

The climate of Shanghai

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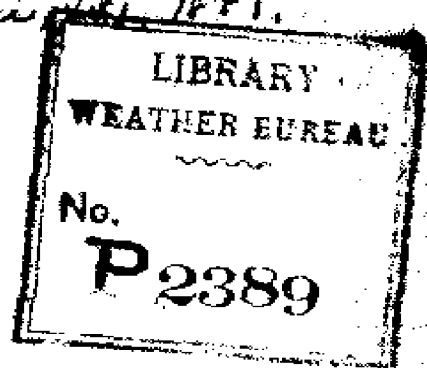
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Shanghai, 1881.



ARTICLE IV.

THE CLIMATE OF SHANGHAI.  
ITS METEOROLOGICAL CONDITION.\*

BY

THE REV. FATHER M. DECHEVRENS, S.J.

Director of the Zi-ka-wei Observatory.

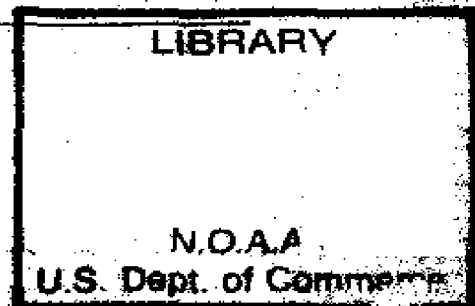
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The ever growing importance of the study of climates cannot be called in question nowadays, and all serious minds, though sometimes apprehensive of the difficulties of such a study, are led to admit that the modifications brought about in the human organism under the influence of climate are as important as those we seek for in the practice of public and private hygiene.

*Prevention is better than cure*: the knowledge of the various climates will effect that object, and it has been said with reason that whenever the science of hygiene shall have advanced so far as to point out to every one what country he must prefer, the power of medicine may be said to be doubled. Ages of observation go to prove that for any disease recovery is difficult in the medium where it originated; whereas it is possible to prevent the formation, or at least to stop the progress of chronic diseases by keeping off the external causes on which they depend, or by sparing to patients the impressions they would receive from such causes. But to that end one must needs be well acquainted with the characteristics of the various climates that divide the

1 Latitude 31° 14' 32" North.  
Longitude 121° 29' 8" East of Greenwich.  
Height 0 ft.

\* Read before the Society on the 28th October, 1881.



# National Oceanic and Atmospheric Administration

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immense surface of our globe; otherwise the remedy sought for in a change of air or in emigration might be worse than the evil.

This is one of the reasons why Meteorology has lately assumed so great an importance.

What is the true meaning of the word *Climate* and what is understood by *Climatology*?

Ancient astronomers employed the word *κλίμα* or *region* to designate the space comprised between two circles parallel to the earth's equator; such belts or *climates* were used to indicate the duration of days and nights from the equator to the pole. That ill-defined division of the earth into thirty *climates* of unequal breadth has been superseded by the system of latitudes. Hence the word *Climate*, in its most natural acceptation, designates a certain extent of the surface of the globe offering all over the same conditions of existence. In a word, *climate* is the positive influence of air, water and places on man as a unit and on men congregated in numbers and dwelling on a limited spot of the globe. Such was already the conception of climate in Hippocrates' mind, when he treated of the influence of places (*τόπων*), of water (*ὕδρων*), and of air (*ἀέρων*) for maintaining health and generating disease.

*Climatology* is a science devoted to the study of climates; it borrows largely from Physical Geography, Geology, Hydrology, Meteorology, Medicine, and Statistics.

These then are the various sciences we must have recourse to for a complete study of the Climate of Shanghai. The importance acquired by this great mart, the trade of which has taken such a wonderful increase, would call for a serious and complete inquiry. But unable to grasp all sides of the question, I shall only bring in my share of the work and limit myself to the meteorological point of view, which after all is the most important as meteorological phenomena are those that most affect public health.

## I.—TEMPERATURE.

Of all the elements that go to make up a climate, *temperature* is by far the most important. Its variations are the cause of

nearly all the other meteorological phenomena by which climates differ. It therefore always ranks first in the study of a climate.

The increase of temperature with the depth within the crust of the globe, the existence of hot springs and volcanic eruptions, all concur to prove that the heat stored up in the earth does not all proceed from the Sun. Yet, strictly speaking, it can be said that the variations of temperature at the surface are solely due to solar heat.

The mean temperature of a place, as observed by means of thermometers placed in more or less favourable situations, is dependent, more than is generally supposed, upon the nature of the soil and of everything that happens to be in the vicinity of the instruments. Generally speaking, the better all external influence be warded off, the more precautions be taken to get the thermometer in equilibrium of temperature with the air that freely scours over the country, the nearer to the truth will the results be.

The annual mean temperature of the Shanghai district, as given by eight years' uninterrupted observations made under favourable conditions at the Zi-ka-wei Observatory<sup>2</sup> is:

59.° 2 Fahr.

According to Arago the isothermal line of 59°, or the line all the points of which enjoy this mean temperature, passes 0.° 30' North of Chapel-Hill (U. S.), through Montpellier (France), 0.° 20' North of Florence (Italy), 0.° 40' North of Athens (Greece), 1° South of Baku (Caspian Sea), 1.° 5' North of Nagasaki (Japan). This line is far from corresponding to the parallel of Shanghai (31°), which crosses Texas, passes through Morocco, Alexandria and Lahore, countries and towns which all have a much higher mean temperature than Shanghai. The isothermal line of 59° is considerably deflected to the South on reaching the Eastern coast of Asia.

All the points of an isothermal line do not enjoy the same climate, since a climate with regard to temperature may either be extreme or temperate according as the mean temperatures of

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<sup>2</sup> The Zi-ka-wei Observatory (French Jesuit missionaries), 3.5 miles S.W. of Shanghai.

Winter and Summer differ more or less. Thus at Yakutsk (Siberia) the annual range of mean monthly temperature, or the difference between the mean temperatures of January and of July, is  $104.^\circ 7$ , an enormous variation if compared with Bangkok (Siam) where it does not exceed  $5.^\circ 4$ . At Shanghai the annual variation of monthly temperature is  $45.^\circ 3$ , indicating a rather severe climate.

The mean temperatures of the four seasons, from eight years' observations, are:

Winter	$39.^\circ 1$
Spring	$56.^\circ 9$
Summer	$78.^\circ 2$
Autumn	$62.^\circ 6$

The mean temperature for each month is as follows:—

January	.....	$35.^\circ 8$	July	.....	$81.^\circ 1$
February	.....	$39. 6$	August	.....	$80. 1$
March	.....	$46. 8$	September	.....	$73. 4$
April	.....	$57. 2$	October	.....	$63. 3$
May	.....	$66. 9$	November	.....	$51. 3$
June	.....	$73. 4$	December	.....	$41. 9$

It may be both interesting and useful to know the mean temperature of all the days of the year to be enabled to foretell changes of weather with some degree of probability. The following table gives the mean temperatures of each five days, as deduced from all the observations of the last 8 years (1873-1880). One may notice the coldest day on January 5th ( $30.^\circ 6$ ) and the hottest on July 6th ( $83.^\circ 7$ ), giving a range of  $53.^\circ 1$ .

*Mean temperature at Shanghai for each five days.*

from 1 to 5 January	$33.^\circ 8$	from 2 — 6 March	$41.^\circ 9$
„ 6 — 10 „	$36. 0$	„ 7 — 11 „	$45. 6$
„ 11 — 15 „	$36. 0$	„ 12 — 16 „	$46. 3$
„ 16 — 20 „	$36. 4$	„ 17 — 21 „	$47. 8$
„ 21 — 25 „	$36. 6$	„ 22 — 26 „	$49. 4$
„ 26 — 30 „	$35. 1$	„ 27 — 31 „	$51. 2$
„ 31 — 4 February	$37. 8$	„ 1 — 5 April	$54. 1$
„ 5 — 9 „	$38. 1$	„ 6 — 10 „	$55. 0$
„ 10 — 14 „	$37. 6$	„ 11 — 15 „	$54. 0$
„ 15 — 19 „	$39. 2$	„ 16 — 20 „	$56. 6$
„ 20 — 24 „	$42. 4$	„ 21 — 25 „	$60. 4$
„ 25 — 1 March	$42. 0$	„ 26 — 30 „	$62. 9$

from 1 — 5 May	63.° 7	from 3 — 7 September	77.° 1
„ 6 — 10 „	65. 4	„ 8 — 12 „	74. 8
„ 11 — 15 „	65. 6	„ 13 — 17 „	71. 9
„ 16 — 20 „	66. 6	„ 18 — 22 „	72. 5
„ 21 — 25 „	70. 0	„ 23 — 27 „	70. 7
„ 26 — 30 „	70. 3	„ 28 — 2 October	69. 4
„ 31 — 4 June	70. 6	„ 3 — 7 „	67. 6
„ 5 — 9 „	71. 7	„ 8 — 12 „	64. 8
„ 10 — 14 „	72. 4	„ 13 — 17 „	63. 4
„ 15 — 19 „	74. 4	„ 18 — 22 „	62. 9
„ 20 — 24 „	73. 8	„ 23 — 27 „	60. 2
„ 25 — 29 „	75. 7	„ 28 — 1 November	57. 0
„ 30 to 4 July	79. 0	„ 2 — 6 „	55. 4
„ 5 — 9 „	82. 8	„ 7 — 11 „	52. 6
„ 10 — 14 „	80. 1	„ 12 — 16 „	51. 7
„ 15 — 19 „	80. 3	„ 17 — 21 „	51. 2
„ 20 — 24 „	81. 5	„ 22 — 26 „	48. 1
„ 25 — 29 „	81. 9	„ 27 — 1 December	46. 2
„ 30 — 3 August	81. 9	„ 2 — 6 „	45. 3
„ 4 — 8 „	81. 6	„ 7 — 11 „	42. 4
„ 9 — 13 „	82. 1	„ 12 — 16 „	44. 1
„ 14 — 18 „	80. 9	„ 17 — 21 „	40. 7
„ 19 — 23 „	79. 3	„ 22 — 26 „	39. 6
„ 24 — 28 „	77. 7	„ 27 — 31 „	37. 7
„ 29 — 2 September	77. 7		

To give a fair idea of the variations of temperature at Shanghai, I subjoin the means of the maxima and minima for the same 8 years :

	Minima.	Maxima.
January	17.° 8	57.° 2
February	24. 3	61. 0
March	30. 2	75. 9
April	36. 7	84. 2
May	46. 9	89. 2
June	57. 7	92. 8
July	67. 8	97. 2
August	65. 3	95. 5
September	55. 8	90. 7
October	40. 1	82. 6
November	28. 9	72. 7
December	21. 2	65. 3

Mean of the { absolute minima : 16.° 5    absolute minimum : 12.° 2    January 1878  
 { absolute maxima : 97. 7    absolute maximum : 102. 0    July 1875

In this period of 8 years (1873-1880) there were on an average 14 days, each year, whose mean temperature was lower than *freezing point*, or 32° Fahr. (0° centigrade). In 1878, from the 3rd to the 22nd of January, there were 17 days on which the temperature kept under 32°. For the sake of comparison, let us mention that in Paris, from 1820 to 1872, there were no more than 21 days on which the temperature kept below 32°, the annual average being only 0.4 day.

*Mean temperature of a few towns as a term for comparison:*

	Year.	Winter (D J.F.)	Summer (J.J.A.)
Shanghai	59.° 2	30.° 1	78.° 2
London	49. 6	39. 2	61. 0
Paris	51. 3	37. 9	64. 9
Peking	53. 2	27. 0	77. 0
New York	53. 8	29. 8	79. 2
Madrid	57. 7	42. 1	74. 1
Rome	59. 7	46. 6	73. 2
Hongkong	72. 5	60. 1	82. 3

We will see, when treating of moisture, how such variations of temperature can influence public health. For the manner in which the human body is affected is quite different with dry or moist air, whether warm or cold; and on such actions the salubrity of a country depends for a great part, together with the advantages or inconveniences it may offer with regard to public and private hygiene.

The variation of the temperature of the air in the course of a day is mostly dependent upon the relative length of days and nights and the clearness of the atmosphere, especially at night. The following table shows this variation at Shanghai for the four seasons of the year: it will be seen that the daily range is not invariable, being smallest in summer and greatest in spring. The greater length of days and the less obliquity of the sun's rays, in summer, are amply compensated by the mantle of vapour in the air which covers the country and prevents the cooling through radiation at night.



*Daily variation of temperature for the four seasons at Shanghai  
(5 years, 1876-1880):*

Hours.	Winter.	Spring.	Summer.	Autumn.	Year.
1 a.m.	36° 0	52° 4	73° 6	58° 5	55° 1
4 "	35. 2	51. 2	72. 9	57. 7	54. 2
7 "	34. 7	53. 4	75. 9	59. 2	55. 8
10 "	41. 2	60. 4	81. 7	67. 8	62. 8
1 p.m.	44. 2	63. 3	83. 7	69. 6	65. 2
4 "	43. 1	62. 0	82. 0	67. 7	63. 7
7 "	38. 7	56. 4	77. 0	61. 7	58. 5
10 "	36. 9	53. 9	74. 7	59. 7	56. 3
Minimum	h. m. 5. 30 a.m. 34. 0 5	p. m. 5. 0 a.m. 51. 0 5	h. m. 4. 30 a.m. 72. 0 8	h. m. 5. 0 a.m. 52. 0 7	h. m. 5. 30 a.m. 54. 0 2
Maximum	2. 00 p.m. 44. 5	2. 00 p.m. 63. 5	1. 30 p.m. 83. 0	1. 0 p.m. 69. 5	1. 45 p.m. 65. 2

II.—SOLAR RADIATION.

Though light and heat are intimately connected as radiated by the Sun, yet the causes of diminution for each are not the same. The interposition of a cloud between the Sun and the soil suffices to extinguish a great part of the solar light without materially diminishing the amount of heat absorbed by the air in a short interval. However exceptional a year may be in regard to variations of temperature, never will January or February be found warmer than July or August; but the amount of light received by the surface of the soil can easily be greater in Winter than in Summer. Let the Winter be very cold and dry with a very clear sky and the Summer be warm and wet with a great deal of rain and clouds, and there will be a similar contrast in the general lighting of the air. Thus, in July 1880, we did not receive, at Zi-ka-wei, more than .83 of the light which the Sun can send us under the most favourable conditions, whilst in January 1881, we were exceptionally favoured and received .49 of that light. Thus again, January and July 1880 both received the same proportion of light.

Now it is well known that every living being requires, not only the Sun's heat, but also and almost in the same degree his light. Valuable information about the Climate of a place may thus be supplied by *Actinometry*, or that department of Meteorology which deals with solar radiation comprising the heat and light available at the surface of the soil.

Herewith are the results of the last 6 years, calculated from only the three principal observations of 10h. a.m., 1h. p.m. and 4h. p.m.

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Year
1875	.39	.36	.36	.44	.45	.31	.47	.48	.33	.37	.37	.36	.38
1876	.25	.25	.36	.37	.47	.37	.48	.48	.51	.44	.39	.34	.39
1877	.35	.41	.43	.46	.46	.41	.39	.58	.39	.49	.25	.25	.39
1878	.42	.30	.43	.32	.43	.44	.41	.46	.40	.34	.34	.41	.38
1879	.36	.39	.42	.43	.39	.43	.58	.55	.48	.38	.39	.46	.42
1880	.33	.20	.33	.45	.49	.48	.33	.41	.40	.44	.46	.39	.41
Mean	.35	.32	.42	.40	.44	.41	.44	.48	.41	.41	.35	.37	.39

These results, which I have purposely given in full, may be greatly useful to Shanghai physicians if compared with the sanitary state of the Settlements. For comparison's sake, I may add that, at Paris, the mean proportion of light for the period 1872-1878, observed in the same manner as at Zi-ka-wei, was .28 in December (minimum) and .65 in July (maximum), the annual mean being under .49. It must be remarked however that in the calculations the observations of 6 a. m. and 6 p. m. were taken into account.<sup>3</sup>

### III.—MOISTURE.

The determination of this element is of great importance. Moisture has been considered by climatologists as one of the physical properties of the air most injurious to human life. A moist atmosphere checks the spontaneous evaporation of the surface of the skin and exercises a debilitating action on all organic functions: a dry air, on the contrary, favours evaporation; it is vivifying and bracing. Whoever has resided at Shanghai for a few years knows by experience how in Summer the strongest man feels oppressed and sluggish, whilst in Winter he has a sense of exalted vitality and excessive muscular energy. It is because in the hottest months, June, July, and August, the air is loaded with moisture, whilst in the cold season, December, January, and February, it is very dry. I shall hereafter, when speaking of the winds, give the reason of this remarkable difference between Summer and Winter in this country.

But first, what is properly moisture? It is easier to feel it than to give a definition of it. One often hears of the air being more or less moist, more or less saturated with humidity: what is the precise meaning of these expressions?

<sup>3</sup> Annuaire de l'Observatoire de Montsouris, 1879.

Physicists easily prove that a volume of air cannot, at a given temperature, contain more than a certain quantity of vapour: it is then said to be *saturated*; any water in excess of that quantity will remain in the liquid state. Thus a cubic foot of dry air, at a pressure of 30 inches and at 32° Fahrenheit, weighs 563 grains; under these conditions it cannot take up more than 2.11 gr. of water as vapour; at 90° it could hold 13.47 gr.

Knowing the maximum weight for each temperature and degree of atmospheric pressure, and possessing instruments whose indications give the means to calculate the actual weight of vapour in a cubic foot of air, it will be easy to ascertain the exact degree of moisture of that air and consequently of the mass of air to which it belongs; for the degree of moisture is nothing else than the ratio of the actual weight of vapour contained in the air to the maximum weight it could hold at the same temperature and pressure. The instruments most in use for that purpose are the Psychrometer or better still Regnault's condensation hygrometer.

The following tables will help to form an idea of the hygrometric conditions of this place.

*Weight of vapour in a cubic foot of air at Shanghai (8 years).*

January.	February.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.	gr.
2.00	2.26	2.85	4.11	5.99	7.42	9.39	9.08	7.87	5.91	3.27	2.43	5.10

*Degree of moisture of air for each month (8 years).*

January.	February.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
°/°	°/°	°/°	°/°	°/°	°/°	°/°	°/°	°/°	°/°	°/°	°/°	°/°
80	79	77	78	78	84	84	83	83	78	76	77	80

*Degree of moisture of air at different periods of the day for the four seasons (5 years).*

Hours.	Winter.	Spring.	Summer.	Autumn.	Year.
	°/°	°/°	°/°	°/°	°/°
1 a.m.	88.7	89.4	93.6	91.1	90.7
4 "	89.7	90.8	94.6	91.9	91.8
7 "	90.3	87.6	89.0	89.9	89.2
10 "	74.6	69.9	73.4	67.3	71.3
1 p.m.	65.8	63.4	70.6	60.6	65.1
4 "	68.1	66.4	73.9	64.6	68.2
7 "	81.0	80.5	86.5	82.4	82.6
10 "	86.4	86.6	92.0	88.2	88.3
Mean	80.6	79.3	84.2	79.5	80.9

Continents naturally supply less vapour to the atmosphere than the sea; the degree of moisture is therefore generally lower in the interior than on the coast. If then we have a coast where the wind in the course of the year blows alternately from the interior of the continent and from the open sea, the moisture will increase or diminish as the wind blows from the sea or from the land. The absolute quantity of water in the air will generally reach its maximum during the warm season, but the relative moisture will mostly depend upon the prevailing winds. At Shanghai, E. and S. E. winds from the sea are the prevailing winds during the six months of the warm season, N. E. and N. W. winds being the most common during the cold months. There is then a double reason for Summer being the moist season, as the capacity of air for vapour rapidly rises with the temperature; and the air blown from the sea is always near its point of saturation. In winter, on the contrary, the vapour in the air is far from saturating it, notwithstanding the low temperature; and the winter at Shanghai is often very dry.

The passage from one system to the other is slow as it appears from the foregoing tables, and this gradual transition is far better for the body than the rapid change that generally takes place in the interior of the continent, at Peking for instance.

We will review in a few words the advantages and drawbacks of those two mediums in which residents in this country live by turns in the course of the year.

*Winter—Cold and dry air:*

Contraction of the capillary vessels of the skin—Diminution of perspiration—Increase of the quantity of urine—Greater consumption of oxygen—Quicker breathing—More regular appetite—Muscular activity and strength—Exuberance of animal spirits.

*Summer—Warm and moist air (containing, for the same volume, less oxygen):*

Quick and laborious breathing: hence incomplete hematosis.—The peripheral vessels receive an abundance of liquids, but capillary circulation is sluggish—Moisture checks the evaporation of the perspiration—Appetite blunted, digestion laborious—The relaxation of tissues by warmth and moisture creates a predisposition

to congestions—Increase in the weight of the body—Weakness of the muscular system.

It is evident that, were it not for the benefit of its cold and dry winter, the climate of Shanghai would be most detestable.

#### IV.—ATMOSPHERIC PRESSURE.

This element is of no great importance for a station situated, as Shanghai, at the level of the sea. It would be otherwise at a great altitude, as is the case with numbers of towns in mountainous countries or on high plateaux: the conditions of life are quite different and the phenomena of organic life are intimately connected with the density and pressure of the air.

I shall therefore confine myself to giving the daily variation of the barometer at Shanghai and its monthly variation, since it is the cause of the opposite regular winds (monsoons) which blow by turns through the course of the year.

##### *Daily variation of atmospheric pressure at Shanghai (1876-1880).*

1 a.m.	30. <sup>in</sup> 034	
4 "	30. 017	1st minimum.
7 "	30. 043	
10 "	30. 062	1st maximum.
1 p.m.	30. 018	
4 "	30. 001	2nd minimum.
7 "	30. 024	
10 "	30. 047	2nd maximum.
Mean	30. 031	

##### *Monthly mean atmospheric pressure at Shanghai (1873-1880).*

January	30. <sup>in</sup> 388	July	29. <sup>in</sup> 711
February	30. 296	August	29. 766
March	30. 198	September	29. 920
April	30. 037	October	30. 144
May	29. 876	November	30. 265
June	29. 778	December	30. 315

Annual mean 30.<sup>in</sup> 058.

*Mean atmospheric pressure for each period of 5 days (1873-1880).*

from 1 to 5 Jan.	30. <sup>m</sup>	341	from 30 to 4 July	29. <sup>m</sup>	742
" 6 — 10	"	.891	" 5 — 9	"	.687
" 11 — 15	"	.443	" 10 — 14	"	.713
" 16 — 20	"	.414	" 15 — 19	"	.709
" 21 — 25	"	.876	" 20 — 24	"	.717
" 26 — 30	"	.879	" 25 — 29	"	.735
" 31 — 4 February	"	.322	" 30 — 3 Aug.	"	.720
" 5 — 9	"	.821	" 4 — 8	"	.728
" 10 — 14	"	.261	" 9 — 13	"	.709
" 15 — 19	"	.330	" 14 — 18	"	.755
" 20 — 24	"	.241	" 19 — 23	"	.800
" 25 — 1 March	"	.275	" 24 — 28	"	.815
" 2 — 6	"	.278	" 29 — 2 Sept.	"	.901
" 7 — 11	"	.231	" 3 — 7	"	.863
" 12 — 16	"	.201	" 8 — 12	"	.866
" 17 — 21	"	.192	" 13 — 17	"	.953
" 22 — 26	"	.162	" 18 — 22	"	.917
" 27 — 31	"	.119	" 23 — 27	"	30 .001
" 1 — 5 April	"	.116	" 28 — 2 Oct.	"	29 .996
" 6 — 10	"	.042	" 3 — 7	"	30 .108
" 11 — 15	"	.110	" 8 — 12	"	.145
" 16 — 20	"	.084	" 13 — 17	"	.179
" 21 — 25	"	29 .947	" 18 — 22	"	.103
" 26 — 30	"	.956	" 23 — 27	"	.171
" 1 — 5 May	"	.974	" 28 — 1 Nov.	"	.226
" 6 — 10	"	.898	" 2 — 6	"	.216
" 11 — 15	"	.888	" 7 — 11	"	.260
" 16 — 20	"	.884	" 12 — 16	"	.311
" 21 — 25	"	.844	" 17 — 21	"	.263
" 26 — 30	"	.792	" 22 — 26	"	.270
" 31 — 4 June	"	.858	" 27 — 1 Dec.	"	.275
" 5 — 9	"	.839	" 2 — 6	"	.293
" 10 — 14	"	.771	" 7 — 11	"	.307
" 15 — 19	"	.736	" 12 — 16	"	.286
" 20 — 24	"	.758	" 17 — 21	"	.320
" 25 — 29	"	.779	" 22 — 26	"	.348
			" 27 — 31	"	.344

The two last tables show that atmospheric pressure, at Shanghai, undergoes a perfectly perceptible oscillation during the

course of the year; at its maximum in January (the 13th: 30.<sup>th</sup> 476), it sinks gradually till July (the 6th: 29.<sup>th</sup> 674) to rise again. This variation is not peculiar to our station; it is observed all over Asia: its cause and consequences we must briefly explain.

#### V.—WINDS—MONSOONS.

On the whole Southern and Eastern slope of Asia we see a mutual reaction of continental and oceanic influences, the great *Monsoons*. In our Winter the continental regions of Asia are cooler than the surrounding seas and pressure is higher; the air consequently, actuated by gravity, flows from the continent towards the ocean: hence we have steady Northerly (N. E., N. and N. W.) winds which blow through the Winter and are naturally cold and dry. This is the *Winter Monsoon* and the *dry Season* on the Eastern coast of China. In our Summer, pressure is very low over a great part of the Asiatic continent, owing to the heat and the ascending current produced by it: therefore the air of the ocean will flow towards Asia. Hence the winds from E., S. E. and S. which prevail at Shanghai and bring the well-known excess of moisture. This is the *Summer Monsoon* and the *wet Season*.

Herewith we give the mean direction of the wind at Shanghai, determined from hourly observations made during eight years at Zi-ka-wei by means of self-registering anemometers giving each moment the direction and velocity of the wind.

*Mean direction of the wind at Shanghai (1873-1880) and mean velocity per hour (1875-1880).*

Jan.	N. 4° W.	8.2 miles.	July	S. 41° E.	8.8 miles.
Feb.	N. 11 E.	8.7 "	Aug.	S. 70 E.	7.2 "
March	N. 51 E.	8.8 "	Sept.	N. 54 E.	6.4 "
April	S. 79 E.	8.8 "	Oct.	N. 32 E.	6.1 "
May	S. 54 E.	9.0 "	Nov.	N. 6 W.	6.4 "
June	S. 66 E.	8.5 "	Dec.	N. 11 W.	8.1 "

Annual Mean: N. 62° E.—7.9 miles.

Thus the wind which blows from N. in January, veers to N. E. between February and March, to E., between March and April, to S. E. in May; it turns a little to E. again in June, whilst July enjoys the most Southerly wind. From that month to the end of the year it turns to E. and N., getting in December as far as N. 11° W. The oscillation is then perfectly definite. The alternation of the two Monsoons is equally a constant fact not subject to any exception.

Squalls or gales, though not violent, are frequent enough at Shanghai, as this port is about equally distant from the most common track of two kinds of storms that come now and then to break the sameness of the settled Monsoons. In Winter, there are frequent atmospheric depressions issuing from Central Asia; they run from West to East, crossing with great velocity Siberia, Mongolia and Japan; they rush towards the area of minimum pressure that exists in the middle of the North-Pacific Ocean. In Summer, there are Typhoons in the South, between 15.° and 25.° latitude North, following the opposite direction, from East to West, and proceeding from the Equatorial Pacific towards the Philippines and Southern China or Tonquin; sometimes, chiefly in July and August, they take a run northward, approach Shanghai and carry havoc over Japan.

During the passage of those Northerly storms that usually rage with violence along their path, the winds at Shanghai are convergent to the centre of the depression: they consequently begin by blowing feebly from E. or E. S. E., then they turn slowly as the depression approaches, as shown by the progressive sinking of the barometer. While the storm is raging North of Shanghai, the barometer is at its lowest point; the wind comes from S. or S. W., bringing a high temperature and a great amount of moisture; when at last the depression moves, there is generally a strong gale from N. W. which, in Winter, brings very cold weather.

The Typhoons are much smaller in diameter than the Northern atmospheric depressions, and whenever they keep in Southern regions, they are not perceived at Shanghai except by a slight fall of the barometer, the winds being E. or N. E.



These two kinds of storms, with regard to the amount of rain they bring on, both partake of the nature of the seasons during which they usually form: the Winter depressions, coming from the interior of the continent with the great dry air current that issues from it, raise enormous masses of dust which they carry far and wide, increasing the barrenness of the countries they pass over. The Typhoons, on the contrary, originating in the warm and moist maritime regions of the Equator, are invariably characterized by diluvial rains.

#### VI.—RAIN.

This peculiar system of rain in the Monsoon regions appears clearly from the following tables calculated from the observations taken at Zi-ka-wei.

*Frequency and amount of rain fallen at Shanghai (1873-1880).*

	days.	inches.		days.	inches.
January	9.4	2.269	July	11.2	3.560
February	11.7	2.887	August	10.5	4.655
March	12.0	2.871	September	10.9	5.714
April	12.5	3.588	October	8.7	2.840
May	11.1	2.871	November	6.9	1.962
June	13.0	7.857	December	6.1	1.390

Annual Sum: 124 days. 42.464 inches.

*Of these 124 rainy days we have:*

in *Winter* 54.8 days giving 14.219<sup>in</sup> of water.  
 in *Summer* 69.2 „ „ 28.245 „

The heaviest shower was that of October 24th 1875, during which there fell 7.088<sup>in</sup> of water in 3½ hours, equal to 2.024<sup>in</sup> per hour.

*Snow* is frequent in Winter, particularly in January, the coldest but not the driest month of the year.

#### VII.—NEBULOSITY, OR CLOUDS.

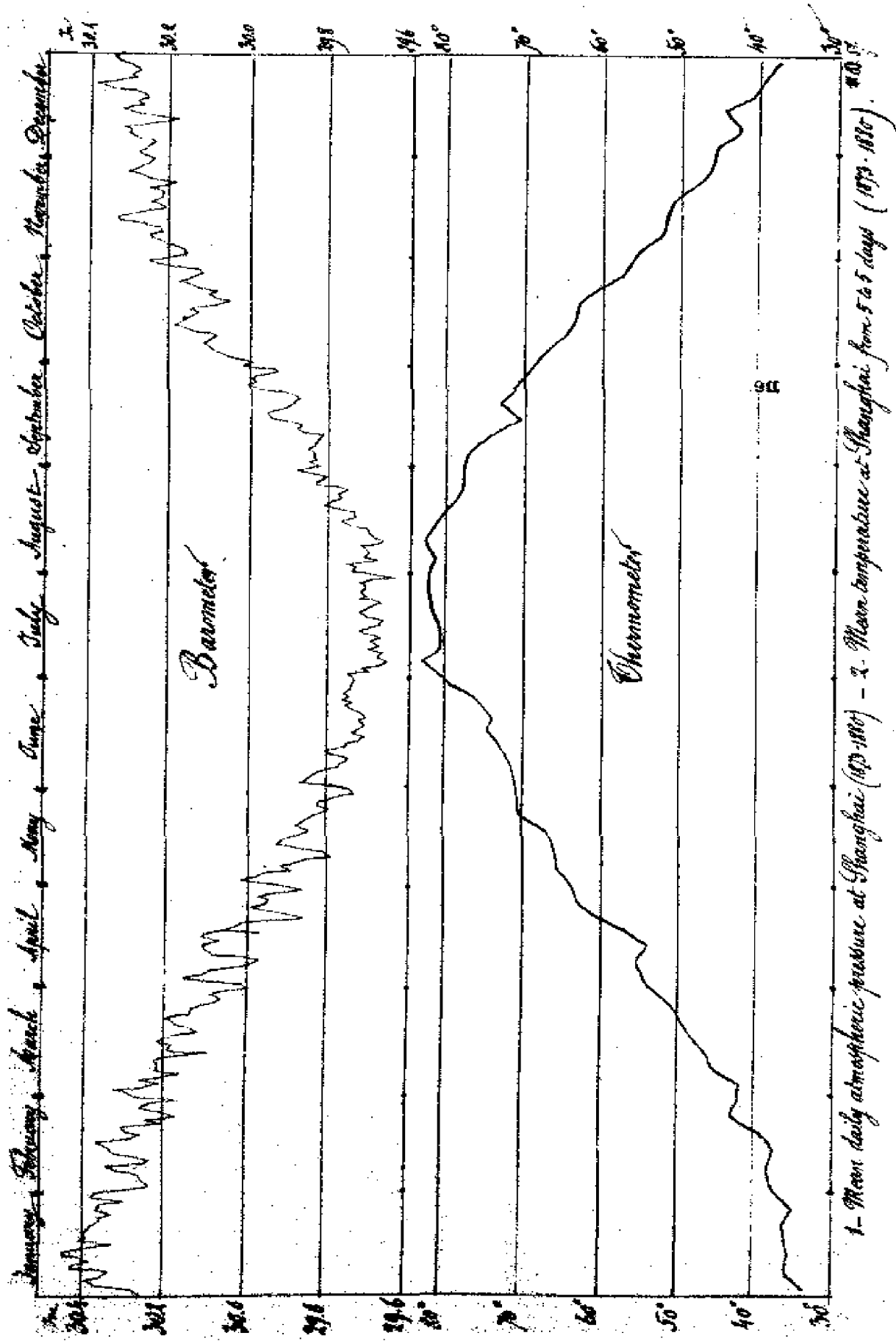
The state of the sky, its clearness or nebulosity, is evidently closely connected with the moisture of the air. Yet, with the exception of November and December, usually the finest months

of the year, the mean co-efficient of nebulosity varies little from one season to another: the reason is that the upper regions of the atmosphere are swept by a huge current which for 9 or 10 months always runs from West to East, carrying along clouds (cirri) that have nothing to do with the moisture or dryness of the lower strata of air. Those clouds (alto-cumuli, cirri, cirrostrati), of a thousand shapes and varieties, are always of a graceful aspect; they may truly be said to make up two-thirds of the nebulosity of our sky.

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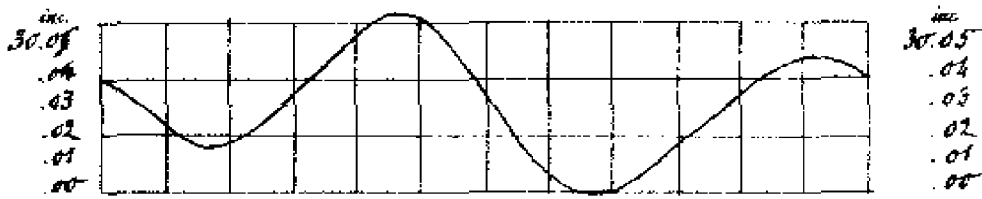
These indications with regard to the meteorological conditions of the Climate of Shanghai, though brief, are yet sufficient to enable physicians to form an opinion upon the salubrity of the port. To complete the study of this climate, the water and soil should be inquired into, and the knowledge thus acquired would throw light on the causes of the prevailing diseases, and would also explain how residence in Shanghai might be beneficial to some patients. I must however leave this to others more versed in these questions.

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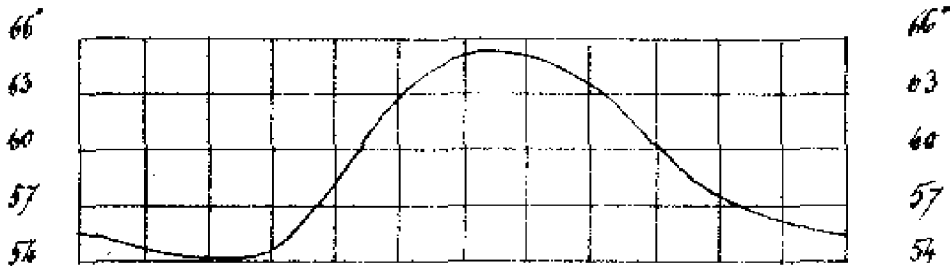


1- Mean daily atmospheric pressure at Shanghai (1873-1880) - 2- Mean temperature at Shanghai from 5 to 5 days (1873-1880).

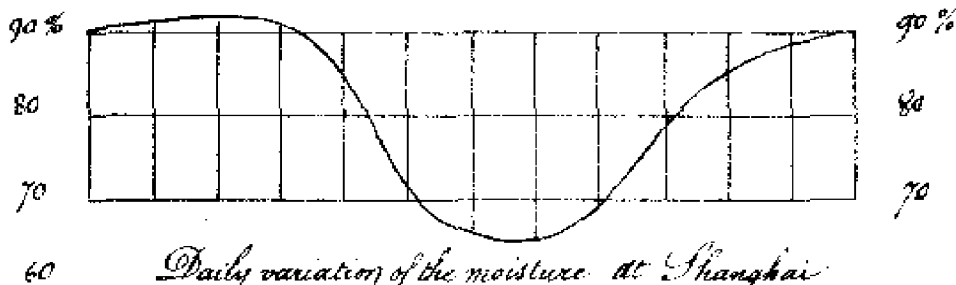
Midn. 2<sup>h</sup> 4<sup>h</sup> 6<sup>h</sup> 8<sup>h</sup> 10<sup>h</sup> Noon 2<sup>h</sup> 4<sup>h</sup> 6<sup>h</sup> 8<sup>h</sup> 10<sup>h</sup> Midn.



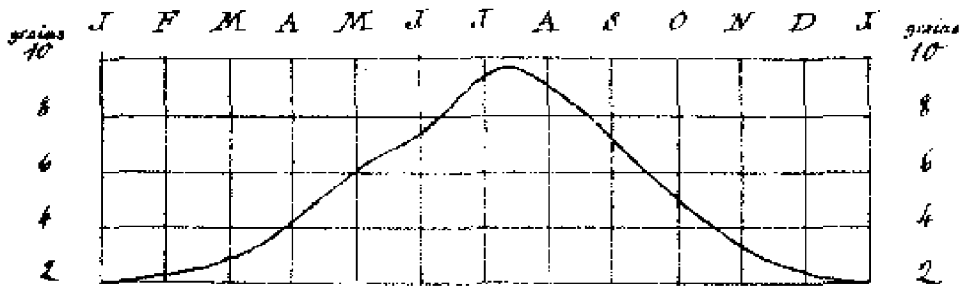
Daily variation of the Barometer at Shanghai.



Daily variation of the Thermometer at Shanghai.



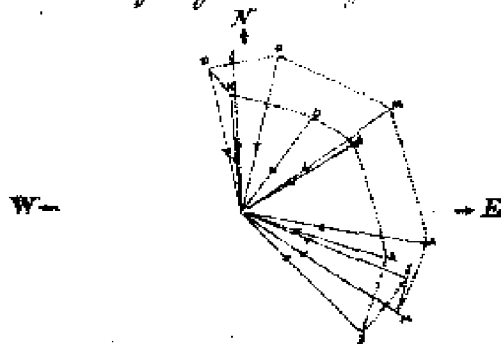
Daily variation of the moisture at Shanghai.



Monthly weight of vapour in a cubic foot of air at Shanghai.



Frequency and amount of Rain fallen at Sh.



Prevailing winds, mean velocity

N.D. of