TABLE 6.—*Lowest minimum temperatures (°F.) 1901 to 1923, at Williamstown, Mass.*

	June	July	Aug.
1901	44	48	[3] 56
1902	41	47	44
1903	38	43	42
1904	41	44	[1] 35
1905	38	47	42
1906	38	48	46
1907	38	45	43
1908	37	48	40
1909	43	43	42
1910	37	49	43
1911	45	49	44
1912	[1] 35	[1] 41	[2] 38
1913	[2] 35	44	41
1914	42	47	45
1915	38	48	40
1916	40	47	46
1917	[3] 48	[3] 50	46
1918	37	[2] 42	42
1919	42	48	45
1920	38	44	44
1921	38	[3] 50	44
1922	43	47	45
1923	42	46	[2] 38
Average	39.9	46.3	43.1

[1] Lowest average. [2] Next lowest average. [3] Highest average.

TABLE 7.—*The departure from normal of the various months of 1816 (°F.)*

	January	February	March	April	May	June	July
Cambridge	+5.0	−0.6	−4.1	−2.5	−4.5	−6.0	−6.5
New Bedford	−2.2	+1.6	−1.9	−1.4	−2.5	−5.0	−5.8
New Haven	−4.0	0.0	−4.0	−5.0	−5.0	−7.0	−7.0
Salem	−0.4	+0.3	−4.7	−0.7	−3.0	−5.4	−5.7
Williamstown	−1.5	+4.0	+0.6	+0.7	−1.4	−3.2	−3.8
Do	−0.8	+2.5	−2.3	−1.0	−3.8	−5.2	−5.4

	August	September	October	November	December	Year	Normal based on—
Cambridge	−3.2	−4.8	−0.1	+3.5	−2.3	−2.2	----------
New Bedford	−2.2	−3.3	+0.8	+2.6	+2.0	−1.4	1813–1856
New Haven	−2.0	−5.0	−1.0	+2.0	0.0	−3.0	1778–1920
Salem	−1.6	+0.5	−1.6	+1.7	+1.8	−1.5	1786–1828
Williamstown	−2.0	−3.4	+1.4	+0.6	+2.3	−0.5	1816–1819
Do	−2.1	−3.9	+1.5	+3.6	+2.0	−1.3	1816–1838

TABLE 8.—*The departure from normal of the months of various years at Williamstown, Mass., °F.*

	January	February	March	April	May	June	July	August	September	October	November	December	Year
1816	−0.8	+2.5	−2.3	−1.0	−3.8	−5.2	−5.4	−2.1	−3.9	+1.5	+3.6	+2.0	−1.3
1817	−1.0	−7.6	−3.0	+0.1	−2.3	−6.4	−2.6	−0.5	−0.2	−1.8	+2.7	+1.3	−1.8
1835	−1.6	−2.8	−1.7	−1.4	−1.8	−1.3	−1.4	−0.9	−4.0	+4.6	+0.4	−5.5	−1.5
1836	+1.0	−7.0	−5.5	−3.3	−0.7	−3.6	−0.2	−5.3	+0.1	−6.4	−3.3	−2.1	−3.0
1837	−8.5	−1.1	−3.3	−3.3	−4.7	−2.6	−3.5	−2.1	−2.4	−2.4	−0.3	−1.1	−3.9
1838	+7.4	−9.6	+1.4	−5.8	−2.6	+2.5	+2.2	−0.6	+0.2	−3.0	−4.6	−7.0	−1.6
1912	−7.6	−2.4	−4.3	+0.2	+1.5	−1.6	+0.6	−1.6	−0.1	+0.8	+2.3	+6.6	−0.4
1913	+11.4	+0.4	+5.3	+2.5	−1.5	+1.0	+0.1	+1.1	−1.8	+3.9	+4.9	+3.9	+2.6

TABLE 9.—*Solar constant values and Wolfer, 1920–1924*

	January	February	March	April	May	June	July	August	September	October	November	December	Year
1920	1.964	1.956	1.946	1.952	1.953	1.939	1.945	1.930	1.942	1.943	1.949	1.955	1.948
1921	1.958	1.951	1.946	1.947	1.949	1.934	1.945	1.936	1.944	1.947	1.954	1.951	1.947
1922	1.945	1.946	1.934	1.927	1.927	1.917	1.911	1.917	1.903	1.918	1.919	1.927	1.924
1923	1.926	1.915	1.913	1.913	1.915	1.916	1.926	1.931	1.933	1.930	1.931	1.923	1.923
1924	1.930	1.919	1.916	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

WOLFER SUN-SPOT NUMBERS, 1920–1924

1920	57.3	50.9	71.9	14.3	33.7	38.8	26.5	18.6	38.7	48.8	24.6	39.9	38.7
1921	28.8	27.6	27.5	30.5	22.3	34.5	42.4	20.8	16.7	16.1	13.4	15.7	24.7
1922	10.2	27.9	60.0	11.4	7.7	5.8	9.7	5.3	5.2	8.1	6.7	18.7	14.7
1923	5.3	1.6	4.0	5.4	3.2	9.0	3.7	0.5	13.7	11.5	7.3	1.1	5.5
1924	0.7	5.7	2.2	11.5	20.7	24.8	-----	-----	-----	-----	-----	-----	-----

A NEW CLASSIFICATION OF TYPHOONS OF THE FAR EAST [1]

551.515 (5-012)

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INTRODUCTION

Cyclonic storms have often played a part in the history of nations. The wreck of the Spanish Armada in 1588 is probably the best-known illustration. In the east, there is a singular parallel in the complete demolition of the Mongolian fleet by a typhoon in the early summer of 1281, during Kublai Khan's invasion of Japan. The immediate cause of this expedition was the execution of Kublai's ambassador by the Japanese emperor in the spring of 1280. The next year, Kublai sent an army of 100,000 men, who embarked in 3,500 ships, to undertake the subjugation of Japan. On July 17, 1281,[2] just at the beginning of the typhoon season, a violent tropical storm came up which sank most of the ships of the grand fleet, then anchored off the coast of Kiushiu Island. Of the 100,000 men on board the ships, only 3 returned to China alive.

In most recent times, all the far Eastern countries have paid heavy tolls to these terrible scourges. During the Cantabria cyclone of September, 1905, hundreds of thousands of dollars' worth of property was destroyed in southern Luzon and in the Visayas, and more than 140 people were killed. In the typhoon of September 7–12, 1904, 4,000 persons were killed in Hué, the capital of Annam. A storm wave caused by the Shanghai cyclone of 1905 overwhelmed the island of Tsun-Ming off the coast of Shanghai, and several thousand persons were drowned. A great flood accompanying the typhoon of August 7–11, 1910, killed more than 1,200 people in Japan. More recently, the Swatow typhoon of August 2, 1922, brought calamities to the region around Swatow; more than 5,000 people were killed or drowned in Swatow alone.

Before considering the characteristics and habits of typhoons, it is necessary to define what is meant by "typhoon." Algué has described a typhoon as a vast whirl of aerial currents which surround a central calm space of relatively small dimensions called the "vortex," or center of the storm. The central region of calm, relative or absolute, is, however, only found in the better-developed tropical cyclones. In the reports of the Zikawei Observatory, practically all the tropical storms are called typhoons. Because of the diversity in the use of the word, a clear distinction between a typhoon and a mere depression, based upon the intensity of the storm, has to be made.

The barometric readings do not indicate the intensity of a cylcone, for this intensity depends upon the rate of

[1] Acknowledgments.—With a few alterations this paper was written in 1918 to fulfill part of the requirement for the degree of Ph. D. in Harvard University, Cambridge, Mass. Since then, quite a few papers have been written on the subject of the typhoons of the Far East, the most notable being Father Louis Froc's Atlas of the Tracks of 620 Typhoons 1893–1918, published by Zikawei observatory, Shanghai. In view of the new light thrown upon the subject by the recent papers, additional footnotes have been inserted wherever occasion demands. The subject of this thesis was chosen mainly because of the economic importance of typhoons in the Far East. The writer has also an added interest because of the fact that he is a native of a region on the coast of China which is visited by those storms. The material used in this report has largely been obtained from the annual and monthly meteorological reports of the Zikawei Observatory (Bulletin des Observations), the Journal of the Meteorological Society of Japan, the annual reports of the Central Meteorological Observatory of Japan, and especially from the monthly bulletin of the Philippines Weather Bureau; without these publications this investigation would not have been possible. It has been the privilege of the writer to carry out his work under the supervision of Prof. Robert DeCourcy Ward, to whose advice, encouragement, and helpful suggestions the writer takes this opportunity to express his sincere thanks.

[2] The Chinese date for this memorable event is the first day of the seventh month in the eighteenth year of Chi-Yuen, Juen dynasty. In western chronology, this is July 17, 1281 (according to Rev. P. Hoang's Concordance des Chronologies neomeniques, Chinoise et Européenne, Shanghai, 1910, p. 269.) In this connection, attention may be called to an interesting book written by a Japanese author, N. Yamada, The Mongol Invasion of Japan, published in London in 1916.