 8 A. M. and 10 P. M. being the critical hours at the former period, and 10 A. M. and 8 P. M. at the latter. With regard to the variable amount, if we take advantage of the double hours of observation, and select the actual maxima, we shall find the following amounts of oscillation :

SEASONS.	MORNING PERIOD.		EVENING PERIOD.	
	Hour.	Oscill.	Hour.	Oscill.
Spring, ...	8	.0213	10	.0202
Summer, ...	8	.0181	10	.0151
Autumn, ...	10	.0136	8	.0074
Winter, ...	10	.0031	8	.0031

We thus see that both the morning and evening tide exhibits the same order of decrease through the seasons, descending in winter, to a very minute amount.

If we employ the fixed hours of 10 A. M. and 10 P. M. for the maxima, we shall find the oscillation at a maximum in spring and autumn, lower in summer, and the decided minimum in winter. This agrees perfectly with the results of the observations made at the apartments of the Royal Society, in London, which I have collected from the Philosophical Transactions for the last four years, during which the meteorological register has been conducted on a much improved plan.

Year.	SPRING. Mar. Apr. May.	SUMMER. June, July, Aug.	AUTUMN. Sept. Oct. Nov.	WINTER. Dec. Jan. Feb.
	Inches.	Inches.	Inches.	Inches.
1827.	{ .013 .025 .024	.032 .021 .014	.025 .026 .021	.021 .026 .025
1828.	{ .027 .024 .036	.016 .008 .035	.079 .019 .024	.006 .010 .011
1829.	{ .031 .025 .027	.028 .023 + .005	.007 .006 .064	.012 .005 .014
1830*.	{ .035 .006 .012	.009 .013 .026	.011 .036 .059	.002 .047 + .001
Sum, Mean,	.285 .0237	.220 .0183	.377 .0314	.178 .0148

That these differences are really owing to the influence of the seasons may be inferred from the excellent agreement of the four total annual means, which are .0227, .0246, .0205, .0214. And we may reasonably conclude, by the analogy of my observations, that, had the true hours of tides been observed, the order in intensity would have been the same. The best observations in other parts of the globe, afford us, it must be admitted, somewhat anomalous results. In the excellent observations of MARQUÉ VICTOR, at Toulouse, little or no difference from the influence of the seasons was observed †. At Clermont Ferrand the admirable observations of RAMOND assure us that the maximum oscillation occurs in spring, and the minimum in winter ‡, with a secondary maximum and minimum in autumn and summer.

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* For part of those for 1830, I am indebted to Mr HUDSON, the observer, whose zeal in the examination of this phenomenon promises soon to afford us new and valuable data.

† Bibliotheque Universelle, xx. 246.

‡ Memoires de l'Institut, 1812.

At Paris, from eleven years' results, the maximum is also in spring, but the principal minimum in summer, and having a second maximum in autumn. On the Plateau of Bogota, near the Equator *, there are two maxima, which appear nearly to coincide with the maximum intensity of the solar rays, occurring towards the equinoxes. The observations of DORTA, at Rio Janeiro, in 23° S. Lat., give nearly the same results, the maximum being in April, or at the autumnal period in southern latitudes †. It is remarkable also, that the observations of Dr RUSSEL at Berhampour (Lat. 24° N.), and of Mr PRINSEP at Benares (Lat. $25\frac{1}{2}^{\circ}$ N.), each continued for three years, give, severally, a minimum in summer, and one not so low in winter, with a decided maximum in spring, and a strong indication of a smaller one in autumn ‡. If, as I think we have good reason to believe, the real maximum is in spring, according to the majority of observations, we may account for this very general apparent maximum in autumn, by considering the effect of change in the hour of tide. For, suppose the barometer observed, as has very generally been the case, constantly at 9 A. M., this corresponds to the true critical hour very exactly at the equinoxes; but in summer, as this hour becomes earlier, the barometer will have passed its maximum at 9 A. M., and the oscillation will come out too small, giving an *apparent* minimum in summer, when perhaps none ought to exist. This, probably, will account satisfactorily for this extensively observed fact, and accords well with the results of my observations at double hours. If we can trust to the reductions of MARQUÉ VICTOR's observations at Toulouse, they present the greatest anomaly in this part of the subject.

* HUMBOLDT, *Relation Historique*, iii. p. 302

† Ibid. p. 298.

‡ Philosophical Transactions, 1828.

The monthly oscillations at the remarkable station of the Grand St Bernard will be noticed in Section 11.

8. Without dwelling farther at present upon the deductions from my own observations, I proceed to make some inquiry into the law which regulates the geographical distribution of this remarkable phenomenon.

The general fact that the amount of the barometric oscillation decreases from the Equator towards the Poles, has been long established. The active researches of HUMBOLDT, between the tropics, above thirty years ago, excited a spirit of inquiry in Europe, in which the distinguished RAMOND took the lead, and which terminated in the detection of the horary oscillation among the great accidental variations of atmospherical pressure, at the same hours nearly, but much smaller in amount, than in lower latitudes. The labour of observation was therefore greatly increased, requiring some years of accurate data to afford the desirable precision as to amount, which might be obtained by a few days observation near the Equator. Allowing for accidental irregularities, the progressive decrease has been very satisfactorily proved; but two very remarkable registers have, within the last few years, furnished us with unexpected and curious results, which must occupy a prominent place in any theory on the subject. The first of these was the register kept at the convent of the Grand St Bernard, which, as well as a precisely corresponding one at Geneva, was adapted to the investigation of the horary oscillations, immediately after the publication of the third volume of HUMBOLDT's "*Relation Historique*." The St Bernard observations demonstrate, by the regular annual results of the last five years (1826-30), that, at 8000 feet above the sea, the barometer is *lowest* at 9 A. M. and *highest* at 3 P. M., precisely the reverse of what had hitherto been observed. HUMBOLDT had remarked that, between the tropics, though the amount was diminished, the hour of maximum was not changed. These two

results have sometimes been much misunderstood, and spoken of as if they stood in opposition to each other. MR DANIELL (who is almost the only English writer by whom this subject has been considered at any length), treats the question as one of *quality* not of *degree*. The atmospheric tide is much smaller in Europe, at the level of the sea, than at the same level at the Equator: if, therefore, we consider the influence of height to be equal in both cases, and in the same direction, it is very obvious that while, at the Equator, the oscillation may be only diminished in dimension, at the same height in the Temperate Zone, it may have become null, or changed its sign; that is, being *negative*, the time of maximum below will correspond with that of minimum above, and *vice versa*,—a phenomenon perfectly in conformity with the laws which ordinarily regulate physical causes, and deducible from the abstract consideration of quantity, therefore to be considered in no respect as an anomaly in the *quality* of the effect, or as a change *per saltum* in the course of nature.

9. But, what is very remarkable, a precisely analogous fact has been discovered in Lat. 74° , by Captain Sir EDWARD PARRY, whose admirable meteorological registers were a most valuable donation to science. This circumstance had for some years been suspected, from the earlier journals of PARRY and other Arctic voyagers; but these results were received with just doubt, because the barometric registers wanted the indispensable element of the temperature of the mercury, which, under any circumstances, and especially those of an arctic voyage, might produce, by an average difference of temperature at one hour of the day from that at another, results, erroneous in amount, or even opposed to the truth. For example, it will be seen by the four first tables attached to this paper, that in the entire annual results, even in this temperate climate, a constant excess of temperature at 4 P. M. was observed above that at 8 A. M., amounting to a degree and a half of Fahrenheit, which, supposing no oscillation, would give rise to a *negative* one of between four and five thousandths of an

inch, or nearly half the observed amount in this latitude. It is, therefore, not wonderful that the first observations, which wanted the attached thermometer, should have been received with distrust, and it is rather surprising that Mr DANIELL should have so overlooked this source of error, as to have placed the utmost confidence (in the first edition of his work) in the existence of oscillations which might have been caused by a change of temperature amounting to little more than 1° Fahrenheit; and that he should have published his deduction for the horary oscillation at London from his own observations, which wholly wanted this element. The last voyage of Captain Sir EDWARD PARRY afforded results worthy of the highest confidence, from observations with excellent instruments, of which the indications were registered with an assiduity and precision which puts to the blush anything of the kind, at least in Britain, destined to the furtherance of the science of meteorology. These excellent observations indicate the existence of all the oscillations observed in lower latitudes, including that at 4 A. M., which has rarely been observed in any part of the globe, and give all the values with a negative sign, relatively to the ordinary oscillations. The six monthly means (Nov. 1824—April 1825) give *every one* the negative tide from 4 A. M. to 10 A. M., and likewise from 10 A. M. to 4 P. M., and from 10 P. M. to 4 A. M.; and every month but one from 4 P. M. to 10 P. M. As the greatest observed tide was that from 4 A. M. to 10 A. M., or $-.0089$ inch, I shall adopt it in future computations, more especially as from three months' observations, when the daily number was extended to twelve, the critical hour in the afternoon appeared to be later than 4, perhaps considerably*.

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* A similar fact with regard to Northern Europe has been suggested by some observations made at the apartments of the Royal Society of London, in a paper by Mr LUBBOCK, V.P.R.S. in the Phil. Trans. for 1831, of which the author has been kind enough to favour me with a copy since this paper was read.

These observations, then, establish the existence of an oscillation in Lat. 74° , nearly equal to that in Lat. 56° , and affected by an opposite sign.

10. The number of observations in different parts of the globe being now very considerable, it appeared to me of high importance, in the present state of the science of meteorology, to endeavour to generalize them, and see how far they might be represented by an empirical law. I was accordingly engaged in classifying observations collected from every quarter, when I was fortunate enough to meet with an abstract of a very important memoir, by M. BOUVARD, of the observatory of Paris, upon this subject, and read recently at one of the annual meetings of the Helvetic Society. It is upon the hourly variations of the barometer; and the only abstract of it I have met with is that contained in the *Bibliothèque Universelle* for 1829, nor have I seen it in any other periodical work. M. BOUVARD, whose important contributions to meteorology are universally known, has here amassed a great addition to the observations collected by HUMBOLDT; and he undertakes the bold enterprise of representing the extent of the oscillation in any latitude, at any height above the sea, and at any period of the day or year, by an arbitrary formula: but though his table presents perhaps more accordance with observation than might have been expected from so sweeping a generalization, I think there is much reason to question the accuracy of the formula, which is founded on these conditions;—that at the equator the extent of the oscillation is proportional simply to the temperature, on the centigrade scale, of the period during which the oscillation is observed at the given spot, the oscillation and temperature at the level of the sea being unity;—that in any other latitude, the same law is to be modified by introducing the additional proportionality to the square of the cosine of the latitude. Or, representing by m and t the tide and mean temperature at

any place and for any period, in latitude θ ; and by m' and t' those quantities at the equator, M. BOUVARD gives

$$m' = \frac{t'}{t} \frac{m}{\cos. 2 \theta}$$

By this the column of calculated results in the table I now sub-join has been computed, the temperatures in which, it is to be observed, are not the mean temperatures of the place, but of the hours included in the great period from 9 or 10 A. M. till 3 or 4. P. M. I must also remark, that where the number of daily observations was considerable, M. BOUVARD has made use of a formula depending on the sine of the diurnal arc. The application of this formula is very briefly noticed in the abstract to which I allude; but it appears to have been almost entirely confined to inter-tropical observations, where the oscillation has frequently to be eliminated from the irregular observations of a few days. In northern latitudes I have generally found the amount unaltered from the original announcement in the various publications to which these scattered results have been confined. I have added to this valuable table, which contains many results previously unpublished, a few remarks as they occurred to me.

TABLE of the First Period of the Hourly Variations of the Barometer, reduced to the Equator at the Level of the Sea, by M. BOUVARD's Formula.—Equatorial Temp. = 30° Cent.

OBSERVERS.	LOCALITIES.	Height in Metres.	Latitude.	Temp. Centigr.	Oscillations observed.	Reduced to Equator.	REFERENCES.
					Millim.	Millim.	
Duperrey.	Offak, 3 days observation, ...	10	0 2	28,0	2,93	3,14	From MS. obs.
Freycinet.	Rawak, 4 days, ...	10	0 2	26,0	2,61	3,01	Ditto.
La Condamine.	Quito, doubtful observations, ...	2907	0 14	16,5	2,25	4,09	Humboldt.
Humboldt.	Antisana, a single day, weather unfavour.	4093	0 33	8,5	0,97	3,42	Ditto.
Caldas.	Popayan, 4 days, ...	1776	2 26	18,0	2,07	3,45	Ditto.
Jacquín Purera.	St Louis Maranhán, a year, Engl. Bar. } without thermometrical correct. (a), }	10	2 30	29,0	3,79	3,93	Orig.
Humboldt.	Ibague, 3 days, ...	1370	4 28	21,0	2,59	3,72	Humboldt.
Caldas.	Santa Fé de Bogota, 19 successive months,	2660	4 36	17,0	2,10	3,73	Ditto.
Boussingault.	Idem, by more than 1000 observations,	—	—	17,0	2,30	4,09	Ditto.
Duperrey.	Payta, 5 days (b), ...	10	5 6	27,0	2,66	2,98	MS. obs.
Idem.	Ascension (Isle) 3 days, 6 A.M. to 6 P.M.	10	7 55	28,0	2,43	2,72	MS. obs.
Freycinet.	Coupang, 9 days, ...	10	10 9	28,0	2,96	3,27	MS. obs.
Humboldt.	Cumana, 12 days, ...	10	10 28	26,0	2,55	3,05	Humboldt.
Idem.	Caracas, 11 days, ...	936	10 31	21,0	2,70	3,99	Ditto.
Idem.	Guayra, 11 days, ...	10	10 36	26,5	2,75	3,22	Ditto.
Idem.	Lima, 4 days, ...	166	12 3	23,0	2,77	3,77	Ditto.
Idem.	Callao, 3 days, ...	10	12 3	20,0	2,22	3,48	Ditto.
Simonoff.	O-Taïti, 7 days, ...	10	17 29	24,0	2,15	2,95	Zach, Corr. Astr.
Humboldt.	Mexico, 3 days, ...	2231	19 26	17,0	1,80	3,57	Humboldt.
Freycinet.	Port Louis, Isle of France, 20 days,	10	20 10	22,0	1,72	2,66	MS. obs.
Duperrey.	Idem, 4 days, ...	—	—	24,0	1,92	2,73	MS. obs.
Freycinet.	Rio Janeiro, 2 days, ...	10	22 54	24,2	2,58	3,77	MS. obs.
Dorta.	Idem, 12 months, ...	—	—	—	2,33	3,39	Humboldt.
Russell.	Berhampour (India), 3 years, ...	.....	24 4	24,0	2,23	3,42	Phil. Trans.
Prinsep.	Benares, 3 years, ...	.....	25 30	26,0	2,69	3,81	Ditto.
Coutelle.	Cairo, 25 days, ...	.....	30 3	22,0	1,89 (c)	3,44	Voyage d'Egypte.
Freycinet.	Port Jackson, 19 days, ...	10	33 51	21,0	1,71	3,52	MS. obs.
Gambart.	Marseilles, 5 years, ...	46	43 17	16,0	0,83	2,94	Conn. des Temps.
Marqué Victor.	Toulouse, 4 years, ...	156	43 36	15,0	1,00 (d)	3,81	Acad. Toulouse.
Valz.	Nismes, 1 year, ...	65	43 50	16,5	0,98	3,42	Orig.
D'Hombres Firmas.	Alais, 3 years, ...	132	44 7	16,5	0,99	3,49	Ditto.
Gasparin.	Orange, 5 years, ...	.....	44 8	16,5	0,85	3,00	Ditto.
Billiet.	Chambery, 18 months, ...	267	45 34	14,0	1,00	4,37	Acad. Chambery.
	St Bernard, 5 years (e), ...	2491	45 42	—0,7	+0,046	4,04	Bibl. Univ.
Ramond.	Clermond-Ferrand, 7 years, ...	410	45 46	12,5	0,94	4,53	Mem. de l'Institut.
	Geneva, 3 years, ...	407	46 12	12,8	0,74 (f)	3,62	Bibl. Univ.
	Bever (Switzerland), ...	1657	46 34	7,5	0,45	3,81	Orig.
Fueter.	Berne, 10 years, ...	532	46 57	12,0	0,90	4,82	Bibl. Univ.
Horner.	Zurich, 1 year, ...	405	47 22	13,0	0,88	4,43	Ditto.
	St Gall, 1 year, ...	635	47 26	11,0	0,56	3,34	Ditto.
Herrenschneider.	Strasburg, 12 years, ...	150	48 35	13,0	0,88	4,29	Orig.
Bouvard aîné.	Paris, 12 years, ...	65	48 50	13,8	0,76	3,81	Mem. de l'Institut.
Nell de Bréauté.	La Chapelle, 8 years, ...	154	49 49	11,5	0,49	3,07	Orig.
Crahay.	Maëstricht, 9 years, ...	52	50 51	13,0	0,57	3,30	Quetelet.
Royal Society.	London, 1 year (g), ...	30	51 29	12,6	0,57	3,50	Phil. Trans.
Sommer.	Königsberg, 8 years, ...	30	54 42	6,0	0,20	3,27	Humboldt.

(a) On account of the want of an attached thermometer, this series ought to be discarded.

(b) Modified from the result given by Humboldt, Rel. Hist. iii. 312.

(c) This amount, somewhat different from that given by Humboldt, appears to be the result of a new analysis of the original observations in the "Voyage d'Egypte."

(d) This is smaller than was originally assigned by Marqué Victor.—See § 13. Note.

(e) These are the first five of the years given in § 11, with the exception of 1821. By a more extended and systematic reduction from the Table there given, I find the amount to be + .009 lines = 0^{mm}.020.

(f) There is probably some mistake in assigning 0.74 as the amount at Geneva. For the years 1826–8, to which M. Bouvard must probably have referred, it was 0^{mm}.86; and the mean of five years, 1826–30, gives 0^{mm}.81.

(g) It will be seen by § 7, that the mean of four years gave .0223 inch. = 0^{mm}.566.

11. I have now some more particular observations to add upon the theoretical part of the Table. 1st, I conceive that it is little to be expected, or perhaps desired, that one formula should represent the decrement both in latitude and height, and the change at different hours and seasons, which, even in the much better known facts of terrestrial temperature, has never been, nor satisfactorily could be, executed. I conceive that, in the purely physical bearings of the question, the existence of such a common law would be surprising, because such a coincidence must have been derived from the concurrence of independent agencies. 2d, The observations at considerable heights, in different latitudes, are too few, too brief, and too inconsistent, to afford us any thing like satisfactory results. For example, the observations at Caracas, at a height of 3000 feet, give a greater amount of oscillation than those at Cumana, at the level of the sea, at the same latitude. 3d, M. BOUVARD proposes his formula as capable of expressing the variation observed at any period of the day or year, and has shewn that the ratio of the different mean temperatures of the periods of forenoon and evening oscillations, correspond tolerably nearly with that of the observed amount of these oscillations, at least in Europe; but I would ask, Why do not the great differences of temperature, corresponding to the seasons, give the marked results which his formula would suppose, producing a tropical amount in summer, and an arctic one in winter? At Paris, for instance, where the mean of the summer temperatures, that is, of the months of June, July, and August, is, according to HUMBOLDT*, $18^{\circ}.1$ Cent.; and of the winter months (December, January, and February), $3^{\circ}.7$ Cent., the ratio is $4.9 : 1$; whilst the corresponding oscillations, which, according to M. BOUVARD's formula, ought to have the

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* Des Lignes Isothermes. Mem. d'Arceuil, tom. iii. Table.

same ratio, are $0.\overset{\text{m.m.}}{7}66$ and $0.\overset{\text{m.m.}}{6}85$, or as $1.1 : 1$,—this ratio being less than *one-fourth* of the other. Yet the Paris observations for the barometric tide are among the best we possess ; and these numbers are a mean from the registers of eleven years. Again, at the very important station of the Grand St Bernard (to which M. BOUVARD strongly appeals in support of his formula), where the mean result is negative with regard to the oscillation at the level of the sea, the mean temperature of the year being below 0° cent., therefore rightly expressed in the preceding Table, we should have a very striking difference of result in summer and winter. The temperature of the three summer months being about $+ 6^{\circ}$ cent., and of the three winter months about $- 6^{\circ}$ cent., the first should give a considerable *positive* oscillation, the latter a considerable *negative* one. Let us see, therefore, how the case stands. For this purpose, I shall classify under the seasons the whole of the monthly results which have been published, and of which the last five years are complete. The sign of $+$ in the following Table indicates a rise between 9 and 3, that of $-$ a fall : the former, therefore, is to be considered *negative* with regard to the ordinary course, since the barometer rises when it usually falls at the level of the sea. I may add, that, by taking the mean temperature of the day in place of that of the particular period in computing the oscillation by M. BOUVARD's formula, here and at Paris, we are doing it no injustice, as, though the summer and winter temperature would both be somewhat higher *, the *ratio* would be almost the same ; and it is about no evanescent differences that we are disputing.

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* Indeed there seems much reason to doubt whether the period of the day alluded to has a mean temperature below 0° cent. If it has not, M. BOUVARD's formula would totally fail, as the equatorial oscillation would come out with a wrong sign.

CONVENT OF THE GRAND ST BERNARD.

Year.	SPRING. March, April, May.	SUMMER. June, July, August.	AUTUMN. Sept. Oct. Nov.	WINTER. Dec. Jan. Feb.
	Lines.	Lines.	Lines.	Lines.
1821,	{		— 0.03 — 0.09	— 0.14
1822,	{ + 0.04 + 0.06 — 0.08	— 0.01 + 0.11	— 0.06	— 0.15 — 0.12 — 0.15
1823,	{ — 0.05 + 0.09 + 0.11			— 0.09 — 0.07
1826,	{ — 0.01 + 0.07 + 0.05	+ 0.03 + 0.35 + 0.11	— 0.38 0.00 + 0.13	— 0.04 — 0.07 + 0.05
1827,	{ — 0.02 + 0.11 + 0.08	+ 0.08 + 0.01 — 0.04	— 0.05 — 0.08 — 0.03	— 0.02 + 0.51 + 0.06
1828,	{ + 0.11 + 0.06 — 0.02	+ 0.07 + 0.19 + 0.06	— 0.01 + 0.03 + 0.12	— 0.03 + 0.05 — 0.01
1829,	{ + 0.11 + 0.06 — 0.02	+ 0.07 + 0.19 + 0.06	— 0.01 + 0.03 + 0.12	— 0.03 + 0.05 — 0.01
1830,	{ — 0.36 — 0.12 + 0.09	+ 0.05 + 0.04 — 0.01	— 0.03 — 0.07 — 0.18	— 0.14 — 0.22 — 0.03
Sum, Mean,	+ 0.38 + 0.018	+ 1.36 + 0.080	— 0.59 — 0.033	— 0.60 — 0.029

It can hardly require a word from me to point out how well the individual results justify the deductions of the mean, so that there are only *three* — results in the summer period, and only *five* + in the winter one; therefore, instead of an oscillation corresponding to the Temperate Zone in summer, and to the

Arctic Regions in winter, we have precisely the reverse. It is hardly necessary to remark, how totally opposed this is to the theory of M. BOUVARD*.

12. I would remark, *fourthly*, upon M. BOUVARD's formula, that, by fixing the mean temperature from which he calculates his numerical results at the mean of the period from 9 A. M. to 3 P. M., he has given himself certain limits of which it is almost impossible for a speculator not to avail himself, and which must be at all times unsatisfactory on account of the great want of the thermometrical observations for fixing the mean temperature of any particular portion of the day in so many latitudes. I have to observe, in the *last* place, that the results are far from satisfactory even when the difficulties of the subject are considered. By consulting the last column of the table already given, we find the deduction of the formula for the oscillation at the Equator range from 2.72 to 4.82 millimetres; and, what is worse, that the + and — errors from the mean are not well balanced throughout the quadrant of latitude, but that there is a general rise in their value as we proceed farther from the Equator. As it is undeniable that the tropical observations, from the smallness of the reductions required, afford the most correct results, I am strongly of opinion that the mean of his numbers would give us an equatorial oscillation greatly above the truth. By looking over M. BOUVARD's table, we shall find not a single authentic series of observations gives an oscillation of three millimetres (we except the observations at St Louis Maranhão, which, wanting the results of the attached thermometer, should be discarded), the maximum being 2.93, which occurred at the very Equator. HUMBOLDT considers 3.3 millimetres the extreme limit

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* In 1829, the mean temperature of the seasons, distributed as above, was — 1°.5 R. + 4°.8 R. + 0°.5 R., and — 4°.6 R. In 1830, it was colder, as follows: — 0°.1 R. + 4°.5 R., — 0°.7 R., and — 7°.7 R. respectively.

for the Equator ; and I believe there is no series in existence, continued for several days together, which gives such a mean result. The observations of DUPERREY, at Payta, which, by HUMBOLDT'S table, was reckoned at so extreme an amount as 3.4, has dwindled, by the analysis of M. BOUVARD, to 2.66, which is, in all probability, a very correct result ; and my own opinion is, that future observations will limit the equatorial oscillation to 3 millimetres, or perhaps even lower, except in anomalous situations. Now, the result of the table we are discussing, generally gives an oscillation nearer 4 than 3 millimetres ; but what is remarkable, the larger numbers occur only where the amount of reduction is considerable. Thus, confining ourselves to observations not at extraordinary heights above the level of the sea (that is, under 2000 metres), we do not find a single observation under latitude 45° , affording an equatorial oscillation amounting to 4 millimetres ; whilst between 45° and 55° , in less than half the number of localities, we have no less than five results above 4 millimetres. This alone indicates something wrong. Had M. BOUVARD limited his passion for generalization to the law of *latitude* only, he would easily have given a nearer approximation ; this was what I had proposed to undertake before I had the good fortune to meet with his paper, and what I afterwards executed with the aid of his data.

13. As M. BOUVARD has presented us in his table with a considerable number of unpublished results, which I was unwilling to lose, I have trusted to the skill and fidelity of the author in deducing the numbers which he has given as the *observed amount* in his table. From observations continued but a few days, and at irregular hours, it requires some labour and judgment to obtain the truest results. It is therefore almost entirely in equatorial results that M. BOUVARD differs in his numbers from the quantities already assigned by such observers as have published their registers, and from a very careful and extended comparison which I have made with the originally published synopses of observations

made in the Temperate Zone, I rarely find any change made upon them *. The table given in Sect. 10 has therefore been my guide, as far as absolutely observed results are there given; and it would be unjust not to add here, that M. BOUVARD deserves the thanks of all who take an interest in the subject, for the spirited and valuable paper from which the table is extracted, and for the unpublished or scattered results which he has there combined, as well as that his particular theory is proposed with much diffidence.

As my investigation extends merely to the law of diminution connected with latitude, I have confined myself to observations near the level of the sea. The greatest exception is the result of M. RAMOND at Clermont-Ferrand, at the height of 410 metres; but the excellence of the observations is such, and they agree so well with those in the same parallel, that I could not omit them. I have added the value given by Captain Sir EDWARD PARRY'S observations for Port Bowen, and my own for the neighbourhood of Edinburgh. My object being to determine the law of variation with latitude which should best represent a given number of trust-worthy observations of the horary oscillation, I have employed a mode of investigation similar to that used by Mr ATKINSON, in his analysis of the law of mean temperature, forming

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* The principal deviation which I have remarked is in the extensive series of M. MARQUÉ VICTOR, at Toulouse, where the observations were made many times a-day, and probably had M. BOUVARD'S formula of reduction for hours applied to it. However, it seems rather unaccountable how any formula of this kind should *diminish* instead of increase the amount of oscillation, which it actually does in this case, unless there be some numerical mistake, the amount derived by M. MARQUÉ VICTOR (and which I have verified as far as the combination of the annual means is concerned) being $1^{\text{mm}}.20$; according to M. BOUVARD it is $1^{\text{mm}}.00$. As, however, M. BOUVARD treats this as the best determined point in Europe, it is probable that he had carefully examined the tables in the *Memoires de l'Academie de Toulouse*, the later volumes of which I have not been fortunate enough to see.

part of his elaborate paper upon Astronomical Refractions, inserted in the second volume of the Memoirs of the Astronomical Society.

14. I assumed the form of the function of the latitude which expresses the oscillation, to be some unknown power of the cosine, affected by an unknown coefficient, and constant. These quantities are therefore to be eliminated from three or more equations, derived from observation in different parts of the globe. Let the barometric oscillation be represented by z, z', z'', z''' , in latitudes $\theta, \theta', \theta'', \theta'''$, respectively: then, denoting by n the unknown power of the cosine, and by α and ϵ the other constants, we may separate the first of these unknown quantities from three equations of the form $z = \alpha \cos^n \theta + \epsilon$, by putting them under that of $\frac{z' - z'''}{z' - z''} = \frac{\cos^n \theta' - \cos^n \theta'''}{\cos^n \theta' - \cos^n \theta''}$. Whence the value of n may be deduced by approximation. For this purpose, I selected nine values of z from the list of observed oscillations, and, for greater convenience of calculation and tabulation, I shall employ these during the rest of this paper in the form of *millimetres*, which in fact, since HUMBOLDT wrote, have become the most common units of measure for these results. These numbers were not in general single results, but were combined from several in such a way as appeared best to correct accidental irregularities. Three observations nearly equatorial were taken, three towards the tropics, and three in high latitudes, as follow:

	Lat.	Oscill.		Lat.	Oscill.		Lat.	Oscill.
		m.m.			m.m.			m.m.
Ascension,	7° 55' S.	2.43	Cumana,	10° 28' N.	2.55	Lima,	12° 3' S.	2.77
Coupang,	10° 9' S.	2.96	La Guayra,	10° 36' N.	2.75	Callao,	12° 3' S.	2.22
Mean,	9° 2'	2.70	Mean,	10° 33'	2.65	Mean,	12° 3'	2.49
		m.m.			m.m.			m.m.
Isle of France,	20° 10' S.	1.72	Cairo,	30° 3' N.	1.89	Port Jackson,	33° 51' S.	1.71
Rio Janeiro,	22° 54' S.	2.58						
Mean,	21° 22'	2.14						

	N. Lat.	Oscill. m.m.		N. Lat.	Oscill. m.m.		Lat.	Oscill.
Marseilles,	43° 17'	0.83	Maëstricht,	50° 51'	0.57	Port	73° 48'	-0.22
Toulouse,	43 36	1.00	London,	51 29	0.57	Bowen,		
Strasbrug,	48 35	0.83	Königsberg,	54 42	0.20			
Paris,	48 50	0.76	Edinburgh,	55 55	0.27			
Mean,	46 4	0.86	Mean,	53 14	0.40			

Selecting nine of the possible combinations by threes, we obtain the following values for n :

Lat. $\left. \begin{array}{l} 9 \ 2 \\ 21 \ 22 \\ 46 \ 4 \end{array} \right\} n = 5.0$	Lat. $\left. \begin{array}{l} 10 \ 33 \\ 30 \ 3 \\ 53 \ 14 \end{array} \right\} n = 1.6$	Lat. $\left. \begin{array}{l} 12 \ 3 \\ 33 \ 51 \\ 73 \ 48 \end{array} \right\} n = 1.8$
Lat. $\left. \begin{array}{l} 9 \ 2 \\ 38 \ 3 \\ 53 \ 14 \end{array} \right\} n = 1.8$	Lat. $\left. \begin{array}{l} 10 \ 33 \\ 33 \ 51 \\ 73 \ 48 \end{array} \right\} n = 2.2$	Lat. $\left. \begin{array}{l} 12 \ 3 \\ 21 \ 22 \\ 46 \ 4 \end{array} \right\} n = 3.1$
Lat. $\left. \begin{array}{l} 9 \ 2 \\ 33 \ 51 \\ 73 \ 48 \end{array} \right\} n = 2.2$	Lat. $\left. \begin{array}{l} 10 \ 33 \\ 21 \ 22 \\ 46 \ 4 \end{array} \right\} n = 4.9$	Lat. $\left. \begin{array}{l} 12 \ 3 \\ 30 \ 3 \\ 53 \ 14 \end{array} \right\} n = 0.8$

Mean value of n , = 2.60, or about $\frac{5}{2}$.

15. In order to modify the co-efficient and constant in the arbitrary formula, so as best to agree with observation, we shall select a series of observations from M. BOUVARD'S Table, which, from their intrinsic merit, or from their representing accurately a group of minor observations, shall seem best fitted to give accurate results. We shall first take an approximate value of α and ϵ from the observations at Cumana and Toulouse, which represent pretty nearly the whole of the rest. From them we obtain the two following equations:

$$2.55 = \alpha \cos^{\frac{5}{2}} 10^\circ 28' + \epsilon = .959 \alpha + \epsilon,$$

$$1.00 = \alpha \cos^{\frac{5}{2}} 43 \ 36 + \epsilon = .446 \alpha + \epsilon.$$

$$\text{Whence } \alpha = 3.02; \epsilon = -0.35.$$

Substituting these values in the expressions for the selected oscillations, we obtain the following approximations:

PLACE.	Latitude.	Oscillation.		Error.
		Observed.	Approx. Calc.	
		Millimetres.	Millimetres.	Millimetres.
Payta, ...	5° 6' S.	2.66	2.64	— 0.02
Cumana, ...	10 28	2.55	2.55	0.00
Otaheité, ...	17 29 S.	2.15	2.33	+ 0.18
Isle of France, ...	20 10 S.	1.82	2.23	+ 0.41
Rio Janeiro, ...	22 54 S.	2.45	2.11	— 0.34
Cairo, ...	30 3	1.89	1.76	— 0.13
Toulouse, ...	43 36	1.00	1.00	0.00
Clermont, ...	45 46	0.94	0.88	— 0.06
Paris, ...	48 50	0.76	0.71	— 0.05
Maestricht, ...	50 51	0.57	0.61	+ 0.04
Königsberg, ...	54 42	0.20	0.42	+ 0.22
Edinburgh, ...	55 55	0.27	0.36	+ 0.09
Port Bowen, ...	73 48	— 0.22	— 0.23	— 0.01

It is well worthy of remark upon the preceding Table, that, by means of the constants derived solely from the employment of observations in Latitudes $10^{\circ} 8'$ and $43^{\circ} 36'$, which have both a sign of +, we obtain a result for Lat. $73^{\circ} 48'$ N. not merely giving a sign of —, but agreeing in amount with singular precision with that which observation affords, proving that a *negative* oscillation, instead of being in any way anomalous, is nothing else than we might have inferred *à priori* for high latitudes.

16. In order that the constants may express the general result of all these thirteen observations in the best possible manner, we must reduce the sum of the squares of the errors to a minimum. Let $\alpha + \alpha'$ and $\epsilon + \epsilon'$ be the new values of the constants upon this supposition; let also e be the error of the above table, and E the reduced error. We then have

$$(\alpha + \alpha') \cos^{\frac{5}{2}} \theta + (\epsilon + \epsilon') - z = E,$$

and therefore,

$$\alpha' \cos^{\frac{5}{2}} \theta + \epsilon' + e = E,$$

which gives the following thirteen equations of condition :

$$\begin{array}{ll}
.990 \alpha' + \epsilon' - .02 = E_I & .446 \alpha' + \epsilon' = E_{VII} \\
.959 \alpha' + \epsilon' = E_{II} & .407 \alpha' + \epsilon' - .06 = E_{VIII} \\
.889 \alpha' + \epsilon' + .18 = E_{III} & .352 \alpha' + \epsilon' - .05 = E_{IX} \\
.854 \alpha' + \epsilon' + .41 = E_{IV} & .317 \alpha' + \epsilon' + .04 = E_X \\
.814 \alpha' + \epsilon' - .34 = E_V & .254 \alpha' + \epsilon' + .22 = E_{XI} \\
.697 \alpha' + \epsilon' - .13 = E_{VI} & .235 \alpha' + \epsilon' + .09 = E_{XII} \\
& .041 \alpha' + \epsilon' - .01 = E_{XIII}
\end{array}$$

From which, proceeding by LEGENDRE'S method of minimum squares, we shall deduce $\alpha' = .0106$ and $\epsilon' = -.0254$, which, being substituted in the general equation, together with the values of α and ϵ found above, it becomes

$$\begin{aligned}
z &= 3.031 \cos^{\frac{5}{2}} \theta - .381 \text{ for millimetres,} \\
&= .1193 \cos^{\frac{5}{2}} \theta - .0150 \text{ for English inches.}
\end{aligned}$$

The formula for millimetres being applied to the observations already discussed, we obtain the following, as the *nearest possible* results :

PLACE.	Latitude.	Oscillation.		Difference.
		Observed.	Calculated.	
		Millimetres.	Millimetres.	Millimetres.
Payta, ...	5° 6' S.	2.66	2.620	— .04
Cumana, ...	10 28	2.55	2.525	— .02
Otaheité, ...	17 29 S.	2.15	2.312	+ .16
Isle of France, . . .	20 10 S.	1.82	2.206	+ .39
Rio Janeiro, ...	22 54 S.	2.45	2.087	— .36
Cairo, ...	30 3	1.89	1.732	— .16
Toulouse, ...	43 36	1.00	0.971	— .03
Clermont, ...	45 46	0.94	0.851	— .09
Paris, ...	48 50	0.76	0.685	— .07
Maestricht, ...	50 51	0.57	0.579	+ .01
Königsberg, ...	54 42	0.20	0.388	+ .19
Edinburgh, ...	55 55	0.27	0.332	+ .06
Port Bowen, ...	73 48	— 0.22	— 0.256	— .04

By referring to Plate VII., the observed oscillations will be found projected by means of round dots, the distances of which from the line AX representing the quadrant of latitude, indicate the

amount. The curve YMy , drawn through these points, AX being the axis of the abscissæ, AY that of the ordinates, represents the formula of greatest probability, just found. Since the oscillation becomes negative, there must be some point M where the curve crosses the axis, or where the oscillation is $= 0$. This latitude, which may be denoted by L , is readily found by equating the value of z to zero, which gives

$$\cos L = \left(\frac{.381}{3.031} \right)^{\frac{2}{5}}, \text{ and } L = 64^{\circ} 8' 6''.$$

By putting $\theta = 0$ and $\theta = 90^{\circ}$, we obtain for the equatorial oscillation, or AY , $2^{\text{mm}}.650$; and for the polar, or Xy , $-0^{\text{mm}}.381$; or .119 and .015 English inches.

17. By means of the formula $z = \alpha \cos^n \theta + \epsilon$ (putting for α and ϵ the corrected numbers), we may further deduce the mean amount of the atmospheric tide for the quadrantal arc of the meridian, and likewise corresponding to the entire surface of a hemisphere. In the first case, its mean value will correspond to the integral of $z d\theta$, taken between the limits $\theta = 0$ and $\theta = 90^{\circ}$, and divided by the length of the quadrant of latitude, or

$$\frac{2}{\pi} \int (\alpha \cos^n \theta + \epsilon) d\theta.$$

In the second case, we must introduce the expression for the length of the parallel of latitude, and divide the integral taken within the same limits as before, by the *surface* of the hemisphere, that is,

$$\frac{\int 2\pi \alpha \cos^{n+1} \theta d\theta + \int 2\pi \epsilon \cos \theta d\theta}{2\pi} = \int (\alpha \cos^{n+1} \theta + \epsilon \cos \theta) d\theta.$$

Since we have employed $n = \frac{5}{2}$, the integration of both these expressions comes under that of elliptic transcendentals; by a simple alteration, however, we shall obtain a direct solution, abundantly accurate for our present purpose. We have seen that $n = 2.6$; if, therefore, we make it $= 3$, instead of $\frac{5}{2}$, and mo-

dify α and ξ , we may obtain a different expression, which shall very closely represent the observations. We shall find for the new equation

$$z = 3.07 \cos^3 \theta - .36 \text{ as a near approximation.}$$

The first of the above integrals then becomes

$$\frac{2}{\pi} \int (3.07 \cos^3 \theta - .36) d\theta,$$

which, taken between the limits $\theta = 0$ and $\theta = \frac{1}{2} \pi$, gives for the mean oscillation, in relation to the quadrant of latitude,

$$\frac{4.09}{\pi} - .36 = 0.94^{\text{m.m.}}$$

The other integral above given becoming

$$\int (3.07 \cos^4 \theta - .36 \cos \theta) d\theta,$$

there results, within the same limits,

$$3.07 \cdot \frac{3}{16} \pi - .36 = 1.45^{\text{m.m.}}$$

for the mean value with regard to the surface of a hemisphere.

These numbers correspond to homogeneous columns of air at the ordinary pressure and temperature $10\frac{1}{2}$ and 16 metres in height respectively. In the investigation of any supposed connection with temperature, these mean results will be of some value.

18. I am satisfied for the present with having pointed out a formula representing very closely the observed amount of oscillation at the level of the sea, as depending upon latitude. For any successful generalization upon the influence of height, we must wait for vastly more extended data than we already possess; and the same remark is applicable, though to a less extent, to the influence of the seasons. That temperature has an important connection with the geographical distribution of this phenomenon, I have no doubt. It appears probable, that, among places under the same latitude, and having different

mean temperatures, the coldest has the smallest oscillation *. We know that in ascending above the level of the sea, they diminish together, the curve of temperature being probably asymptotic, whilst that representing the oscillation would appear to cross the axis at a certain height. At present, I have confined myself to arriving at a generality of the first degree; the higher degrees, which will embrace the element of temperature, will probably go far towards an explanation of the *cause*, with which that element is certainly nearly concerned. But we must be contented to wait in the mean time for additional data.

19. I have done perhaps as much as can be expected from a solitary observer towards fixing the minute quantity corresponding to this latitude. It is from public and learned bodies alone that we can look for registers of perfect regularity, combined with precision as to the hours of observation. I look with sanguine expectations towards the establishment of such a one by this Society. Strange though it be, I believe we may safely affirm, that Great Britain does not at this moment produce a register worthy of the present advanced state of meteorology. Scotland, by her geographical position, is well situated for unfolding many important phenomena of Nature, and, amidst the disadvantages of her inconstant sky, offers some peculiar recommendations to the zealous observer both in meteorology and magnetism; but of these it has been her misfortune to meet with few or none.

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* Thus Königsberg, though in a lower latitude, appears to have a smaller oscillation (see § 6.) than Edinburgh; but then the temperature appears to be only 43° F. (*Astronomische Nachrichten*, Feb. 1823), while that of Edinburgh is 47°. It must be hardly necessary here to observe, that, supposing the mean temperature of a place known in a function of the latitude, my formula admits of a direct comparison with the temperature (t) at the level of the sea. Thus, if Dr BREWSTER's formula of $t = 81.5 \cos \theta$ be employed, my formula becomes $z = at^{\frac{5}{2}} - c$; a being a new coefficient.

But the spirit must be fostered by her Societies. “La simultanéité et la durée,” says an accomplished French philosopher, speaking of these bodies, “que leur institution donne à des efforts mortels, complètent la puissance de la méthode expérimentale. Elles seules pouvaient désormais assurer la continuité du progrès des connaissances humaines; seules elles pouvaient développer les grandes théories, et faire obtenir des résultats qui, par leur difficulté, par la diversité, la persévérance, et l’étendue des travaux qu’ils exigent, n’auraient jamais été accessibles pour des individus*.”

20. I cannot help remarking, in conclusion, that this observation was never more completely verified than in the hourly thermometrical observations made for some years together under the auspices of this Society, at the suggestion of its late learned Secretary Dr BREWSTER, which, I hesitate not to affirm, is the noblest donation ever made towards the progress of meteorological science†. Valuable, not merely from the specific results, important as they are, which it afforded, but even more so, as demonstrating the susceptibility of the science to assume a mathematical form, and proving that the confused obscurity which so long overhung the laws of mean temperature was due to the imperfections of our mode of observation, not to any anomaly in Nature itself, which experience daily more firmly convinces us is governed by laws equally immutable, whether palpable to the senses, or veiled by an indefinite series of secondary causes.

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* BIOT, Notice des opérations entreprises pour déterminer la figure de la terre.

† The results are published in the Society’s Transactions, Vol. X.

21. Since this memoir was read, I have been favoured with a confirmation, particularly interesting, of the identity of the law which regulates the horary oscillation in the northern and the southern hemisphere. Captain PHILIP P. KING, R. N. permits me to make use of the results deduced from his admirable MS. register kept for six months together, at Port Famine, in the Straits of Magellan, South Lat. $53^{\circ} 38'$; West Long. $70^{\circ} 54'$. The following numbers give the difference of height in the barometer, reduced to 32° F. between 9 A. M. and 3 P. M. for each month* :

1828, February, ...	— .016
March, ...	— .008
April, ...	— .026
May, ...	— .026
June, ...	— .006
July, ...	— .042
Mean Oscillation, ...	.0207
Calculated by the Formula, ...	.0173
Error, ...	— .0034

The temperature was so low (not exceeding 43° F. for the period from 9 A. M. to 3 P. M.) that M. BOUVARD's formula would err very greatly in defect.

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* The abstracts of Captain KING's observations are about to be published in the proceedings of the Royal Geographical Society, vol. I.

TABLES.

N. B. The Barometric Numbers in the following Tables are all reduced to 32° F.

TABLE I.—1827.

Month.	Number of Obs.	10 P. M.		8 A. M.		10 A. M.		4 P. M.		8 P. M.	
		Barometer.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.
		Inches.		Inches.		Inches.		Inches.		Inches.	
Sept.	50	29.5767	63.0	— .0342	— 0.4	— .0153	+ 4.5	— .0330	+ 1.2	— .0024	0.0
Oct.	138	29.3271	62.5	— .0050	— 2.4	— .0072	— 0.1	— .0175	— 1.4	— .0006	+ 0.3
Nov.	145	29.5311	62.1	+ .0358	— 4.7	+ .0325	— 1.4	+ .0339	— 3.0	+ .0080	— 0.6
Dec.	129	29.0804	63.3	— .0040	— 5.9	+ .0049	— 2.3	+ .0009	— 1.8	+ .0029	+ 0.3
Sum,	462	117.5153	250.9	— .0074	— 13.4	+ .0149	+ 0.7	— .0157	— 5.0	+ .0079	0.0
Mean,		29.3788	62.7	— .0018	— 3.3	+ .0037	+ 0.2	— .0039	— 1.2	+ .0020	0.0

TABLE II.—1828.

Month.	Number of Obs.	10 P. M.		8 A. M.		10 A. M.		4 P. M.		8 P. M.	
		Barometer.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.
		Inches.		Inches.		Inches.		Inches.		Inches.	
Jan.	151	29.4211	55.2	— .0234	— 2.5	— .0135	— 1.2	— .0076	— 2.8	+ .0026	— 0.4
Feb.	142	29.2914	56.0	+ .0148	— 2.8	— .0099	— 1.7	— .0107	— 3.6	+ .0008	— 0.5
Mar.	152	29.3473	57.5	+ .0098	— 3.1	+ .0038	— 1.9	— .0178	— 2.1	+ .0006	— 0.3
April,	143	29.1989	60.0	— .0025	— 2.4	+ .0050	— 1.7	— .0144	— 1.5	— .0021	— 0.1
May,	120	29.4034	63.1	+ .0108	+ 0.3	— .0002	+ 2.2	— .0297	— 0.3	— .0082	— 0.6
June,	132	29.5063	63.7	+ .0036	+ 1.5	— .0084	+ 2.8	— .0161	+ 1.8	— .0135	+ 1.6
July,	126	29.2452	63.2	+ .0056	+ 1.2	— .0093	+ 1.8	— .0186	+ 1.5	+ .0021	+ 0.5
Aug.	131	29.3716	63.4	+ .0209	+ 1.2	+ .0139	+ 1.8	— .0099	+ 1.6	— .0052	— 0.1
Sept.	86	29.4750	61.6	+ .0121	+ 0.5	+ .0291	+ 2.5	— .0101	+ 1.0	+ .0185	+ 0.2
Oct.	128	29.5492	58.8	— .0086	0.0	+ .0137	+ 2.5	— .0330	+ 0.2	— .0006	+ 0.2
Nov.	144	29.3286	63.3	+ .0180	— 6.1	+ .0245	— 1.5	+ .0052	— 0.7	+ .0038	+ 0.2
Dec.	117	29.2393	61.9	— .0257	— 5.9	— .0004	— 3.3	+ .0218	— 2.3	+ .0037	+ 0.7
Sum,	1572	352.3773	727.7	+ .0354	— 17.9	+ .0209	+ 2.3	— .1409	— 7.2	+ .0025	+ 2.0
Mean,		29.3648	60.6	+ .0029	— 1.5	+ .0017	+ 0.2	— .0117	— 0.6	+ .0002	+ 0.2

TABLE III.—1829.

Month.	Number of Obs.	10 P. M.		8 A. M.		10 A. M.		4 P. M.		8 P. M.	
		Barometer.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.
		Inches.		Inches.		Inches.		Inches.		Inches.	
Jan.	139	29.5066	58.2	— .0058	— 6.3	+ .0011	— 2.7	— .0105	+ 0.2	— .0032	+ 1.1
Feb.	81	29.7275	62.2	+ .0324	— 5.9	+ .0473	— 1.7	+ .0035	— 1.1	+ .0041	+ 0.4
Mar.	126	29.4268	60.7	— .0055	— 4.3	+ .0001	— 0.1	— .0190	— 1.3	— .0040	— 0.7
April,	138	29.1368	60.8	— .0356	— 3.9	— .0334	+ 0.8	— .0287	0.0	— .0092	— 1.0
May,	147	29.6175	61.4	— .0097	+ 0.3	— .0077	+ 0.7	— .0227	— 0.5	— .0047	— 1.0
June,	51	29.4425	65.5	+ .0068	— 0.4	— .0087	+ 0.4	— .0266	+ 0.2	— .0100	— 0.3
July,	107	29.2338	64.7	+ .0078	+ 0.8	— .0022	+ 0.8	— .0096	+ 0.3	— .0072	— 0.2
Aug.	79	29.4656	64.5	+ .0064	+ 0.6	+ .0099	+ 0.9	— .0099	— 0.1	— .0042	— 0.3
Oct.	117	29.4712	60.8	+ .0202	— 2.8	— .0065	— 0.3	+ .0123	— 0.6	+ .0104	0.0
Nov.	122	29.6093	61.4	+ .0079	— 4.1	+ .0308	— 2.0	— .0026	— 1.6	— .0013	0.0
Dec.	115	29.7644	56.4	— .0273	— 5.0	— .0348	— 3.6	— .0169	— 2.0	— .0031	— 0.1
Sum,	1222	324.4020	676.6	— .0024	— 31.0	— .0041	— 6.8	— .1307	— 6.5	— .0324	— 2.1
Mean,		29.4911	61.5	— .0002	— 2.8	— .0004	— 0.6	— .0119	— 0.6	— .0029	— 0.2

TABLE IV.—1830.

Month.	Number of Obs.	10 P. M.		8 A. M.		10 A. M.		4 P. M.		8 P. M.	
		Barometer.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.	Barom.	Attach. Ther.
		Inches.		Inches.		Inches.		Inches.		Inches.	
Jan.	121	29.7290	55.1	— .0063	— 3.9	— .0437	— 2.1	— .0090	— 0.5	— .0069	+ 0.4
Feb.	110	29.3549	57.8	— .0069	— 5.2	+ .0308	— 2.2	+ .0071	— 1.1	+ .0027	— 0.6
Mar.	116	29.5025	60.6	+ .0119	— 2.5	— .0270	— 0.7	— .0137	— 0.9	— .0007	0.0
April,	86	29.2313	61.0	+ .0065	— 1.6	— .0090	+ 0.7	— .0218	— 0.9	+ .0041	— 0.3
May,	131	29.4119	60.4	+ .0235	+ 1.1	+ .0222	+ 1.2	— .0140	+ 0.2	+ .0039	— 0.6
June,	126	29.4197	62.3	— .0161	+ 0.5	— .0292	+ 0.8	— .0321	+ 0.1	— .0058	— 0.2
July,	140	29.4428	65.8	— .0135	+ 1.0	— .0158	+ 1.0	— .0144	+ 0.2	— .0117	— 0.1
Aug.	85	29.3519	64.1	+ .0052	+ 1.3	+ .0086	+ 0.3	+ .0009	— 0.5	+ .0065	— 0.7
Sept. }											
Oct. }	54	29.2583	62.7	+ .0323	— 2.1	+ .0230	— 0.2	+ .0243	— 2.3	+ .0193	— 1.2
Nov.	123	29.1858	59.2	— .0130	— 2.0	+ .0129	— 0.4	— .0060	— 0.8	— .0061	+ 0.2
Dec.	62	29.3108	58.3	+ .0132	— 2.9	+ .0403	— 2.0	+ .0119	— 0.5	+ .0076	+ 0.2
Sum,	1154	323.1989	667.3	+ .0368	— 16.3	+ .0131	— 3.6	— .0668	— 7.0	+ .0129	— 2.9
Mean,		29.3817	60.7	+ .0033	— 1.5	+ .0012	— 0.3	— .0061	— 0.6	+ .0012	— 0.3

TABLE V.

SPRING PERIOD.

Month and Year.	Number of Obs.	8 A. M.	10 A. M.	4 P. M.	8 P. M.	10 P. M.
		Inches.	Inches.	Inches.	Inches.	Inches.
March 1828,....	152	29.3571	29.3511	29.3295	29.3477	29.3473
April 1828,.....	143	29.1964	29.2039	29.1845	29.1968	29.1989
May 1828,.....	120	29.4142	29.4032	29.3737	29.3952	29.4034
March 1829,....	126	29.4213	29.4269	29.4078	29.4228	29.4268
April 1829,.....	138	29.1012	29.1034	29.1081	29.1276	29.1368
May 1829,.....	147	29.6078	29.6098	29.5948	29.6128	29.6175
March 1830,....	116	29.5144	29.4755	29.4888	29.5018	29.5025
April 1830,.....	86	29.2378	29.2223	29.2095	29.2354	29.2313
May 1830,.....	131	29.4354	29.4341	29.3979	29.4158	29.4119
Sum, ...	1159	264.2856	264.2302	264.0946	264.2559	264.2764
Mean, ...		29.3651	29.3589	29.3438	29.3618	29.3640

TABLE VI.

SUMMER PERIOD.

Month and Year.	Number of Obs.	8 A. M.	10 A. M.	4 P. M.	8 P. M.	10 P. M.
		Inches.	Inches.	Inches.	Inches.	Inches.
June 1828,.....	132	29.5099	29.4979	29.4902	29.4928	29.5063
July 1828,.....	126	29.2508	29.2359	29.2266	29.2473	29.2452
August 1828,...	131	29.3925	29.3855	29.3617	29.3664	29.3716
June 1829,.....	51	29.4493	29.4338	29.4159	29.4325	29.4425
July 1829,.....	107	29.2416	29.2316	29.2242	29.2266	29.2338
August 1829,...	79	29.4720	29.4755	29.4557	29.4614	29.4656
June 1830,.....	126	29.4036	29.3905	29.3876	29.4139	29.4197
July 1830,.....	140	29.4293	29.4270	29.4284	29.4311	29.4428
August 1830,...	85	29.6571	29.3605	29.3528	29.3584	29.3519
Sum, ...	977	264.5061	264.4382	264.3431	264.4304	264.4794
Mean, ...		29.3896	29.3820	29.3715	29.3812	29.3866

TABLE VII.

AUTUMN PERIOD.

Month and Year.	Number of Obs.	8 A. M.	10 A. M.	4 P. M.	8 P. M.	10 P. M.
		Inches.	Inches.	Inches.	Inches.	Inches.
Sept. 1827, ...	50	29.5425	29.5614	29.5437	29.5743	29.5767
Oct. 1827, ...	138	29.3221	29.3199	29.3096	29.3265	29.3271
Nov. 1827, ...	145	29.5669	29.5636	29.5650	29.5391	29.5311
Sept. 1828, ...	86	29.4871	29.5041	29.4649	29.4935	29.4750
Oct. 1828, ...	128	29.5406	29.5355	29.5162	29.5472	29.5492
Nov. 1828, ...	144	29.3466	29.3531	29.3358	29.3324	29.3286
Oct. 1829, ...	117	29.4914	29.4647	29.4835	29.4816	29.4712
Nov. 1829, ...	122	29.6172	29.6401	29.6067	29.6080	29.6093
Sept. } 1830, ...	54	29.2906	29.2813	29.2826	29.2776	29.2583
Oct. }						
Nov. 1830, ...	123	29.1728	29.1987	29.1798	29.1797	29.1858
Sum, ...	1107	294.3778	294.4224	294.2858	294.3599	294.3123
Mean, ...		29.4378	29.4422	29.4286	29.4360	29.4312

TABLE VIII.

WINTER PERIOD.

Month and Year.	Number of Obs.	8 A. M.	10 A. M.	4 P. M.	8 P. M.	10 P. M.
		Inches.	Inches.	Inches.	Inches.	Inches.
Dec. 1827, ...	129	29.0764	29.0853	29.0813	29.0833	29.0804
Jan. 1828, ...	151	29.3977	29.4076	29.4135	29.4237	29.4211
Feb. 1828, ...	142	29.3062	29.2815	29.2807	29.2922	29.2914
Dec. 1828, ...	117	29.2136	29.2389	29.2611	29.2430	29.2393
Jan. 1829, ...	139	29.5008	29.5077	29.4961	29.5034	29.5066
Feb. 1829, ...	81	29.7599	29.7748	29.7310	29.7316	29.7275
Dec. 1829, ...	115	29.7371	29.7296	29.7475	29.7613	29.7644
Jan. 1830, ...	121	29.7227	29.6853	29.7200	29.7321	29.7290
Feb. 1830, ...	110	29.3480	29.3857	29.3620	29.3576	29.3549
Dec. 1830, ...	62	29.3240	29.3511	29.3227	29.3184	29.3108
Sum, ...	1167	294.3864	294.4475	294.4159	294.4466	294.4254
Mean, ...		29.4386	29.4447	29.4416	29.4447	29.4425

EXPLANATION OF PLATE VII.

THIS Diagram is intended to exhibit the curve by which the Horary Oscillation of the Barometer is connected with the Latitude.

The axis AX represents the quadrant of latitude extended into a straight line; and the distances of the points which are laid down on either side of it, give the projections upon an arbitrary scale of the amounts of barometric oscillation. The ordinates are reckoned *plus* to the right hand of the axis, and *minus* to the left. The curve YMy drawn through these points, gives the best expression of the law which connects them, the sum of the squares of the deviations of the observed ordinates from the computed ones being reduced to a minimum, as was shewn in the preceding paper, this curve being merely a mechanical projection of the final equation.

The amount of the equatorial ordinate AY is 2.650 millimetres. That of the polar ordinate Xy is —0.381 millimetres. The latitude at which the oscillation changes its sign, or where the curve cuts the axis at M, is $64^{\circ} 8' 6''$.