P. S. *June 29th*, 1880.—After the earlier part of this paper was drafted, I learnt that M. St. Claire Deville had proposed to make standards of the Commercial Kilogram in a new manner. The metal is to be the Platinum-iridium alloy so as to secure hardness and indestructibility, but, in order that the density may be nearly that of brass, it is to be hollow, the parts are to be soldered together by fusion so as to enclose a constant mass of air, which, of course, will be included in the weighings. This plan has been adopted by the International Commission for making the European Metric Standards, and will no doubt be a great improvement on the old Commercial Standard of France, which is made of brass. The volume of these weights is to be 125 cubic centimetres, so that the density will be 8·0; which is a little lower than that of good sound weights of brass, and materially lower that that of gilt bronze; while it is greater than that of iron.

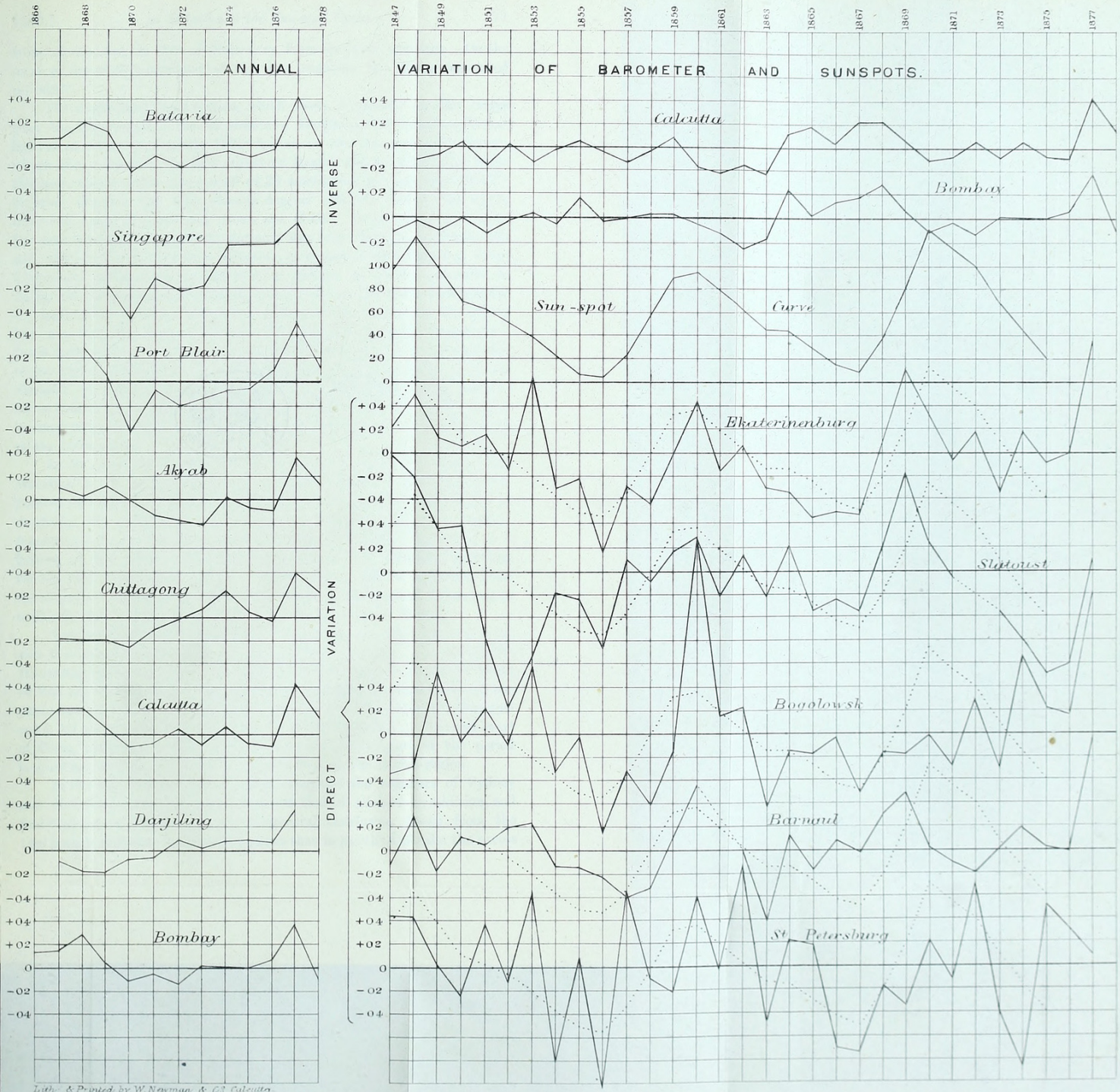
Certainly, the visible Commercial unit, to which reference can be made, appears preferable to the imaginary unit of England. Such a weight would vary in Calcutta with respect to the scientific unit to the extent of about 11 milligrams, and it would be needless to take notice (for commercial purposes) of the much smaller variations with respect to such weight as may be compared with it.

VI.—*On the High Atmospheric Pressure of* 1876-78 *in Asia and Australia, in relation to the Sun-spot Cycle.*—*By* Henry F. Blanford, *Met. Rep. to the Govt. of India.*

(Received December 24th, 1879; Read January 6th, 1880.)

(With Plate I.)

The three years 1876, 1877, and 1878, more especially the two former, were characterized by a deficiency of rainfall in one or many parts of India, and by a more general and very persistent excess of atmospheric pressure. With but slight and local interruptions, from August (in some parts of India from May) 1876 to August (in some cases only to May) 1878, over the whole of the Indian area, the barometer ranged above the average of many years. Nor was this excess of pressure restricted to the land. The register of Port Blair at the Andaman Islands, and that of Nancowry at the Nicobars, shew that, at these insular stations, the excessive pressure was of greater duration and more persistent and intense than at any continental station at or near the sea-level; indeed, with one striking exception, more intense than at any other station in the entire region. At these islands, the pressure rose above the average in May 1876; and, from that time to August 1878 inclusive, the mean pressure of every month was from ·004″ to ·071″ in excess of the average; derived, in the case of Port Blair



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from eleven, and, in that of Nancowry, from six years' registers. On the mean of the whole period and of the two stations, the excess amounted to ·0327″.

The single exceptional station, which shews a greater average excess than the Bay islands, is the hill station of Darjiling in the Sikkim Himalaya, at an elevation of nearly 7000 feet above the sea. At this station, where the barometer has been registered steadily for upwards of 12 years, the mean excess of the same period of 28 months was not less than ·0332″; or, since the first rise took place in August 1876, the mean of the whole unbroken period of 25 months' excess was ·0379″. On the plains of Bengal, the mean excess (average of six stations) was only ·0298 on the 28 months and ·0354 on the 25 months, a reduction, as compared with Darjiling, which is probably explained by the fact that, in Bengal, as indeed generally in India, the mean temperature of the air was also on the whole considerably in excess of the average; so that the stratum of air resting on the plains had less than the average density. This fact is of pregnant importance; for it shews that the excessive pressure in question was due to the condition of the higher atmosphere; of those strata, at all events, that lay above the elevation of 7000 feet; and that, in fact, the prevailing excess, instead of being caused by the conditions recorded at observatories on the plains, was to some extent counteracted by a deficiency in the mass and static pressure of the lower strata.

In his report on the Meteorology of India in 1877, Mr. Eliot drew attention to the persistently high barometric pressure of that year, and pointed out that the barometric registers of Sydney and Melbourne in Australia also "indicated, on the whole, a marked tendency to excessive pressure; and that, therefore, there is a slight probability that this is a feature of the whole area, from India southwards to Australia, including the sea area of the Indian Ocean." Furthermore, that it appeared, from the register of Hongkong, "that the pressure in that part of China was as markedly and persistently in defect as it was in excess in India."

A re-examination of the data shews, however, that this latter conclusion is extremely doubtful, and indeed probably mistaken. I find that the Hongkong barometric registers of past years have been so variously treated that no trustworthy comparison can be instituted on them; and, on the other hand, I find that the excellent registers of Zi-ka-wei near Shanghai point to an opposite conclusion, and shew that here also, on the east coast of China, the pressure was excessive during the greater part of the period in question, though to a much less degree than in the Indian region.

In the case of Australia, Mr. Eliot compared the registers of Sydney and Melbourne only. I have examined that of Adelaide in addition, and find that not only does it confirm the general conclusion drawn from the two former registers, but, further, shews that in South Australia the excess

was more intense than at any other station yet examined either in Australia or India. At this station, the pressure rose above the average in May 1876 (as at the islands in the Bay of Bengal) and, with the exception of 4 months, remained in excess until June 1878; the average excess of the whole period being not less than ·0681″ or $\frac{1}{15}$ of an inch of the barometer. At Melbourne, during the same period, it averaged ·0387″ and was less prolonged. For Sydney, I have registers only up to September 1878, and these shew an excess much below that of Melbourne. It would seem, therefore, that in Australia as in Asia the excessive pressure diminished towards the east coast of the continent.

As a link between the data of the Indian and Australian regions, I have the registers of Singapore and Batavia; for the latter of which I am indebted to the kindness of Dr. Bergsma. At Singapore, the same barometer has not been in use throughout. The barometer registered in 1869 and 1870 having been injured, was replaced by another in 1871 which had never been compared directly or indirectly with the former; and the relative values of the registers in the two former and subsequent years are, therefore, more or less open to doubt. The position of the instrument also has been changed once or twice; but, in comparing the registers of past years, I have applied an appropriate correction for the changes of level. The registers extend from May 1869 to the present time. According to these, during the four and a half years, from May 1869 to October 1873, and certainly from July 1871, in only two months, was the mean pressure of any month slightly above the general average of the month, as deduced from the whole series of years; whereas, from November 1873 to February 1875 (16 months in all), ten months ranged above it, and six only below it; and from March 1875 to June 1878, every month shews an excess, excepting April 1876 (which was the same as the average) and November 1876 and December 1877, which were slightly below it. Hence, it appears that the excessive pressure began earlier and was more prolonged at Singapore than at any other station yet examined; but it was less than half as intense as at Adelaide; the average of the 26 months, May 1876 to June 1878, being only ·0293″.

The register of Batavia affords evidence very similar to that of Singapore. Here also from November 1869 to August 1873, a period of 3 years and 10 months, in only four months did the pressure range slightly above the average; from the latter date to April 1876, in ten months it exceeded the average; and from May 1876 to August 1878, it was above the average in every month except three. The average excess of this period was ·0256.″ Thus, at these two sub-equatorial stations, there is evidence of a gradual rise of atmospheric pressure since 1870; and the Batavian register recorded under the careful superintendence of Dr. Bergsma is of the highest validity.

In Ceylon and Southern India, the excessive pressure was of shorter

duration than at the Bay islands, and on the average of the whole period not more than half as great; *viz.*, ·020′.

As far as can be judged, then, from the available evidence, the excess appears to have been greatest (in the Indian region) on an axis lying between the Nicobars and Bengal. And, in Australia, at Adelaide, or possibly to the westward of that station. In the absence of any sufficient registers for Western Australia, this must remain an open question. To the eastward, however, it certainly diminished greatly at Melbourne, and still more at Sydney. Whether, however, the condition of excessive pressure was continuous between Batavia and South Australia or otherwise, there is no distinct evidence to show.

In Asia, the excess was less in Assam than in Bengal, and was comparatively small at Shanghai (Zi-ka-wei). To the westward, it also diminished, but not quite regularly; since, in Orissa and on the Gangetic plains, it was less than on the plateaux of Chutia Nagpur and Bundelkand, and slightly less than in Rajputana and Sind. Some of these irregularities probably depend on variations of the temperature, and therefore density, of the lower atmosphere; and partly also are apparent only, and owing to the fact that the averages which have served as the standard of the comparison are derived, in some cases, from longer series of years than in others. That, notwithstanding these irregularities, there was, on the whole, a general decrease of the excessive pressure to the westward of the axis above defined, appears, however, pretty clearly, from the following average values of this excess for the whole period of the 28 months of its duration.

		Gangetic plain	+ ·0191″	Punjab	+ ·0132″		
Bengal	+ ·0298″	Chutia Nagpur & Bundelkand	+ ·0284′	Rajputana and Sind	+ ·0215″		
Arakan	+ ·0317″						
Bay islands	+ ·0327″						
				Nagpur and Berar	+ ·0219″	Bombay	+ ·0196″
		Orissa	+ 0164″	Dakhan	+ ·0127″	W.Coast	+ ·0102″
				Carnatic	+ ·0199″	Ceylon	+ ·020″

It may here be observed that this axis or ridge of greatest intensity, if prolonged, lay across the middle of the two great continental masses, Asia and Australia, from Western Siberia to South Australia; a position which suggests the probability that the phenomenon was in some measure dependent on the presence and position of these large land masses.

The variation of the anomalous pressure from month to month, at all the stations above referred to, is given in the accompanying Table I, which shows the deviation of the pressure, in each month, from the average of that month and place (or district), as derived from the registers of many years.

TABLE I.—*Deviation of pressure in each month from the*

		Punjab.	Gangetic plain.	Bundelkand, &c.	South Central Provinces and Berar.	Dakhan and Mysore.	East Coast and Carnatic.
1876.	April,	— ·045	— ·054	— ·033	— ·055	— ·043	— ·054
	May,	— ·045	— ·046	— ·037	— ·043	— ·018	— ·029
	June,	— ·008	— ·012	+ ·008	— ·003	— ·002	— ·008
	July,	— ·037	— ·048	— ·049	— ·041	— ·026	— ·025
	August,	+ ·004	+ ·005	+ ·015	0	+ ·005	— ·015
	September,	+ ·024	+ ·014	+ ·016	+ ·010	+ ·020	— ·001
	October,	+ ·034	+ ·044	+ ·044	+ ·042	+ ·028	+ ·022
	November,	— ·008	— ·015	— ·004	— ·004	— ·009	— ·004
	December,	+ ·051	+ ·034	+ ·042	+ ·044	+ ·032	+ ·044
1877.	January,	+ ·067	+ ·067	+ ·069	+ ·059	+ ·030	+ ·056
	February,	+ ·024	+ ·052	+ ·054	+ ·031	— ·004	+ ·021
	March,	+ ·015	+ ·024	+ ·033	+ ·029	+ ·005	+ ·026
	April,	+ ·053	+ ·060	+ ·065	+ ·050	+ ·025	+ ·045
	May,	+ ·030	+ ·025	+ ·055	+ ·033	+ ·010	+ ·019
	June,	+ ·032	+ ·037	+ ·038	+ ·034	+ ·026	+ ·033
	July,	+ ·011	+ ·012	+ ·040	+ ·057	+ ·054	+ ·038
	August,	— ·022	— ·027	— ·005	+ ·011	+ ·032	+ ·022
	September,	+ ·020	+ ·018	+ ·051	+ ·060	+ ·028	+ ·045
	October,	+ ·043	+ ·048	+ ·053	+ ·060	+ ·033	+ ·067
	November,	+ ·014	+ ·008	+ ·016	+ ·041	+ ·032	+ ·031
	December,	— ·008	— ·007	— ·004	+ ·002	+ ·003	+ ·009
1878.	January,	+ ·031	+ ·035	+ ·044	+ ·018	+ ·011	+ ·030
	February,	+ ·030	+ ·028	+ ·034	+ ·028	+ ·038	+ ·046
	March,	+ ·040	+ ·043	+ ·062	+ ·034	+ ·031	+ ·046
	April,	+ ·022	+ ·041	+ ·050	+ ·035	+ ·027	+ 038
	May,	+ ·029	+ ·050	+ ·048	+ ·023	+ ·012	+ ·023
	June,	+ ·014	— ·007	+ ·020	+ ·006	— ·010	— ·008
	July,	+ ·034	+ ·033	+ ·035	+ ·012	— ·015	— ·005
	August,	+ ·018	+ ·019	+ ·002	— ·014	— ·030	— ·009
	September,	— ·039	— ·031	— ·023	— ·041	— ·039	— ·028

average of the month and place.

Orissa.	Lower Bengal.	Darjeeling.	Assam and Cachar.	Arakan.	Bay Islands.	Singapore.	Batavia.	Rajputana and Sind.
— ·062	— ·052	— ·016	— ·048	— ·044	— ·023	0	— ·037	— ·040
— ·037	— ·017	— ·005	— ·002	— ·012	+ ·025	+ ·033	+ ·008	— ·025
— ·003	+ ·014	+ ·004	— ·002	+ ·012	+ ·023	+ ·030	+ ·001	+ ·002
— ·050	— ·045	— ·018	— ·035	— ·027	+ ·019	+ ·032	+ ·009	— ·047
— ·017	+ ·005	+ ·025	— ·018	— ·010	+ ·009	+ ·023	— ·003	+ ·002
— ·017	+ ·014	+ ·046	+ ·003	+ ·013	+ ·033	+ ·025	+ ·003	+ ·030
+ ·022	+ ·047	+ ·060	+ ·058	+ ·048	+ ·034	+ ·040	+ ·012	+ ·036
— ·036	— ·029	+ ·002	— ·029	— ·030	+ ·008	— ·014	+ ·004	+ ·009
+ ·034	+ ·028	+ ·043	+ ·030	+ ·042	+ ·049	+ ·037	+ ·033	+ ·038
+ ·064	+ ·065	+ ·107	+ ·084	+ ·073	+ ·066	+ ·060	+ ·054	+ ·054
+ ·062	+ ·072	+ ·031	+ ·065	+ ·060	+ ·039	+ ·043	+ ·047	+ ·023
+ ·034	+ ·038	+ ·029	+ ·027	+ ·044	+ ·029	+ ·026	+ ·028	+ ·014
+ ·065	+ ·070	+ ·028	+ ·061	+ ·058	+ ·034	+ ·029	+ ·030	+ ·039
+ ·041	+ ·042	+ ·019	+ ·032	+ ·037	+ ·027	+ ·020	+ ·016	+ ·047
+ ·015	+ ·032	+ ·041	+ ·022	+ ·014	+ ·049	+ ·049	+ ·051	+ ·034
+ ·032	+ ·023	+ ·015	— ·001	+ ·002	+ ·045	+ ·045	+ ·057	+ ·065
— ·032	— ·032	+ ·012	— ·037	— ·040	+ ·034	+ ·054	+ ·066	+ ·044
+ ·057	+ ·058	+ ·037	+ ·051	+ ·078	+ ·056	+ ·040	+ ·054	+ ·055
+ ·062	+ ·077	+ ·066	+ ·081	+ ·082	+ ·071	+ ·049	+ ·058	+ ·032
+ ·008	+ ·008	+ ·028	+ ·017	+ ·031	+ ·042	+ ·036	+ ·033	+ ·017
— ·018	— ·003	+ ·011	— ·004	+ ·016	+ ·015	— ·003	+ ·008	— ·008
+ ·019	+ ·045	+ ·021	+ ·044	+ ·054	+ ·035	+ ·015	+ ·026	+ ·038
+ ·017	+ ·030	+ ·042	+ ·035	+ ·062	+ ·046	+ ·033	+ ·051	+ 037
+ ·036	+ ·050	+ ·068	+ ·069	+ ·073	+ ·051	+ ·036	+ ·039	+ ·041
+ ·040	+ ·055	+ ·059	+ ·058	+ ·042	+ ·032	+ ·016	+ ·012	+ ·029
+ ·035	+ ·060	+ ·029	+ ·049	+ ·035	+ ·004	+ ·002	— ·002	+ ·013
— ·011	+ ·015	+ ·026	+ ·011	+ ·019	+ ·007	+ ·005	+ ·006	+ ·017
+ ·024	+ ·067	+ ·056	+ ·066	+ ·071	+ ·012	— ·014	— ·022	+ ·001
+ ·003	+ ·047	+ ·047	+ ·050	+ ·061	+ ·021	+ ·014	+ ·002	— ·036
— ·042	— ·023	— ·009	— ·028	— ·025	— ·014	— ·011	— ·015	— ·040

TABLE I.—*Deviation of pressure in each month from the average of the month and place.*—(Continued.)

		Bombay.	Ceylon.	Zi-ka-wei.	Sydney.	Melbourne.	Adelaide.
1876.	April, ...	— ·039	— ·039	— ·037	— ·167	— ·094	— ·002
	May, ...	+ ·009	— ·003	+ ·030	+ ·072	— ·106	+ ·110
	June, ...	+ ·026	+ ·002	+ ·018	+ ·039	+ ·043	+ ·094
	July, ...	— ·020	— ·007	+ ·021	+ ·007	+ ·097	+ ·072
	August, ...	+ ·018	— ·007	— ·016	+ ·013	+ ·048	+ ·101
	September, ...	+ ·034	+ ·006	+ ·043	— ·061	+ ·001	+ ·100
	October, ...	+ ·045	+ ·017	— ·018	+ ·120	— ·060	— ·031
	November, ...	— ·004	— ·013	— ·071	— ·191	— ·119	— ·053
	December, ...	+ ·023	+ ·028	+ ·014	+ ·035	+ ·056	+ ·077
1877.	January, ...	+ ·038	+ ·045	+ ·022	— ·051	+ ·007	+ ·040
	February, ...	+ ·027	+ ·032	+ ·036	+ ·052	+ ·026	+ ·026
	March, ...	+ ·025	+ ·017	— ·011	+ ·061	+ ·060	+ ·057
	April, ...	+ ·029	+ ·027	— ·019	+ ·024	+ ·053	+ ·079
	May, ...	+ ·035	+ ·017	+ ·012	— ·209	— ·152	— ·112
	June, ...	+ ·055	+ ·057	+ ·006	+ ·196	+ ·204	+ ·285
	July, ...	+ ·097	+ ·043	+ ·005	+ ·137	+ ·163	+ ·090
	August, ...	+ ·052	+ ·050	+ ·015	+ ·065	+ ·087	+ ·118
	September, ...	+ ·038	+ ·040	+ ·024	+ ·077	+ ·152	+ ·162
	October, ...	+ ·034	+ ·060	+ ·030		+ ·121	+ ·101
	November, ...	+ ·020	+ ·029	+ ·004		— ·002	+ ·081
	December, ...	— ·015	— ·003	— ·008		+ ·011	+ ·063
1878.	January, ...	+ ·015	+ ·020	+ ·045		+ 125	+ ·114
	February, ...	+ ·043	+ ·037	+ ·079		+ ·064	+ ·092
	March, ...	+ ·039	+ ·035	+ ·080		— ·018	+ ·013
	April, ...	+ ·020	+ ·026	+ ·052		— ·039	— ·025
	May, ...	+ ·025	+ ·009	— ·015		+ ·072	+ ·104
	June, ...	+ ·022	+ ·007	— ·001		— ·099	+ ·014
	July, ...	0	— ·010	+ ·020		— ·155	— ·161
	August, ...	— ·049	— ·003	+ ·033		— ·076	+ ·003
	September, ...	— ·083	— ·009	— ·058		— ·115	— ·133

Not received.

Evidence bearing on the northern prolongation of the axis of maximum pressure across Central Asia (at least up to the end of 1877) is afforded by the old established observatories of the Russian empire; the registers of which, since 1847, are given in the 'Annales de l'Observatoire Physique Central de Russie'. Before, however, proceeding to notice the barometric condition of this region during the special period in question, I must draw attention to another class of facts, which have an important bearing on the subject, and which, although not entirely new, have been brought out in the present investigation with remarkable clearness and prominence.

I have already noticed the evidence furnished by the registers of Singapore and Batavia, of a persistently low pressure from 1869 to the latter part of 1873, of its gradual rise during the subsequent years, and its culmination in 1877. The Batavian register extends as far back as 1866; comprising, therefore, a period of 13 years, and somewhat more than a complete cycle of sun-spot variation. The deviation of the mean pressure of each year from the general average of the whole period is given in the second column of Table II; and, in the first, I have given the variation of Wolf's sun-spots numbers up to 1875, the latest date for which I have them. I need only add that from 1875 to the early part of the present year, was a prolonged period of minimum solar activity. The coincidence of the barometric variation with that of the sun-spots is too obvious to need comment; and it is emphatically to be noticed that the minimum of pressure coincides with the maximum of spots, and *vice versâ*. The remaining columns of the table give the annual deviation of the mean pressure of each year from the general local averages, for the stations Singapore, Port Blair, Colombo, Akyab, Chittagong, Calcutta, and Darjiling, from 1867 to 1878; and the accompanying plate represents graphically the course of variation at each station from year to year. All these exhibit, more or less distinctly, an oscillation similar to that of Batavia; being most pronounced at insular and sub-equatorial stations. Table III gives the annual barometric variation of Calcutta and Bombay from 1848 and 1852 respectively, and Plate I, the corresponding curves.

TABLE II.—*Annual variation of barometric pressure in Indo-Malayan region.*

Years.	Wolf's sun-spot numbers.	Batavia.	Singapore.	Colombo.	Port Blair.	Akyab.	Chittagong.	Calcutta.	Darjiling.	Bombay.
1867	8·8	+ ·006	...	...	...	+ ·009	— ·017	+ ·022	— ·008 (6)	+ ·015
'68	36·8	+ .020	...	...	+ ·029	+ ·003	— ·019	+ ·022	— ·017	+ ·027
'69	78·6	+ ·011	— ·018 (1)	...	+ ·006	+ ·012 (4)	— ·019	+ ·006	— ·019	+ ·005
'70	131·8	— ·023	— ·044	...	— ·042	— ·001 (5)	— ·026	— ·011	— ·009	— ·012
'71	113·8	— ·009	— ·011 (2)	...	— ·006 (3)	— ·013	— ·008	— ·008	— ·007	— ·004
'72	99·7	— ·020	— ·023	— ·020	— ·020	— ·017	— ·001	+ ·004	+ ·009	— ·014
'73	67·7	— ·010	— ·017	— ·005	— ·013	— ·021	+ ·007	— ·008	+ ·001	— ·010
'74	43·1	— ·006	+ ·018	+ ·003	— ·007	+ ·001	+ ·023	+ ·005	+ ·008	— ·011
'75	18·9	— ·011	+ ·018	— ·004	— ·006	— ·008	+ ·002	— ·008	+ ·009	0
'76	...	— ·002	+ ·019	+ ·002	+ ·010	— ·009	— ·003	— ·009	+ ·006	+ ·007
'77	...	+ ·042	+ ·037	+ ·037	+ ·052	+ ·036	+ ·039	+ ·044	+ ·035	+ ·037
'78	...	— ·001	— ·002	0	+ ·010	+ ·012	+ ·022	+ ·014	+ ·012	— ·011

(1) Last eight months.

(2) Last six months.

(3) January, February and last six months.

(4) Wanting February and December.

(5) Wanting January.

(6) Last six months only.

TABLE III.—*Annual variation of pressure at Calcutta and Bombay.*

Years.	Calcutta.	Bombay.	Years.	Calcutta.	Bombay.
1847	...	— ·012	1858	— ·003	+ ·003
'48	...	— ·004	'59	+ ·009	+ ·004
'49	...	— ·011	'60	— ·019	— ·005
'50	...	— ·001	'61	— ·023	— ·012
'51	...	— ·013	'62	— ·017	— ·026
'52	...	— ·004	'63	— ·024	— ·017
'53	— ·013	+ ·005	'64	— ·011	+ ·023
'54	— ·002	— ·005	'65	+ ·018	+ ·002
'55	+ ·005	+ ·015	'66	+ ·004	+ ·013
'56	— ·004	— ·003	'67	+ ·022	+ ·015
'57	— ·013	— ·001	'68	+ ·022	+ ·027

From these facts, it may be concluded that, in the Indo-Malayan region, the pressure of the atmosphere is subject to a cyclical variation, coinciding in period with that of the sun-spots; and such that the epoch of maximum pressure corresponds to that of minimum sun-spots and that of minimum pressure to that of maximum sun-spots. When, however, we turn to Western Siberia, we find an oscillation, not less, nay, far more pronounced, and precisely of the opposite character; the maximum of pressure there coinciding with the maximum of sun-spots, and *vice versâ*. The station which exhibits this most prominently, is Ekaterinenburg at the eastern foot of the Oural. But it is also very distinctly recognizable at Bogolowsk to the North, at Slatoust to the South-west, at Barnoul at the northern foot of the Altai, and, as Mr. Archibald pointed out some time since in the pages of 'Nature,' at St. Petersburg. The annual differences at these stations are given in Table IV, and the corresponding curves in the accompanying plate.

TABLE IV.—*Annual variation of barometric pressure in Russia and Western Siberia.*

Years.	Wolf's sun-spot numbers.	St. Petersburgh.	Bogolowsk.	Ekaterinenburg.	Slatoust.	Barnoul.
1847	97·4	+ ·045	— ·034	+ ·022	+ ·097	— ·011
'48	124·9	+ ·044	— ·027	+ ·049	+ ·078	+ ·028
'49	95·4	+ ·003	+ ·053	+ ·011	+ ·033	— ·017
'50	69·8	— ·027	— ·009	+ ·006	+ ·037	+ ·011
'51	63.2	+ ·036	+ ·023	+ ·014	— ·055	+ ·007
'52	52·7	— ·012	— ·012	— ·015	— ·118	+ ·019
'53	38·5	+ ·065	+ ·059	+ ·065	— ·074	+ ·023
'54	21·0	— ·081	— ·034	— ·032	— ·019	— ·013
'55	7·7	+ ·008	— ·003	— ·023	— ·024	— ·013
'56	5·1	— ·104	— ·087	— ·087	— ·069	— ·024
'57	22·9	+ ·064	— ·032	— ·029	+ ·009	— ·040
'58	56·2	— .010	— ·062	— ·045	— ·010	— ·031
'59	90·3	— ·022	— ·016	— ·004	+ ·015	+ .008
'60	94·8	+ ·061	+ ·171	+ ·046	+ ·028	+ ·055
'61	77·7	— ·005	+ ·014	— ·016	— ·021	
'62	61·0	+ ·086	+ ·022	+ ·006	+ ·014	
'63	45·4	— ·049	— ·064	— ·031	— ·023	— ·062
'64	45·2	+ ·021	— ·014	— ·034	+ ·021	+ ·013
'65	31·4	+ ·018	— ·018	— ·056	— ·036	— ·017
'66	14·7	— ·071	— ·004	— ·052	— ·025	+ ·008
'67	8·8	— ·073	— ·052	— ·053	— ·035	— ·003
'68	36·8	— ·017	— ·017	+ ·008	+ ·017	+ ·030
'69	78·6	— ·034	— ·019	+ ·071	+ ·082	+ ·050
'70	131·8	+ ·023	— ·001	+ ·030	+ ·025	+ ·002
'71	113·8	— ·012	— ·029	— ·009	— ·007	— ·011
'72	99·7	+ ·070	+ ·030	+ ·017	?	— 020
'73	67·7	— ·040	— ·033	— ·038	— ·034	— ·001
'74	43·1	— ·087	+ ·066	+ ·016	— ·060	+ ·019
'75	18·9	+ ·051	+ ·022	— ·007	— .088	+ .003
'76	...	+ ·031	+ ·015	0	— ·080	— ·001
'77	...	+ ·008	+ ·121	+ ·095	+ .010	+ ·098

All these stations, be it observed, are in Western Siberia or European Russia; and it now becomes of interest to ascertain over what area this kind of oscillation obtains. To do this, I have tabulated the barometric data for Tiflis on the South-west, and Nertschinsk and Pekin on the East. No one of these stations exhibits characters resembling those of the stations in Western Siberia; and the curve of Pekin, which is fragmentary, seems rather to exhibit the Indo-Malayan type of variation than that of the Ural stations. Hence, it would seem there is a reciprocal oscillation of atmospheric pressure between Western Siberia and the Indo-Malayan region

(perhaps including China) having a period which coincides with that of sun-spot variation; and that Tiflis on the one hand and Nertschinsk on the other lie beyond the limits of its influence.

Now, seeing that the Indo-Malayan barometric maximum of 1876-78 coincided with a portion of the prolonged sun-spot minimum of 1876-79, the facts detailed above would lead us to expect a corresponding deficiency of pressure in Western Siberia. Strange to say, however, this was not the case. The registers of Bogolowsk, Ekaterinenburg, Slatoust, and Barnoul agree in showing a great excess of pressure in 1877, which in the case of Ekaterinenburg was greater than that of any Indian stations, and nearly as great as that of Adelaide. I have not yet received the volume of the 'Annales' for the year 1878; but, on the average of the 20 months from May 1876 to December 1877, it amounted to ·0611." The great excess appears to have been restricted to the stations in Western Siberia. At St. Petersburg, although the pressure was above the average in 1876 and 1877, the excess was far less striking; and that of 1877 was less than that of 1876. At Tiflis, the pressure of the two years was either about the average or below it; and, at Pekin and Nertschinsk, it was not greater than at Shanghai [Zi-ka-wei].

Hence, there prevailed in Asia generally, in 1877, an anomalous (*i. e.*, apparently non-periodic) accumulation of atmospheric pressure, culminating in Western Siberia, and diminishing both to East and West, and also to South. And this seat of maximum lies on the prolongation to the North-west of the Indo-Malayan axis of excessive pressure noticed in the earlier part of this paper. It is at least probable that this anomalous accumulation of pressure extended in a much diminished degree to the Indo-Malayan region, where it was superimposed on the normal periodic excess of that region, and produced a maximum which was more intense than any previously recorded. Also that the excessive pressure of Australia was a phenomenon of the same order as that of Siberia; indeed its southern counterpart. It is at least certain that they exhibit a resemblance in certain not unimportant features to which I shall draw attention in a subsequent paper; merely remarking that, in both cases, these great oscillations of pressure, both periodic and non-periodic, appear to depend mainly, perhaps, indeed, entirely, on the variations of the winter season. Of this, in the case of Ekaterinenburg more especially, the evidence is most striking and convincing, and, as far as I have yet examined the Australian registers, it appears to hold good in their case also.