CLOUD HEIGHT ACCORDING TO DIRECTION OF MOTION

551.576

By ARTHUR F. PIPPO

[Weather Bureau, Madison, Wis.]

In recognition of the need of more reliable determinations of "ceiling" by eye observation, a summary of cloud heights at Madison, Wis., Washington, D. C., and Blue Hill near Boston, Mass., was made. It includes five common types, which occur within the "flying level," and for which data are available. Mean heights of clouds above the surface were calculated for the different directions of their motion, the directions being combined into approximate quadrants, first quadrant, ESE. to NE., second quadrant, NNE. to NW., etc.

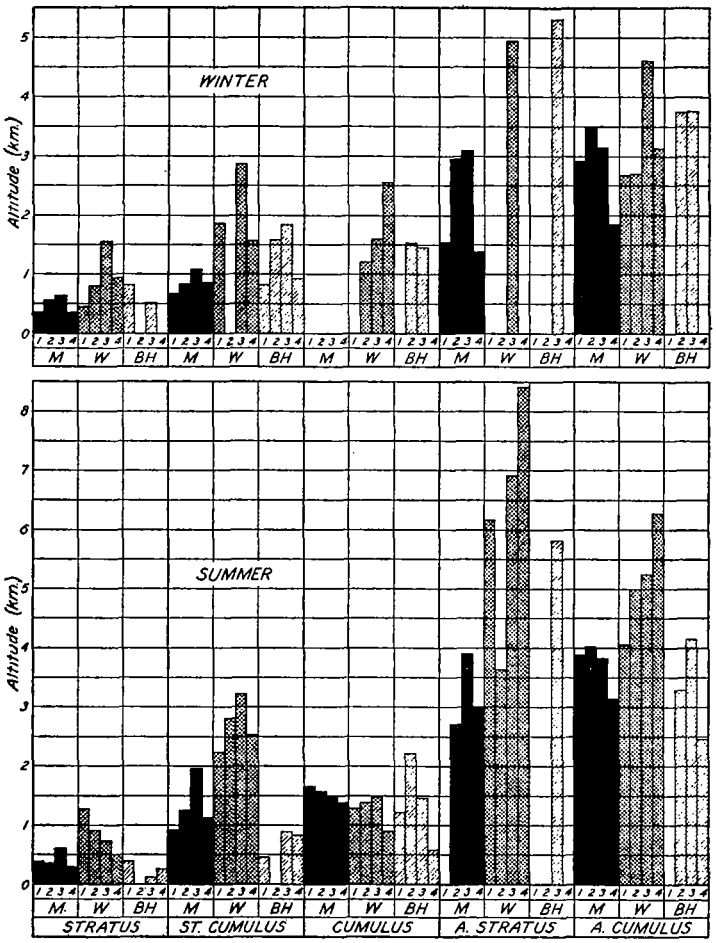

FIGURE 1.—Cloud heights at Madison (M), Washington (W), and Blue Hill (BH)

It is a well-established fact that whatever condition tends to increase the humidity of the air lowers the height of the condensation level. This is apparent from the position (well to the eastward of the center of the low) of the region of maximum condensation in our extra-tropical cyclones. Examination of the accompanying figure which has been prepared from the summarized figures in Table 1 reveals conclusively the necessity of observing the direction of motion in estimating cloud base heights by eye observation.

The data for Madison (307 meters above sea level) consist of 1,245 observations by means of pilot balloons during the period May, 1919, to February, 1927. The Washington (36 meters above sea level) data (1) include a total of 836 determinations by theodolite triangulation during the international cloud year, 1896–97, while the record for Blue Hill (202 meters above sea level) data (2) contains only 290 observations of the types considered during the same year. The averages for Washington and Blue Hill are for 6-month periods, while the Madison data has been divided into 3-month seasons.

From the figure it is evident that clouds are highest when moving from westerly points and lowest from points east. The stratus type, for instance, is twice as high from west as from the east. An obvious inconsistency appears in the Washington data for stratus, it averaging over 1 kilometer in two cases, whereas the international committee on clouds in 1905 defined the limits of stratus base at that figure. In the case of strato-cumulus, the differences in height from the different quarters is essentially the same at the three places, but the average height for the type varies widely. On the other hand, convective cumulus and alto-cumulus occur at a fairly common average height at the three places, but the height-direction characteristics show little agreement.

As with stratus and strato-cumulus, so also alto-stratus shows a large difference in the average height at Madison and Washington. This apparent divergence of elevation of stratiform clouds, and the close agreement of convective levels, makes for an open problem. It is evident, however, that observation of cloud motion is of considerable value in estimating "ceiling" where no instruments are available, and with the ever-increasing records from the numerous aerological stations sufficient data should not be lacking to make interesting a thorough comparative investigation of this phase of cloud study.

CITATIONS

(1) Bigelow, F. H. Report on the International Cloud Observations, Report of the Chief of the Weather Bureau, 1898–99, vol. 2, p. 334.

(2) Clayton, H. H. Measurement of Cloud Heights, Velocities, and Directions. Annals of Harvard College Obs., vol. 42, p. 249.

TABLE 1.—*Average altitude of clouds above the surface, according to season and direction of motion, at Madison, Wis., Washington, D. C., and Blue Hill near Boston, Mass.*

		Direction from—	Stratus	Strato-cumulus	Cumulus	Alto-stratus	Alto-cumulus		Stratus	Strato-cumulus	Cumulus	Alto-stratus	Alto-cumulus
Madison	Winter	ESE. to NE.	328	659	X	1,544	2,886	Summer	378	901	1,650	X	3,869
		NNE. to NW.	537	804	X	2,921	3,471		363	1,250	1,567	2,700	4,017
		WNW. to SW.	612	1,069	X	3,066	3,124		620	1,974	1,483	3,896	3,812
		SSW. to SE.	340	823	X	1,362	1,854		293	1,128	1,379	3,018	3,130
	Spring	ESE. to NE.	344	896	1,350	2,768	X	Autumn	356	825	1,330	X	2,403
		NNE to NW.	547	951	1,411	2,632	3,149		434	864	911	3,680	3,007
		WNW. to SW.	439	1,276	1,430	3,352	3,008		821	1,419	1,551	3,083	3,333
		SSW. to SE.	461	1,144	1,078	2,237	3,068		449	1,162	927	3,912	4,896
Washington	Winter	ESE. to NE.	449	1,856	X	X	2,664	Summer	1,267	2,249	1,289	6,148	4,060
		NNE. to NW.	806	X	1,201	X	2,682		899	2,840	1,383	3,648	4,988
		WNW. to SW.	1,562	2,835	1,581	4,940	4,639		732	3,231	1,492	6,935	5,234
		SSW. to SE.	922	1,550	2,549	X	3,146		747	2,539	904	8,410	6,272
Blue Hill	do	ESE. to NE.	824	802	X	X	X	do	382	452	1,213	X	X
		NNE. to NW.	X	1,580	1,516	X	3,753		X	995	2,225	X	3,295
		WNW. to SW.	510	1,813	1,452	5,276	3,777		127	894	1,447	5,820	4,146
		SSW. to SE.	X	917	X	X	X		270	832	590	X	2,495